A governance model for managing Robotics Process Automation (RPA)

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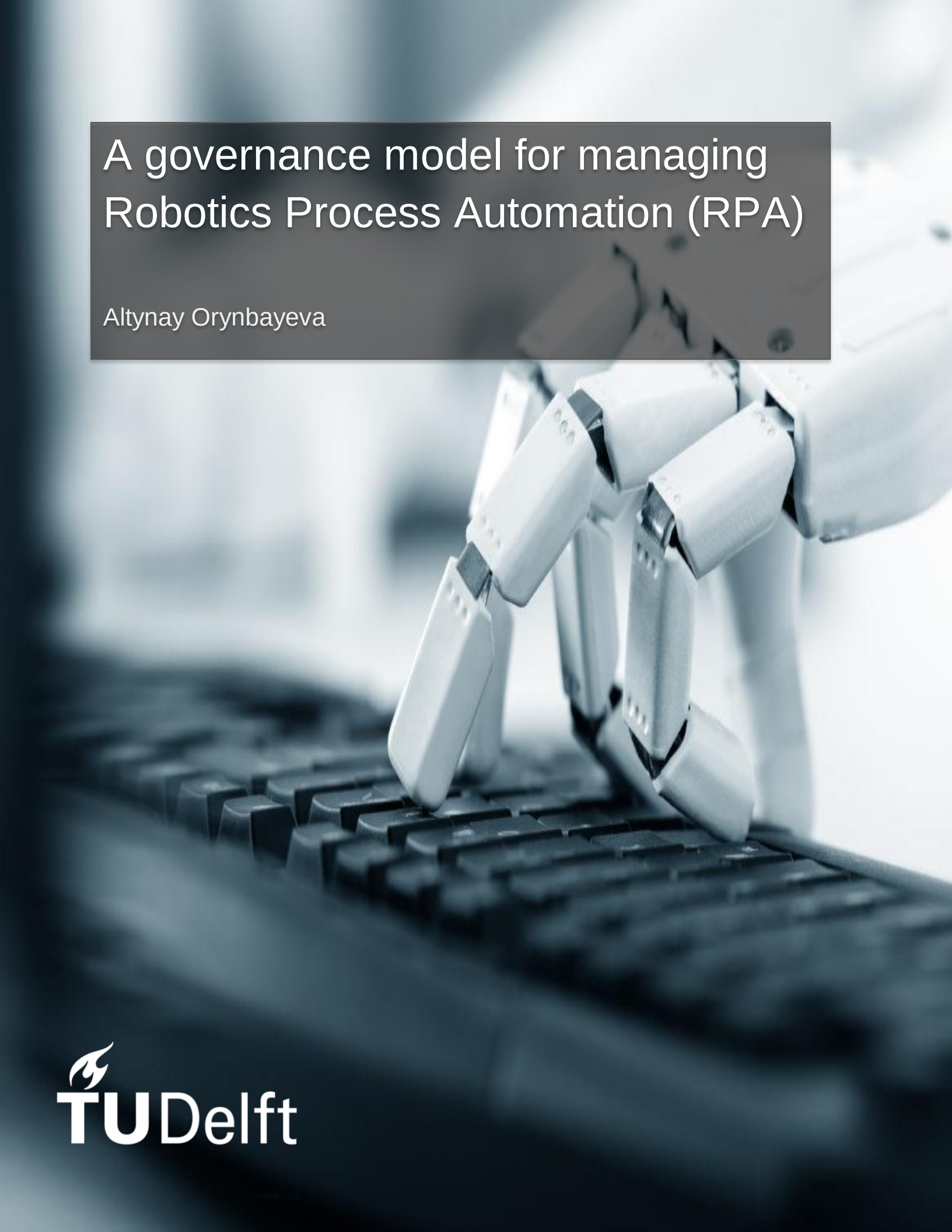

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A governance model for managing Robotics Process Automation (RPA)

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Preface

This thesis marks the end of my master program in “Management of Technology” at Delft University of Technology. It has been a great experience and knowledge gained during these two years of study. This journey would not have been possible without the support and help of a number of dedicated individuals. Therefore, I take this opportunity to thank everyone that somehow contributed to writing this thesis.

Firstly and foremost, I would like to thank my first supervisor, Professor Marijn Janssen for his continuous guidance and expertise on the topic throughout this research. I am really grateful for his time given to me, being supportive and providing constructive feedback to structure this thesis. I would like to sincerely thank my second supervisor Carlos Hernandez Gañán for patiently reviewing my paper and giving me valuable feedback which enriched this thesis.

Second, I want to thank all the anonymous interviewees for participating and providing invaluable input in this research. I would also like to acknowledge my colleagues from whom I have learned a lot. Special thanks to my manager Paul for the time spent reading my thesis and providing feedback. Also, thanks to everyone else who contributed in either a formal or informal way to this thesis by providing additional input.

Third, I also want to thank all my friends and fellow students, who made these study years unforgettable and all the time spent together. I am especially thankful to my best friend and micromanager CY (Chun Yu) for his ongoing support and help to get through this. For my friend Bhupinder, who mentioned about RPA topic for the first time and triggered my enthusiasm. Thank you Caecilia, Grace, and Tushar for being supportive, asking about my progress and all our great time together. Sincere thanks for the people who distract me sometimes from the working on my thesis with their unusual conversation. I could not mention all my friends here and back in Kazakhstan one by one, but each of them has a special spot in my heart.

Last but not least, I would like to express deep gratitude to my dearest family here and back in Kazakhstan for their unconditional love and belief in me. Thanks to my dear cousin Aikosha for spending time together in the library and her endless support. This achievement would not be possible without them.

Altynay Orynbayeva
The Hague, August 2019

Executive summary

Companies today are continually looking for new ways to digitize and automate their processes in order to maximize productivity and efficiency. Existing academic research has shown the efficiency and benefits of process automation using Robotics Process Automation (RPA). Based on the existing studies about RPA, in this thesis, RPA is described in the following manner: *a software tool designed to execute and automate repetitive, routine and rules-based tasks by mimicking human interactions across multiple applications.*

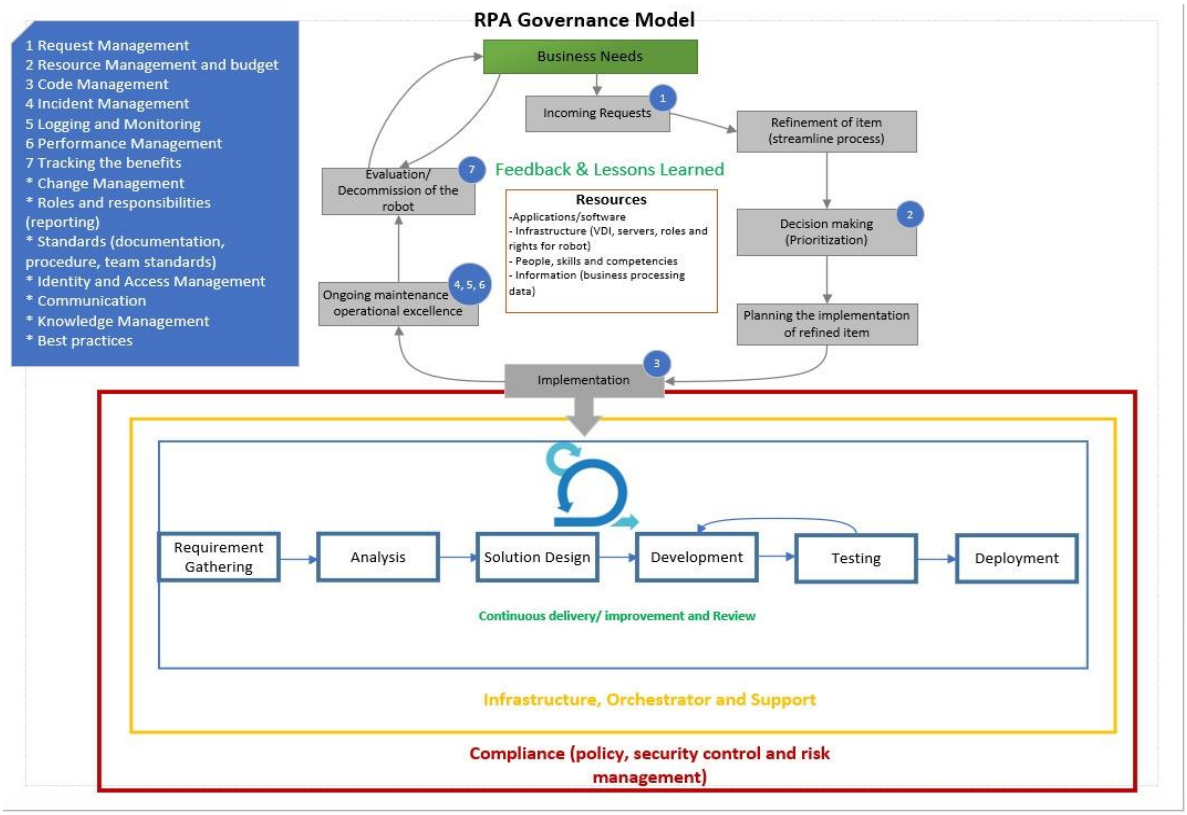
RPA is currently a widely used software tool for automating manual processes. Through preliminary research, we observed that most of the companies have stagnated in a pilot or proof of concept of implementing RPA phase which implies that they are still learning how to manage RPA. The success of scaling up RPA lies in proper governance that may establish guidance, processes and mechanisms to manage and control the RPA activities in order to realize the expected benefits from technology. It is vital to assure that RPA robots are efficiently used, running as expected and following the security controls within the organization. There is a void in the academic literature which means that the current study does not provide a sufficient understanding of RPA governance, and there is no existing proper governance model for managing RPA. Therefore, the main goal of this master research is *to develop a governance model for Robotics Process Automation using design science methodology from a management and operational perspective*.

In order to develop a model, the design science research methodology (DSRM) framework proposed by Peffer et al. (2007) is adopted where the main steps of the framework are: *problem identification and motivation, define objectives for a solution, knowledge base, design and development, demonstration and evaluation, communication.* The first two steps of the DSRM framework is presented in the first chapter of the thesis. To achieve the main objective, sub-questions are formulated in alignment with adopted DSRM methodology for the thesis.

The knowledge base of this thesis is built through a literature review and case study analysis and used to answer the sub-search questions. The literature review focused on the fields of Robotics Process Automation, IT Governance and BPM Governance. Literature review insights have created a basis for extracting key elements to be applied in the governance model, building understanding about RPA technology and its implementation. To give support, practical knowledge was gained through case study analysis. Case study analysis is done through data collection of mainly eight conducted interviews from four different business units of a large financial services company. The practical knowledge from these cases has been depicted in the sense of formulating a comprehensive list of ongoing challenges and problems, listing practices on managing software robots in terms of failures and discussing the differences between managing RPA and IT applications.

In the design and development steps of the DSRM methodology, the governance model for managing RPA is developed by dint of outcome from the literature review, case study analysis and the setup of high-level requirements.

In the demonstration and evaluation step, the governance model has been evaluated based on three semi-structured evaluation interviews and informal communication. With feedback given in the evaluation, the resulting RPA governance model with adjustments is presented and shown below.



The developed RPA governance model in the thesis can be defined as a logical framework which incorporates management and governance process mechanisms for implementation, development, maintenance and orchestration of RPA. On the basis of the developed model, RPA governance is found to be a combination of IT governance and BPM governance aspects.

This thesis contributes to the existing literature by creating theoretical knowledge, developing and evaluating the developed artefact (a governance model for managing RPA), by contributing to design science research, by enlisting ongoing problems and challenges of managing RPA and by increasing the existing academic literature about RPA. In practical contribution, the study can provide an overview of governance processes in managing RPA with related key components and steps in the form of a logical and understandable framework. Also, practical knowledge can be gained from an overview of comparative case study analysis which can be beneficial to see the current situation and practices in a large financial services company.

The limitations and recommendations for future research and the analyzed financial services organization are drawn at the end of the thesis. The thesis ends with a personal reflection from the author.

Keywords: Robotics process automation (RPA), software bots, governance, Design Science Research.

