TAMPERE UNIVERSITY OF TECHNOLOGY

HELGE JALONEN

Assessing Robotic Process Automation Potential

Master of Science Thesis

Examiner: Professor Samuli Pekkola
Examiner and topic approved by the vice-dean of faculty of Business and Built Environment
on 24th February 2017

ABSTRACT

HELGE JALONEN: Assessing Robotic Process Automation Potential
Tampere University of Technology
Master of Science Thesis, 61 pages
May 2017
Master's Degree Programme in Information and Knowledge Management
Major: Information Analytics
Examiner: Professor Samuli Pekkola

Keywords: RPA, Robotic Process Automation, BPO, Business process outsourcing, software robotics

Major part of work nowadays is done, at least partly, with computers. In many cases a single company might contain dozens of different information systems, and as systems have evolved a lot during their history, they are often from different eras. As such, especially the older systems often contain gaps in their use when they are connected to newer systems, creating a need for human employees to fill those gaps with often simple series of actions, which are mundane but necessary.

Robotic process automation is an emerging field that aims to automate these kind of straightforward processes in knowledge work, such as copy-pasting from a system to another or making certain decision-processes automated for certain, so-called "happy path" cases. RPA works in the presentation layer of the software, so no underlying programming code needs to be touched. When compared to more traditional IT-development, RPA is faster and cheaper, yet in some ways more error-prone, as simple user interface updates might cause need for robot reconfiguration.

A single company may consist of hundreds or thousands of processes and sub-processes, and rooting out which ones should be automated is a huge task. Aim of this research is to find out how business processes should be chosen for robotic process automation implementation, and in which order they should be automated. The focus is in the preliminary assessment, ie. before any actual robot development has been done. Example questions are "what makes a process viable for robotisation" and "what makes this process beneficial to automate." Currently almost all companies use different kinds of tools to assess these kind of questions, yet they are mostly subjectively and/or intuitively created without proper benchmarking.

This research covers 3 companies, of which 2 or RPA clients and 1 is RPA vendor. Their models for preliminary assessment were studied, and the acquired data was complemented with interviews with key personnel of the preliminary assessment process. Then the results are analysed with analytical hierarchical processing (AHP) essential factors for the preliminary assessment mapped.

TIIVISTELMÄ

HELGE JALONEN: Prosessin robotisointipotentiaalin määrittäminen
Tampereen teknillinen yliopisto
Diplomityö, 61 sivua
Toukokuu 2017
Tietojohtamisen koulutusohjelma
Pääaine: Informaatioanalytiikka
Tarkastaja: Professori Samuli Pekkola

Avainsanat: RPA, ohjelmistorobotiikka

Merkittävä osa nykyhetken työstä tehdään vähintäänkin osittain tietokoneiden avustamana. Monissa tapauksissa yksittäinen yritys saattaa sisältää jopa kymmeniä erilaisia tietojärjestelmiä eri aikakausilta. Koska tietojärjestelmät ovat itsessään kehittyneet merkittävästi vuosikymmenien saatossa, on näiden väliin kuitenkin jäänyt aukkoja, joita on totuttu paikkaamaan ihmistyöntekijöiden toimesta. Näin on syntynyt monimuotoisia ja -mutkaisia prosesseja, joista suuri osa on toistuvaa, konemaista työtä, joka jonkun on vain tehtävä.

Ohjelmistorobotiikka on uusi tekniikka, joka tähtää tällaisten suoraviivaisten prosessien automatisointiin. Tällaiset "paikkausprosessit" saattavat yksinkertaisimmillaan sisältää vain tiedon kopiointia järjestelmästä toiseen, kun vanhaa järjestelmää ei saada liitettyä uuteen riittävän aukottomasti. Ohjelmistorobotiikka käsittelee tietojärjestelmää vain esittävän kerroksen kautta - mitään muutoksia siis itse ohjelmistoihin ei tarvitse tehdä, vaan robotit käyttävät ohjelmistoja täsmälleen kuten ihminenkin. Perinteisempään tietojärjestelmäkehitykseen verrattuna ohjelmistorobotiikka on nopeampaa ja halvempaa, mutta tietyssä määrin myöskin virhealttiimpaa, sillä pienetkin päivitykset käyttöliittymään voivat vaatia robotin uudelleenohjelmointia.

Yksittäinen yritys saattaa sisältää satoja tai tuhansia ohjelmistorobotiikalle sopivia prosesseja sekä aliprosesseja. Ongelmaksi muodostuukin sen päättäminen, mitä halutaan automatisoida ensimmäisenä - mistä siis voidaan saada nopeasti irti hyötyjä tai missä tarvitaan nopeasti lisää resursseja. Tätä karsintaa tehdään jokaisessa ohjelmistorobotiikkaa hyödyntävässä yrityksessä omalla tavallaan.

Tutkimus suoritettiin tapaustutkimuksena, ja sitä varten kerättiin kolmen yrityksen käyttämät mallit, joilla pyritään arvioimaan prosessin robotisointipotentiaalia. Mallien analysointia täydennettiin avainhenkilöiden haastatteluilla. Analysointityökaluna hyödynnettiin AHP:ta, jonka avulla saatiin kartoitettua esiarvioinnin olennaisimmat tekijät.

PREFACE

This work was originally supposed to be done in 3 months. After 7 months, there is finally some light in the end of the tunnel. While the field of study was really interesting, it was also part of my employment in Digital Workforce. During my employment my interest in working with RPA has been constantly rising, which took my work engagement into levels where theoretical study was often left behind when compared to more practical work.

During my studies I have managed to create a social network that extends across study programs, classes, and even industries. It started with the Guild of Information and Knowledge Management, Man@ger, who rooted the freshman out of me. Later in my studies I have found myself in different positions of trust in our student union, TTYY, which, along with the network it helped me to build, made me the person I am today.

Thank you for the department of Department of Information Management and Logistics and all of its employees, who have guided me through the years and even provided me with employment for two years. This time increased my interest in academic world and opened my eyes to the diversity of our field. And what an incredible field it is! Little did I know when I began in 2010 what was coming to me. Especially thank you to Samuli Pekkola and Jari Jussila, who first helped me to start with this thesis, and in the end patiently waited me to hand over this thesis despite the schedule that held almost none.

So long, and thanks for the fish.

Helsinki, 09.05.2017

HELGE JALONEN

CONTENTS

ABBREVIATIONS

BPO	Business Process Outsourcing
CoE	Robotics Center of Excellence
CI	Cognitive Intelligence
DWF	Digital Workforce
FTE	Full-Time Equivalent
IS	Information system
KPI	Key Performance Indicator
PSA	Professional Services Automation
RPA	Robotic Process Automation

1. INTRODUCTION

Term "knowledge work" was first coined by Drucker (1999), who stated that knowledge work is a group of tasks, where knowledge is the source, tool, and product of work. However, so far a big part of this knowledge work is mundane and repetitive. Willcocks & Lacity (2016) call these repetitive tasks "swivel chair" tasks, as they are usually done in big offices with hundreds or thousands of cubicles. As an example, consider a day in the work of a doctor: according to a questionnaire done to several hospital districts in Finland, one out of three doctors spend more than six hours of their shift on a computer, waiting for some information to process or entering information to several different systems (Vihavainen, 2016).

Another interesting example on automation in general was researched by McKinsey Global Institute in the US: according to Chui, Manyika & Miremadi (2016), throughout industries, approximately 16 percent of work consists of data processing, and 17 % of data collection - tasks that are currently mostly done by human workers. The potential for automation, measured in percentage of time used, is 69 % in data processing and 64 % in data collection. Combined, 33 % of the work done in the future may have average automation level of 66,5 %. These figures do not contain any physical work, which usually hints to the direction of knowledge work, or in the case of data collection, automated sensor arrays.

Robotic Process Automation, or RPA, is an emerging topic that has been on the rise in the past few years (Willcocks & Lacity, 2016). It bears many names, such as software robotics or botsourcing (Vedder & Guynes, 2016; Davenport & Kirby, 2016), but in the end of the day, they are the same thing - taking robot out of humans and letting human employees focus on tasks that cannot be handled by a robot. Everest Group even defined RPA as "a sub-set of overall business process service delivery automation" (Willcocks & Lacity, 2016, p. 66). The definition makes an useful distinction from traditional physical or IT automations. The base idea of RPA is to interface with software in order to automate it - no changes in the actual programming code of the underlying software is made, which makes RPA quicker and easier to deploy, while in the same time it expands its capabilities to major operating systems (Willcocks & Lacity, 2016, pp. 70-71). The interfacing is done with an automation software. To list some examples, there are Blue Prism (http://www.blueprism.com/), UIPath (https://www.uipath.com/), and Automa-

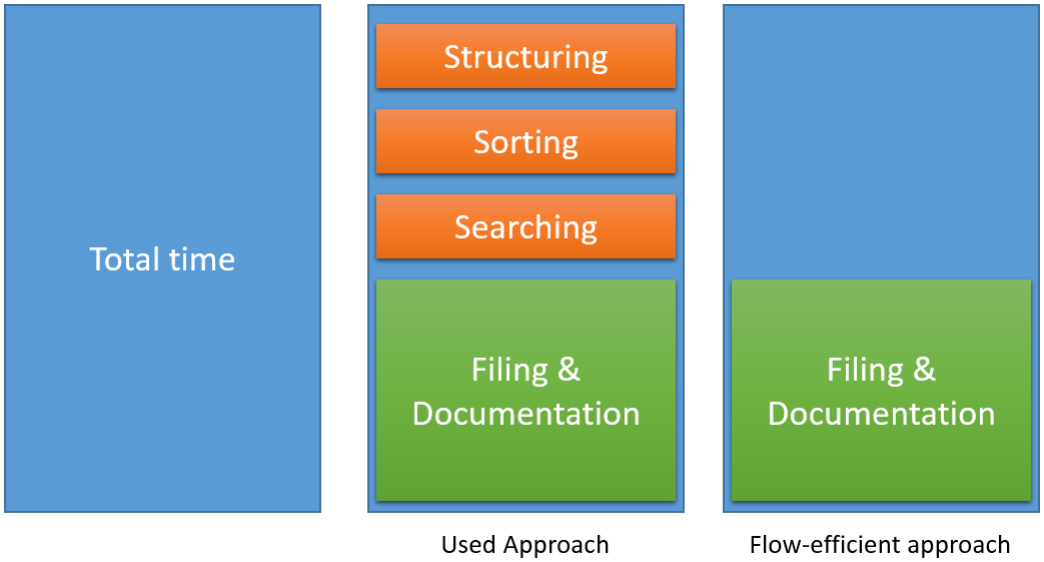

Figure 1: Illustration of basic idea behind superfluous work and lean (Modig & Åhlström, 2012, p.62).

tion Anywhere (https://www.automationanywhere.com/). New interfacing software is released constantly, but none has gained a position of clear market leader.

Some basic understanding on lean business strategy helps understanding the groundings of the need for RPA. These mundane tasks that are to be automated with RPA are identified in lean philosophy as "superfluous work" (Modig & Åhlström, 2012). In basic terms, lean is an ideology that puts organisation's core functions to maximum level of importance. Everything else is considered "waste", which must be eliminated. If it is not eliminated, the amount of waste will increase even further: if a customer is not satisfied with provided service quickly enough, he might produce some secondary needs for example due to high waiting time. These secondary needs are needs that should not exist in the first place, but emerge as time goes on. Instead, the whole focus of the company should be on the customer and so-called "flow-efficiency". Modig and Ålström (2012) demonstrated this by using the process of filling out travel bills. If the bills were handled instantly after the trip, the task was small and nearly all of the work was done on the bill. Usually the bills stacked up though, to be handled later. This created a need to sort, file, and arrange them in order to handle them properly. This required a lot of superfluous work or, as labelled earlier, secondary needs. This idea is presented in figure 1.

The connection between lean and RPA emerges from the framework of business process outsourcing (BPO). "Business process outsourcing (BPO) is defined simply as the movement of business processes from inside the organization to an external service provider" (Duening & Click, 2005). As one implements lean and starts focusing on the most vital parts of the value chain, outsourcing the less vital parts gets more and more appealing. The resources in these non-core functions are not

constantly needed, or the tasks are so mundane that no special expertise is required, for constant improvement to be effective. All the superfluous work is often hard to remove completely in the early stages of implementing lean (Modig & Åhlström, 2012), so outsourcing or botsourcing can also be seen as a "middle-step" of the process leading into a lean organisation philosophy, where mundane tasks are automated instead of removing them completely.

In order to understand the need for RPA, one should consider historical viewpoint of ICT. Moschella (1997) identified four main eras of ICT, which transfer from system-centric (roughly 1964-1987) into content-centric (roughly 2005-2025) eras. The idea is that the systems itself are no longer a source of competitive edge, but the focus has moved into more content-centric development. Moschella (1997) identifies this development as the Law of Transformation - the relative amount an organisation or industry is bit-based (ie. electric) as opposed to atom-based (ie. physical products). In this era the "extent of an industry's subsequent transformation would be equal to the square of the percentage of that industry's value-added - accounted for by bit - as opposed to atom processing activity" (Willcocks & Lacity, 2016, pp. 39-40). This has led into development of "back-offices", where operational tasks for services are built, managed and delivered. And there lies the real potential of RPA. RPA is basically the next wave of automation in mundane of knowledge work. It is not artificial intelligence, which will most likely be still years ahead. It is difficult and often high-costed to renew information systems in order to reduce or remove repetitive tasks, but RPA solves this with relatively quick and easy automation of systems that should by now be retired.

The task of implementing robotics to a business process is not usually straightforward, as often business processes have evolved in an organic manner around different information systems, which in turn are often from different eras. RPA aims to fill this currently human-filled gaps with automatic, error-free, around-the-clock way (Holder et al., 2016). Often bigger companies consist of hundreds or thousands of processes and sub-processes. It is not about finding out if there is anything to be automated: the question is what should be automated first to reap the benefits.

RPA suits almost any IT environment disregarding what it is based on, with few exceptions. For example if the whole IT environment is based on virtualized layer (eg. Citrix), there may be some severe complications, as most of the automation software cannot "penetrate" the virtual layer. Instead automation would require so-called "surface automation" which is based on unreliable image recognition. Even slightest changes in colors, screen resolution or such in the target system could render the robot unusable.

In the end it often comes down to a simple question: "What should be robotised?" This paper aims to answer this question in the state where only a little or no

robotisation has been made. The actual vocabulary has not yet been established, but Digital Workforce calls the phase "quick-scan" of the processes. Some clients use words such "preliminary assessment" or just "process assessment", but they all indicate the same thing: Finding out which processes are viable for RPA, or, what are the processes that should be automated next.

This preliminary assessment is relevant as while the robotisation as a technical matter is often quite trivial, defining the business process and the environment inadequately can lead to severe increases in development costs. In some rare cases this could even lead to termination of the implementation as a whole. As has been noticed by the client case companies, doing assessment to the process before any development is made, many challenged can be tackled beforehand.

1.1 Research Questions

The main research question aims to reveal what are the key performance indicators of a business process that is being assessed for being automated with robotic process automation.

1. What are the most critical factors in the assessment process?

In order to define the factors, current methods of the assessment must be studied and analysed. Hence, a supporting research question was defined.

2. How the potential of a process for robotic process automation is currently being assessed?

Due to concurrent nature of the phenomenon, it was also considered relevant to assess existing knowledge of RPA in general. This led to second supporting questions.

3. What existing literature knows about RPA?

The questions are important, as by defining good processes that have high viability for RPA has a major impact on the business case on the automation procedure. The economic or other business measurement factors might be initially high, but if the process itself is not suitable for RPA, the costs of automation and the process development might end up higher than the business benefits. In the other hand as a company starts in its journey with RPA, too difficult business processes in the beginning could wither the initial interest built up with robotics, which could cause resistance in the later development steps. Hence, in order to guarantee success in the early steps of RPA, and to find out how to build business cases that still hold after the development process has begun, it is important to choose right processes.

Figure 2: The big picture of RPA process in Digital Workforce.

1.2 Research Scope

This research only considers "robots" as a software without physical form, which automates processes regarded as "knowledge work". While phrase "software robotics" is sometimes used regarding robotic process automation (Asatiani & Penttinen, 2016), the term "robotics" is misleading. This discrepancy caused problems in the making of literature review, as using simply term "robotics" yielded mostly results regarding physical products in production lines. This led to scoping out the word "robotics" in the queries.

The research aims only to assess the initial potential, before any robot configuration takes place. After beginning the configuration, something may come up that weakens the business case, which is not in the scope of this thesis. This research is not about what *can* be automated, it is about what *should* be automated. The study will not go too deep in the technical level, but focuses on the business management side of the phenomenon. The research question could be interpreted as "What are the critical KPIs when building a viable business case." The big picture of how this process works in Digital Workforce is presented in 2. As it can be seen, the process starts with assessing the organisation as a whole: does it have IT personnel and how many knowledge processes it contains. Often this contains creation of long-list of processes contained. From there it is prioritised, which also creates a short-list of processes that are the first ones to go to development track. This study attempts to build a tool to assist this short-list-creation. After the prioritised short-list has been created, the processes on top of the list are looked more closely, which could alternate the prioritisation, but it is left for future studies.