Table of Contents

List of Figures

List of Tables

Table of Abbreviations

AI	Artificial Intelligence
BPM	Business Process Management
CoE	Center of Excellence
DSRM	Design Science Research Methodology
FTE	Full Time Employee
GDPR	General Data Protection Regulation
GUI	Graphical User Interface
IS	Information Systems
IT	Information Technology
ITG	Information Technology Governance
ITGI	Information Technology Governance Institute
MoT	Management of Technology
ORM	Operational Risk Management
SDLC	Software Development Life Cycle
SMEs	Subject Matter Experts
SQ	Sub-research Question
PoC	Proof of Concept
RE	Requirements Engineering
RPA	Robotic Process Automation
UAT	User Acceptance Test

1 Introduction

Digitalization and automation remain paramount in the strategic agenda of many companies. Companies are observing for new ways to digitize and automate their processes to maximize productivity, efficiency in order to boost the value of their business. The advent of new digital technologies (e.g. Internet of Things, Social Media, Artificial Intelligence) led to new business acronyms and brought fundamental changes to the business world and the way of working in organizations. Those digital technologies are considered as a critical driver of technology-induced changes in companies and business processes. Especially, Artificial Intelligence (AI) and its related technologies such as computer vision, cognitive services, machine learning and RPA can be seen as a whole new business disruptor named as “automation arbitrage, the term used by research company, named Gartner, to describe the recalibration of human labour to drive business outcomes” (Suri et al., 2017).

One of such new business disruptors is Robotic Process Automation (RPA). Nowadays, RPA acronym is on the rise. According to estimations from Forrester Research, by 2021, the RPA market has the potential to reach $ 2.9 billion from $ 250 million in 2016 (Le Clair et al., 2017). RPA is a solution for automating digital processes that use computer coded software. The RPA term is mostly referred to “robots”, “software robots”, “virtual robots” and “bots” in the literature, and will be referred to as such in this thesis as well. This type of software can be programmed to replace the need of a human standard (or primary) workforce by performing repetitive, rule-based tasks, but in a faster and more accurate way. The user can see how the RPA is applied to execute user actions by moving the cursor around and how the software interacts with different applications (Suri et al., 2017). RPA can be used starting from front offices to Finance, Human Resources (HR) and Operations by helping organizations become more efficient, reduce costs and bring some value. The common cases of using RPA are automated data entry, data transfer, data gathering, process reconciliation and rule-based processing. For instance, the software robots can be used for entering invoice details into an application, gathering data from different sources to create reports and HR processes including new hire recruitment and on-boarding. Conducted case studies by researchers have also highlighted considerable benefits achieved by implementing RPA (Slaby, 2012; Lacity, Willcocks & Craig, 2015). RPA can increase the degree of automation by exempting human resources or simply by reducing labour costs. This is a benefit in different dimensions such as an increase in efficiency, low-cost and quickness to implement.

Today, most organizations have already succeeded in launching software robots. However, most of the companies that implement RPA have stagnated in a pilot or proof of concept mode, which means they are still learning how to implement and manage RPA. According to Ernst and Young (EY), in 2017, 30-50% of RPA projects had failed, not scaled or moved to other solutions (EY, 2017). Knowledge Capital Partners (KCP) found that organizations challenged with problems where 25 per cent of problems derived from tool selection, but 75 per cent from management mistakes (KCP, 2018).

RPA can be considered as part of the Artificial Intelligence (AI) umbrella, as it also describes the ability of a computer to imitate human actions. Since RPA can be combined with cognitive services and machine learning capabilities, more advanced robotic solutions will continue to evolve and will be used across all different industries. Hence, it is essential for them to take it into account and have a better understanding of managing underlying technology by navigating governance processes to take advantage of potential capabilities of RPA to scale up faster in the future.

1.1 Problem Statement and Motivation: need for governance

The Forrester Institute forecasts the development of around 4 million software robots by the end of 2021 and the rapid increase of this estimate becomes a management problem for organisations (Le Clair et al., 2017). For those responsible in their organisation, ensuring that RPA is implemented and maintained properly is essential to maintain the continuous delivery of value that RPA was designed to bring. The success of scaling up RPA lies in effective governance, risk and control program. To this end, the development of the concept has raised questions like “How to handle the maintenance of hundreds of software robots? What action will be taken if the bot stops? How to keep the software robot running during the change of the IT landscape and regulations?” Especially when General Data Protection Regulation (GDPR) requirements fully come into place, being able to handle legacy changes is a relevant topic to investigate in the matter of RPA effective governance.

Moreover, there are different stakeholders who are involved in RPA venture. Bryson (2004) stated the importance of considering the interests of the stakeholders and their expectations by wisely using stakeholder identification and analysis techniques. However, these multiple stakeholders’ groups often have their own work processes, views and interests. The stakeholder theory does not provide an answer on how to choose and make a decision between the various inconsistent interests of the stakeholders in order to maximise value for the organisation (Jensen, 2001). Hence, those different interests could result in insufficient funding of resources from sponsors, lack of visible progress and more time to deliver the RPA project solution (Lacity & Willcocks, 2016). Additionally, a large number of stakeholders is more likely to lead to complexities and inadequate management processes. It may cause unclear and inappropriate division of roles or responsibilities, not knowing what to do and how to respond to changes in the internal and external circumstances.

Furthermore, as the initiatives of applying RPA grow, complexity and ambiguity will also increase. Notably, today, RPA robots have drastically become widespread and are often seen in a scale up stage in organisations (Deloitte, 2018). RPA can be integrated with machine learning, cognitive technologies and will become more advanced in the future. Consequently, it becomes even harder to manage RPA within the organisation. Those management issues and risks related to RPA requires some sort of guidance, for example, it can be done through proper governance, which can mitigate risks that can handle these complexities and ambiguities.

As having governance is essential for any successful business and project to be able to achieve objectives and drive improvements. However, there is no single final definition for a governance term. For instance, the Governance Institute defines governance as “the system by which an organisation is controlled and operates, and the mechanisms by which it, and its people, are held to account. Ethics, risk management, compliance and administration are all elements of governance” (Governance Institute, n.d., para.1). Hence, for this research governance can be considered as *an establishment of guidance, processes and mechanisms to manage and control the RPA activities by ensuring achievement of objectives, compliance and risk management for the related organisation*.

The governance of RPA is needed to ensure secure and safe operation of deployed robots and that these deployments will not result in any breaches of regulations. Besides, software robots deployed without governance can be inefficient and most likely will be costly and burdensome. Governance is a critical tool for the evolution of software bots. The governance of RPA in the field are opportunities for information technologies to create new knowledge and model. Moreover, there is a need to solve this problem because it has not just impact in the present, but also will have significant relevance in the future.

1.2 Research Gap

As stated in the previous section, managing RPA becomes harder when companies intend to scale up the use of robots across their organizations. There are also the multi-actor aspects as RPA management and its implementation involve a complex set of interactions between different stakeholders with their roles and interests. Hence, it results in the need of some structure and guidance which can be done through governance.

The scientific relevance becomes more evident, as the academic literature about RPA and its governance is limited. A considerable amount of articles by consulting firms (e.g. KPMG, EY, Deloitte and etc.) can be found on the Internet, however they do not provide scientific basis with a proper study. The range of the available academic literature is not extensive. RPA has been discussed a lot by consulting companies and software providers (e.g. UIPath, Blue Prism), but there are few talks about the problems and challenges around the governance of RPA with more precise management details in scientific literature.

It is expected that an attempt to solve the above-mentioned problem statement will provide new knowledge and insights which might be useful for any other future studies. To this end, this research is aimed to fill the observed gap that researcher intends to complement in this area.

1.3 Research Objective

The governance of RPA projects is critical to successful identification, development and deployment of software robots within organizations. There is a lack of existing scientific research in the field of RPA to provide a governance model. As stated in the sections above, demand for the present study exists since it will contribute to giving insight into RPA governance and to address the knowledge gap.

The main goal of this master research is *to develop a governance model for Robotics Process Automation using design science methodology from a management and operational perspective*.

The RPA governance is novel and defined research objective makes a clear scientific contribution by creating the artefact which based on analyzing and putting together collected information. This study establishes the first attempt in developing a governance model for RPA.

This research objective complies with the master's degree in Management of Technology. The research focuses on emerging technology, thus most of the knowledge gained during the study curriculum will be applied and elaborated more in the reflection part of the last chapter. For the researcher, the motivation for writing this research is to become more familiar with the topic of Robotics Process Automation, as it has become one of the technologies with a lot of questions and misapprehensions around it.

1.4 Research Scope: Financial industry

The main scope of the research focuses on large companies operating in financial services that have already implemented RPA within their organisations. Financial institutions include commercial banks, insurance companies, non-bank financial companies, pension funds, mutual funds and other smaller financial institutions. A specific focus is put on financial service companies that are not in a phase of implementing RPA pilot (or proof of concept) but in a more mature phase of working with RPA. Hence, the study will not investigate the phase of generation and acceptance of RPA programme in the organization.

The research scope is relevant to the **Management of Technology (MoT)** programme as this study explores and shows an understanding of how the large companies use and manage RPA technology to improve their efficiency and outcomes. Consequently, this thesis is indicated as a typical MoT thesis by studying management of RPA in a high tech environment.

Given the time and resource limitations, it would not be possible to analyse and construct a model for all three levels of governance (strategic, management and operational). Moreover, considering that today most of the large companies implementing robots work in an agile way, this research focuses on management and operational level governance of RPA and applies a prompt way of working into the model. Extensive validation of the model is not possible, because it requires testing and application of the model in multiple business cycles and a business environment of several (fiscal) years.

1.5 Outline of The Thesis

Figure 1 presents the outline of the thesis with a short description of what will be included in each chapter. *Chapter 1* introduces the related problem statement, research objective and research scope. The remainder of the thesis is structured as follows:

Chapter 2, Research Approach, explains the research methodology (Design Science Research Methodology) used for performing this research. The selection for this methodology is substantiated and the chapter also covers the research questions which help to achieve the research objective with a description of steps and methods.

Chapter 3, Literature Background, will go into the core concepts of this research, Robotic Process Automation (RPA) and governance (IT and BPM Governance), and sets the knowledge base for this research. Each topic is discussed to provide enough context information to continue with the study.

In *Chapter 4*, the case studies will be constructed and analyzed from the outcomes of semi-structured interviews. Both literature review and case study analysis will frame the preliminary RPA governance model.

After establishing both theoretical foundations and analysis, *Chapter 5* will outline the outcome of design and development phase by presenting the RPA governance model.

In the *Chapter 6*, the developed model will be evaluating and improved by applying recommendation feedback gathered from evaluation interviews.

Finally, *Chapter 7* presents the conclusion, limitations of the research and recommendations for further study. An overview of the answers on each sub-research questions is presented. References and appendices can be found at the end of thesis.

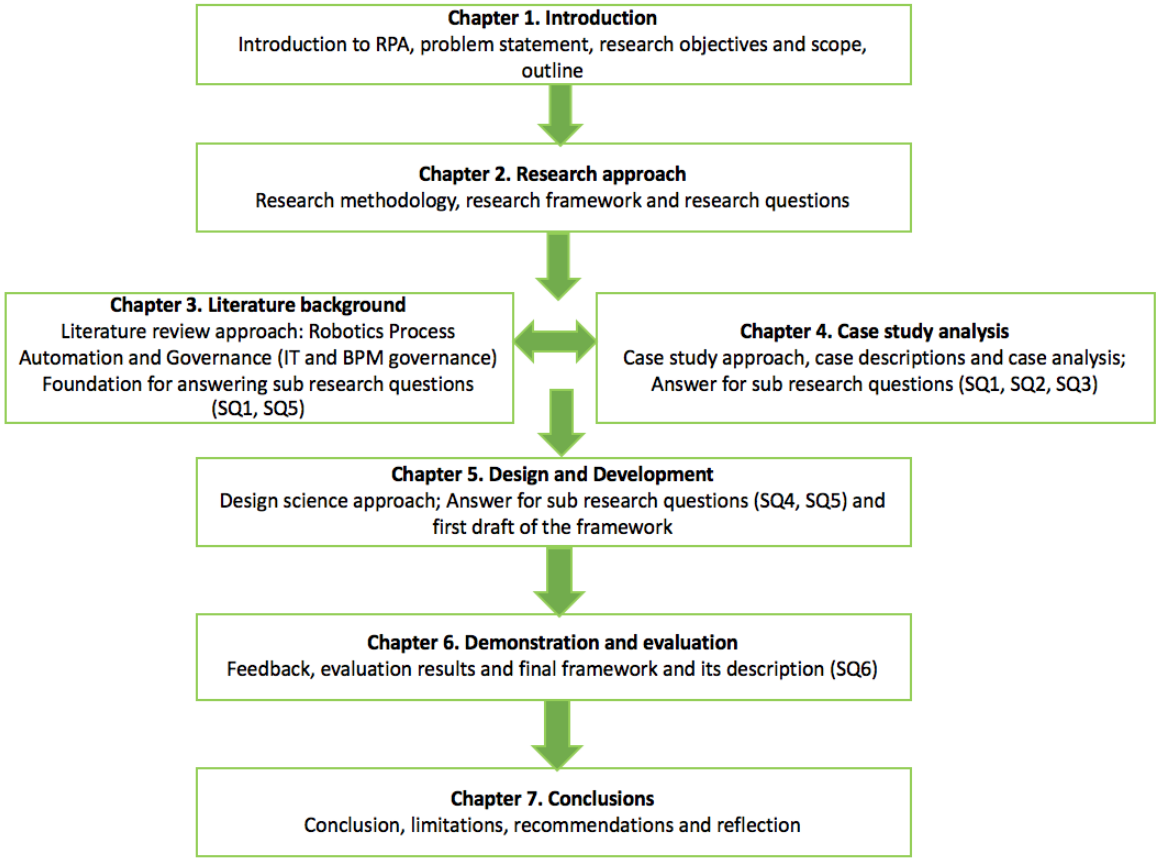


Figure 1: Outline of the Thesis

2 Research Approach

The previous chapter discussed the problem statement and research objective. This chapter will provide a presentation of a research approach to keep this study focused on the research objective. *Section 2.1* considers pros and cons of the DSR methodology and clarifies the motivation for choosing this methodology. Moreover, this section also describes Hevner guidelines and explains the application of those guidelines to the research. *Section 2.2* will present the selected framework with steps of design science methodology for this research. This section will also cover research questions combined with the adapted design science methodology steps.

2.1 Research Methodology

In order to achieve the primary research objective to develop a governance model for RPA, a design science research (DSR) is used. In this section, this methodology is described in detail, and it is explained why this approach was selected.

By the end of the 1990s, DSR was becoming increasingly popular for use in scientific research in the Information System (IS). IS is a unique discipline based on how IT interacts and how it is managed to improve the effectiveness and efficiency of the organization. IS research has enabled to gain knowledge using two complementary, but different paradigms: behavioural science and design science (Hevner et al. 2004). Behavioural science originates from the natural science paradigm which seeks to find the truth starting with a generating hypothesis and developing a theory (Hevner et al. 2004). Design science is a problem-solving paradigm which is aimed to create an artifact that relies on existing kernel theories which are applied, modified, and extended (Hevner et al. 2004). The relevance of a design science research in the field of IS can be seen in articles “Design Science in Information Systems Research” (Hevner et al., 2004), “Design and Natural Sciences Research in Information Technology” (March & Smith, 1995) or “Building Information Systems Design Theories for EIS Vigilance” (Walls et al.,1992).

By definition, DSR is “a research activity that invents or builds new, innovative artifacts to solve problems or achieve improvements” (Livari & Venable, 2009, p. 1644). Consequently, DSR generates new knowledge by designing and analyzing a unique artifact which solves the practical problem. Four forms are essential for deriving a design science research methodology: concepts, models, methods or instantiations (March & Smith,1995). DSR can contribute to theory building, therefore it provides two outcomes which are artifacts and scientific contribution.

There are several reasons to consider DSR as a good fit to be applied for this study. First, this study is aimed to aid in solving a practical problem by inventing or building a novel artefact, which is the governance model for RPA. Secondly, in the design process, this study also intends to create new knowledge with regards to the components, problems and challenges of the governance model. Thirdly, this approach is selected because the research domain is centred around the Information System (IS) discipline. RPA can be seen as a software technology, which IS can explain well as a system that collects and processes data. Finally, this approach is to have a set of relevant evaluation criteria which is essential to the artefact.

Hevner et al. (2004) introduced a number of guidelines to help researchers to provide a design science research with the high quality. The guidelines, description and explanation of the application of those guidelines are shown below in *Table 1*.

Guideline	**Description** (taken from Hevner et al., 2004, p.83)	**Application of guidelines to the research**
Guideline 1: Design as an artifact	DSR must produce a viable artifact in the form of a construct, a model, a method, or an instantiation.	Development of a governance model for managing RPA that will help organizations
Guideline 2: Problem relevance	The objective of DSR is to develop technology-based solutions to important and relevant business problems.	The proposed model will tackle the problem (explicated) on governing RPA in management level
Guideline 3: Design evaluation	The utility, quality, and efficacy of a design artifact must be rigorously demonstrated via well-executed evaluation methods.	Essential feedback and evaluation will be executed by semi-structured evaluation interviews and informal communication
Guideline 4: Research contributions	Effective DSR must provide clear and verifiable contributions in the areas of the design artifact, design foundations, and/or design methodologies.	During the case study analysis and a literature review, a new knowledge is expected to be created
Guideline 5: Research rigor	DSR relies upon the application of rigorous methods in both the construction and evaluation of the design artifact.	Research rigor can be fulfilled by using case studies, different data collection methods and frameworks
Guideline 6: Design as a search process	The search for an effective artifact requires utilizing available means to reach desired ends while satisfying laws in the problem environment.	DSR is inherently iterative, literature research and interviews, analysis of data will be used with continuous improvement
Guideline 7: Communication of research	DSR must be presented effectively both to technology-oriented as well as management-oriented audiences.	Publication of the research as an academic master thesis and introducing the results in the organization for the relevant stakeholders

Table 1: Guidelines for DSR research and application of them to the research.

The primary outcome of this research is an RPA governance model. This clearly indicates the applicability of guideline 1, as Hevner et al. (2004) claimed that design science research should produce a viable artefact. *Chapter 1* has already set forth the problem statement and research gap. Based on this it can be said that the RPA governance model tries to address the problem of governing RPA at the management level. Evaluation of the artefact included in the study by conducting semi-structured interviews and informal feedback. The fourth guideline concerns novelty, which is applicable because a literature review has shown a deficiency in the research related to RPA governance and non-existence of proper model. The study is trying to provide new knowledge in this area. Application of research rigorous methods are applied in both development and evaluation of the design artefact using literature review and extending the knowledge with case study analysis. Most of the available academic literature about RPA has been covered and used in the research. The iterative loop is also present as the elements for the model investigated via literature study and then refined and extended through case study analysis. This research supports elements which are relevant for both technology-oriented audiences (individuals who are interested in technology and its implementation) and for a management-oriented audience (managers, executives who govern and manage RPA projects). The content is expected to be clear for both types of audience and thus meets the criteria for guideline 7. All seven Hevner guidelines were taken into account, which means that it is expected to assign a certain level of quality to the research.

However, like a typical research strategy, Design Science Research also tends to have some disadvantages regarding the correlation of two results. The researcher should pay attention to balancing the importance of two results which is artifact and scientific contribution. In the case of misbalance of those two outcomes, the created artifact cannot be related to a real-world environment or can be impractical to users due to the inadequate knowledge base. Other implications include the appliance of rigorous evaluation methods and difficulty to generalize the created artifact because it could lead to producing the perishable study. Therefore, mitigation of the above-mentioned implications is being done by actively seeking feedback and knowledge on the design of the RPA governance model by semi-structured interviews and informal personal communication with relevant stakeholders.

2.2 Research framework overview

Different methods and frameworks for design science research have been published over time. The most used frameworks are Design Science Research Methodology for Information Systems Research (Peffers, 2007), Three Cycle View of Design Science Research (Hevner, 2007) and Action Design Research (Sein et al., 2011). A number of different frameworks were presented and it can provide valuable guidelines to construct the research. The researcher might use the steps or methods from frameworks but it is only useful when one can apply it their problem context and design situation. As every design science research requires a certain level of steps, the researcher adapt the structure presented by Peffers et al.(2007) which is shown in *Figure 2*.

Peffers et al. (2007) offer a methodology for design research that consists of principles, practices, and procedures. The framework presents six steps of a process model: problem identification and motivation, setting objectives for a solution, design and development, demonstration, evaluation and communication. Moreover, the framework determines the four entry points: problem-centered initiation, objective-centered solution, initiation-oriented design and development, client / context initiated.

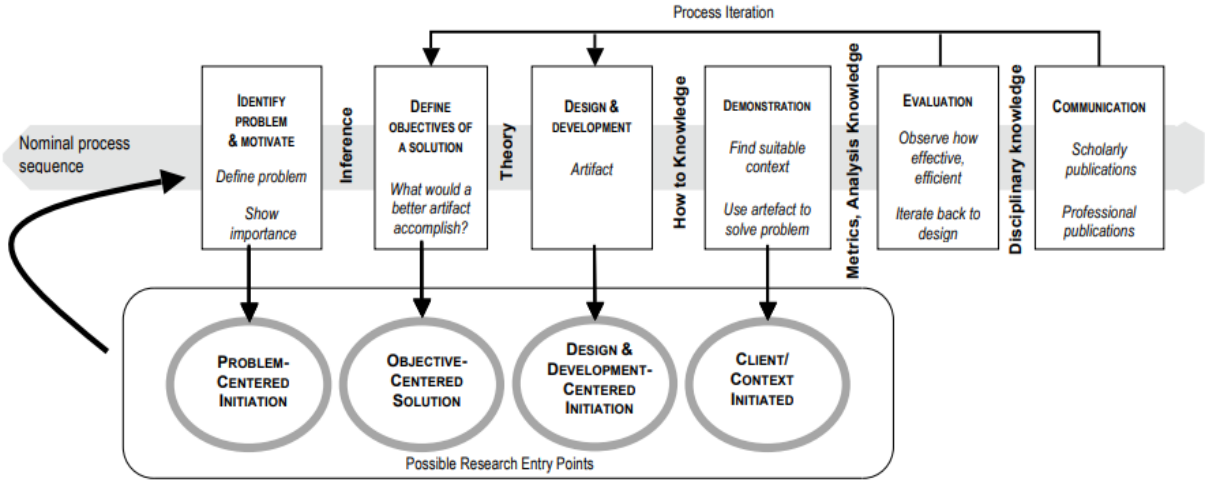


Figure 2: Design Science Research Methodology (Peffers et al., 2007)

2.2.1 Research questions with applied research framework

Research questions are essential to realizing the main objective of the proposed master's thesis. In order to achieve the main objective, a set of steps shall be followed. The objective of this study is to define a model on how to govern RPA from management and operational perspective.

The sub-questions (henceforth SQs) are formulated which aid to realize the objective of the research. These sub-questions for the thesis are constructed as follows:

SQ1: What are the problems and challenges experienced in managing RPA?
SQ2: How to manage RPA in terms of risk and failures?
SQ3: What is the difference between managing RPA and managing IT applications?
SQ4: What are the high-level requirements for a comprehensive RPA governance model?
SQ5: What elements will be addressed in the RPA governance model?
SQ6: How well does the developed RPA governance model fulfil the defined high-level requirements?

To answer these sub-questions, this research adapts the structure of a design science research methodology (DSRM) presented by Peffers et al. (2007) which can be from *Figure 3*. Before the Design and Development phase, Knowledge base is added, and then Demonstration and Evaluation phase is combined.

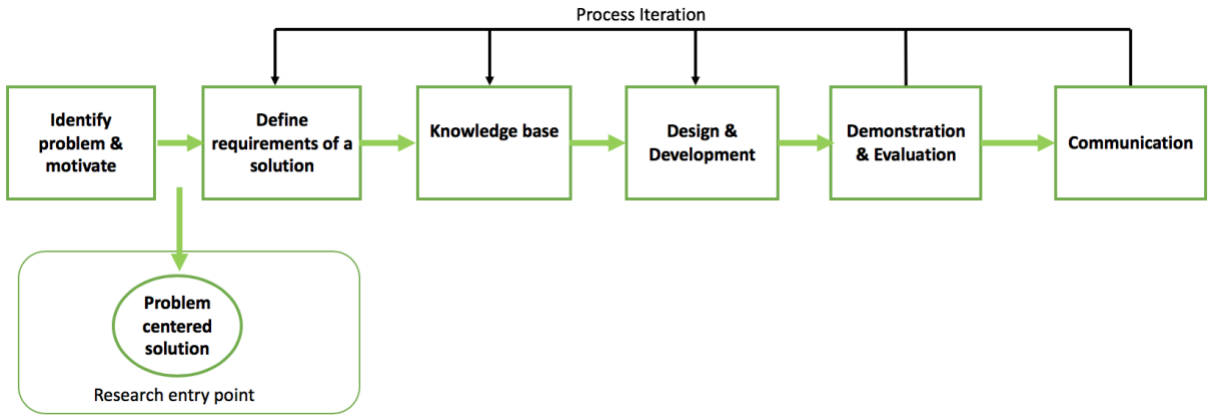


Figure 3: Design science research methodology for this study, adapted from Peffers et al.(2007)

A problem-oriented entry point is initiated due to a problem observed by researchers and businesses in the field of RPA. The first two steps (**Identification of the problem and motivation, Definition of the objectives for a solution**) can be found in *Chapter 1*. However, the objectives of the solution derived from the problem statement and knowledge in the form of research objectives and research gap.