1.3 Methods

Research approach of this thesis is built on the research 'onion' (Saunders et al., 2007), as presented in figure 3. Starting from the outer rim, first the research

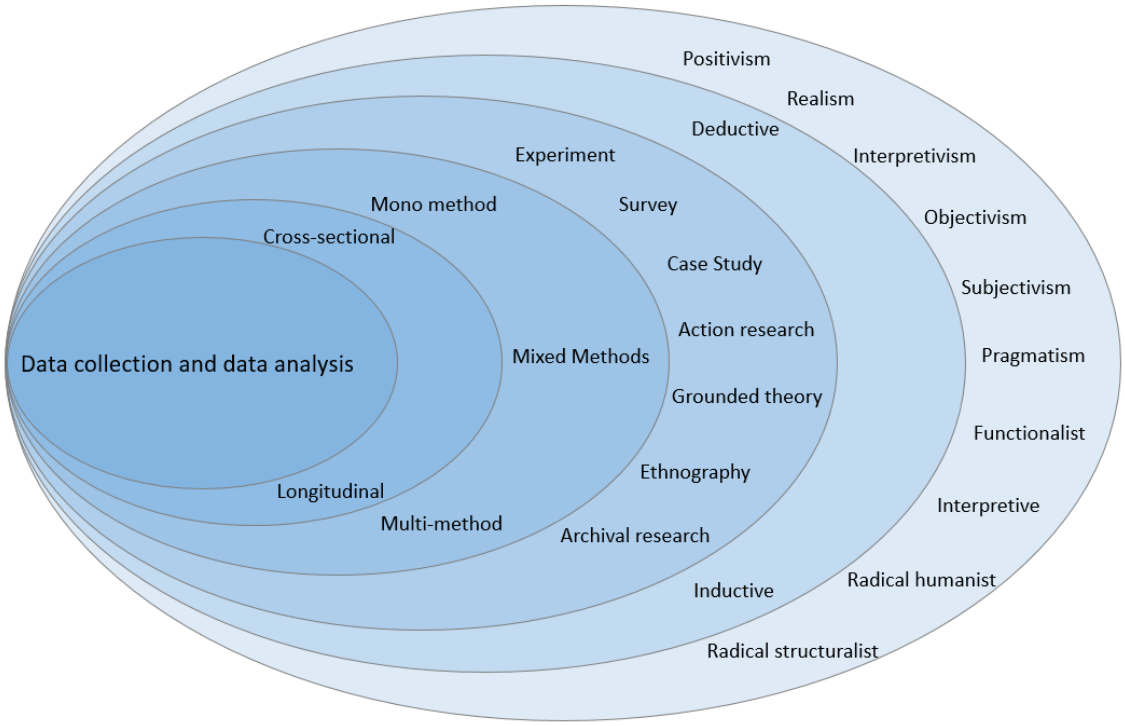

Figure 3: The research approach of this thesis is defined by using the research 'onion' (Saunders et al., 2007, p.132).

paradigm was chosen. It must be noted that this research is a study of management - no assessment of automation potential can be done without a proper context. The context itself is highly social, as some of the measures used for assessment are based on feelings of employees or managers. Hence it is proper to start defining the research approach in the framework of social theory (Saunders et al., 2007), as is presented in 4. The research adopts primarily a functionalist research paradigm, as explained in figure 4. It aims to observe the phenomenon from objective point of view and to rationalize the way processes are assessed for robotic automation. According to experiences among the clients of Digital Workforce, currently the assessment process is mostly built with "gut feeling", reflecting various, more traditional IT system development processes and vendor suggestions. Vendor-provided assessment processes, however, often contain too complex logic for the quick roll-outs customers usually hope for, especially in the initial stages of automation strategy. The research approach itself is hence deductive, as many possible models are considered and the critical parts assessed.

1.3.1 Literature review

Initially literature was queried according to Webster and Watson (2002). In the process *"robotic process automation"* was queried in order to gain insights on what is the extent of current literature. After finding out major contributors, they were

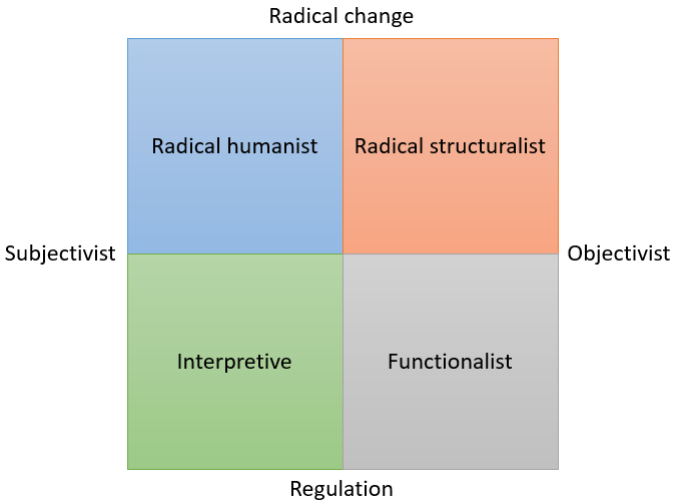

Figure 4: Four paradigms for the analysis of social theory (Saunders et al., 2007, p.112).

backtracked in order to gain more insights. After backtracking, internet service Web of Science was used to track articles that have been referred to by newer articles.

For the search terms, Robotic Process Automation was deemed the most unique phrase for referral, as it was used by the most cited writers Lacity & Willcocks (2016, for example), while botsourcing ties it to chosen framework of business process outsourcing (Vedder & Guynes, 2016; Waytz & Norton, 2014), hence making it a bit more nuanced. The book "Service Automation: Robots and the future work" (Willcocks & Lacity, 2016) was in general deemed to contain the most well-grounded source, as it contained several published case studies as well as insights from both vendors and clients.

Literature review was then conducted as a systematic review of all the literature published on RPA. Search was conducted via Google Scholar and TUT's search engine, Andor. This is explained more in-depth in chapter 3.

1.3.2 Empirical study

The empirical part of this thesis is conducted via case studies and systematic literature review. Finding data for the case studies proved to be difficult, as only few companies employ RPA and even less are willing to share their methods in fear of competition. These were also the first hints for choosing case study method.

Case study is considered to be most fitting for new theory building (Eisenhardt, 1989; Yin, 2009; Flyvbjerg, 2006). Yin (2009) also emphasizes how case study is the most fitting research method when the research "investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident."

The sole contemporary nature of the subject ruled out experimentation and his-

torical research, but also survey study was considered as a possible method. In the end it was deemed that it would be hard to get enough respondents, as the field is still new. Case study also enables researcher to find out new information that was not initially considered, which could lead to new major insights (Yin, 2009).

In the case study three companies implementing RPA were chosen (2 RPA end-users and 1 RPA vendor, Digital Workforce), and their RPA potential assessment researched. The client cases are major companies in Finnish financial sector. The case companies were chosen on the basis that they have been working with RPA for 1-2 years, which, according to experiences in Digital Workforce, is above average among Finnish companies. Both companies also work on their own RPA capabilities. Only organisations that came close with the amount of experience were from public health care sector. The models they use are much like the model used by the vendor Digital Workforce. The sample could be thought as "critical cases" (Flyvbjerg, 2006), as their assessment processes are probably the most developed ones in Finland.

While initially the research is only done with explicit existing assessment models, research was later turned from mono-method into a multi-method qualitative study, as it will be complemented with interviews from the case companies. Companies were chosen from the field of finances, as researcher already had contacts there, and in general was already familiar with the field.

1.4 Thesis structure

Above, the methodology of this thesis is described. In the following sections first theoretical background is presented via literature review in the framework of business process outsourcing and time before robotic process automation. It was considered as essential framework to reflect against robotic process automation, and hence it is first explained in order to gain extensive insight on the area of management where RPA stands.

After explaining the field of study, a closer look to RPA is taken. There is only little literature on RPA, but as much of it as possible will be considered in this section. Hence a systematic literature review was chosen as an additional method.

Next three cases from real-life companies implementing RPA are presented. Their models are analysed along with data collected via case interviews. This research focuses on finding out how these case companies assess robotic process automation, and finally, attempts to converge the different models into a single, better-grounded model.

2. BEFORE ROBOTIC PROCESS AUTOMATION

Before diving into the idea of Robotic Process Automation (RPA), a brief historical analysis should be covered. This should help understanding the underlying concepts on which RPA is built on, hence making it easier to understand the need for such solution. The main idea that has been affecting the rise of this need is business process outsourcing (BPO).

With the internet and networking becoming more and more ubiquitous, focusing on core functions is turning into a more favourable option, as value-chains are turning into value networks. Core functions are the primary sources of value in the organisation's product or service, and according to lean ideology, the primary function organisation should work on.

This has given rise to Business Process Management (BPM), which aims to literally manage business processes in a more central way, and often via standardization. Davenport (2005) predicted that this kind of standardization can lead to revolutionizing of business as a whole. This is true on many levels - business process management has gained more and more foothold through different industries, and standardization and constant development of processes has lead to higher levels of excellency in product delivery (Romero et al., 2015). Naturally some variance will always be present, as overdoing standardization may turn into micromanagement which has proven to have negative impact on employee efficiency (Tregear, 2010), and as Tregear points out, there is usually a trade-off between the benefits of variability and benefits of standardization. For example Romero et al. (2015) have reviewed business process standardization in more depth, and developed a model on how to and when to standardize processes. BPO, or RPA for that matter, is mostly not about technology. While technology plays a big part of the final outcome, both of them should be viewed as part of operational strategy (Duening & Click, 2005; Willcocks & Lacity, 2016; Yang et al., 2007). They both allow the organisation to focus on their core functions, and spend as little resources as possible to non-core functions, such as bookkeeping or recruiting.

BPO is often thought mainly as offshoring, aiming to move labour-intensive work to countries with lower personnel costs and to transfer at least some of the risks to supplier (Bals et al., 2016; Manuj & Mentzer, 2008; M. C. Lacity et al., 2010). More recently it has also gained broader ground in service sector (Slaby, 2012; Willcocks

& Lacity, 2016; Duening & Click, 2005; Luo et al., 2010), where the primary aim is in cost-savings or improving service levels (Duening & Click, 2005; Yang et al., 2007). Especially in service sector, focus is usually not only in reducing personnel: with more personnel working on same mundane tasks, service levels can actually be higher. Outsourcing can also be seen as a source of flexibility, for example in case of cyclical demand (Luo et al., 2010; Yang et al., 2007). Not very coincidentally, the goals are same as with RPA - hence RPA is sometimes referred as botsourcing (Willcocks & Lacity, 2016; Waytz & Norton, 2014).

As also pointed out by Davenport (2005), outsourcing is often risky, as there often is little guarantee on the quality of service or product provided by the vendor. However, as the process is more and more standardized and streamlined, variance and therefore risk-levels decrease, which makes it more appealing to be out- or botsourced (Duening & Click, 2005; Willcocks & Lacity, 2016; Davenport, 2005).

BPO naturally cannot be implemented without risks. Information system outsourcing, for example, often has higher possibility of generating incidents regarding human resources (Yang et al., 2007), and while some may aim to improve their service levels by outsourcing, it may as well cause more problems than benefits. In more general situation, Nassimbeni et al. (2012) assessed a case study where biggest security risks were failure concerning the activity selection, failures concerning the contract drafting and failures concerning location choice. When compared to RPA, most major risk resides in activity selection. This has indeed proven to be a difficult task to manage in Digital Workforce, as many business processes have high variance and/or are based on human judgement. Often the process to be modelled for the robot is re-engineered for robotics, which in exchange may cause information loss in the long run, as the original process might be forgotten. So far such cases have not been met.

Slaby (2012) makes a note of the bridge between BPO and RPA: *"Why outsource when you can automate?"*. Outsourcing is often politically unpopular and contains hidden costs (Slaby, 2012), but in the other hand business must find fast and easy ways to enhance their tactical business processes, while IT is overworked with more strategic projects. Gulla & Gupta (2011) presented this in the framework of outsourcing by defining three tiers of expected impact (of outsourcing) depending on the timeframe of the expectations. At the moment, as many companies struggle with legacy IT and the new era of digitalization, RPA is expected to gain business benefits on short and medium terms, while more traditional IT development works on the long-term benefits.

2.1 Decision-making Regarding BPO

For example, selective outsourcing may be even more complex than so-called "full outsourcing", where a whole department may be outsourced. This requires a lot of contractual work and mutual agreements on how the outsourcing process is going to work, which may take months in itself - and still the outcome is not guaranteed (Majanoja et al., 2014).

Yang et al. (2007) created another model on assessing potential determinants of BPO. They divided the decision factors into three different categories: Expectations, risks, and environment. Expectations consisted of cost savings, focusing on core competence and flexibility, and was in general very similar to other literature studied. Interestingly, risks were not only in information security and loss of control, but they included political effects, such as morale loss.

Lacity et al. (2010) conducted a thorough literature review on existing information technology outsourcing, which provides usable data on what are the strongest motivational factors in Make-or-Buy situations. The strongest was the "desire to reduce costs on what is viewed as non-core IT activity better provided by suppliers with superior skills, expertise, and technical capabilities" (M. C. Lacity et al., 2010). Other significant factors can be found in the table 1. These were also used as part of the template for the empirical part of the study.

Another method for considering how to outsource, a six-step process has been proposed by Duening & Click (2005, p.38):

1. Establish a BPO Analysis Team.
2. Conduct a current-state analysis.
3. Identify core and non-core activities.
4. Identify BPO opportunities.
5. Model the BPO project.
6. Develop and present the business case.

In this study, especially steps 4,5, and 6 can be considered relevant, and hence they should be examined more closely.

2.1.1 Identifying BPO opportunities

According to Duening & Click (2005), there are many factors to be considered in assessing outsourcing potential, including:

- Goals of the outsourcing initiative

Table 1: Information technology outsourcing decision-making factors according to Lacity et al. (2010).

Category	Factor	Effect	Notes
Motivational	Cost Reduction	++	Cost reduction was the strongest driving factor by far (a strong positive effect was found in 90% of the reviewed articles.
	Focus on core capabilities	++	Was found relevant in 21 times of the 23 times examined.
	Access to Skills/Expertise	++	Third most major motivational factor, found relevant 16 out of 17 times.
	Business/Process improvements	++	This considered getting hands on technology that was not available in-house. It was found very relevant 10 out of 10 times studied.
Transaction attributes	Uncertainty	-	With all transaction attributes, a negative linkage was found. For example, more uncertain the IT environment is, less likely it is to be outsourced.
	Critical role of IS-Transaction	-	
	Transaction costs	- -	
	Business Risk	-	
Influence sources	Mimetic	++	Every time when peer organizations were perceived more successful, the ITO-decision was more likely to be positive.

Table 2: BPO Selection Matrix (Duening & Click, 2005).

Tier	Cost	Productivity	Mission-criticality	Notes
Tier 1	High	High	High	Difficult to outsource, but have high costs. C-suite functions.
Tier 2	High	High	Low	Technical workers on non-mission-critical systems. Prime candidate for BPO.
Tier 3	Low	High	High	Clerical employees with mission critical tasks. Low cost, unattractive for outsourcing, but possible.
Tier 4	Low	High	Low	Low cost & low mission criticality hints at non-core function. Prime candidate for BPO.
Tier 5	High	Low	High	Good candidates for BPO.
Tier 6	High	Low	Low	Technical workers with no offering in own country.
Tier 7	Low	Low	High	Not attractive for BPO
Tier 8	Low	Low	Low	Low risk processes for experimenting, but not ideal from economic point of view.

- Ability to recruit a motivated internal project sponsor
- Business case supporting the initiative
- Timing of the project
- Culture of the unit slated for outsourcing
- Amount of work required to implement the outsourcing initiative
- Expectations of senior management
- Risk to business

Decision process is strategic and personnel under effect should be included. BPO Selection Matrix contains 8 types, as presented in 2. Costs can be calculated while making initial analysis of the processes in step 2 of Duening & Click's (2005) 6-step-approach. Productivity should be assessed by using industry standards, or if there are none, qualitative assessments and judgements. Mission criticality is assessed by for example identifying is the process is critical, key, or support process. These are analysed on step 3 of the model.

2.1.2 Modeling the BPO Project

In order to model the BPO project, organisation must assess timing, costs, risk mitigation and deliverables. Assessing timing means defining milestones and making sure where the BPO process is going. With costs, (at least) implementation, transition, and maintenance costs should be covered. The costs can be fundamentally divided into two groups: direct financial costs, such as training employees (or developing robots), getting outside consultation, and preparing change management, and hidden costs, which include for example loss of learning. Building a secure environment is a problem with traditional outsourcing as well (Luo et al., 2010).

When considering outsourcing, the costs are usually higher when outsourcing to a location further away from home nation (Gerbl et al., 2016). Naturally, this is no problem with RPA. More difficult task is to handle the expectation management. According to experiences with Digital Workforce, often automation projects are expected to be perfect, while RPA has quite strict borderlines it cannot cross. The robot always does only what it is programmed to do, and the automation level defines the cost, and therefore major part of the profitability of the project (Slaby, 2012).