Before starting to design and development phase, it is essential to define a concept of RPA and Governance that have provided a deeper understanding of the context and construct a knowledge base. It will be done by constructing a literature background for RPA and Governance in *Chapter 3*. It gives preliminary knowledge background for the RPA governance model. The foundation for SQ1 and SQ5 will be captured through literature study. The gained knowledge will be extended by case study analysis which is described in *Chapter 4. Chapter 4* will answer for sub questions (SQ1, SQ2 and SQ3) which are investigated from practical knowledge gained of interviewees in case studies.

Answering to SQ1 aims to articulate the initial problem and explore its root causes. The answer for question will identify and investigate problems and challenges in managing RPA. In this step, the SQ1 will be answered with the help of literature review about RPA and with the knowledge base acknowledged from the workshop (Hackathon) in the organization. As the workshop was in the organization (selected case study), it was decided to show it in *Chapter 4* (Case study analysis). To answer the question, literature is used as sources but also websites and white papers. Furthermore, participation in Hackathon gave an opportunity to directly contact with stakeholders of RPA practices where they expressed views and opinions about problems themselves.

By looking to the challenges and problems, it is possible to prevent and manage risks that could happen with operation of deployed software robots. Hence, the purpose of SQ2 is to identify how to manage and control the robots in terms of risks and failures.

Answering to SQ3 aims to identify the difference on how to manage software robots in comparison with normal software application systems. The answer for this question will investigate the differences in order to show how the software robots are coordinated and managed differently. As if the organization only view software robots as IT software, they may govern RPA similarly to other traditional IT products. Hence, the question lead to defining some differences and how it will be incorporated on designing the RPA governance model. Those above mentioned three questions are more practical which give understanding about the challenges and how to manage RPA in order to implement governance model. From the analysis of case studies, the basis for the developing artifact will be defined.

The next step is the **Design and Development** phase will focus on the development of the basis (first draft) of the final deliverable which is RPA governance model by answering to SQ4 and SQ5. Answering SQ4 can help to outline an artefact defining high-level requirements for the RPA governance model and requirements for addressing the problems related to managing RPA. Answering to SQ5 can help identify elements what will be addressed in the proposed RPA governance model. The literature review and desktop research are served as an initial model where some RPA governance components have been identified. To support the model designing, a qualitative research approach and case study analysis are used. These approaches are carried out to get a real picture based on the human experience itself in a real life environment due to the reason that designing model requires more profound emphasis and concentration. Designing and development phase are also taken some inspiration and creativity by looking at different types of governance models.

The **Demonstration and Evaluation** step of the framework are combined emphasizing on the fact that these steps should be highly iterative. The final Demonstration and Evaluation step is tend to answer sub-research question SQ6 - *"How well does the RPA governance model fulfil the defined high-level requirements?"* Moreover, the steps are combined because even the literature is described them as similar steps. The demonstration is similar to light-weight evaluation which is used to show feasibility works of the artifact to "solve one or more instances of the problem" (Peffers et al., 2007, p. 56). In comparison to the demonstration, the evaluation is more formal and extensive including quantitative measures or qualitative feedback. The position of this step is "to evaluate how well the artifact supports the solution to the problem" (Peffers et al., 2007, p. 56). This step is focused on assessing if the development of a model does satisfy the formulated requirements. Semi-structured interviews are preferred for this step because it creates an opportunity to step on possible new insights that are not yet covered by knowledge. In this Demonstration and Evaluation phase, the main focus are the evaluation interviews. Therefore, the feedback from interviews and communication will be incorporated in the artifact. In the **Communication** step, the designed RPA governance model are presented by means of master thesis and defense presentation.

3 Literature Background

This chapter will cover the foundation for answering the research question 1 (SQ1) - "*What are the problems and challenges experienced in managing RPA?*" and the research question 5 (SQ5) - "*What elements will be addressed in the RPA governance model?*".

In this literature background, the key concepts on Robotics Process Automation and Governance will be defined. The aim of the literature review is to provide a theoretical basis and a foundation for answering the two research questions which are mentioned above. In *section 3.1* a literature review approach will be presented. Literature review will start with key concepts RPA (*section 3.2*) and then *section 3.3* presents IT and BPM governance literature.

Investigating the literature and creating this theoretical basis provide more insights into achieving thesis objective of creating the RPA governance model. However, designing model, from a design science methodology perspective, is an iterative process based on theory and practice. Hence, this chapter focuses on the theoretical part, while *Chapter 4* focuses on the more practical knowledge part.

3.1 Literature review approach

A literature study is required to achieve the research objective and construct knowledge base. A literature review is "the use of ideas in the literature to justify the particular approach to the topic, the selection of methods, and demonstration that this research contributes something new." (Hart, 1998, p.1).

The first step in this master thesis is to define a concept of RPA and Governance that have provided a deeper understanding of the context. In order to search articles, Scopus and Google Scholars have been used as the leading search engines. Both engines allow seeing some citations to the article that helps to find out how relevant the article is. The primary fields of the research are Robotics Process Automation (RPA) and Governance, that is why "Robotics Process Automation (RPA)", "RPA implementation", "RPA Governance", "RPA lifecycle", "RPA challenges", "IT Governance" and "BPM Governance" were used as the main keywords. Just keyword RPA stands for a lot of abbreviation in different fields and even excluding all of them and focusing in it give not relative results, so the main keyword was robotics process automation. 26 (32 including new papers from 2019) results were founded in Scopus.

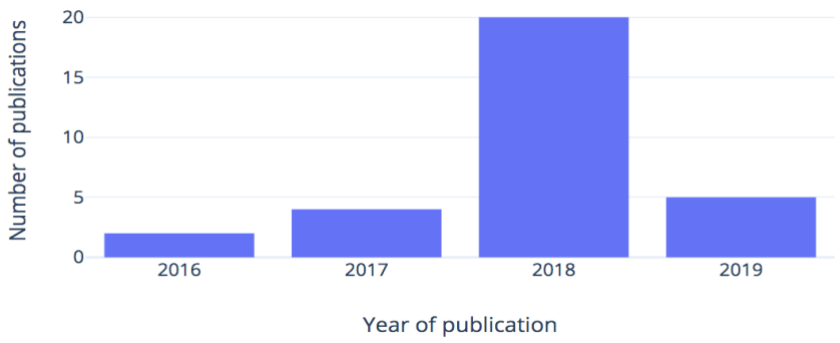


Figure 4: Academic papers published per year from Scopus

The first relevant publication is from 2016, which shows that RPA is a quite young research field. In *Figure 4* is shown the increase of research in a year. However, in comparison, during the research, a lot of white papers from software providers and consulting firms have been coming across. For instance, in the software vendors website, UIPath (30 white papers) and Blue Prism (41 white papers) can be found during years 2016-2019. Uploaded white papers to their websites are mostly from consulting firms such as KPMG, Deloitte, Accenture and PwC. Through the focus of the research is about organizations and business processes in companies, some of the papers from Scopus related to the drones, robotics systems and other fields like agriculture and manufacturing are excluded. Those articles (12 results) from Scopus after refinement have started been the primary source of the reading material and then it was expanded with relevant papers. Most of the publications about RPA is from Lacity and Willcocks authors.

IT and BPM governance areas have been selected for this study due to the characteristics of RPA and its applicability. On the one hand, RPA is a software technology concept which needs infrastructure and support to build software robots, thus IT governance literature has been investigated. On the other hand, both BPM and RPA technologies focus on improving and automating processes, thus BPM governance literature has found suitable to construct a literature background. Regarding IT governance and BPM governance literature, there is more literature focused on IT governance in comparison than BPM governance from the results in Scopus. For instance, the number of academic papers with the search "BPM Governance" in Scopus showed 123 results while "IT governance" gave a lot of results even with limiting it to business management subject area. The results on BPM governance were scoped to "BPM governance elements" where the highest cited papers from Rosemann (2005), Spanyi (2015) and Santana (2011) created the initial set for theoretical background on BPM governance.

Regarding IT governance literature, from the prior knowledge of the researcher and recommendations from the professor, the sources about IT governance from Peterson et al. (2004), Van Grembergen & De Haes (2006), and Weil & Ross (2004) have been investigated. This method is found appropriate for this research, as the domain on IT governance is well established and includes some well-known fundamental research papers. Moreover, it was more time-effective rather than using database searches which generates too much noise. This small number of articles is used as a starting point for generating understanding of IT governance. In both IT and BPM governance discipline, scanning every available literature in Scopus assumed to not ultimately lead to better selection of literature, therefore those selected initial articles are deemed to provide general understanding on these domains.

After looking at the papers, the literature that seems relevant after reading the abstract, introduction and conclusion will be elaborated further and incorporated for establishing knowledge for the thesis. Backward reference searching has been done after reading the papers by looking at the references or works cited in an article and searching the interesting article manually from Google.

3.2 Robotics Process Automation

This section will give an overview of RPA with more detailed information. This includes a more detailed definition of RPA and its characteristics in *section 3.2.1*. The benefits and drawbacks of RPA will be described in *section 3.2.2*. The implementation methodologies in RPA life cycle are covered in *section 3.2.3.* Moreover, section *3.2.4.* presents lessons learned from the implementation of RPA.

3.2.1 RPA characteristics

The formal definition of RPA produced by the Institute for Robotic Process Automation and Artificial Intelligence is "the application of technology that allows a company's employees to configure computer software or a robot to capture and interpret existing applications for transaction process, manipulate data, trigger responses and communicate with other digital systems" (IRPAAI, 2013). The term Robotic Process Automation (RPA) was created by Patric Geary, a marketing director in the Blue Prism and first used in 2012 (Hindle et al., 2018). The concept often leads to forming an idea of real robots roaming about the office and performing tasks in the way that people would do. However, RPA is not as glamorous in reality. Robotic Process Automation (RPA) does not involve any form of a physical robot, it is a computer software that behaves like a human. More than 45 tools were marketed as RPA around the middle of 2017 (Hindle et al., 2018) including vendors such as Blue Prism, UiPath, Automation Anywhere, Workfusion and Advanced System. Therefore, it is vital to know from organizations how RPA tools can be distinguished from other automation tools and to make sure that the right software vendor is used to achieve their short-term and long-term goal. By using and implementing, RPA companies can develop robot systems to automate a vast range of activities in front and back offices, thereby bringing the organization together and transferring employees to perform high value-added tasks.

Despite the fact that RPA can be deemed as a young field of studies, various definitions already exist for the RPA notion. Lacity, Willcocks & Craig (2015) defined the notion of RPA as a software robot that is not only a desktop script which helps human agents, but it also replaces all previously executed human tasks. Similarly, to all automation, the concept replaces processes that have previously been carried out by humans. Automation can be also interpreted as performing a task (process) without human intervention. In this case, a process is a step by step sequence of information which need to be performed. In fact, it is argued that RPA compete with outsourcing (Slaby et al., 2012). Another definition of RPA described as a software-based solution for automating business processes quickly and cheaply based on rules involving routine tasks, structured data and deterministic results (Slaby et al., 2012). RPA solutions integrates with other software systems on the front-end interface, whereas other traditional IT applications is communicated through the server (back-end interface) (Asatiani & Penttinen, 2016).

Based on the current RPA study and existing definitions, in this research RPA is described in the following manner: *a software tool designed to execute and automate repetitive, routine and rules-based tasks by mimicking human interactions across multiple applications.*

RPA has been labelled as a lightweight IT system, as IT architecture is non-invasive and solution is driven by business users (Bygstad, 2017). Author summarized the difference between a lightweight IT and heavyweight IT in the research which are shown in more detail in *Table 2*. Even labelling RPA as a lightweight IT, Bygstad (2017) pointed the limitations of his research and proposed the need for developing practical model of applying both IT forms. The author also suggested that RPA should be handled and

integrated by a combination of heavyweight and lightweight approaches, as the governance of RPA requires different controls and are mutually dependent on each other (Bygstad, 2017).

	Heavyweight IT	**Lightweight IT**
	A knowledge regime, driven by IT professionals, enabled by systematic specification and proven digital technology and realized through software engineering	A knowledge regime, driven by competent users need for solutions, enabled by consumerisation of digital technology and realized through innovation processes.
Profile	Back-end: Supporting documentation of work	Front-end: supporting work processes
Owner	IT department	User and vendors
System	Transaction systems	Process support, apps, BI
Technology	PCs, servers, database, integration technology	Tablets, electronic whiteboards, mobile phones
IT Architecture	Fully integrated solutions, centralized or distributed	Non-invasive solutions, frequently meshworks
Development culture	Systematics, quality, security	Innovation, experimentation
Problems	Increasing complexity, rising cost	Isolated gadgets, security
Discourse	Software engineering	Business and practice innovation

Table 2: Lightweight vs. Heavyweight IT (Bygstad, 2017, p.182)

RPA can be considered as an extension of automation phase of business processes. Some articles describe characteristics that indicate differences between RPA and other automation technologies. For instance, RPA was distinguished from automation technology like Business Process Management (BPM) as formulated below (Willcocks & Lacity, 2016):

- RPA is applied on top of existing information systems. The software solution is able to reach different platforms through presentation level. This means that no basic logic of system programming is affected.
- Unlike most packages of BPMN modelling, it is not necessary to have programming skills to be able to configure the software interface of RPA solutions. The set works only by dragging, deleting and linking icons.
- RPA solutions do not require a database and data model, such as a BPMS system. For that reason, there is no need to store transactional data and create a new application.

RPA is mostly compared to BPM technologies as both technologies use the term “process” in their name and it would seem that both will automate the process. However, there is a difference, and it is fundamental. BPM is used in processes involving the selection of a sequence of actions to streamline the process, while RPA is used to implement a uniquely defined sequence of steps to replace human manual effort. RPA and BPM may well be used together and complement each other (Willcocks & Lacity, 2016).

To determine and assess the suitability of any task (process) to be performed for RPA, some factors need to be taken into consideration. Fung (2014) proposes some generic criteria for Robotics Process Automation for deciding whether a process is suitable for RPA as illustrated in *Table 3*.

Criteria	Description
Low cognitive requirements	There is no necessity to have a subjective viewpoint, interpretation skills to make decisions in order to perform tasks.
High volume transactional operations	Task considered for RPA is routine, repetitive and frequently performed
Multiple-system access	A process requires access to multiple platforms and systems to perform work.
Restricted handling of exceptions	Highly standardized tasks with minimal exceptional cases need to be handled
Proneness to human error	Tasks handled by manual labour are more prone to errors and rework

Table 3: Criteria for RPA, adapted from Fung(2014)

3.2.2 The benefits and drawbacks of RPA

Most of the literature and case studies present some benefits and downsides of RPA. The main benefits of employing robots are illustrated in *Figure 5*.

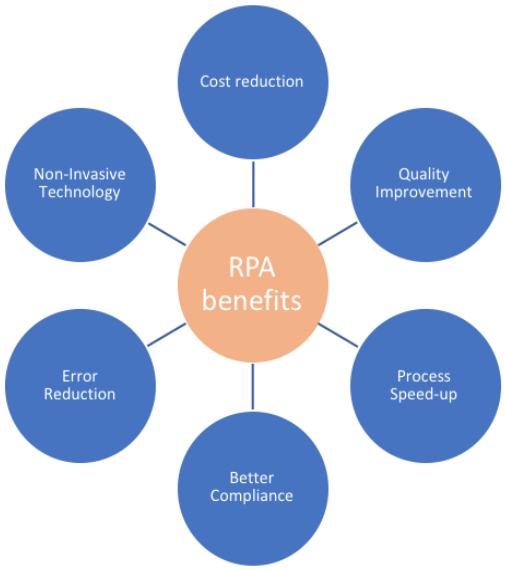


Figure 5: The main benefits of RPA.

The main benefit of RPA is the reduction of costs which based on improvements in productivity, and the process speed related to the RPA configuration, the capacity of the hardware and the response time to the accessing applications (Aguirre & Rodriguez, 2017). RPA solutions can operate continuously (24/7), are able to work rapidly with underlying architecture, to reduce the data entry costs by up to 70 per cent, and cost only 30 percent of a full-time employee (FTE) costs, so companies can achieve a fast return of investment (Anagnoste, 2017).

Correspondingly, the key advantages for “customer satisfaction, financial performance and process compliance” have been observed by the deployment of RPA taken from the Deutsche Telekom case (Schmitz et al., 2018). The implementation of RPA in the Deutsche Telekom case is linked to the digital strategy of the company and illustrate the advantages of results linked to strategic, methodological and operational perspectives. Since the RPA was mainly implemented without changing the existing application

landscape (non-invasive technology), rapid implementation was achieved. During the project, it was observed that training broad-minded employees from the IT division is easier rather than giving an explanation on the business perspective of the RPA solution to workers with a completely technical background (Schmitz et al., 2018).

The other remaining benefits of RPA is the possibility to train users to use software in order to perform repeatable and routine tasks that interact with multiple systems when making complex decisions based on set of rules. The interaction between RPA agents and people is interesting due to the fact that the RPA tool aims to learn as human beings do. Moreover, by observing complex cases of human handling, the RPA system can learn.

Despite the benefits, RPA has its disadvantages (Asatiani & Penttinen, 2016):

(1) Interface integration due to the fact that it still being inferior to the back end integration (machine-to-machine communication).
(2) Outsourcing even the RPA is very promising, its lack of similar credentials with outsourcing.
(3) Adoption and acceptance by employees.
(4) Only suitable for specific types of processes with non-judgemental tasks.

As stated by the author, the critical implementation challenges are the "unclear division of responsibilities between the IT department and business groups, the lack of understanding of what RPA means and where it can be applied, lack of management support, and the fact that it is a delicate change management process throughout the organization" (Suri et al., 2017). The RACI chart (responsible, accountable, consulting and informing) is suggested by the authors as an excellent tool for documenting the division of duties in the implementation of RPA (Suri et al., 2017). Introducing an overview of the RACI matrix for automated processes helps in the design process control mechanisms of various functions, responsibilities and roles.

The risks to consider are that RPA agents which imitates people can begin to make incorrect decisions due to the contextual changes that may not be noticed for some time and which may lead to catastrophic situations (van der Aalst, Bichler, & Heinzl, 2018). Moreover, security and ethical risks also exist when RPA agents imitate and act as people. Lacity and Willcocks organized the RPA risk into 8 categories: strategy, sourcing, tool selection, stakeholder buy-in, launch/project, operational/ execution, change management and maturity risks (Lacity & Willcocks, 2017).

3.2.3 Life-cycle of an RPA implementation

There is no international standard for the implementation of RPA within the organization. Most of the software vendors of RPA as well as IT consultancy firms have their own life-cycle methodologies. Popular vendors in RPA space are Blue Prism, UiPath and Automation Anywhere. It was found that these firms have robust current product offerings and strong market strategy (Le Clair et al., 2018). These software vendors offer their own guidelines and methodology in RPA development. For instance, Blue Prism presents its "Delivery Methodology" for RPA in *Figure 6*.

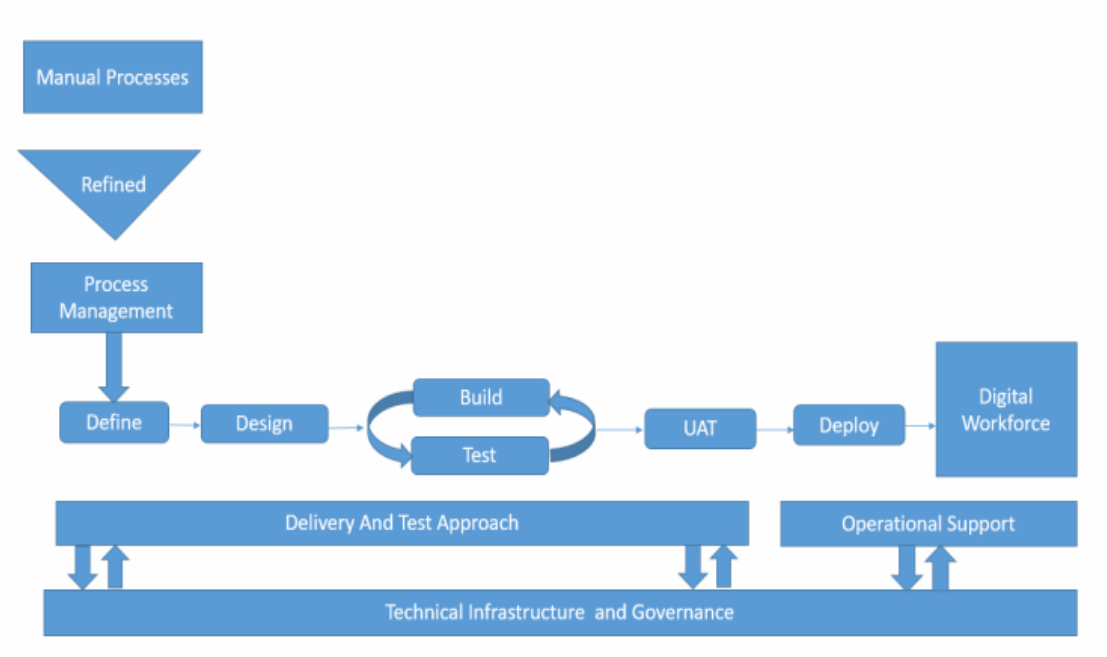


Figure 6: "Delivery Roadmap" of Blue Prism. Source: Blue Prism (n.d., p.4)

According to another software provider UiPath, the implementation consists of 6 steps which are described in *Table 4* below.

Phase	**Outcome**	**Deliverables**
Planning	- Operating model components required for delivering the engagement are in place and clear to all parties involved - Delivery team assembled - The plan for delivering the project is built	- Project Plan - Team Charter - Risk matrix - Infrastructure architecture - Status Report
Analysis	- In scope processes are documented with the most detailed steps, including exceptions and how these are handled - IT Security and Compliance requirements are identified	- Process Definition Document (PDD)
Solution Design	- Overall solution is documented - Test cases are built and test data is identified	- Solution Architecture Document (SAD) - Test Cases & Data - *Updated PDD* - *Updated Project Plan*
Development	- Automations are developed - Deployment plan is created	- Development Specifications Document(DSD) - Move to Production Document (MTP) - *Updated SAD* - *Updated Project Plan*
Testing	- Solution is tested and deployed on production environment	- User Acceptance Testing (UAT) Report - *Updated DSD* - *Updated MTP* - *Updated Project Plan*

Hyper-Care	- Solution is handed over to operations team - Various team members monitor the first process run and business representative validate - Lessons learned are captured	- Lesson learned - Documentation is updated

Table 4: UiPath implementation methodology (UiPath, 2019)

Looking at the two proposed methodologies by BluePrism and UiPath in *Figure 6* and *Table 4* respectively, it can be said that both implementation methodologies is quite similar and just differ in their terms and representation. They can both be mapped against and understood from the more commonly used Software Development Life Cycle (SDLC). SDLC is a systematic approach which describes the phases of planning, developing, testing and maintaining software application (Everatt & McLeod, 2007). However, it can be seen that the focus of implementation of software robots is the process, not software like in SDLC. For instance, in software development, the requirements gathering and analysis are about specifying and defining the software product requirement and its architecture. In RPA, it is about process description and process analysis as software robots deliver process automation.