2.1.3 Developing the business case

Vital part in deciding the outsourcing strategy is choosing where to outsource - and especially the physical location. Gerbl et al. (2016) studied effects of the physical location of company's home nation and outsourcing country. They divide outsourcing into three distance-factors: local, nearshore and offshore. The findings propose that further the outsourcing location is from the home nation, more codified and mature processes should be - just as is the case of RPA. And just like RPA, often so-called "offshore outsourcing" focuses on back-offices (Gerbl et al., 2016; Willcocks & Lacity, 2016). While Willcocks and Lacity (2016) have not found RPA generating re-shoring, i.e. returning jobs from offshoring sites to home nation, it is still a possibility (Bals et al., 2016), as they in many ways aim to resolve the same problem: make repetitive, codified process cheaper and faster.

While developing the business case the underlying infrastructure must also be considered. Duening & Click (2005, p.175-177) separated required infrastructure regarding outsourcing into four independent levels, which all contain strengths and weaknesses:

- First let us consider hardware infrastructure. It consists of the actual underlying hardware and the general architecture of the information systems. Often some business process re-engineering is also required, as many times human

workers have developed certain routines for the process which aim to fill gaps in its development - which are actually often the same gaps RPA aims to fix.

- Software infrastructure should also be considered independently, as with BPO, it can cause dissension regarding data ownership .However, when it comes to RPA, this is not a problem. Instead by analysing software infrastructure it should be considered how viable the underlying information systems are for RPA. This may help to mitigate hidden costs that emerge from more challenging or erratic systems.

- Knowledge infrastructure considers the tacit and explicit knowledge contained in the business unit to-be outsourced or automated. With BPO, there are many challenges for example regarding data streams coming from various corners of earth, and the focal idea of how the data is actually formed. The development of this and the actual knowledge of the process can be permanently lost as the process is outsourced.

- Finally, training & support infrastructure must be taken into account. This consists of basic and advanced employee education. The employees must understand what is the new process, how and why it has been changed, and what it requires from them. This can be a major differentiator between success and failure of BPO project, as well as an RPA project.

Developing the business case for outsourcing is not, however, straightforward. There have been plenty of studies on how difficult it is to measure costs or benefits (McFarlan & Nolan, 1995; Trent & Monczka, 2005). Somewhat more recently Wang et al. (2008) as well as McIvor et al. (2009) have conducted case studies on the topic, describing possible problems in quantifying different key performance indicators, such as defining success or savings. This kind of uncertainty naturally makes outsourcing less attractive option, and the problem is not unlike the ones with RPA.

3. ROBOTIC PROCESS AUTOMATION

In order to find out what is currently known, and what current models most likely are based on, it was deemed necessary to conduct a systematic literature review. According to Okoli & Schabram (2010), it is good for graduate thesis, as it "synthesizes the understanding a student has on their particular subject matter, it stands as a testament for student's rigorous research dedication, it justifies future research (including the thesis itself), and it welcomes the student into scholarly tradition and etiquette." They also considered systematic literature review in the context of information systems research, which can be considered quite similar to RPA research.

The review contains following steps:

1. Defining the purpose,
2. Searching for literature,
3. Making practical screening,
4. Making a synthesis, and,
5. Writing the review.

It should be noted that Okoli & Schabram (2010) considered a few more steps: 1) Establishing protocol, which was not deemed necessary as only one reviewer was used, 2) Quality appraisal, which was was not thoroughly conducted due to lack of researcher's experience, and 3) Data extraction, on which Okoli & Schabram itself admit that there is little information on how to extract data on qualitative studies, which in this case almost all of the found articles were.

3.1 Search process

Search was conducted via Google Scholar and TUT's search engine, Andor, as well as TUT's thesis search engine TUTDpub. For the search terms, Robotic Process Automation is the most unique phrase for referral and it is used in most journals found in initial searches. Botsourcing, in the other hand, ties it to chosen framework of business process outsourcing, hence making more nuanced (Waytz & Norton, 2014; Vedder & Guynes, 2016). Search query was hence defined to be *"Robotic Process Automation" OR Botsourcing*.

As the subject itself is new, only 45 publications were found with this query in either their keywords or titles, and which were published before September 2016. Generally only publications written in English and published in peer-reviewed journals or conferences were considered relevant in the practical screening. Of these 45 publications, 7 were not accessible (Oshri et al., 2009; Lakshmi et al., 2014; Norton et al., 2015; M. C. Lacity et al., 2016; Shekhar, 2016a, 2016b; Srinivasan, 2016), 3 were broken links with no data on what the contents were supposed to be, and other 6 were duplicates of other studies in the same set. 5 were not research papers, but public letters or low-quality magazine articles instead. 2 were not in English, but in Spanish. Another 5 were included in the book "Service Automation: Robots and the Future Work" (Willcocks & Lacity, 2016), which was found as a major source of knowledge in the initial review.

This left only 17 publications to be observed in the practical screening beyond Willcock and Lacity's (2016) book. Interestingly, almost all the publications have been published after 2014 - this supports the fact that the field of study is an emerging one.

Another distinction criteria was made according to abstracts: only papers considering actual usage of robotic process automation, software robots or possible similar concepts were considered relevant. This left out articles dealing with work automation via physical robots, or articles focusing mostly on out- or backsourcing, where RPA seems to get some mentions as a tool but is not the subject itself. This lead to excluding 11 articles from the review, as presented in table 3.

3.2 What is currently known about RPA

In the synthesis phase of the review, the remaining 6 journal publications and 1 book were categorized and, as told by Webster & Watson, (Webster & Watson, 2002), mapped by focusing on the key concepts mentioned in the article.

According to the review, there is hardly any perfect definition of what RPA is. Willcocks & Lacity (2016, p. 65) described RPA as follows: "Robotic Process Automation (RPA) is one type of service automation software - - RPA is well suited for tasks in which human being takes data from one form of digital inputs, transforms the inputs following structured rules, and passes the transformed digital outputs to another computer system." These "robots", which are the basis of RPA, are actually software that works on the presentation layer of different underlying software. Another possibly term is used by Fung (2014), who writes about information technology process automation (ITPA), which he defines as "IT capabilities that automate system and network operational processes while interacting with elements like applications, databases and hardware infrastructure" (Fung, 2014). ITPA could be considered broader term than RPA, but many of the theories applying to ITPA ap-

Table 3: Practical screening of RPA literature - List of articles not included in the review.

Source	Exclusion reason
(Bals, Daum, & Tate, 2015)	Focuses backsourcing as a trend, where RPA is mentioned as one factor among others.
(Bals et al., 2016)	Focuses on re-shoring, where RPA is partly the reason.
(Bott & Milkau, 2016)	Focuses on Distributed Ledger Technologies, where RPA is once mentioned as something that induces cost-savings.
(Frey & Osborne, 2013)	Not peer-reviewed article.
(Jones, 1991)	Paper published by NASA considering usage of physical robots in manufacturing.
(Kembery, 2016)	No notion of automation.
(M. Lacity, Khan, & Carmel, 2016)	Focuses on offshoring and reshoring, no notion of RPA.
(M. C. Lacity & Willcocks, 2016)	Mentions general technology-assisted automation, but not RPA.
(Oshri et al., 2009)	One notion of RPA as a "way of sourcing".
(Piçarra, 2014)	Focuses on social robotics technologies.
(Hull & Nezhad, 2016)	Focuses on cognitive computing instead of robotic automation.

Table 4: Synthesis of the systematic literature review.

Article	Concepts				
	History	Benefits	Targets	Legal	Challenges
(Asatiani & Penttinen, 2016)		x	x		
(Devanney, Quilliam, & DuVal, 2016)	x	x			
(Fung, 2014)		x	x		x
(Holder et al., 2016)		x	x	x	
(Vedder & Guynes, 2016)		x			x
(Waytz & Norton, 2014)					x
(Willcocks & Lacity, 2016)	x	x	x		x

Table 5: Categories of software robots, as defined by Devanney et al. (2016).

Name	Function
Task bot	Repetitive tasks in multiple different processes.
Meta bot	Complex processes requiring multiple skills.
IQ bot	Processes involving unstructured data that requires learning via experience.

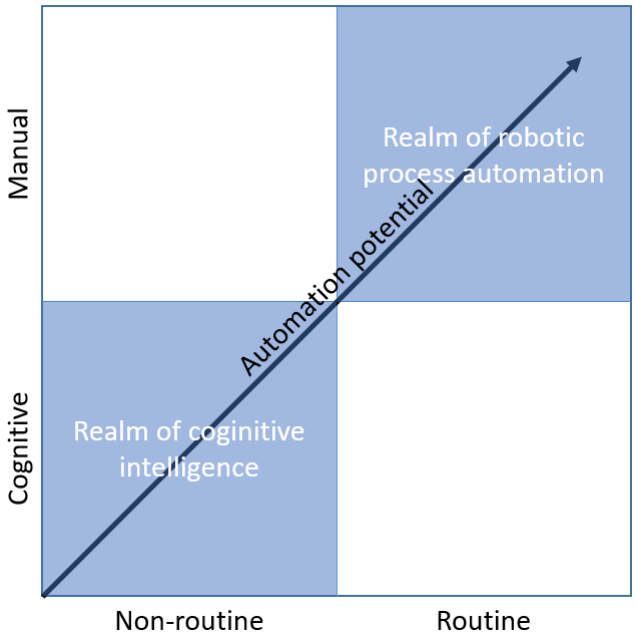

Figure 5: Realms of cognitive intelligence and RPA (Asatiani & Penttinen, 2016).

ply to RPA as well, and for example Asatiani & Penttinen (2016) have quite directly applied Fung's (2014) writings into RPA.

Devanney et al. (2016) theorised RPA to be part of a bigger scheme called Professional Services Automation (PSA). It is a growing market that aims to automate business processes, such as billing. RPA is seen as the future of long-lasting life-cycle of PSA. Devanney et al. (2016) also divide bots into three separate categories: task bots, meta bots, and IQ bots, as presented in table 5. The base idea of RPA is to work on straightforward processes without the need for learning: this is also the difference between a task bot and other bot types. Meta bots can learn from experience, and IQ bots can actually even predict from what they have already learned (Devanney et al., 2016). The view is not far from Willcocks & Lacity's work (2016, p. 66), though they consider task bots as the primary form of RPA, where meta bots and IQ bots are moved to the realm of cognitive Intelligence (CI), as presented by Asatiani & Penttinen (2016) in figure 5.

Mostly current literature seems to focus on benefits of RPA. This is probably due to the need of marketing as well as lack of experiences. Common benefit seen is generally reducing costs, usually in form of full-time equivalents (FTEs) (Asatiani

& Penttinen, 2016; Holder et al., 2016; Willcocks & Lacity, 2016; Fung, 2014; Devanney et al., 2016). Cost-reducing is often tied to thinking RPA as an alternative to outsourcing (Asatiani & Penttinen, 2016; Holder et al., 2016; Willcocks & Lacity, 2016; Vedder & Guynes, 2016). However, other benefits are listed, too: for example Holder et al. (2016) as well as Fung (2014) make notes of better data collection, cleansing and analysis across information systems, which could improve decision-making. In short: improved quality and control (Vedder & Guynes, 2016). Fung (2014) also makes additions to the list: RPA could increase IT service repeatability and predictability, as well as reduced IT service risk. Devanney et al. (2016) writes that PSA software "will always be focused on servicing its customers and their markets", and they make much more major point on increased customer satisfaction and lower turnover rates. All this is very similar to what Willcocks & Lacity (2016, p. 67) describes based on their extensive case studies.

Regarding targets of RPA, the criteria to assess the viability of the process for RPA is quite well aligned with all the studies. Most major factors are high transaction volumes, high value transactions, stable environment, and unambiguous business rules (Asatiani & Penttinen, 2016; Fung, 2014; Holder et al., 2016; Willcocks & Lacity, 2016). Again, Fung (2014) extended this by noting that the process viability for RPA is also increased by the need of accessing multiple systems, where human users often struggle, and the proneness of human error in the IT process. Willcocks & Lacity (Willcocks & Lacity, 2016, p.149) have similar experiences in their case study with a major utility company in energy sector, but they also also bring out the positive effects of higher process maturity level in their case study with Telefonica O2 (Willcocks & Lacity, 2016, p.92). However, they also emphasize that companies should develop their own criteria for assessing process robotisation potential (Willcocks & Lacity, 2016, p.92).

Interestingly, challenges of RPA is not nearly as well covered as benefits and targets. Most of the work has been done by Fung (2014), who lists job losses, requirements of staff re-training, increased automation-induced complacency, lack of human touch in the finished service, and costly deployment. Vedder & Guynes (2016) especially emphasize on what human labour should do after botsourcing. In the other hand Waytz & Norton (2014) had completely different aspect, as they studied how people reacted to robots taking over cognition-oriented versus emotion-oriented jobs. While they were talking botsourcing in more general term than RPA, this can still be extrapolated to the context of RPA: people most likely will more easily accept robots doing repeating, mundane tasks, instead of working with at least seemingly emotion-based tasks such as giving decisions on a mortgage, even while the process of mortgage decision can be broken down into unambiguous business rules. Maybe the most interesting view has been written by Holder et al. (2016)

who considered challenges from legal viewpoint, answering questions such as "who has the control over the intellectual properties robots handle and generate", and "who has the responsibility if the robot fails." Unfortunately, these are mostly just asked questions and the answers are left for future research. Once again, Willcocks & Lacity (2016, p.93-95, 118,126-128,146-148) have covered this area in their case studies, with most essential lessons learned being taking IT onboard as early as possible, getting adoption from the C-suite, and being very careful but open with internal communications.

3.3 Summary

Robotic Process Automation has many names, such as ITPA, botsourcing or software robotics. They all have slightly different nuances, but from practical point of view they all mean the same phenomenon: automating simple IT tasks with external software.

Best processes for RPA have high value and high volume, with unambiguous business rules and stable environment. Most often the benefits are calculated in full-time equivalents, or similar cost-reduction figure. The business case calculations are often conducted the same way as with business process outsourcing, and RPA is often considered as an alternative for moving the tasks outside the organisation. It could also help improving the quality of the processes, as the outputs have steady variance, and human error can be eliminated. This could also lead to cost-savings in lowered IT service risk.

Challenges are mostly focused on the human resources management: personnel need to be adjusted to new work in one way or another, as robots can often replace major parts of their daily tasks. There are also extensive legal compliance risks, which mostly have yet to be solved.

4. ASSESSING THE MODELS CURRENTLY IN USE VIA CASE STUDIES

The study was conducted as multiple case qualitative study. The case companies involved were chosen from the clients of Digital Workforce Services with a focus on financial sector, which was the field where the researcher was currently working, and hence he was already familiar with it.

From each case company 1-2 employees were chosen to be interviewed, as presented in table 6. The interviewees were in leading roles as well as practical workers in making the actual RPA potential assessments. Initially group interviews with RPA teams was also considered, but in the end individual interviews were seen as better source of knowledge. It lets the interviewees to speak more directly with no social pressure, which could affect the answers (DiCicco-Bloom & Crabtree, 2006). This was deemed necessary as automation is still seen as a way of reducing the headcount in a company, which may cause fear of job loss among employees. Audio from the interviews was recorded. After completing the interviews, they were transcribed and sent to interviewees, who then had a chance to correct their statements or to make other remarks that they possibly did not think at the time, as described by Yin (2009).

Interviews were held as semi-structured. There were several planned questions, but they were not formally followed. Instead the interviews focused on discussion. Aim was to make it possible to find out surprising elements that the researcher could

Table 6: Personnel interviewed for this study.

Case	Role	Description
DWF	Consultant	Actively uses the DWF assessment model among different clients. Has lately updated the current model himself.
A	Development and robotics lead	Has been working with the company's robotics project from the beginning.
B	Robotics project manager	Has been working with managing the robotics project for some time.
B	Business developer	First-hand experience with the tools used.

not have foreseen (Eisenhardt, 1989).

The actual analysis of the data took place constantly during the data gathering process. Transcriptions were written instantly after the interview to ensure no data was lost, and between the interviews, questions were focused more and reiterated (DiCicco-Bloom & Crabtree, 2006; Merriam & Tisdell, 2015). After the data had been collected the transcriptions were codified, focusing on the research question, as described by Tisdell & Merriam (2015). However, as the interviews were only semi-structured, this left interviews open for new insights that were not directly considered to be part of the research questions. For example there were issues that cannot be interpreted as direct factors in assessment models, but are still important parts of the automation pre-assessment.

Basically only two top-level categories were used: 1) mentions of direct factors that should be part of the pre-assessment model, and 2) important insights that should (probably) be contained in the pre-assessment model, despite they were more non-metric.

After making the initial analysis, all the models and ideas from interviews were analysed with analytical hierarchical processing (AHP) (Saaty, 2008). AHP is a tool used to formalize decision-making process. It was introduced by Saaty (1994), but it has then been refined (Saaty, 2008). The tool has been widely used for BPO-related decision-making (Kivijärvi & Toikkanen, 2015; Yang et al., 2007; J.-J. Wang & Yang, 2007; Gulla & Gupta, 2011, for example).

4.1 Vendor side: RPA in Digital Workforce

Digital Workforce (DWF) was established in late 2015. Its focus is solely on robotics, knowledge work automation, and offering Robotics-as-a-Service (RaaS). Currently this primarily means RPA, but there are projects researching possibilities of CI or other similar, more advanced techniques.