Before the development of the robot, the infrastructure and operating model should be setup. It happens by designing the server architecture and setting up test, development and production environments. Moreover, a company needs to outline the security policy and procedures with input from Business, IT, Security and Access Control departments. In essence, both methodologies define an Analysis, Design, Development, Testing, Deployment and Maintenance Phase. Analysis phase, where the current processes (as-is process) for automation are assessing and documenting, which forms the requirements for design. In the design phase, the as-is state of the current processes is formulated and documented. Next Development phase, where building the actual robots is happening based on preceding assessments and design. The testing phase is basically performing an integration test and supporting user acceptance test (UAT). After the successful testing phase, in the final Deployment phase, the robot goes into production (so-called “go live”). In the Maintenance phase, continuously monitoring of robots and operational support are provided. As the focus of this thesis is also an operational perspective, this implementation methodology was used to construct the RPA governance model.

3.2.4 Lessons learned from implementation of RPA

The following areas in which RPA booked the most significant business results are (Willcocks et al., 2015): Finance and Accounting, Human Resources, Supply Chain and IT services. The reasons provided are that they have high volume, repeated tasks, such as payroll obligations, accounts payable and accounts receivable, onboarding and so on. Mature tasks have more predictable outcomes that make them less risky for RPA. The successful instances of implementation RPA in organizations are: Telefonica O2, Xchanging, Deutsche Telekom and OpusCapita cases. For instance, in the case of Telefonica O2, the payback period for 10 automated processes using RPA would be 10 months compared to BPMS which was going to take 3 years (Lacity & Willcocks, 2016). These cases extract valuable lessons for future RPA projects which are aimed at the automation of processes of various business services.

The following *Table 5* lists the lessons learned from the mentioned successful instances of RPA implementation.

Lessons learned	Case & Source
RPA is one of the tools along with eliminating processes, improving processes and using other business automation tools. However, RPA views as a complementary tool to BPMS.	Telefonica (Lacity & Willcocks, 2016)
Robots must be provided with more clear instructions than humans because they lack common sense.	Telefonica (Lacity & Willcocks, 2016)
It is important to ensure that the internal infrastructure of the companies keeps pace with automation	Telefonica (Lacity & Willcocks, 2016)
Consider what is the best sourcing option. The sourcing options can be deployed through the six transformation levers described by Lacity and Willcocks for transforming back office services to meet performance imperatives. These transformation levers were “centralize, standardize, optimize, relocate from high-cost to low-cost destinations , technology enable, and automation”.	Telefonica case (Lacity & Willcocks, 2016)
To be an RPA pioneer, some risks must to be taken such as seeking permission for everything you do which slows down the outcomes.	Telefonica case (Lacity & Willcocks, 2016)
Fast and successful digital transformation can be achieved by applying the agile development process.	Deutsche Telekom (Schmitz et al., 2018)
It is essential to understand technical innovations as a digital transformation facilitator.	Deutsche Telekom (Schmitz et al., 2018)
Investigate interrelations between technologies and organizational entities from the beginning.	Deutsche Telekom (Schmitz et al., 2018)
RPA is more than just a tool which purely decrease costs.	Deutsche Telekom (Schmitz et al., 2018)
Concerns about the impact of RPA should be carefully monitored from the beginning	Deutsche Telekom (Schmitz et al., 2018)

Table 5: Overview of lessons learned from the different cases

Willcocks et al. (2015) have described eight key lesson learned*(Table 6)* for implementing RPA identified from case studies.

Lesson Learned	Description
Establish Business-RPA alignment	Define the vision and meaning of RPA in alignment with corporate strategy.
Define the organizational design	Structure of organization and role of Head of RPA
Form an RPA Governance board	The board accountable for demand management and benefits tracking. Basically, who keeps RPA wheels turning
Agree on RPA delivery methodology	Define the pipeline process for RPA
Establish support	Support for end-users in their problems
Define roles and responsibilities	Clearly defined roles with set of responsibilities
Define a scalable environment	Establish low maintenance infrastructure and associated growth strategy
Plan for scaling	Prepare to leverage

Table 6: List of RPA lesson learned from implementation, adapted from Willcocks et al. (2015).

From the literature, creating the RPA Center of Excellence (CoE) is considered as a long term and efficient way to scale quickly of building software robots after a company has passed a pilot phase (Anagnoste, 2017). According to Willcocks & Lacity (2016), CoE can operate in all business units and divisions of an organization with main goals of identifying, prioritizing processes for automation and development of those processes in RPA. Furthermore, CoE takes care of the control and monitoring of software robots in production (Willcocks & Lacity, 2016).

3.2.5 RPA conclusions

From the literature review about RPA, it can be seen that RPA is still developing as a technology. The range of the available literature is not very wide. In this range, definitions of RPA can vary, along with the associated benefits and drawbacks. In the literature, most insights are drawn from looking at RPA life-cycle and its implementation by the eyes of various RPA vendors. The focus then is on the implementation of RPA from different business perspectives and domain contexts, such as from the perspective of finance, human resource functions and telecom domain. In the examined papers, reports from consulting companies are used widely, but they do not intend to address and consolidate the underlying fundamental concepts which can be found in literature. It seems that most of the literature is focused on the notion of what RPA is and its characteristics. Many of the articles appear as a case study or teaching case study.

In this thesis, the research scope is set to view RPA from not only the operational level, but also from a management level of large financial service organization. In this view, we exclude the strategic level perspective in developing the model. From the RPA governance literature, implementation methodologies and development phases of RPA have been examined and will be addressed further in the RPA governance model as it is a part of operational level. Additionally, lessons learned from case studies on the implementation of RPA has been investigated and will also be considered in designing the model. For instance, the lessons from case studies by Willcocks et al. (2015) such as suitability of agile delivery methodology, ensuring proper infrastructure, defining roles and responsibilities have been found as important components in the implementation of RPA.

3.3 IT Governance and BPM Governance

From the previous chapters, RPA can be characterized as a software tool which is intended to automate business processes. For that reason, the governance of technology (IT) and governance processes (BPM) are chosen for the literature study. BPM governance covers wider scope (both business and IT) which ensures continuous process improvement through optimizing core business processes to achieve corporate goals. BPM governance ensures how BPM initiatives controlled, directed and governed. On the other hand, IT governance are focused on establishing structures and mechanisms to achieve business objectives which supported and realized via technology. In the case of RPA, specific attention is given to the frameworks of IT governance for software tool development and BPM governance elements in *section 3.3.1*. and *section 3.3.2* respectively. Deep understanding of the structure and concepts of IT and BPM governance considering RPA perspective can be served as the building blocks for identifying key elements for the RPA governance model.

3.3.1 IT Governance

IT governance has become an intense research area in the last decade and it can be observed from different perspectives. There are different definitions and sources on IT governance and some of them are shown below in *Table 7*.

IT Governance Definition	**Authors & Reference**
"IT governance is the degree to which the authority for making IT decisions is defined and shared among management, and the processes managers in both IT and Business organizations apply in setting IT priorities and the allocation of IT resources"	Luftman in 1996 (Van Grembergen, 2004, p.41)
"IT governance is the organizational capacity by the board, executive management and IT management to control the formulation and implementation of IT strategy and in this way ensure the fusion of business and IT."	Van Grembergen in 2002 (Van Grembergen, 2004, p.41)
"IT governance is the responsibility of the board of directors and executive management. It is an integral part of enterprise governance and consists of the leadership and organizational structures and processes that ensure that the organization's IT sustains and extends the organization's strategies and objectives."	IT Governance Institute (ITGI 2003, p.10)
"IT governance is not about what specific decisions are made. This is management. Rather, governance is about systematically determining who makes each type of decision (a decision right), who has input to a decision (an input right) and how these people (or groups) are held accountable for their roles. Good IT governance draws on corporate governance principles to manage and use IT to achieve corporate performance goals"	Weill(2004, p.2-3)
"IT Governance is the strategic alignment of IT with the business such that maximum business value is achieved through the development and maintenance of effective IT control and accountability, performance management and risk management."	Webb, Pollard, and Ridley (2006, p. 7)

Table 7: Some definitions of IT Governance

Considering the definitions of IT governance in *Table 7*, some common elements can be seen from the definitions such as distribution (prioritization and resource allocation) of decision rights, strategic alignment of IT with business and control mechanisms.

As noted by Van Grembergen et al. (2003), IT governance is established at several levels in the organization: (i) at the strategic level where board of directors (ii) at the management level within the C-suite and senior management (iii) operational level with IT and business operational management are involved. From the RPA perspective, operational level is mainly focused on developing and maintaining software robots, whereas management level focuses on the monitoring, controlling, administrative activities and decision making.

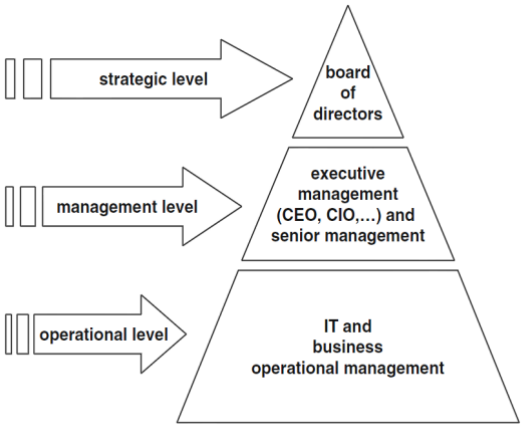


Figure 7: Three layers of IT governance responsibility (Van Grembergen et al., 2003, p.6)

Peterson (2004) made the distinction between IT management and IT governance. Peterson(2004) argues that IT management is focused on efficient internal delivery of IT services and on management of current IT operations. On the other hand, IT governance is much broader and concentrates on fulfilling future business demands and business customers. Furthermore, Peterson (2004) established a framework that indicates which aspects should be taken into account when implementing IT Governance. As can be seen from *Figure 8*, there are a set of structures, processes and relational mechanisms.

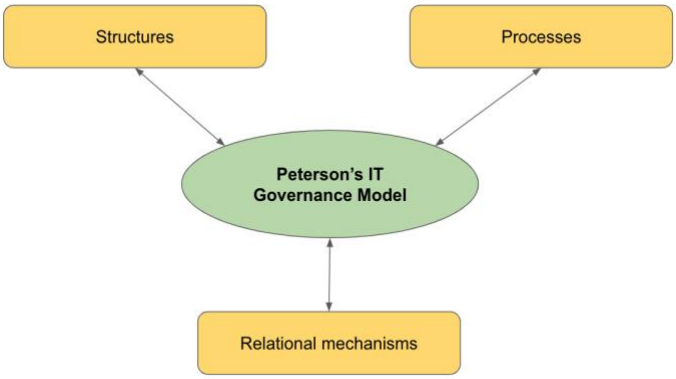


Figure 8: Peterson's IT Governance Model

The description of the three types of governance is the following :

- Structure mechanisms - formalizes the set of roles and responsibilities in the IT decision-making process in the way of committees, executive teams, and business/IT managers.
- Processes mechanisms - the processes that daily behaviours are consistent to which helps to define the decision making, control, and evaluation criteria.

- Relational mechanisms - basically, communication that can be used to bridge the gap between business and IT.

To develop IT Governance, companies use a mixture of different structures, processes and relational mechanisms. It can be found in Appendix A *(Table 18*) where relational mechanisms, processes and structure are clearly separated. These areas require their own approaches that should govern and manage optimally. From those IT governance mechanisms, this thesis is focused more on process mechanisms. where relational mechanisms, processes and structure are clearly separated. These areas require their own approaches that should govern and manage optimally. From those IT governance mechanisms, this thesis is focused more on process mechanisms.

As it can be seen from the process mechanisms in *Table 18*, the one of the components of those process mechanisms is IT governance framework. Various models have been developed by scholars to measure, evaluate or develop IT governance framework in an organization. To have an overview, IT governance framework by Weill & Ross (2004), model by the IT Governance Institute (ITGI), the COBIT framework were chosen to study in more details because those researches have often cited and used in the organizations.

IT governance framework developed by Weill and Ross (2004). The structure is established by three sections: 1) enterprise strategy and organization, 2) IT governance mechanisms, and 3) business performance goals. Weill and Ross (2005) proposed a matrixed approach to designing IT governance which can be useful for companies to allocate IT decision rights and accountabilities. It is stated in the article that IT governance contains five decisions domains: IT principles, IT architecture, IT infrastructure, the Business application need and prioritization and investment decisions (Weill & Ross, 2005). According to the authors, companies should design and implement governance mechanisms which consist of (1) decision-making structures (2) alignment process and (3) formal communications. As there is no best model for IT governance in companies, governance can also vary from centralized approaches to decentralized approaches, with federal (hybrid) approaches in between (Weill & Ross, 2005). Lewis (2004) weighed the pros and cons of centralized, decentralized and hybrid IT governance structures.

Characteristics	**Centralized**	**Hybrid**	**Decentralized**
Strategic driver	Profitability and cost effectiveness	Profitability and retention of innovativeness	Fast growth and innovativeness
Key IT governance mechanism	Enterprise-wide management mechanism	IT leadership team	Local accountability
IT infrastructure	Not locally customizable shared services	Shared services centrally coordinated	Local customized capability with few required shared services
Pros	Cost-efficient, controllability, corporate-wide spreadability	Cost-efficient, reacting to local needs, benefits from shared services	Agile response to local requirements, innovativeness, service quality
Cons	Incapable of reacting to local requirements, loss of innovativeness	Confusing structure of responsibilities, need for talented matrix management	Not cost-efficient, lack of corporate-wide controllability

Table 8: Centralized, Hybrid, Decentralized governance characteristics. Adapted from Lewis (2004) and (Weill & Ross, 2005)

The approach of ITGI is more practical as it has developed by companies. The focus of the model organization performance and value delivery. ITGI defines five different decision-making areas which are: “strategic alignment, value delivery, risk management, resource management and performance management”. The ITGI model is primarily focused on the value delivery and optimization of the provision of services for the organization.

Strategic alignment	**Value delivery**	**Risk Management**	**Resource management**	**Performance Management**
Ascertain IT strategy alignment	Deliver solutions and services	Ascertain risk transparency	Maintain awareness for new developments	Verify objective achievements and eliminate surprises
Ascertain IT delivery	Enhance reputation, leadership and efficiency	Allocate board responsibility for risk	Ensure IT resources can fulfill requirements	Maintain balanced scorecards
Direct IT strategy definition	Provide customer trust and time to market	Create consciousness for risk mitigation	Improve efficiency and effectiveness of the IT infrastructure	
Ensure culture support		Consider proactive risk management	Sustain investments for education	
		Embed risk management		
		Ascertain security processes		

Table 9: ITGI Mechanisms (ITGI, 2004)

At a later stage, the Control Objectives for IT (COBIT) is a framework developed by the IT Governance Institute (ITGI) for managing and controlling IT services. The framework provides best practices to contribute to the value creation process in a company. It includes existing standards (for example, ISO, EDIFACT, codes of conduct) and practical audit guidelines. This structure deals with 34 processes related to 4 areas (plan and organize, acquisition and implementation, delivery and support, monitor and evaluate). The COBIT framework supported by more than 300 control objectives to effectively implement IT governance.

3.3.2 BPM Governance

BPM (Business Process Management) is an management approach of optimizing business processes to ensure maximum efficiency and value. This is an in-depth look at how processes work. BPM look at how processes work by identifying areas for improvement and developing solutions. BPM Governance is also indicated by Spanyi (2008) as “create the right structures, metrics, roles, and responsibilities to measure, improve, and manage the performance of a firm’s end-to-end business processes.” (Spanyi, 2008, p.1). There are a lot of publications on BPM Governance covering from definitions and theoretical background to describing lessons learned and best practices. According to Tregear (2005), the five key elements to BPM governance are measurement, ownership, accountability, control and support. Moreover, it is stated that the setting of process standards is part of BPM governance which allows an organisation to link process and IT (Rosemann & DeBruin, 2005). BPM governance typically covers the same aspect as more traditional corporate and IT governance, but with a focus on business processes.

Table 10 presents a synthesis of BPM elements found in the literature (Santana et al., 2011; Bhat & Fernandez, 2007). This list of elements of BPM governance is useful to identify components for RPA model.

BPM governance element	Description
Objectives	It is usually considered as ensuring the alignment of BPM initiatives with organizational strategic objectives.
Roles and responsibilities	Functions and duties which focuses on executing BPM initiatives.
Standards	Standardization enables consistency of the business processes initiatives via methods, metrics, document templates and process architecture for all aspects of BPM.
Tasks	Tasks and procedures related to roles involved in BPM initiatives.
Organization Governance Structure	Organizational structure BPM's and the scope of their tasks and duties for the individuals concerned.
Control Mechanisms	It can be considered as the decision making process (decision criteria and limits) for prioritization and goal setting.
Assessment Mechanisms	Indicators, collection of metrics and additional forms of monitoring the performance of BPM initiatives
Appropriate Change Management	Managing change around BPM
Infrastructure & Architecture	Technical and non-technical base needed to implement BPM practices, including the physical structure, software, personnel, and other resources.

Table 10: Overview of BPM governance elements. Adapted from Santana et al. (2011) and Bhat & Fernandez (2007)

3.3.3 Governance conclusions

From the described IT governance frameworks, it can be seen that the framework by Weil and Ross (2004) focus more on organizational structure from a strategic perspective, whereas the ITGI model focuses on management IT process approach in alignment with COBIT framework. Considering that the focus of the research is the RPA governance model on operational and management level, the elements from COBIT processes which is combined with ITGI key objectives have found more suitable to the further investigation. It is assumed that all those embedded internal and external controls in the framework are present in large organizations. For example, it can be said for the large financial organizations, compliance, policy or risk management elements of governance are already in place. The focus for the development of the desired RPA model will be incorporating management processes and domains from COBIT which ensures the following governance objectives: "strategic alignment, value delivery, risk management, resource management and performance management". However, it is not the case that RPA project should be aligned with enterprise strategy (may be just a tactical solution) or deliver value for the organization's business itself. In respective to RPA characteristics as a software tool, the management processes from the COBIT framework such as managing incidents, managing changes, communication management and more have found applicable. Moreover, after investigating RPA implementation from *section 2.3*, the main management domains (plan, build, deliver and monitor) from COBIT seems not to conflict.

BPM is related to the RPA as both of technologies focus on gaining efficiency by improving processes, but has substantially distinct objectives. BPM is about re-engineering and redesigning of business processes, whereas RPA is often a surface-level fix to automate existing business workflows. However, RPA can be still considered as a toolset In comparison to IT governance, BPM governance covers a wider scope. From looking the BPM governance key elements in *Table 10*, it can be derived that all the elements are important. However, aligning objectives strategically and organization governance structure are not in a scope of this

thesis. Standards is essential which can be seen from the RPA definition and characteristics that the processes to be automated should be rule-based and standardized (Slaby et al., 2012). It leads to that control mechanisms to make decisions (prioritize) what processes are suitable for software robots are important. It was observed from assessment of selection criteria for suitability of tasks to be performed for RPA by Fung (2004). Hence, it is essential to have detailed overview after case study analysis to derive the elements for RPA governance model.

3.4 Conclusions: Literature Background

This chapter provides an overview of literature on RPA, IT and BPM governance which sets a knowledge foundation for this research. Conclusions have been drawn after each subsection. Regarding having the foundation to answering sub research question SQ1, some challenges in the implementation of RPA has been found. The challenges can be listed as: unclear division of roles, lack of user know-how about RPA, security issues, poor change management, lack of communication and not having proper documentation.
The foundation of identifying key elements for developing RPA governance model has been obtained mostly from IT governance process mechanisms and BPM governance elements. Insights, layouts and form to the design of governance model will be drawn from COBIT 4.0 framework. The COBIT framework is assumed to help on adapting its generic management processes and domains (plan, build, deliver and evaluate) to the RPA governance model. Considering the scope of the research (large financial organization with already implemented RPA projects), it can be assumed that governance elements such as compliance, risk management, roles and responsibilities, standards, resource management, infrastructure are already present in the organization.

4 Case study analysis

This chapter will cover the case study analysis and consequently answer to the sub research questions SQ1 – *"What are the problems and challenges experienced in managing RPA?",* SQ2 – *"How to manage software robots in terms of risk and failures?"* and SQ3 – *"What is the difference between managing RPA and managing IT applications?".* This chapter discusses the empirical findings from the selected case study on the use of the Robotic Process Automation. The chapter will start with describing the case study approach (*Section 4.1*) where the reason for choosing the certain case study method and case selection criteria will be elaborated. Secondly the case overview will be presented and then data collection methods for the cases will be defined. The data is collected mainly via semi-structured individual interviews and some internal documents. Further, the case study description *(Section 4.2)* will be constructed based on collected data and each case study will be described in detail. From the collected interviewees' input, the comparative case study analysis is described in *section 4.3*.

4.1 Case study approach

The objective of applying the case study approach to this research is to investigate and emphasize in-depth content about RPA and its governance in real-life scenarios, which allows us to develop the RPA governance model and answer the research questions.

A case study is an empirical description of particular cases of a phenomenon investigated based on a variety of data sources (Yin,1994). It has been used to develop and build a theory about topics using one or more cases. Some challenges and opportunities of theory building from case studies have been taking into account following the paper Eisenhardt and Graebner (Eisenhardt & Graebner, 2007). Taking into consideration the characteristics mentioned by Yin (1994), the case study approach is more suitable for the research as the contemporary phenomenon is RPA governance and it is context dependent. Moreover, not so much research has been done on the RPA governance topic and it is not properly formalized within organizations. Therefore, the strive for depth analysis makes a case study more preferable rather than other research methods like surveys or experiments. Moreover, the case study approach is largely exploratory and it addresses the "how" and "why" questions (Yin, 1994).

There are two different ways to differentiate a case study (Yin, 1994), which are a single case design and multiple case design. Furthermore, single cases and multiple cases can be holistic or embedded (Yin, 1994). A holistic case implies a comprehensive approach to the research question with one unit of analysis while an embedded case is carried out with several units of analysis. This research is based on a single and embedded case design which is suitable for the objective of this research. It involves several cases (RPA teams in different business units) with one unit of analysis which is a financial service organization. The information-oriented selection is used for case selection strategy as the selected case is based on expectations about information content (Flyuberg, 2006). From different strategies like extreme cases, multiple variations of cases, critical and paradigmatic cases (Flyuberg, 2006). For this research the strategy for selection of case is paradigmatic case. According to the Flyuberg (2006) paper, it is hard to constitute and identify paradigmatic cases in advance as they are more intuition based. However, it may appear as a prototype and could be function as a center for founding a new thoughts and insights.

Considering that case study approach has its limitations such as single case cannot generalize the outcome, researcher bias (subjective feeling which could influence the research) and difficulty of creating theoretical knowledge. Some of those limitations can be considered as misunderstandings perceived when

considering case studies as a research method. Flyuberg (2006) article investigates five common misunderstandings and concludes on them one by one. The author argues that “case knowledge is central to human learning” by explaining and correcting the misunderstanding (“theoretical knowledge is more valuable than practical knowledge”) in his research (Flyuberg, 2006).

4.1.1 Case selection criteria

This section elaborates on why a financial services company was chosen for the case study.

For this research, a financial services company (parent holding company) which is actively operated in 18 countries with approximately 15 thousand employees is selected. This parent company has its different independent brands providing its products and services. The company’s business activities are structured within life and non-life insurance products, banks and asset management. It has been justified to focus on one organization as building an in-depth understanding of the case is valuable for the research. Moreover, as it was mentioned in the scope, the focus is on the organization which has experience of implementing RPA. According to Willcocks, Hindle & Lacity (2019), the maturity level of working with RPA arrives after two years which depicts a key checkpoint date for evaluating the progress and making corrections. Therefore, this company was selected due to the following reasons described below:

First, this type of company is relevant to the scope of the research as the RPA journey within the company has been started two years ago. The organization operates and is actively present in financial services. Second, the presence of various RPA teams in the organization which could provide with relevant data and their valuable insights regarding the topic of this master thesis. Moreover, it was assumed at the beginning that the company has some challenges related to the governance on the basis of preliminary informal investigation which was considered to be informative regarding the implications of RPA model. These aforementioned reasons for selecting the proposed financial services company give us the case selection criteria.

In the case study research, there is no ideal number of cases as it depends on the nature of the research question, timeline for the studies, resources and case accessibility. However, for this research, we investigated 4 cases from the selected organization where RPA is applied on a bigger scale.

4.1.2 Case studies overview

To this study, a large financial services company with a multidivisional form is selected. Generally, it is one parental holding company, which consists of some various autonomous units operating separate businesses. Legally, all smaller companies use the group brand and name which are owned by a parent company. Inevitably, central (financial) management controls and guides the entire organization, but decisions are left to autonomous units, which enables them to behave independently.