In order to understand the focus of this thesis, let us briefly examine the project model used by DWF. As can be seen from figure 6, the goal for beginning phase of the project is just 4-5 months. After making 1-2 pilots, which take considerably more time that latter ones, the actual RPA process for the client should be implemented and processes be automated in a constant stream.

In the first phase, where pilot-projects are being chosen, a 3-stream model is usually used. This model, as illustrated in 7, consists of 4 different kinds of workshops:

1. Setting targets for RPA (1 workshop)
2. Long list creation (1-3 workshops)
3. Process "quick-scan" (1-3 workshops)

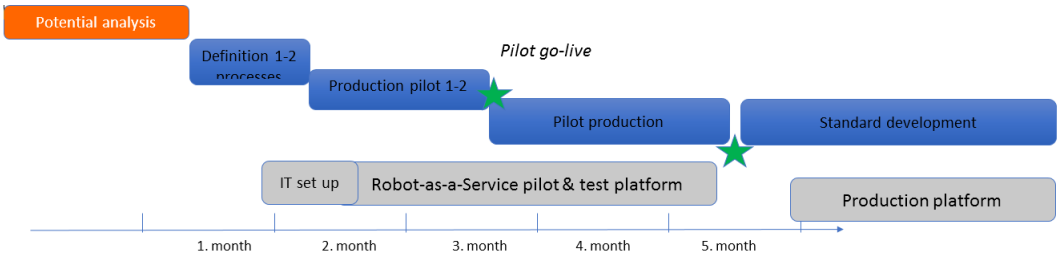

Figure 6: Digital Workforce RPA implementation process model (Digital Workforce, 2017)

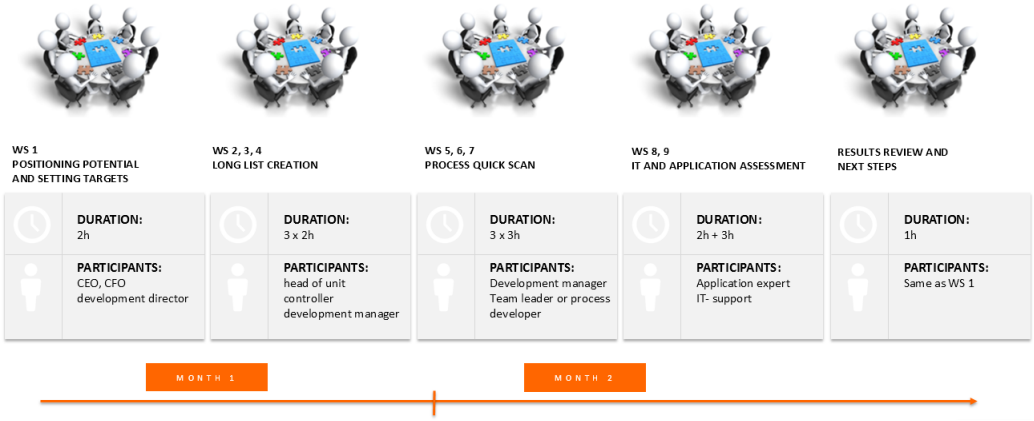

Figure 7: Digital Workforce 3-stream model for beginning phases (Digital Workforce, 2017)

4. IT and application assessment (1-2 workshops)

Setting the targets is done by the C-suite representatives, and it aims to build the big picture for RPA planning. The creation of long list is quite straightforward - first list of possible processes are listed, then rough estimations of FTE-savings is calculated. In this phase also first "red flags", which could prevent efficient use of RPA, are also considered: primarily this means checking if data is in digital form and if the decisions made in the process are based on solid business rules. The third part assesses the most viable processes of the long-list a little more delicately, yet it still does not actually go through the process step-by-step. Finally, the target applications and IT environment are assessed in order to gain insight on what generally is being dealt with.

The pilot processes seldom are the best targets for RPA, as in many cases there is a lot of challenges in the IT and application environment. The pilot projects often struggle through these challenges, and after they have been dealt with, the actual robotics production process (also called "robotics implementation") may begin. This is where new processes are constantly being discovered, re-engineered for RPA, and finally automated.

In order to keep the automation flow constant, the quick-scan of the processes

Table 7: Digital Workforce Process Assessment tool, critical attributes from November 2016. Questions are numbered for later reference.

Critical attributes

No.	Assessment criteria	Scale
1	Everything in the process is in digital format	Y/N
2	All the data involved in the process is structured	Y/N
3	Logical thinking and decision-making in the process is based in unambiguous business rules	Y/N

must be comprehensive enough to tackle most of the problems that could be raised after the development has started. Otherwise some superfluous work would be created as major difficulties in the development process could ruin the business case. The preliminary assessment is done via set of more or less simple questions. As client companies may contain hundreds or thousands of processes and/or sub-processes, it is necessary to keep the tool quite simple, yet it still has to provide enough information to assist decision-making. This is the core problem of this study.

4.1.1 RPA Assessment model used by Digital Workforce

Digital Workforce has been developing a model for assessing RPA potential since early 2016. Originally the model was based on the work of the RPA software vendor Blue Prism (http://blueprism.com/), but the vendor model was considered too time-consuming and detailed. The first draft of the model was built in March 2016, and it was updated in November 2016 by Jari Annala, who was also interviewed for the case study. He described his job "helping clients evaluate RPA-potential and potential benefits." The actual model update process consisted of making the questions more unambiguous and "easy to answer", as well as dropping some irrelevant ones out.

The current model is presented in tables 7, 8 and 9. If in table 7 any of the questions are answered as "No", it is considered as a red flag for the process - it should not be considered for automation at all, not at least in the initial stages. The table 9 assesses the strength of the business case in the process, as in how much benefits can be reaped with automatisation. The most interesting one is the table 8, which focuses on how difficult would it be to automate the process, which roughly translates to development costs.

The model has few easily noticeable strengths. First, it is easy to fill - almost anyone without any background with robotics can fill the answers. However, the questions are very subjective, except the few questions concerning volume or number of systems used. This makes the model suspect for being biased. In the other hand unambiguous questions somewhat mitigate the problem, but still if two people were to fill the model, it would not be surprising if the results were different.

Table 8: First draft of the Digital Workforce Process Assessment tool, difficulty of robotisation from November 2016. Questions are numbered for later reference.

Difficulty of robotisation

No.	Assessment criteria	Scale	Goal
4	Can a "summer intern" do the task using only the task instructions	Y/N	Finding out how difficult human worker thinks the task is
5	There are clear and detailed working instructions of the process	Y/N	Has the process been already accurately defined.
6	The software in the process are stable and work in the same manner each time they are used	Y/N	Is the IT environment good for RPA.
7	Of the process' tasks how many can be completed based on unambiguous rules (%)	No	Are cognitive skills required to complete the task.
8	Exception handling can be allocated to nominated persons in a centralised team	Y/N	Are there people who can handle the non-automatable cases.
9	The number of software applications used in the process	-2, 2-5, 5-	Gives some hint on how complex the process is.
10	Is any software used through a virtual layer (e.g. Citrix)	Y/N	Citrix and similar technologies prevent easy use of RPA.

Table 9: Digital Workforce Process Assessment tool, benefits of robotisation from November 2016. Questions are numbered for later reference.

Benefits of robotisation

No.	Assessment criteria	Scale	Goal
11	Number of cases in year	No	Assessing the volume.
12	Case duration in minutes or total man-years	No	Assessing the costs.
13	A change in the number of cases is to be expected (Over 10%)	Y/N	Assessing the volume.
14	Automation will speed up the roll-out of new services	No	Assessing the potential future benefits.
15	Automation will improve the customer experience	No	Assessing non-financial benefits.
16	The team currently responsible for the process lack resources or important tasks are left undone	Y/N	Assessing non-financial benefits.
17	The interval updates are made for the software used in the process	Y/N	Assessing how long can the robot run without updates.
18	There are large seasonal changes in the number of cases	Y/N	Assessing if robot can solve non-financial benefits.
19	The errors in the process cause significant risks	Y/N	Is it possible there will be problems with risk management.
20	Errors or mistakes in the process cause expenses in other processes (k€/year)	Y/N	In case of failure, does the robot affect other processes.

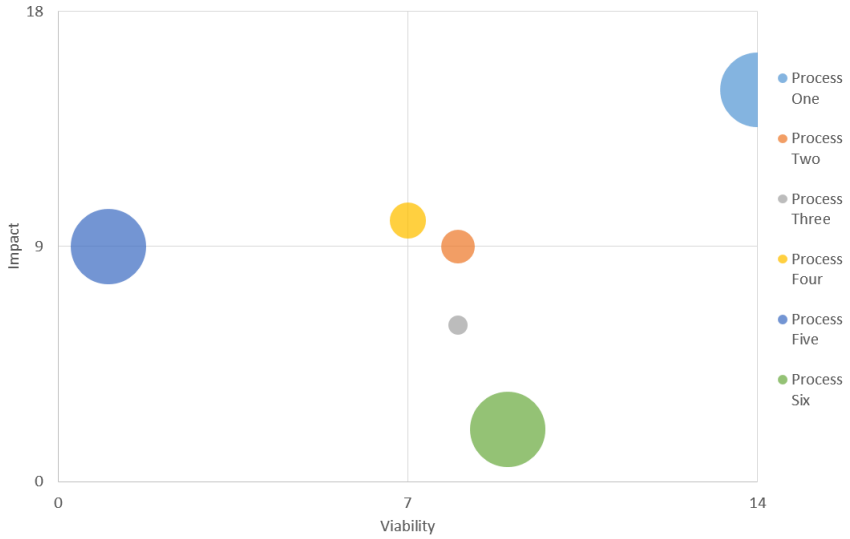

Figure 8: Example of process heatmap created by DWF RPA assessment tool (Figure acquired from Digital Workforce).

"The original tool used by DWF was developed for screening multiple processes, and finding viable piloting processes among them. This is the refined model, which aims to support creation of a roadmap (for robotics implementations). It does not leave the client with just few processes to automate, but it creates a (so-called) 'heatmap' (Figure 8) which indicates what is viable for implementations", described interviewee. In the heatmap strongest business cases end up in the top right corner, and the weakest cases in the bottom left. Visualization is the key - it helps reiterating the results of the questionnaire, as it makes the workshop participants wonder why certain process ended up in an area or another in the heatmap. This should lead the participants thinking more deeply if the process is viable for automation or not.

While the ready-made questions are general, and answer the most vital questions, the tool also leaves space for client's views on relevant KPIs. "For example if the client focuses on working error-free or pushing down the costs, they can be added to the model", as told by Annala. He also continued: "This (model) cannot be an absolute truth. There are people with different skillsets and know-how, so the knowledge is not (ever) unambiguous." Annala also continued that the aim is to prioritise the different processes, not necessarily to define them. The definition comes later, as documentation is prepared for the robot developer. This is a valuable note, as the tool is labelled "quick-scan tool" for a reason: aim is to quickly go through several processes and not to delve too deep into the processes. Automation viability estimations seems to be rough at best, so the goal is in combing out which processes seem to be viable enough for implementation - not necessarily the exactly perfect prioritisation. "Usually we reserve 3 hours for the quick-scan phase, where about half a dozen processes are processed. If we also have to create a long-list of processes,

we need 2-3 hours more", describes Annala when queried about the length of the analysis workshops.

Annala also described this challenge and its effects in the process definition phase: "The business case is calculated only roughly, as estimating many of intangible benefits is really hard, and estimating intangible benefits after the implementation is even harder. Hence we have only calculated estimated FTE-savings, which gives some direction. But even it has a lot of noise - - and focusing on reducing headcount is not the baseline. If it is focused too narrowly, the goal - getting people to work smarter, or to keep from hiring new employees for the moment - might disappear from sight." This further grounds the fact that the assessment could be defined more as "informed guess" than an absolute roadmap of future robotisations.

When directly queried for the weaknesses in the model, Annala mentioned that the tool is somewhat "mechanistic". By this he meant that the parameters are not valued against each other, but they are all equal. The final view created by the tool is rough, but it should still be accurate enough to give direction on what should be inspected closer.

"There are cases where we have written the PDD (Process Definition Document), and told the client that if these things cannot be changed (for example, if there is a lot of work with Citrix involved), we suggest the robotisation is not implemented for the whole process. It is still better to do a few days' work in vain than to use weeks trying to develop a robot that is robust enough to fit the complex IT environment", told Annala. He also added that often the processes clients suggest are also too complex, either because of the IT or business environment the client is working in. It is easy to see why IT environment complexity could be an issue: if the ITis too complex, for example if target applications are too rapidly changed or updated, it might be necessary for the train the client itself to do small changes to robots. Constantly using external workforce could wither the long-term cost-savings.

Having complex business environment is a bit more difficult to define, but it too can cause issues: "If the business environment and the business rules are really complex, it might prove difficult to find people who can do the actual decisions: for example if robot cannot charge automatically sums that are considered too high, defining the "too high" can be a challenge if no correct person is found with the mandate to make the call", describes Annala. It is clear that understanding these kind of definitions are in many regards essential when it comes to robotics, as robot does only what it is programmed to do. Mapping responsibilities is essential in turning the robotics initiative into continuous strategic tool, and it should probably be part of pre-assessment, as the goal of the robotics strategy is to achieve a state where processes are robotised constantly. This kind of successful initiative of software robotics keeps the so-called "automation flow" constant (term coined by one of

the interviewees). At such stage as many development issues as possible should be resolved as early as possible in order to ensure that the development lead time is as short as possible.

Another fact worth noting is that getting the right people to attend the model-filling workshops is essential. As described by Annala: "About 5-6 people is good. If there are too many people, it is not efficient. If there is too little, there is a risk that the group is too homogeneous." Homogeneity could lead to all the members of the group agreeing on something, as they fail to see the facts from someone else's point of view. This could generate issues later in the development process due to lack of relevant information.

"In the end the tool is about facilitating discussion between the stakeholders. After going through half dozen processes, the clients take a look at the heatmap and start to notice how the assessment should be thought. As the processes are clearly presented in the map, it is easy to explain why this one is on the left and this one on the right", described Annala. This is a major factor in the long run - after the clients have been initially trained with the tool, later they can potentially notice viable processes by intuition, and the tool is no longer required. Of course, the road to understanding of RPA is long, and there are often many business units, which have to be trained separately. This last quote is maybe the most important one. It highlights that the tool is essentially a facilitator for discussion. After the processes have one through the questions they have most likely developed certain mindset on how to think of processes from RPA point of view. This target must be kept in mind when developing the model.

4.2 Client Case companies

Both companies are major actors in Finnish financial sector. They have 1-2 years of experience with RPA, which hints that capabilities are not yet completely mature, but initial problems have mostly been resolved. Both companies are in the middle of information systems renewal process due to the uprising of digital age. They have a lot of legacy IT-systems that should be renewed, but as the renewal process as a whole is slow, robotics have been found to provide faster benefits in the short run while the bigger renovations are in progress. Hence the robotics projects are well-resourced and companies have big expectations on benefits with RPA.

The interviewee from company A is a development and robotics team lead, who has the responsibility over the developers and the robotics as an in-house product. He has been in the project since almost the very beginning and has good insight on the challenges and opportunities faced. Their way of work with robotics emphasizes on doing things and learning with trial-and-error, as the subject itself is new and little information was available at the time the project started. The robotics project

is seen as a major actor in a service centralization project, which involves all the business units in the company. The driving factors of robotics are shorter automation lead times, better customer experience, and lower costs.

For the company B, two people were interviewed. Initially robotics project manager was interviewed, but after a suggestion from the program manager, it was complemented with an interview with business developer. Interviews for the two interviewees were held separately. The business developer had more first-hand experience with the tools used, which proved to be very valuable. Company B has several business units and some of them are geopolitically far from the others. However, the robotics project has been started in all of them. While some have been very successful, some others are more or less stagnated due to problems in IT environment. Their way of work could be described as more plan-and-execute than company A's. The driving factors are mostly financial, as described by both of the interviewees, but they also have an extensive IS renewal project going on, and robotics are used as a "bridge between old IT-legacy and newer information systems", as described by the program manager.

In the following sections the case companies, their process assessment tool, and their way of work is described in order to gain insights on what is relevant and what is the working environment when it comes to assessing RPA potential. First the essential points from the interviews are presented from both cases. Then the data is combined and analysed. Then found data is applied to models used in traditional business process outsourcing in order to find similarities and differences, so the framework suitability can be assessed.

4.2.1 Model used by case company A

Case company A uses a model, which has been built with an external consultation company. It is still under development, but it has already been actively used for the past year. It consists of two parts: robotics feasibility assessment and business case calculations. The robotics feasibility assessment questions are presented in table 10. Scale 1-5 translates to "Very well/Well/Partly/Poorly/Not at all". Both parts have been created independently from Blue Prism methodology with help from external consultant. For the business case calculation, which has been omitted due to confidentiality, there are also questions considering how many FTEs are freed, what is the feasible automation level, and other similar factors.

Based on the questions 1-7, question 8 is filled in a similar subjective manner as the others, but instead of the five grade scale, it uses simple three graded scale. The difficulty is defined as "Low", "Medium", or "High". These statements have directive amounts of days the implementation process takes, where low is approximately less than 10 days, medium is approximately 10-40 and high over 40 days. This count is

Table 10: Primary questions asked in case company A process assessment tool. Questions are numbered for later reference.

Assessing the feasibility

No.	Assessment criteria	Scale
1	Project mostly digital and structured	1-5
2	Process uses separate information systems and/or different user interfaces	1-5
3	Completing the process does not require a lot of judgement	1-5
4	Process is rule-based	1-5
5	Process has high transaction volume	1-5
6	Process is prone to human error or the impact of errors is exceptionally high (quality/financial/legal)	1-5
7	Process has little exceptions	1-5
8	Total estimation of implementation difficulty	1-3

used later for calculating the business case.

"Goal is to get a basic idea that robotics could be used in a process like this or that", told the interviewed robotics lead, "and as such details are mostly left out. When the actual robotisation project (for the process) is started, more detailed specification is made." This was the original idea of their robotics model. However, the interviewee itself deemed that this might not be the best way to work: "We have noticed that when we start filling a ballot like this, the (to-be automated) process should be much better understood." While this is quite clear for anyone with technical expertise, it must not be forgotten that analysts who define the processes could be non-technically oriented. Case A seems to distinguish the work of analysts and developers quite sharply. It could be more appropriate to dissipate the line more, so technical aspects would be considered earlier in the process. This is further highlighted by the interviewee, as he states that Case Company A's robotics model is and will be emphasized in the importance of preliminary assessment of processes. If the preliminary assessment is the most important, technical expertise should definitely be part of it, as it defines the most major costs: the actual development.

According to the robotics lead, the tool template is filled by RPA business analysts, who are specialized in doing preliminary assessments, or business developers, who may have been the ones to come up with the idea that robotisation could be utilized in a certain process. Both of the groups are always supported by Case Company's robotics Center of Excellence (CoE), who have better insight on what are the systems' capabilities for robotics, and other potential pitfalls the development process could step into. Preliminary assessment takes approximately 1-2 weeks from the business analyst, and it includes inspecting the process, recording current manual work, and filling the tool. More complex cases may take even longer. At some

point of the preliminary assessment, the process also undergoes examination from representatives of risk management, information security, information architecture, and some other similar units, in order to mitigate possible problems with legal or security compliance.

"Usually the people who fill the template have already done some analysis on the process, as RPA is considered to be just one tool among others in business process development", describes the robotics lead. The process has possibly been built or documented, possible workarounds considered, and business process re-engineering implemented. "Hence only certain part of the process might be suitable for automation, and other parts may be improved with other tools such as business process re-engineering", describes the interviewee, but adds: "RPA is often the fastest way to reap benefits. So-called traditional IS development 'band' might be taken by mandatory things caused by regulation or such, which often leaves the secondary development, ie. business process efficiency development, to be done with RPA." Also, as often employees use several information systems per process, RPA can be considered as the only way to increase its efficiency without implementing a larger-scale information system integrations. This partly explains the emphasis on the business side of pre-assessment: if it is not known which technology is used for the business development, the relevant technical aspects may be hard to define.

The interviewee also tells that the questions in the assessment model, which are presented in table 10, have been nearly the same since the very beginning. Most major changes to the pre-assessment process are adding a mandatory process flowchart and listing of applications that are to be used. The flowchart forces the analyst to actually visualize the process, which helps the SMEs to see possible flaws or exceptions in the process. The list of applications is the only level of technical expertise implemented in the current pre-assessment process. It tells several things: how many applications there are, who are the people responsible of them, and are there existing, re-usable Blue Prism objects for the application. In addition, the interviewee also stated "as our object library grows, I believe the list of applications will be a more major part of the assessment, as it could easily swing the business case to direction or another." Here technical aspects are noted, but they are still quite superficial - knowing which information systems is not too valuable if they have not been tested if they align with RPA. For example, more important than number of information systems is how well they align with Blue Prism. One system can often be more difficult than three, more compatible systems.

The emphasis on the preliminary assessment has, however, raised other problems, which highlight the lack of technical expertise involved. "Often during the actual development of the robot new things emerge", the interviewee describes. By this he means discoveries like restrictions in the underlying IT infrastructure. In such

cases the final developed process might be a lot different from the process that was initially planned. This often leads to underestimation of the complexity of the development. "This (complexity) often defines the business case for the automation process, and if the complexity increases drastically after beginning the development, it could naturally wither the potential business benefits," told the interviewee. He also mentioned that having only an upper level understanding of the process is not enough: "Even if the process was a new, for example if we have not had the manual process before robotisation, we strive to make sure that an employee will test the new manual process to simulate the functions of the robot." Still, even if the business experts are used to make sure the process is viable, the lack of technical expertise involved in the early stages is a bit intimidating. How can costs of development be assessed without understanding what the actual development is about?

The interviewee especially emphasized finding out the correct people who might be affected by the software: "–finding out relevant stakeholders in order to lead through the robotisation, maybe in the middle or in the end of the project. They have been identified and contacted early in the beginning. It is a big thing that the right stakeholders, even if they are not directly tied to development of the robot, are aware of what is going on before the robot is taken into production. Otherwise this could cause some bad blood between business units and stakeholders." This is a key point, especially in the early stages of implementing RPA. From this it can be seen that for the Case Company A, RPA as a strategic tool is still new to the different levels of organisation, even while the robotics project has been running for over a year. Introducing them to RPA is a vital part of making the automation process as lean as possible. This could lead to benefits in the long run, as most automations need approval from different stakeholders when they are moved to production environment. If the stakeholders are contacted as early as possible, the introduction can be done while the developing is in progress, and moving to production will not suffer any delays. The need for these introductions probably decreases over time, yet there is always the possibility of new employees.

The robotics lead considers the biggest weakness in the tool to be its subjective nature. "Improvement of the existing assessment tool questions has been in the talks, but so far nothing better has come up", he describes, and continues: "Blue Prism offers a more complex tool that uses some numeric attributes, such as number of systems, but they have yet to be implemented. Main concern is not in the questions, but to make the assessment tool successful in a way that it ensures quick and flexible implementations without need to wait for user rights, test materials or such." The questions itself are the things that the interviewee feels should be asked in the preliminary assessment, but they still have been thinking if the tool could have more numeric attributes, which could give some hard data on the implementation

difficulty. This could be problematic, though, as increasing the weight of numeric attributes often diminishes the weight of non-numeric attributes - and in RPA they are often more essential. Automation difficulty is most often not defined by the number but the quality of information systems.

When queried about role of RPA in the robotics process, the interviewee replied: "RPA is offered to business as a service by Robotics CoE. The ultimate goal is that business units could independently contact CoE if they have some process that could be viable for automation." He also notes that has yet to be achieved, as many aspects of the robotisation requires certain level of understanding of IT development. While this is not directly relevant to the pre-assessment process, it underlines the idea of implementing software robotics is a strategic one instead of tactical. In the long run it must start emerging itself from the business units.

4.2.2 Model used by case company B

Model used by case company B was built in collaboration with an external consultation company. It is a lot more extensive when compared to one used by company A. It contains three steps. In the first one, primary questions grounding the initial assessment are graded on scale 1-3. On step 2 more detailed questionnaire on the questions is filled. On step 3, the processes are prioritised for implementation based on desired attribute. The primary questions of step 1 are presented in table 11. Steps 2 and 3, in which the actual business case is calculated, are omitted due to confidentiality. In the first step of the assessment tool, the answers are weighted as presented in the table 11. The weightings are subjective and they were given by the external consultant, but neither the program manager nor the business owner saw any reason to change them. "The whole model is based on Blue Prism methodology, but there was a consultation company in-between. So the exact logic is bit of a 'black box'", told the program manager.

"The aim is to find out which processes have lower degree of automation, contain a lots of FTEs, have no big information system changes in the short-term pipeline, and where is generally good, calm ground for RPA. This is one of the tool we use. Some other units have some other tools. But the logic, based on what I have seen, is quite the same. This is maybe from the more detailed end of the spectrum", described the interviewed program manager. Basically, idea is to find out the processes that have high viability and high potential cost-savings. In the end the tool gives a good general overview of the big picture - what could be automated and what should not. After the prioritised pipeline is built, the next step is to draw process diagrams and other visualisations, after which analysts' begin working on the process diagram for the robotised process.

According to the program manager, the tool is filled several times a year. The

Table 11: Primary questions asked in case company B process assessment tool. Questions are numbered for later reference.

High-level opportunity assessment

No.	Assessment criteria	Weight
1	RPA Potential	12
2	Digital data availability	8
3	Data source quality	6
4	Degree of manual labour	8
5	Compliance risk	8
6	Ownership of process	4
7	Existing process automation	6
8	Interaction channel	6
9	Complexity	6
10	Product growth	6
11	Numerous systems	4
12	System change	4
13	Customer value in decreased time to market	8
14	Change portfolio	-10

business developer agrees: "– in the past year, we have filled the form three times with different processes." The RPA function of company B sees itself as agile, and the development roadmap and pipeline are cyclically updated. The processes to be implemented are planned for about the next six months. Keeping automation stream like this highlights RPA being a strategic tool instead of a tactical one.

The preliminary assessment is done by business developer or business analyst in cooperation with team leads and possibly SMEs. Each team lead has general view on what his/her team is doing. The first step is relatively quick to execute: "if the SME-team lead and business analyst are present, it takes approximately 15 minutes to go through the first assessment step per process." The 2nd step, more detailed as it is, takes a bit more time: "when we assess processes in a certain team, it takes about half of a day to go through all the processes in a team." The assessment process pretty much just scratches the surface of the actual process, and does not delve too deeply to the technical side of the process. Indeed, the business developer further noted that while the information systems are sometimes listed in the step 2 of the assessment process, the information is rarely used anywhere.

The business developer would like to bring an IT representative to the process in order to mitigate risk of IT compliance discrepancies and to gain better insight on the target applications. "The list of applications are written (in the detailed step) - - but how much each of them is used is not written - - and in the end, they are

just documentation, and the data does not end up anywhere else - - The list is not comprehensive, so some applications end up missing."

"The first step, the quick analysis, creates a long list of possible processes. From the long list a short list is created, which requires more in-depth understanding of the process. From there the business cases are built, which form the prioritized pipeline. The most viable processes are taken into development roadmap." The process could be described as diminishing funnel. However, often the development is not as straightforward: "In practice, not until the process is taken into development, it is not seen what the actual process is and is the RPA potential the same as calculated in the business case. If it is affected, the trend is usually downward. Or because of some reason only certain part of the process is automated or only happy path is handled", describes the program manager. This raises a question: if the calculations are too rough and often overestimated due to technical issues, should it not be part of the assessment process? It seems that the factor is identified, but it is not currently exploited.

The business developer's view was somewhat different on the subject. "(Before filling the tool) we have presented our team leads on what kind of processes can be robotised, and asked which processes from the team are the most repetitive, do not require human judgement, have no free text... and then we have started filling the assessment on RPA potential. All the processes are relatively familiar – and this (tool) has been actually really easy to execute, as at this state we already know there is RPA potential. So the pre-selection has been done (subjectively) before this tool." This comment explains how using the tool is so efficient - the worst cases have been dropped out before the actual assessment process is even made. This only considers the business side of the assessment, though: technical view is still missing. But in the other hand if all the cases are viable in business sense, it most likely would be even more beneficial to research the technical side.

Business developer also mentioned that while the first step of the assessment process is supposed to comb out non-viable processes before going to the second, more detailed step, basically they have always filled it with all the processes gathered in the first step. This could be seen as duplicate work, but as the business developer described, "- -when we start making the more detailed analysis, the processes that in the first step looked promising necessarily do not stand out in more detailed view - - This mostly is caused by how much hours the development would take. The first step simply states if there is RPA potential or not, but the detailed step assesses if the potential for automation is 50% or 80%." Distinguishing these two aspects is quite interesting: while the step 1 is quick to fill and gives some insight on what could be viable, the actual business case is defined by the feasible level of automation. If the process itself has 10000 cases a day that can be automated, but

8000 of them must be in the end handled manually by an employee, the benefits of automation naturally diminish. This, however, leaves out the possibility of first creating a robot which automates 20% of the cases, which could be later enhanced with different paths to handle the cases that first were moved to manual handling.

The model itself has not undergone any major changed during the time it has been in use. However, the business developer mentioned that it is maybe too extensive, as not all the fields that are to be filled are used at all. For example non-financial benefits are graded, but the outcome does not affect the prioritized list. "It is probably because the tool is diven by financial benefits", assessed the business developer in the interview. "Of course they (non-financial benefits) are important too", interviewee concluded on topic. It seems that while the automation initiative for Case Company B is clearly number-driven, the non-numeric attributes are considered at least to some extent, but they are not really realized in the assessment process.

The program manager also described the most major challenges. First of all, no formal process descriptions practically exist. Secondly, the sheer amount of IT-legacy that has been inherited from different acquisitions causes trouble, as it also leads to rapid changing of the IT environment, as the services are under constant updates. Thirdly, communication is not straightforward, as IT function might not even know there is a thing called "RPA" running in their environment, which leads to unexpected updating, which often requires re-configuration of the robot. As described by the business developer: "if the updates come during the night, they might not even have an impact on our routines (ie. they do not contain any user interface changes), but the robot must still be updated." In the program manager's interview, this was also mentioned: "If this kind of surprise, that IT must be configured (for the process), it of course falls in to the development pipeline of the information system. And as RPA is minor development, only 1-2 FTEs, the priority that the configuration is given is quite slow – This means that something (some robotisation project) is put to hold." It is clear that the robotics program works in some kind of silo, and not all relevant stakeholders know what is going on. This can cause serious disputes between stakeholders, which in turn may slow down the automation of processes.

4.2.3 Summary from the interviews

Summary of the relevant interview findings is presented in table 12, and comparison between Case Companies in table 13. The three Case Companies are dissimilar in many respects, starting from the aim of their preliminary assessment process: DWF attempts to find where there is automation potential, Company A wishes to make the development as lean as possible by tackling possible issues early, and Company B makes sure there is constantly properly prioritised processes in the development pipeline. This discrepancy between goals explains why points raised by different

interviewees vary a lot.

All Case Companies agree that the assessment is rough at best, and the reality is not often met until the actual development is taking place. They all have noticed that the development environment, both business and IT environment, pose challenges. However, only DWF and Company A attempt to map this in their preliminary assessment process. Company B instead maps environmental stability to some extent, but it is not considered part of pre-assessment. Instead it is treated more as a part of the bigger view, where different sourcing options are considered.

Company B also has another major difference when compared to DWF and Company A. Company B uses a lot of numeric values and more detailed scales in their assessment, where DWF and A focus on keeping the model simple by mostly assessing the questions in three tiers, which could be identified as "high", "moderate" and "low".

In Case Company A and DWF the factors that are researched in the assessment model are valued evenly. Company B introduces weightings that affect the final automation potential value, yet their groundings are unknown. Some kind of weighting could be beneficial, but in the other hand, if the result is rough anyway it could just disrupt the outcome even more without proper reason.

Every Case Company has different level where they work on the process assessment. DWF attempts to find potential processes from within the client, and the client decides which business units are included. Company A has already done some initial assessment on which processes are suitable for robotisation, and then moves on to preliminary assessment which takes weeks. In Company B the processes are processed within business units, and units, mostly team leads, make their own calls on which processes are assessed.

Company A's pre-assessment is the most comprehensive, yet it also takes the most time. It focuses on the business aspects of the process. Similar business focus is also contained in the models of DWF and Company B. It is interesting that all Case Companies attempt to assess the business case without taking deeper technical aspects into account, while in the same time they all have noticed that technical problems may hinder the development process drastically.

4.3 Analysis

DWF representative had very distinct views on the assessment when compared to Companies A and B. However, the factors behind the differences can be explained with relative ease: DWF representative works in sales, so he often meets situations where company has no existing RPA capabilities, while Companies A and B aim to get their automation flow more continuous.

Even while the Case Companies have different aims and differing methods, there

Table 12: Summarized findings from interviews with the Case Companies.

Case	Essential findings
DWF	- Assessment results should be presented in visual form.
	- Idea is to go quickly through many processes in order to find where there is potential for automation.
	- Duration of the quick-scan workshop from Â$\frac{1}{2}$ day to one day for one client, about half a dozen processes are processed.
	- The results are always are always rough and they give only general idea of the automation viability.
	- Results aim to generate a development roadmap.
	- Environment complexity causes issues, but currently they are handled later in the development process.
	- Finding the right people to make calls is difficult, yet mapping them is not part of the pre-assessment process.
Case A	- Emphasis of the development pipeline is in the pre-assessment process.
	- Aim of the assessment is to make the development process as lean as possible.
	- Duration of the assessment is 2-4 weeks for one process.
	- Focus in the assessment is in the business side of the process.
	- Assessment model is still in development and will most likely be extended in the future.
	- Costs of development are assessed without deep technical expertise.
	- Numeric assessment factors have been considered, but not yet implemented.
	- RPA complements traditional IS development and is considered as one sourcing option among others.
	- RPA is a strategic tool.
Case B	- Aim is to create a development pipeline, that is updated several times a year.
	- There is distinction between initial automation potential and feasible automation level.
	- Duration of the assessment is 1-2 days for one business unit/team.
	- Viability in business sense is determined before the processes are included in the pre-assessment.
	- Assessment is numbers-driven.
	- Assessment model is considered maybe too extensive.
	- It is recognized that technical factors (e.g IT-environmental issues) swing business cases into one direction or another, but they are only briefly examined in the pre-assessment.
	- RPA is considered essentially a strategic tool.

Table 13: Comparison of the interviews.

Company	DWF	Case A	Case B
Assessment method	Simple questions	Simple questions, KPIs, and environment mapping	More complex questions and KPIs
Assessment length	0,5-1 days	2-4 weeks	1-2 days
Aim	Find automation potential and create development roadmap	Shorten development lead time	Create/update development roadmap
Actions before preassessment	Creating long-list, finding stakeholders	Deciding which processes are botsourced from long-list	Tacitly deducing which processes have RPA potential
Stakeholders	DWF representative, unit leaders, business developers	Business developer/analyst, unit leads, team leads	Business developer/analyst, team leads

are some similar factors in the used questionnaires. All of the models assess same types of attributes. The difference is mostly in how they attempt to map them and what they do with the assessment results.

4.3.1 Factors of IT process outsourcing

As business process outsourcing was seen as a suitable framework for RPA, the preliminary assessment questionnaires in different Case Companies were compared against the factors of IT process outsourcing that were presented in table 1. Results can be seen in table 14, where the parts of the models are referred in question numbers. Due to confidentiality, only parts of the assessment tools could be presented in this study. Omitted parts were direct business case calculations, and hence in the table 14 mark "x" was used in cases where the factor is queried in the model, but could not be presented more accurately.

As it can be seen, the factors used to assess RPA potential are not dissimilar to ones that are used in making outsourcing decision. This is further supported by the views of the case company B's program manager. However, the interpretation of the factors used is, in some cases, different. For example, where the risks involved diminish the willingness of outsourcing, with RPA it can be actually seen as an increasing factor. It is interesting to note how much difference there is in cost reduction calculations. DWF model has 10 questions that either directly or indirectly focus on cost reduction, while Case Company A only assesses the volume of the process. Company B in the other hand contained quite rigorous cost reduction calculations that were tied into numeric values.

Business/process improvements was mostly indirectly queried, and all the case

Table 14: Case Companies' stance on Information technology outsourcing decision-making factors according to Lacity et al. (2010). Number = question number considering the given factor in tables 8, 9, 10, 11. x = queried in the omitted business case calculations.

	Factor	DWF	Case A	Case B
Motivational				
	Cost Reduction	11, 12, 13, 14, 15, 16, 17, 18, 19, 20	5	x
	Focus on core capabilities			
	Access to Skills/Expertise			
	Business/Process improvements	14,15,16	6,7	14,x
Transaction attributes				
	Uncertainty	3,6,17	4,x	1,3,9,12,14,x
	Critical role of IS-Transaction	15,19	1,6,x	8,x
	Transaction costs	11, 12, 13	x	x
	Business Risk	8,19,20	3,6	5,6,x
Influence sources				
	Mimetic			

companies had different aspects to the factor. DWF considered RPA as a possibility to roll out new services, which is similar to Case Company B's aim to decrease service time to market. DWF also considered improving customer experience, and adding resources to current manual workers, who could be overburdened. Company A, in the other hand, aimed to find out if process contained exceptionally high possibility for human error, which could be tackled with RPA, as well as assessing if the process had potential for automation level (ie. low number of exceptions). The latter one was also considered by DWF. Company B was the only one to actually assess improvement factors in their business case calculations.

Uncertainty was used by Lacity et al. (2010) to assess uncertainty in the environment or its factors. In the questionnaires this could be considered as uncertainty in the business or IT environment. DWF tool queries this by assessing target system update intervals and general system stability (ie. do the target systems operate in a consistent manner), which are also contained in the model of Company B. In addition, Company B assesses general RPA potential, which includes most of the uncertainty factors, as well as data source quality, complexity, and possible planned future system changes. Case Company A only considers uncertainty in business sense: is the process rule-based, as in can clear and unambiguous business rules be defined without external factors affecting them in too short intervals.

Critical role of IS-transaction was seen as a negative factor in business process outsourcing (M. C. Lacity et al., 2010), but in RPA, it could actually have positive effect as robots work more consistently with information systems as they are incapable of human errors. The criticality of the role of the information system was, however, only briefly queried by all the Case Companies. In DWF model it is assessed if errors in the IS parts of the process could cause significant risks. As another aspect, IS criticality is also assessed in the amount of customer value created if software robotics is implemented. In Company A model the criticality can be seen from how big part of the process is digital, as well as proneness of the process to human errors. Model from Company B uniquely considers the interaction channels to the customer: if the channel is a self-service application or at least e-mail, the automation potential increases. Such services also increase the criticality of the IS transactions. Both companies A and B assess some of the criticality in the omitted business case calculations.

Transaction costs are naturally mostly considered in the omitted business case calculations, but for the Case Companies A and B, they have relatively major weight. Higher the transaction costs more RPA potential there is in the process. DWF calculates transactions costs via employed FTEs.

Finally, business risks are considered in all the models. DWF model takes into account if there is enough people to handle the exception cases, as otherwise some

transactions could be left pending, which could lead to lost customers. Costs of major errors are also assessed, although DWF interviewee mentioned that almost any flaws in the automated processes almost with no exceptions cause high expenses, which could diminish the meaning of assessing them. It could be more useful to just accept that the costs are always high and the to-be automated processes should contain some mechanisms that prevent major errors. Company A assesses the amount of judgement required in the process, which also has an effect on the potential business risk: if a lot of judgement is required, it means that unambiguous business rules must be defined by the personnel included in the automation process. If the business rules are defined too loosely, it could induce a big risk in the automation, as it could be possible for robot to accept cases that are borderline unacceptable. Company B also considers the legal view, as well as who is accountable for the results of the process. These both naturally affect the contained business risk.

Factors that were not considered in the studied tools are identified as 1) focusing on core capabilities, 2) accessing to skills/expertise, and 3) mimetic. These can be easily interpreted: focusing on core capabilities is not seen as major factor as with outsourcing, as the actual work stays inside the company. The processes that are to be automated with RPA are also repetitive by nature, so no new skills or expertise is necessarily gained or even required. Finally, the mimetic source is not mentioned. Mimetic refers to willingness of doing something because competitors are doing it. RPA is very new phenomenon, and not many companies talk about working with it. Naturally this tends to decrease mimetic influence source.

Most commonly met factors were business/process improvements, uncertainty, and business risk. They were mentioned in all of the interviews as well as the most critical factors. According to the interviews, it seems that in order to make RPA successful, there must be willingness to improve the business processes, hence removing the uncertainty of the process. This ultimately decreases the business risk involved.

4.3.2 Stances on BPO-selection matrix

Case companies held quite similar stances when considering the table 2. Stances derived from the models are presented in the table 15.

These were not directly queried, but the results are assessed from case companies' models combined with the data received from the interviews. For example, all the models considered volume of the transactions in the process as a critical part of business case calculations - hence high productivity usually leads to more RPA potential.

As suggested in the literature review, it seems that the driving factors are costs and volume, along with increasing customer satisfaction. But essentially the true

Table 15: RPA potential in different tiers of BPO-selection matrix.

Tier	Cost	Productivity	Mission-criticality	DWF	Case A	Case B
Tier 1	High	High	High	-	-	-
Tier 2	High	High	Low	++	++	++
Tier 3	Low	High	High	++	++	++
Tier 4	Low	High	Low	+	+	+
Tier 5	High	Low	High	-	-	-
Tier 6	High	Low	Low	- -	-	-
Tier 7	Low	Low	High	- -	- -	- -
Tier 8	Low	Low	Low	+	+	+

benefits of software robotics is always in the volume of transactions. This makes tiers 2 and 3 most attractive areas for RPA, as they have mostly technical or clerical tasks, which could be automated. Tier 4 may be attractive for automation, as it contains mostly non-core functions, but they are probably processes which end up lower in the prioritised development roadmap. Tier 8 may contain some processes that are suitable for testing botsourcing potential of the organisational environment, but they most likely will not yield much benefits.

According to interviewee from case company B, the cost of a robotic worker is always lower than human - if so, the cost-column could be entirely removed from the matrix. In the other hand, mission-criticality is somewhat assessed, but as told by the interviewee from DWF, clients often do not see how mission-critical a process is - or how much of a core-business risk is contained in the process. Hence mission-criticality could also be, if not totally removed, at least understood as not as important factor. This leaves only the productivity column to the matrix. Basically, according to all interviewees, the only driving factor is productivity: as long as robot works faster and more accurately than human employees, the process can be seen as an interesting candidate for RPA.

If such rework of the matrix is done, it leads that tiers 1-4 are the only potential fields for RPA. However, tier 1 should be omitted, as it contains C-suite functions which rarely have unambiguous rules to be worked with. This deduction strengthens the results found.

4.3.3 Modeling with AHP

The basic AHP-process contains four steps (Saaty, 2008):

1. Define the goal of the process,

2. define the factors (and possible sub-factors) that affect that goal, also called 'criteria',

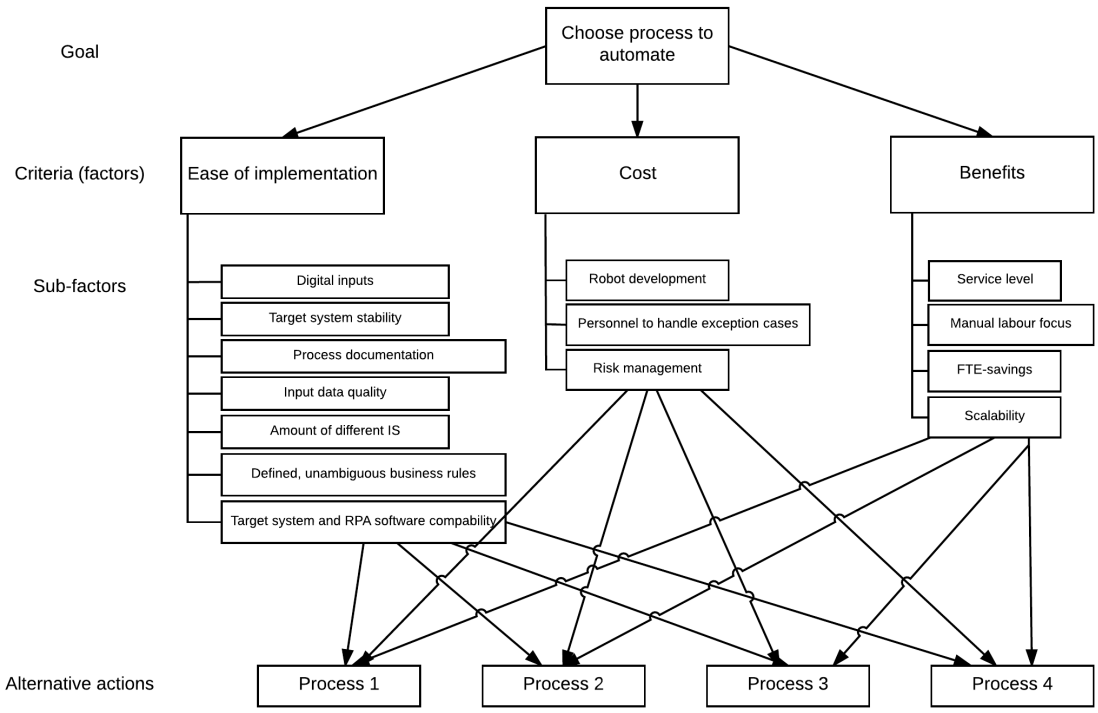

Figure 9: AHP Model of the decision process.

3. construct set of pairwise comparison matrices, and

4. based on the priorities obtained from the matrices, weigh the possible alternatives, working upwards in the hierarchy.

While all the preliminary assessment processes studied had differing aims, the general results assessed is the same: choosing the process to be automated from a set of processes. In order to define the factors that affect this outcome, questions in the pre-assessment models were first generalised and combined. Table from the forming of the factors can be found form appendix A.

Results can be seen in the figure 9.

Digital inputs

Digital inputs are vital for process RPA viability. While it is possible to use so-called "surface automation", which works with image recognition, it should always be the last resort. Surface automation is easily broken with updates, as even the slightest changes in texts, colours or window resolution always require reconfiguration of the robot. Therefore if process has, for example, source data as scanned PDF-files, process RPA should probably not be implemented.

Target system stability

As robotics configuration is based on the presentation layer of the target system, up-

dates may easily break it. For example all Windows-based software windows contain an attribute called "class name", which is often used in the actual programming code to identify a certain window type. However, if the underlying software is slightly redesigned, the programmer might want to change the class name in order to tackle version discrepancies. This might not even be noticeable for ordinary end-user, but robot could instantly fail as it cannot interpret the changed class name. The reconfiguration required might be a minor, 20 minute task, but if it has to be done too often it quickly diminishes the benefits gained with robotics. This is not only due to development costs, but lost benefits due to robot downtime.

As it is rare even for legacy software to be completely un-updated, the solution is usually finding out the usual update interval. It can help calculating the possible reconfiguration costs required. Rarer the updates, the better.

Another aspect to system stability is the actual use of the system. Especially with legacy software, there could be a tendency for occasional software crash or discrepancies in the use of software. For example, Digital Workforce has met software where certain button does not work every time it is clicked - but there is not any kind of error message, and clicking 10 times more might end with the desired result.

RPA exception handling standards can handle many cases of system instability, if the instability is known. For example it is standard to notice if software is not responding and do the necessary steps to reboot it. But undefined instability or random operational problems can cause a lot of problems in the long run.

Process documentation

In order to start RPA implementation, the process must be defined delicately step-by-step (or click-by-click). If the process is undefined before it is considered for RPA, there may be a lot of surprises. It is not uncommon for human to forget different nuances in the process, for example with certain rare exception cases. Readily available documentation makes the preliminary assessment of implementation difficulty a lot more realistic and reduces the work that has to be done after the implementation decision has been made. Interestingly, Case B RPA lead mentioned that a major potential for robotics lies in the currently outsourced back-offices - the outsourced processes have been carefully documented for the outsourcing purpose, which makes them very attractive for RPA.

Input data quality

It could be said that the input data quality is the main source of benefits in RPA. If the data is consisted, does not contain surprising null-values, and in general the inputs are carefully defined, RPA implementation can be really successful. But if the input data is not consisted and often contains either logical or semantic errors,

the robot can behave in unexpected ways.

Amount of different IS
Usually more different target systems means more difficult implementation, as there are more systems to be controlled. From the experiences in DWF, the growth of difficulty is exponential: for example, let us define that handling only one system is of difficulty of arbitrary metric 1. Handling two systems is then 2. But if there is a third system, the difficulty goes up to 4, and if there is even fourth system, difficulty goes up to 8. This is of course affected largely by the target systems itself - if there are 6 systems and all are really consistent and easy-to-automate, the difficulty can be 1 or 2. But if there is no knowledge of the target systems beforehand, it is safe to assume more systems means more difficulty.

Unambiguous business rules
Robots are naturally incapable of intuitive deduction. For example, it is possible for human to deduce that name "Anders Von Something" is a name, as "Von" is a preposition for people with certain status. If robot is told to define first- and surnames of this rare three-parted name, it could not do it. Tracing these kind of rarely occurring business rules may require a lot of effort.

As another example in financial sector, there is a lot of decision-making based on human interaction, such as a loan applicant's trustworthiness or credibility. The attribute is mostly defined by numbers in CRM-system, but the final touch is given by the bank clerk: should the loan be given or not. Writing down decisions like this in unambiguous business rules is not always straightforward, as often they require defining "soft" things such "high amount of money", or "not suspicious".

Target system and RPA software compatibility Different RPA software "attach" to target systems in different ways, and the compatibility should be assessed before any implementation can be done. For example there have been systems that simply do not react to software's attempt to "touch" the presentation layer. While these cases are rare, it should be taken into account in the preliminary assessment. There is always the option to use surface automation, if the problem with compatibility is only in a small part of the process.

Robot development
Robot development ties resources in the development process, which leads to monetary costs. Stakeholders required should be defined in order to guarantee they have resources allocated for the implementation. Usually the costs are mainly formed from the time used by robot developer and the subject matter expert, who has de-

fined the process that is to be implemented.

Personnel to handle exception cases
It is very rare to get the automation rate of a process to 100% with RPA. Usually it ends up being around 50-80%, which leaves 20-50% of exception cases that someone must tend to. This can be done by the people who worked in the manual process, or some other individual or group.

Risk management
Just as other software, robots need supervising that they work in the way they are intended. Managing the risk of failing functionality induces some costs. This can be done by the people who handle the exception cases, robotics center of excellence or some other instance.

Service level
With robotics service level often changes, and usually in the good direction. Robots can work 24 hours a day 7 days a week without resting. They are also impervious for human error, if the input data is of high quality.

Manual labour focus
Automating the most mundane parts of a process releases the manual labour workers to focus on the exception cases. They often require some kind of contact with clients, and with more time in hand, the cases may be handled more carefully.

FTE-Savings
Based on volume and task cycle time, saved FTEs can be directly calculated. This is one of the few numeric values that can be used, although it is not exact: often just defining the average cycle time can be a difficult task to do.

Scalability
Robots are good for processes that require scaling with seasonal changes, for example. Adding more robots to do the same work is trivial, if their design is properly built. In another case there could be expected massive growth of incoming cases: adding robots to do the work could prevent the need to hire more people.

After defining the factors and sub-factors, they are compared pairwise against each other according to prioritization criteria presented in table 16.

The pairwise comparisons are presented in tables 17, 18, and 19. It is assumed that ease of implementation, costs, and benefits are of equal importance in the

Table 16: Prioritization of different factors. (Saaty, 2008)

1	Equal importance
2	Weak or slight
3	Moderate importance
4	Moderate plus
5	Strong importance
6	Strong plus
7	Very strong or demonstrated importance
8	Very, very strong
9	Extreme importance

Table 17: Pairwise comparison of Ease of Implementation.

	Digital inputs	Target system stability	Process documentation	Input data quality	Amount of different IS	Unambiguous business rules	Target system - RPA software compatibility
Digital inputs	1	9	9	7	9	1	7
Target system stability	1/9	1	2	1/2	2	1/3	1
Process documentation	1/9	1/2	1	1/3	2	1/6	1
Input data quality	1/7	2	3	1	5	1/7	1
Amount of different IS	1/9	1/2	1/2	1/5	1	1/9	1/5
Unambiguous business rules	1	3	6	7	9	1	7
Target system - RPA software compatibility	1/7	1	1	1	5	1/7	1
Normalized priority	0.390	0.064	0.044	0.089	0.026	0.320	0.067

decision-making process. Other prioritisations are deduced from the data collected by counting how many times a certain aspect was mentioned, along with possible other given verbal weight. These notions were complemented by inspecting the models used for pre-assessment.

From table 20 it can be seen that from ease of implementation, digital inputs and unambiguous business rules are two most major factors in the difficulty assessment. Digital inputs is always the most vital factor for RPA - without it, the implementation could be impossible. Unambiguous business rules, in the other hand, were mentioned by every interviewee as a source of problems. Making the rules unambiguous enough has repeatedly increased costs and lead time of implementation processes.

After the two most dominant factors, input data quality and IS stability as well as IS compatibility with RPA software gained the highest weights. The amount of different information systems got the lowest weight, but it should also be considered the most situational. The amount of IS itself might not tell much about the difficulty,

Table 18: Pairwise comparison of Costs.

	Robot development	Personnel to handle exceptions	Risk management
Robot Development	1	3	3
Personnel to handle exceptions	1/3	1	2
Risk management	1/3	1/2	1
Normalized priority	0.589	0.252	0.159

Table 19: Pairwise comparison of Benefits.

	Service level	Manual labour focus	FTE-savings	Scalability
Service level	1	1	1/3	1
Manual labour focus	1	1	1/2	1
FTE-savings	3	2	1	2
Scalability	1	1	1/2	1
Normalized priority	0.177	0.195	0.432	0.195

Table 20: Normalized priorities.

Criteria	Sub-factor	Weight
Ease of Implementation		
	Digital inputs	0.390
	Target system stability	0.064
	Process documentation	0.044
	Input data quality	0.089
	Amount of different IS	0.026
	Unambiguous business rules	0.320
	Target system and RPA software compability	0.067
Cost		
	Robot development	0.589
	Personnel to handle exceptions	0.252
	Risk management	0.159
Benefits		
	Service level	0.177
	Manual labour focus	0.195
	FTE-savings	0.432
	Scalability	0.195

but instead the quality of the systems is a big factor.

While considering the costs it should be remembered that the focus of the interviews was mainly on the ease of implementation, and hence "robot development" might have gained a bit higher weight than it should. But in general it seems that at least in the current state of RPA, indirect costs, such as risk management, is not considered as a big issue. The focus is more in the direct costs generated by development and application management.

In the benefits criteria, FTE-savings were very dominant among all interviewees. Especially Case A and DWF interviewees mentioned that while FTE-savings are not actually the only thing that matters, it is the only thing that can be reliably quantified with relative ease.

4.3.4 Other relevant notes from the interviews

As the interviews were conducted in a semi-structured manner, it left opportunity for the interviewees to give further insights on what could be important for the preliminary assessment of processes.

Case company A especially emphasized on bringing relevant stakeholders to process as early as possible, including IT and service managers. This was also described by the DWF representative, who emphasized on having people who can make calls regarding the business rules as well as restrictions imposed by IT. He also mentioned that bringing IT on-board early often proactively mitigates problems. It is also one of the lessons learned from Willcocks & Lacity's case study at Telefonica O2 (Willcocks & Lacity, 2016, pp.84-100) as well as their case study at XChanging

(Willcocks & Lacity, 2016, pp.101-132). Case company A actually had added information of the target systems and relevant stakeholders in their assessment tool. The aim was to shorten the lead time of the automation process by doing more work before the automation process itself starts. However, we have no data on how well it works, and whether the preliminary assessment itself is the correct place to do such analysis. It would require more accurately defining the aim or aims of preliminary assessments.

All case companies made a note of business process re-engineering required before automation. It was considered a major pitfall by Case A interviewee: "The process we think should be automated, it must be at least on some level existent, and it has to be gone through by one of our employees in a way robot would do it at least once or more times. It helps a lot." This was one of the same lessons learned by Paul Donaldson of XChanging (Willcocks & Lacity, 2016, p. 121).

5. DISCUSSION

5.1 RPA in regards to outsourcing

While BPO is a good framework for RPA at this state, when not much literature exists, there are also naturally some subtle differences. For example with outsourcing switching costs, or even cost of modifying the contracts, may require heavy and costly processes (Kivijärvi & Toikkanen, 2015). What is different with RPA, however, is the possibility to revert the decision with relative easiness. with RPA the processes have already been documented before the implementation takes place (much like with outsourcing), but the documentation is often more accurate as the robot needs very clear instructions without a need for human judgement. If the decision to stop implementing robotisation to a process is made, it is still possible to robotise part of it without a need for defining new contracts.

What may cause problems is the knowledge infrastructure of the organisation (Duening & Click, 2005). When it comes to RPA, this is probably the most vital infrastructure to be considered: as a process is automated, especially in a lightweight manner where its life cycle is usually shorter than with heavyweight IT, it is more probable that the automation cannot function eternally. This is indeed one of the pitfalls with RPA - after maturing RPA capability to a level where robots are trusted to a degree where no human has deep insight to the process any more, the situation where robot fails can be very dangerous, as there is no replacement. This risk can be mitigated with proper documentation. Data security must also be taken into account properly, as robots are no more secure than most of the software used by the company (Slaby, 2012). The possible costs included depends on how mission critical the process is (Duening & Click, 2005).

As Yang et al. (2007) presented, there are three different risk categories. While expectations seem to be quite similar with RPA and outsourcing, or at least there is no literature covering them, included risks differ. For example Yang et al. (2007) consider morale loss as a risk, but according according to experiences in Digital Workforce and Willcocks & Lacity (2016), employees consider robots as their fellow employees after initial confusion - at least as long as they handle cognitive tasks (Waytz & Norton, 2014).

The environmental factors considered vendor's quality, market maturity, and competitor positioning (Yang et al., 2007). Considering RPA, vendor quality is vital.

As Digital Workforce has learned by experience, badly implemented RPA can be a major threat to whole RPA process, and especially in the early stages, trust can be easily lost and cooperation with business owners may turn toxic. There can also be seen some movement regarding competitor positioning in the field: some have already started with RPA, but actual "snowball effect" has not yet started.

The contents of table 2 are especially interesting, as despite considering BPO, it can be quite directly be implemented to RPA, but in some regards, RPA has more opportunities. For example considering mission-criticality, RPA can be implemented even in the processes that deliver highly sensitive data about clients or services. The data can be easily encrypted so no human can see it, and only the results are visible. Also, RPA often contains lower costs to implement and to test, which makes tier 3 very attractive, too. Tier 8 is also worth mentioning. As noted, it could be highly suitable for experimenting with RPA. This is supported by Willcocks & Lacity (2016, pp. 84-100) while making a case study at Telefonica O2. There the case company had conducted a controlled experiment, where in-house business process management challenged RPA, insisting that they could do the automation cheaper. As Willcocks & Lacity (2016) note, such an challenge could also be posed to different RPA providers. Conducting a controlled experiment like this in tier 8 process could tremendously affirm the stakeholders involved to take on the RPA road with little or no risk.

5.2 Role of RPA in IT development and outsourcing

Where more "traditional" IT development makes robust and heavyweight information systems, RPA can be seen as "lightweight" IT. It is a tactical tool that can be developed and deployed rapidly. It focuses on the presentation layer of the software instead of touching the code itself, which allows the components to be easily re-used in the processes that utilize the same information resource. The pitfall is that it is highly rules-driven, and the bot cannot do anything but the things it is taught. (Slaby, 2012)

With BPO, after an outsourcing contract ends, one must always make the make-or-buy -decision again. Veltri et al. (2008) studied a phenomenon called "backsourcing", and found out that key problems with BPO were higher than expected costs, poor service quality, loss of control and know-how mismatch. These are similar to risks identified by other researches, such as Yang et al. (2007), Yang & Wang (2007), and Gonzalez et al. (2010). The interesting aspect here is that with RPA, the possibility to lose control is significantly lower, as the business owner still owns the process after RPA implementation. If something goes wrong, the competence to make quick fixes is always in the hands of the business owner, while with more traditional BPO, quick fixes might take weeks or months for vendor to implement.

There are still the questions on service quality and cost expectations, which can be big factors especially in the early stages of implementation, but are often mitigated over time, or at very least it is possible to change vendor in order to mitigate them. The work done by one vendor is often owned by the client company, and often it can be re-used at least partly by the new vendor chosen to do the implementations.

Backsourcing from traditional BPO-agreement may prove to be expensive and complex. Everything needs to be tested thoroughly and meticulously in order to maintain intended service level (Veltri et al., 2008). In RPA, however, this too is easier, though necessarily not cheap: one just has to train new or existing employees to work on the tasks that were previously worked by robots. This might increase serendipity and innovation rates in the long run, but in the other hand, often bot-sourced process are too mundane to form a chance for significant innovations.

5.3 Determining Process Automation Potential

Regarding on which processes to automate with RPA, Willcocks & Lacity (2016, p.149) conducted a case study at major utility provider, which had developed its automation capabilities since 2005. One of their primary lessons learned was a list of factors in processes or sub-processes that were the technical attributes which made the process viable for RPA:

- Unambiguous rules,
- Limited Exception handling,
- High and predictable volumes,
- Operated in a stable environment,
- Accessed multiple systems, and
- Known costs.

When comparing these to models in the case studies, it can be quickly noticed that these are the baseline on what to assess. However, the questions itself are not unambiguous. Defining what is "high" or "stable" can prove more difficult than suspected, as were stated by all interviewees.

Blue Prism's Alastair Bathgate also mentioned that too often decision-makers focus on costs, instead of the overall business benefits (Willcocks & Lacity, 2016, p.112). The possibility to scale with more or less clients without changing the headcount in the company should be taken into greater account. This stands for both outsourced processes as well as in-house processes. The possible value-drivers should

more focus on the so-called "soft-savings" (Nollet et al., 2008) or cost-avoidances (Ashenbaum, 2006, cited by Kivijarvi and Toikkanen, 2015).

The analysis provides an answer for the research question based on the current situation in the case companies. The pre-assessment process should most likely divide into two parts. First, there are so-called "red flags", which should cause reconsideration of the automation attempt. From the table 16 we can see them standing out from the other sub-factors with a lot higher weight than others (more than 0.300). These are already implemented as a part of DWF quick-scan tool, and case companies take these into account in less direct ways. The first two red flags are:

1. All input data must be in digital format, and

2. The process must be possible to be defined with unambiguous business rules.

The first item is quite intuitive: if the data is not in digital format, it would have to be first scanned and then read with some kind of optical character recognition technology. This would require tremendous amounts of manual work and business process re-engineering. Also noting that in current OCR-technologies highest accuracy gained has been 93,59% (Rao, Sastry, Chakravarthy, & Kalyanchakravarthi, 2016),which means that in roughly 7% would go instantly wrong, and the robot would have no way to recognize it made a mistake in them. This does not mean it could not be done, but it does signal that the business case would most likely drop so low that almost any other processes seem more attractive. The second item is somewhat extended from what the interviewees described due to challenges they have encountered so far. Often the processes are not yet defined with unambiguous rules, but it does not mean they are not possible to be defined. This requires some business process re-engineering, but if necessary stakeholders can be found, the business rules can be quite quickly defined.

According to the case companies A and B, one more item could be added as a red flag:

3. Are the FTE-savings significant enough?

This leaves possibility for the client company to define what is their FTE-saving goal. This is in line with Willcocks & Lacity (Willcocks & Lacity, 2016, p.92) statements that organisations should focus on creating their own criteria for assessment. As an example, Case A company regarded less than 1 FTE processes not viable for automation, while Case B did not even consider processes that saved more than 2 FTE - instead they were divided into smaller pieces that were to be automated separately. Focusing on FTE-savings is tricky, though. DWF interviewee emphasized

that while the clients still think of RPA as a tactical tool to reduce costs, while it could be used for creating much more strategic value or even new products. The significance is also emphasized by most of the literature, but there has been no study on "how much is significant" (Asatiani & Penttinen, 2016; Holder et al., 2016; Fung, 2014; Devanney et al., 2016).

Fourth item that got weight of over 0.300 was the "robot development" in the cost criteria. However, it is directly affected by the ease of implementation: if the process is difficult to automate, it naturally takes more time and hence generates costs. Hence it probably should be omitted.

If no red flags are raised in the initial review, the assessment can move into next phase, where the actual process is looked at more closely. Here the factors that got weight of over 0.060 were considered as relevant.

4. Are the target systems stable, so no constant reconfiguration is required?

More constant reconfiguration requirement generates more costs, but finding an answer for this question is not necessarily straightforward. The client should be enforced to actually find out what is the update cycle for the target systems, as often there are updates that are not even visible for the end-user. This is one of the reasons why IT must be taken on-board as early as possible (Willcocks & Lacity, 2016, p.93), as they are probably the only ones who actually know what is going on in the systems. Another thing that should be confirmed by an expert before any actual implementation is done is:

5. Are the target systems compatible with used RPA software?

This is fairly straightforward thing to analyse, as many RPA software comes with some kind of light diagnostics tool, which can be ran from an flash memory. However, if it is not until the actual implementation phase when this is done, the robot development cost may end up much higher than anticipated. This leads us to making sure that robot actually can deliver the value it is expected to deliver by asking the question:

6. Is the input data of high enough quality, so robot the automation rate can be high enough to yield cost-savings?

Anticipating the possible cost-savings or business benefits is maybe the most challenging part of the preliminary assessment. Tracking data quality is one of the more easily done parts, as often manual labour workers have a good insight on their work. For practical use this question should probably be defined in a more practical way for non-IT-expert SMEs. Fung (2014) also highlights that automation actually usually improves the data quality. Hence it can be said that more there is automation, easier it is to automate further.

Rest of the relevant questions consider the actual business case and current situation of the process, ie. is there a need for automation due to lack of resources:

7. Are there resources that can handle the exception cases that robot cannot?

8. Is the manual labour currently well-resourced enough to handle all the exception cases with care, or is their time consumed by the mundane, non-exception cases?

While questions 7 and 8 seem quite similar at a glance, the goal of the questions is subtly different. Question 8 focuses on the possible need for more resources, and question 7 on the availability of resources after the implementation. The questions could also stated like this: "are the current employees capable of handling mixture of different exception cases regarding their current skills and resourcing."

There have been occurrences where the newly-freed employees have been assigned new tasks, and they no longer had time to see to exceptions generated by the robot. In the other hand, there have been processes that seem to have a weak business case, but the case has grown stronger when it is noticed that the current pool of employees do not have enough time to handle the incoming cases, which has created an ever-growing backlog of tasks. This could cause increased employee turnover rate, which RPA could help mitigating (Devanney et al., 2016).

Finally, current state and future of the process should be considered:

9. Is there a need to increase service level?

10. Is there a need for more scalability?

These questions are not currently assessed too much by the case companies, yet from DWF point of view, they probably should be, as RPA could be considered more strategic than operational tool. For example if a process is expected to grow in volume in large measures, RPA could prevent the need for increasing headcount in the company. Another aspect to consider is the 24h-nature of RPA: could the clients benefit from offering a certain service around the clock in case the cases are straightforward enough? This could help reducing lead times in delivering the service, hence increasing service level as written by Devanney et al. (2016).

In financial sector the scalability issue is probably a lot higher than in other sectors like healthcare. Especially end-of-year and start-of-year rush may require hiring more employees just to handle formalities caused by end of fiscal years, which often happen in the end of calendar year. Also taxation and other similar public finances require a lot of attention around December and January. These seasonal changes can at least partly be tackled with RPA, as removing or adding robots in the same work can be considered trivial.

For the whole process to work, relevant stakeholders should be contacted as early as possible to make sure they know what is going on. This may include, but is not limited to, IT personnel, subject matter expert(s), team lead, unit lead, and business developer. Having people through the whole business unit ready for making calls is essential, as defining the unambiguous business rules may require decisions from higher in the organisational hierarchy.

5.4 Limitations

The case studies gave an initial answer to question regarding how preliminary assessment of a process for RPA implementation is currently made in financial sector, and how it probably should be done in the future. However, this research is largely limited by the fact that RPA as a whole is an emerging subject, that only has little prior research, and even the clients who have been working with RPA for "a long time", are still actually in the ramp-up phase of RPA production. Hence a lot of new information and ideas emerge in an almost weekly basis.

The focus of this research was in the financial sector, which has some peculiarities when compared to other sectors. Next extension in this regard could be researching the preliminary assessment in healthcare sector, as it probably has as mature RPA capabilities as financial sector in Finland.

In the end this research mostly focused on assessing the ease of implementation, although costs and benefits were also briefly covered. The reason for this is that as RPA is still a new topic, there has been only little benefit-tracking in the long-run. Assessing benefits and costs without possibility to track them after the implementation does not yield too strong results.

It should also be noted that the goal of the preliminary assessment was defined broadly as "which process should be chosen for software robotics implementation from a certain set of processes." This is not straightforwardly defined, and altering the goal affects the questions that should be asked. For example with Case Company A, the goal was to shorten the development lead time, which covers a lot more than Case Company B's attempt to build development roadmap for next development cycle. One tool cannot cover all of different goals, so probably defining more tools for different phases of RPA initiative could prove more useful.

The AHP pairwise tables were filled by assessing the interviews of 3 people, all of whom are business leaders. This should be enhanced by questioning experts in both business and technical backgrounds more broadly.

6. CONCLUSIONS

RPA will be the next big thing. It is simple yet versatile tool to reduce costs as well as improve service quality. What is interesting is its quite hidden nature: only little literature is available, while there are seems to be a lot of movement on IQ bots and artificial intelligence, even if they are still a decade away.

Assessing business process automation potential should always include some business process re-engineering. Often human personnel have developed workarounds and verifications, which are unnecessary for a robot, as machines are incapable of conducting human error. Moving the tasks to robots instead of humans increases the quality and control over the process. As more processes are automated, the increased quality helps future automations - hence utilising RPA should always be a strategic choice, as the benefits increase over time.

The framework of outsourcing is somewhat fitting, but one should be careful on how extensively it is used. Botsourcing may often be a better sourcing option if the process is possible to conduct without human touch. It may, however, leave the client somewhat reserved, as the automation can often be recognized by the output given to the client. This can especially cause trouble if the task performed by the robot is usually recognized as emotion-based task, even if it was not emotion-based even to begin with.

In traditional outsourcing, most attractive processes have high productivity and low mission-criticality. With RPA, mission-criticality is not necessarily a factor, as the information and data stay inside the organisation itself, and the automation can be enhanced with relative ease. The most critical cases are usually exceptions, which still require human touch and cannot be automated anyway.

Assessing the potential before initiating the actual automation is very complex process. It contains many pitfalls, most of which include having the correct people on correct meetings and enough political power to make decisions. Just having correct business people is rarely enough - if IT department does not know what is happening, it could cause sudden stops or delays in the automation process, which in the other hand could cause trouble to credibility of RPA as a whole. IT department can also see RPA as a nuisance instead of asset, which may lead to catastrophic failure.

The factors in preliminary assessment process should be weighted separately at

least to some extent. The minimum is containing "red flags", which indicate that the process in question should be moved to bottom of the prioritised list. They mean that there is a major issue with the process, such as lack of digital inputs, or non-significant potential benefits. These flags can, especially in the early stages of automation implementations, lead to more easy and successful automations, which reinforce the credibility of RPA. After the credibility is established in the business unit, harder tasks can be worked on, and some adversities can be overcome more easily.

Solution presented in this thesis is just one, and it may be that companies should more focus on generating their own sets of questions instead of trusting more general solutions. Especially on the benefits section a lot depends on what the company is attempting to do: are they leading for cost-leadership, or do they aspire to be the best service provider? These factors often have trade-offs, which could change the questions into completely another direction. However, creating a model that takes the company goal into account would be an enormous task and requires more time for the RPA market to mature. The technical aspect is not straightforward either: much depends on the target systems itself. Their RPA capabilities should be initially assessed before determining whether a certain process should be automated or not.

REFERENCES

Asatiani, A., & Penttinen, E. (2016). Turning robotic process automation into commercial success Case OpusCapita. *Journal of Information Technology Teaching Cases*, *6*(2), 67–74.

Ashenbaum, B. (2006). Defining cost reduction and cost avoidance. *CAPS Research Critical Issues Report*.

Bals, L., Daum, A., & Tate, W. (2015). From offshoring to rightshoring: Focus on the backshoring phenomenon. *AIB Insights*, *15*(4), 3.

Bals, L., Kirchoff, J. F., & Foerstl, K. (2016). Exploring the reshoring and insourcing decision making process: toward an agenda for future research. *Operations Management Research*, *9*(3), 102–116. Retrieved from `http://dx.doi.org/10.1007/s12063-016-0113-0` doi: 10.1007/s12063-016-0113-0

Bott, J., & Milkau, U. (2016). Towards a framework for the evaluation and design of distributed ledger technologies in banking and payments. *Journal of Payments Strategy & Systems*, *10*(2), 153–171.

Chui, M., Manyika, J., & Miremadi, M. (2016, July). *Where machines could replace humans - and where they can't (yet)* (Tech. Rep.). McKinsey Global Institute. Retrieved 2017-07-21, from `https://public.tableau.com/profile/mckinsey.analytics#!/vizhome/AutomationBySector/WhereMachinesCanReplaceHumans`

Davenport, T. H. (2005). The coming commoditization of processes. *Harvard business review*, *83*(6), 100–108.

Davenport, T. H., & Kirby, J. (2016). Just How Smart Are Smart Machines? *MIT Sloan Management Review*, *57*(3), 21.

Devanney, P., Quilliam, W., & DuVal, C. W. (2016). Professional Services Automation: Exploration of Benefits for Organizations. In *International Conference on Accounting and Finance (AT). Proceedings* (p. 79). Global Science and Technology Forum.

DiCicco-Bloom, B., & Crabtree, B. F. (2006). The qualitative research interview. *Medical Education*, *40*(4), 314–321. Retrieved from `http://dx.doi.org/10.1111/j.1365-2929.2006.02418.x` doi: 10.1111/j.1365-2929.2006.02418.x

Drucker, P. F. (1999). Knowledge-worker productivity: The biggest challenge. *California management review*, *41*(2), 79–94.

Duening, T. N., & Click, R. L. (2005). *Essentials Series : Essentials of Business Process Outsourcing (1)*. Hoboken, US: Wiley. Retrieved from `http://site.ebrary.com/lib/ttyk/docDetail.action?docID=10114211`

Eisenhardt, K. M. (1989). Building Theories from Case Study Research. *Academy of Management Review*, *14*(4), 532–550.

Flyvbjerg, B. (2006). Five misunderstandings about case-study research. *Qualitative inquiry*, *12*(2), 219–245.

Frey, C. B., & Osborne, M. A. (2013). The future of employment: how susceptible are jobs to computerisation? *Technological Forecasting and Social Change*, *114*, 254–280.

Fung, H. P. (2014). Criteria, Use Cases and Effects of Information Technology Process Automation (ITPA). *Browser Download This Paper*.

Gerbl, M., McIvor, R., & Humphreys, P. (2016). Making the business process outsourcing decision: why distance matters. *International Journal of Operations & Production Management*, *36*(9), 1037–1064. Retrieved from `http://www.emeraldinsight.com/doi/abs/10.1108/IJOPM-04-2014-0192`

Gonzalez, R., Gasco, J., & Llopis, J. (2010). Information systems outsourcing: a Delphi study from Spain. *Business Process Management Journal*, *16*(2), 244–263.

Gulla, U., & Gupta, M. (2011). Deciding the level of information systems outsourcing: Proposing a framework and validation with three Indian banks. *Journal of Enterprise Information Management*, *25*(1), 28–59.

Holder, C., Khurana, V., Harrison, F., & Jacobs, L. (2016). Robotics and law: Key legal and regulatory implications of the robotics age (Part I of II). *Computer Law & Security Review*, *32*(3), 383–402.

Hull, R., & Nezhad, H. R. M. (2016). Rethinking BPM in a Cognitive World: Transforming How We Learn and Perform Business Processes. In *International Conference on Business Process Management* (pp. 3–19). Springer.

Jones, C. (1991). Robotics in space-age manufacturing.

Kembery, J. (2016). The evolution of the lawyer's lawyer. *Legal Ethics*, *19*(1), 112–121.

Kivijärvi, H., & Toikkanen, J. (2015). Measuring the business value of IT outsourcing: a systems approach. *Strategic Outsourcing: An International Journal*, *8*(2/3), 156–179.

Lacity, M., Khan, S., & Carmel, E. (2016). Employing US Military Families to Provide Business Process Outsourcing Services: A Case study of Impact Sourcing and Reshoring. *Communications of the Association for Information Systems*, *39*(1), 9.

Lacity, M. C., Khan, S., Yan, A., & Willcocks, L. P. (2010). A review of the IT outsourcing empirical literature and future research directions. *Journal of Information Technology*, *25*(4), 395–433. Retrieved from `https://search.proquest.com/docview/814946351?accountid=27303`

Lacity, M. C., Khan, S. A., & Yan, A. (2016). Review of the empirical business services sourcing literature: an update and future directions. *Journal of In-*

formation Technology, *31*(3), 269–328.

Lacity, M. C., & Willcocks, L. (2016). Rethinking legal services in the face of globalization and technology innovation: the case of radiant law. *Journal of Information Technology Teaching Cases*, *6*(1), 15–22.

Lakshmi, N. A., Norman, S. R., Aparna, S., & Divya, S. (2014). Head Movement Based Feeder System for the Physically Challenged Using PSoC. *Int. J. of Multidisciplinary and Scientific Emerging Research*, *3*(2).

Luo, Y., Zheng, Q., & Jayaraman, V. (2010). Managing business process outsourcing. *Organizational Dynamics*, *39*(3), 205–217.

Majanoja, A.-M., Tervala, E., Linko, L., & Leppänen, V. (2014). The Challenge of Global Selective Outsourcing Environment: Implementing Customer-Centric IT Service Operations and ITIL Processes. *Journal of Service Science and Management*, *7*(06), 396.

Manuj, I., & Mentzer, J. T. (2008). Global supply chain risk management strategies. *International Journal of Physical Distribution & Logistics Management*, *38*(3), 192–223.

McFarlan, F. W., & Nolan, R. L. (1995). How to manage an IT outsourcing alliance. *Sloan management review*, *36*(2), 9.

McIvor, R., Humphreys, P., McKittrick, A., & Wall, T. (2009). Performance Management and the Outsourcing Process: Lessons from a financial services organisation. *International Journal of Operations & Production Management*, *29*(10), 1025–1048.

Merriam, S. B., & Tisdell, E. J. (2015). *Qualitative research: A guide to design and implementation*. John Wiley & Sons.

Modig, N., & Åhlström, P. (2012). *This is lean: Resolving the efficiency paradox* (1st ed.). Halmstadt: Rheologica.

Moschella, D. C. (1997). *Waves of power: The dynamics of global technology leadership, 1964-2010*. American Management Assoc., Inc.

Nassimbeni, G., Sartor, M., & Dus, D. (2012). Security risks in service offshoring and outsourcing. *Industrial Management & Data Systems*, *112*(3), 405–440.

Nollet, J., Calvi, R., Audet, E., & Côté, M. (2008). When excessive cost savings measurement drowns the objectives. *Journal of Purchasing and Supply Management*, *14*(2), 125–135.

Norton, M. I., Rucker, D. D., & Lamberton, C. (2015). *The Cambridge Handbook of Consumer Psychology*. Cambridge University Press.

Okoli, C., & Schabram, K. (2010). A guide to conducting a systematic literature review of information systems research. *Sprouts: Working Papers on Information Systems*, *10*(26). Retrieved from `http://sprouts.aisnet.org/10-26`

Oshri, I., Kotlarsky, J., & Willcocks, L. P. (2009). Overview of the global sourcing

marketplace. In *The Handbook of Global Outsourcing and Offshoring* (pp. 4–14). Springer.

Piçarra, N. J. G. (2014). *Predicting intention to work with social robots* (Unpublished doctoral dissertation). UNIVERSIDADE DO ALGARVE.

Rao, N. V., Sastry, A. S. C. S., Chakravarthy, A. S. N., & Kalyanchakravarthi, P. (2016). OPTICAL CHARACTER RECOGNITION TECHNIQUE ALGORITHMS. *Journal of Theoretical and Applied Information Technology*, *83*(2), 275–282. Retrieved from `https://search.proquest.com/docview/1772426831?accountid=27303`

Romero, H. L., Dijkman, R. M., Grefen, P. W., & van Weele, A. J. (2015). Factors that determine the extent of business process standardization and the subsequent effect on business performance. *Business & Information Systems Engineering*, *57*(4), 261–270.

Saaty, T. L. (1994). Fundamentals of decision making. *Pittsburgh: RWS Publications*.

Saaty, T. L. (2008). Decision making with the analytic hierarchy process. *International journal of services sciences*, *1*(1), 83–98.

Saunders, M., Lewis, P., & Thornhill, A. (2007). *Research methods for business students* (4th edition ed.) (Nos. Book, Whole). Harlow, England: Prentice Hall.

Shekhar, S. (2016a). *Managing the reality of virtual organizations*. Springer.

Shekhar, S. (2016b). Virtuality and the Reality of It All. In *Managing the Reality of Virtual Organizations* (pp. 7–29). Springer.

Slaby, J. R. (2012). Robotic Automation Emerges as a Threat to Traditional Low-Cost Outsourcing. *HfS Research Ltd*.

Srinivasan, V. (2016). *The Intelligent Enterprise in the Era of Big Data*. John Wiley & Sons.

Tregear, R. (2010). Business Process Standardization. In J. vom Brocke & M. Rosemann (Eds.), *Handbook on Business Process Management 2: Strategic Alignment, Governance, People and Culture* (pp. 307–327). Berlin, Heidelberg: Springer Berlin Heidelberg. Retrieved from `http://dx.doi.org/10.1007/978-3-642-01982-1_15`

Trent, R. J., & Monczka, R. M. (2005). Achieving excellence in global sourcing. *MIT Sloan Management Review*, *47*(1), 24.

Vedder, R., & Guynes, C. S. (2016). The Challenge Of Botsourcing. *The Review of Business Information Systems (Online)*, *20*(1), 1.

Veltri, N. F., Saunders, C. S., & Kavan, C. B. (2008). Information systems backsourcing: correcting problems and responding to opportunities. *California Management Review*, *51*(1), 50–76.

Vihavainen, S. (2016, April). Kysely: Kolmannes laakareista kayttaa yli kuusi tuntia tyovuorosta tietokoneisiin - "Joka hetki 600 laakaria tuijottaa ruudulla olevaa tiimalasia". *Helsingin Sanomat*.

Wang, J.-J., & Yang, D.-L. (2007). Using a hybrid multi-criteria decision aid method for information systems outsourcing. *Computers & Operations Research*, *34*(12), 3691–3700.

Wang, L., Gwebu, K. L., Wang, J., & Zhu, D. X. (2008). The aftermath of information technology outsourcing: An empirical study of firm performance following outsourcing decisions. *Journal of Information Systems*, *22*(1), 125–159.

Waytz, A., & Norton, M. I. (2014). Botsourcing and outsourcing: Robot, British, Chinese, and German workers are for thinking - not feeling - jobs. *Emotion*, *14*(2), 434.

Webster, J., & Watson, R. T. (2002). Analyzing the past to prepare for the future: Writing a literature review. *Management Information Systems Quarterly*, *26*(2), 3.

Willcocks, L. P., & Lacity, M. C. (2016). *Service Automation: Robots and the Future Work* (1st ed.). Steve Brookes Publishing.

Yang, D.-H., Kim, S., Nam, C., & Min, J.-W. (2007, December). Developing a decision model for business process outsourcing. *Operations Research and Outsourcing*, *34*(12), 3769–3778. Retrieved from `http://www.sciencedirect.com/science/article/pii/S0305054806000335` doi: 10.1016/j.cor.2006.01.012

Yin, R. K. (2009). *Case study research: Design and methods* (4th ed.). USA: Sage Publications, Inc.

A. QUESTIONS LINKED TO FACTORS IN AHP MODEL.

Data sources: number = Question number in the model of Case Company, "I" = Mentioned in the interviews, "BC" = Included in business case calculations

Case	DWF	Case A	Case B
Digital inputs	1	1	2
Target system stability	6,10,17,I	2,I	1,9,12,14,I,BC
Process documentation	4,5	1,I	7,I
Input data quality	1,2,7	7,I	3,8
Amount of different IS	9	2	9,11
Unambiguous business rules	3,5,I	1,3,4,I	5,9
Target system and RPA software compatibility	10,I	I	I
Robot development	11,12,13,17	2,8,I	1,3,9,11,I
Personnel to handle exception cases	7,8,16		4,10
Risk management	19,20	BC	BC
Service level	14,15,18	6,I	13
Manual labour focus	16	I	4,7
FTE-savings	11,12,13,I	5,BC	BC
Scalability	18	I,BC	10,I,BC