As these autonomous units of the parent company are independent and have their own RPA team and way of implementation, it has been analyzed as a separate case study. A high-level overview of the organizational structure and selected case studies are presented below in *Figure 9.*

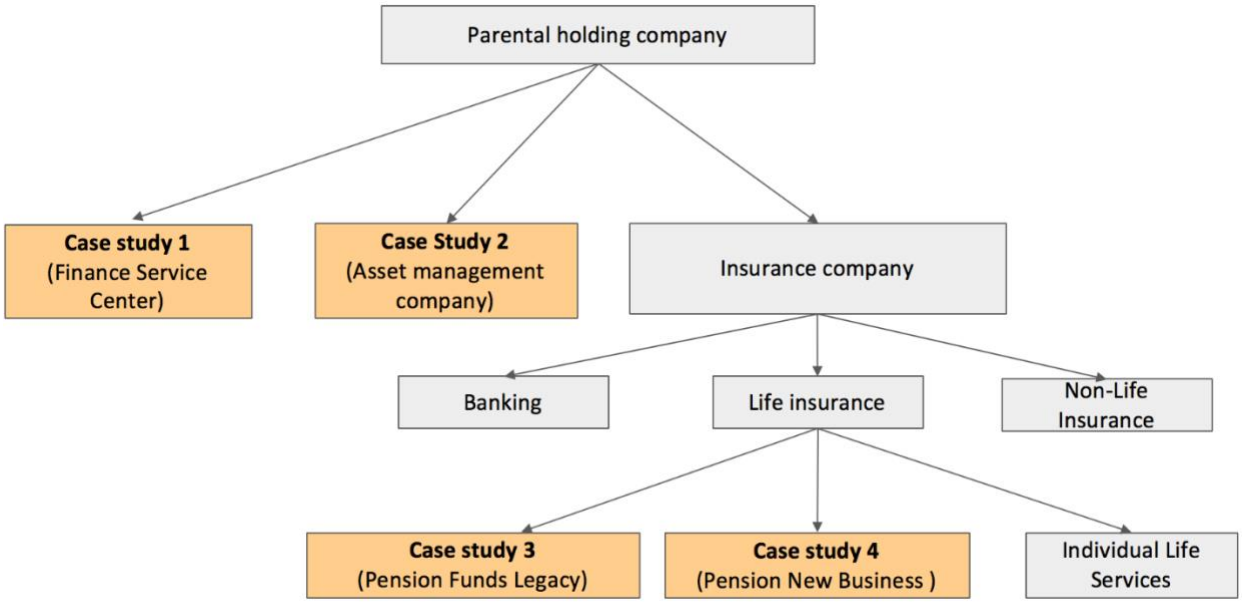


Figure 9: An overview of the organizational structure in a high level

All selected cases represent the full implementation of RPA projects, not a "Proof of Concept stage". Moreover, the current stage of the RPA journey in these divisions is scaling up. The overview of the case studies is shown below in *Table 11*. The number of robots here is one license which means one robot can have different roles and implement more than one process.

Company	**Sector**	**Implemented robots**	**RPA team size**
Case 1	Finance Service Center (CoE)	15 – 16 robots	14 people, including 7-8 pure offshore developers from India
Case 2	Asset Management	7 – 8 robots	8 people including 3 offshore developers from India
Case 3	Life Insurance (Pension Services Legacy)	19 robots	6-7 people. All onshore employees
Case 4	Life Insurance (Pension New Business)	3 – 4 robots	5 people. All external from IT consultancy firm except manager

Table 11: An overview of case studies

4.1.3 Data collection methods

In the data collection methods, the data was mainly obtained through conducting face to face interviews, informal communication within the organization and internal documents (See *Appendix D*). However, it should be noted that conducted interviews were used as the main source for the case study analysis and for answering sub research questions. Internal documents were served as a generic base to better know the organization itself. The interview protocol can be found in *section 4.1.3.2* and interview questions in *Appendix C*. There are 8 interviewees from 4 business units (two interviewees for each business unit). Respondents have connections and are aligned between each other, which gives greater internal validity and reliability. For example, the case study description has been constructed from the data provided by one member of the RPA team and was validated by another member from the same team.

An important part of creating the case study database are the transcribed recordings from the interviews. As it contains a huge mass of information and unstructured data, it should be properly organized to be revised later. Moreover, maintaining this chain of evidence helps to facilitate the interpreted conclusion.

4.1.3.1 Interviews

The semi-structured interviews are chosen, as it allows for flexible wording of asking and answering questions. A pre-determined set of questions has been generated to explore a particular theme. For the interview protocol questions, it is desirable that the interviewees have extensive knowledge in the implementation and management of software robots. The objective of the interviews were to discuss and gain practical expertise from specialists in their particular professional field.

Selection of the interviewees

The segment of the population (sample) for this study has not been chosen using a random selection, it was purposive sampling. Purposive sampling (also called judgement sampling) is a technique in which researcher relies on his or her judgement and select specific target group by setting criteria. The main criteria for the selection of suitable interviewees were based on their involvement in the implementation of RPA to ensure a level of knowledge and field of expertise. To this end, the formal position and the role in the RPA project were required. Initially, the Business Analyst from Case 2 (Interviewee A2) has been reached out to, as the respondent was involved in the RPA project from the beginning and then asked about other potential respondents. Fortunately, the first interviewee provided the opportunity to participate in the Hackathon within the organization where RPA teams from all business units gathered together.

Considering that there are limited people involved in RPA projects who has experience with working and managing software robots in the organization, those participants from RPA teams were assumed as the appropriate contributors to find possible answers to the sub research questions. It was observed during the Hackathon that those individuals have experience with RPA and their tacit knowledge can be valuable for this study. A list of participants was created which turned to shorter list after selection of the respondents which was based on recommendations, scanning their representativeness and considering level of involvement. Mainly, the individuals who involved in implementing (rolling out) RPA project from the beginning in the company were selected. Given that this research focuses on operational and management level, the individuals who is responsible for development and maintenance of the software robotics were chosen as respondents from operational side. Moreover, the individuals who manage the RPA project and RPA product were chosen from management side. Selected interviewees were contacted via e-mail and a meeting was arranged according to their availability. However, bias related to the imbalance towards

operational and management level individuals are present because it was 3 persons from management side and the remaining 5 from operational side. Nevertheless, after conducting 8 interviews, it seemed that the concepts and responses coming from interviewees were similar, and the sample size have not been increased and analysis of the data was started.

In *Appendix B*, the list of 8 interviews with dates, roles of interviewees and knowledge are shown which is sorted through the case studies. All the interviews were conducted in English and took place face to face. All those interviews were tape recorded and took one hour. Together these 8 interviewees represent the four different cases (RPA teams) from the Parental Holding Company. To be more precise, two interviewees form per case study. After having interviewed individuals on the list, it was not expected that additional interviewees would provide new insights as to the details were interconnected between the cases. Transcribed scripts from the interviews have not been send to the respondents to confirm the accuracy, however the information provided from the first interviewee from one business unit was verified by the second respondent in order to achieve improved understanding regarding the particular issues and increase reliability of gathered data.

4.1.3.2 Interview protocol

The main purposes of the semi-structured interviews are the following:

1) Constructing case studies from interviews.
2) Answering the sub research questions.
    a) What are the problems and challenges experienced in managing RPA?
    b) How to manage software bots in terms of risk and failures?
    c) What is the difference between managing RPA and managing IT applications?
    d) What elements will be addressed in the RPA governance model?
3) Investigate existing governance and management process mechanisms within the organization.

Based on the goals of the interview, interview questions are conducted which can be found in *Appendix C*. Types of interview questions can be categorized as personal, RPA team and robot's description, managing robots, challenges and problems in RPA journey, governance in RPA and lessons learned.

4.1.4 Data analysis

It is necessary to analyze the content of the conducted interviews. Therefore, the researcher was organized and prepared to conduct interviews for data analysis, which included transcribing interview records. Then the transcribed interviews were codified using a computer software program (ATLAS.ti). The software was used to create and refine these codes. The coding process is mainly related to the categorization of a specific text fragments of interview transcripts. The categorization was constantly explored and ultimately related to the sub-research questions. By analyzing the data, a more specific picture of the current situation of RPA in the organization was made. In specific, codified data were used to answer the research questions. Moreover, together with literature review it served as the basis for the RPA governance model.

4.2 Case Description

The chosen organization is an internationally and domestically operating financial services company with a strong presence in several European countries and Japan. The company is a parent company which offers its customers a comprehensive range of insurances, investments and banking services. The company has around 15.000 employees. In the organization, there are several business units (6) who have started to implement RPA. 4 business units were selected which created 4 case studies. This selection was mainly based on that two teams consist of just a maximum of 2 people and therefore considered as not mature enough. Each case study description provides an overview of business function, functional use of RPA and number of robots, processes and people. The information for constructing the case description is based on the conducted interviews.

Case study 1 – Finance Service Center

As a result of increased workload, 2,5 years ago the parental company has decided to use RPA as a resource for performing repetitive manual activities within the Financial Accounting Department (Finance Service Center). It started as innovative initiative and Proof of Concept for the first robot was implemented. The first robot was in fact implemented within three months of the decision. This robot arranged for an automated input and a compliant archiving of manual journal entries. After the launch of the first robot, other business units have started to show their interest in RPA. Since then robots have been performing various sub-processes at various departments within the company such as the recruitment of external employees, returning identification deposits and performing of reconciliations, checks, data collection and archiving. They have around 19 robots running at the moment which differ in size. There are approximately 40-50 processes in operation. The biggest robots are the ones that performs all the manual booking to the general ledger and the influx process of external employees. 14 people are working on RPA in this case study where 7-8 are pure offshore developers from India.

Case study 2 – Asset management company

Case study 2 is a stand-alone asset management company of the parental company. Case 2 company's business is focused on three key asset classes: fixed income, multi-asset and equity specialisms. With regards to the RPA journey in the company, it has started 2 years ago with Proof of Concept. The main use case was to recognize emails to combine them for reporting purposes. Currently, there are 7-8 unattended robots which covers 65 processes and 1 attended robot. The 7-8 people are working on the RPA team in this case study.

At the beginning of the RPA journey, HR, IT, Security and Control were involved in developing the software bots. However, after some time when the environment and process have been established, it has found difficult to align all stakeholders. The problem was that the scope of this involved group was unclear and the discussion with them required a lot of content knowledge but at that time the company did not have it. Since then the RPA team has started to involve Security, HR and other stakeholders when it is necessary to the process to be implemented.

Case study 3 – Insurance company (Pension fund legacy)

Case study 3 is an insurance company in pension fund legacy business unit has started their RPA journey in January 2017. The idea of building robots came from a business perspective, as RPA itself was considered as a process. They started their RPA journey with all external parties, around 30 people then

expanded, and the goal was to build 22 robots. However, they started with a very large process instead of taking small and repetitive tasks. Their idea was that a robot can implement the whole processes that one employee does. At the end, 19 robots were delivered as the other 3 were no longer relevant because of development taking too long. The implemented projects are diverse and applied for 4 major divisions of the pension legacy business unit which are start pension, cease, divorce and value transfer. The robots in the start pension division have more gains in terms of what it takes all the user data from the separate systems, creates a letter and then send it out. In the number of cases (the number of implemented tasks), the cease one is most significant, as it also takes data from different systems and creates cases in the BPM system.

Today, the RPA team which consist of 6-7 people (no offshore people) are mainly focused on keeping the robot running and have some new requests to implement in their backlog. Moreover, the team will also consider to combine robots with more intelligent techniques like Machine Learning and Artificial Intelligence solutions. Currently, trying to create roadmap considering exploration of cognitive services capabilities.

Case study 4 – Insurance company (Pension new business)

Case study 4 is an insurance company in pension new business unit focused on the client servicing has a relatively small RPA team which consists of 5 people. They have been working since June 2018. Currently they delivered around 18 to 20 processes by now which is 3-4 robots. Sometimes these processes are part of longer processes like value transfer because it is a very extensive process. However, all delivered processes are temporary projects running only in 2018-2019 within so-called efficiency program. The goal of this program is to achieve staff FTE reduction. Therefore, the RPA team hired an IT consultancy firm. It means that this external team should be handing over the robots by the end of this year. However, the implemented robot still needs to be maintained after the end of the project, and it was unclear how the new team will be organized for maintenance and delivery of new robots.

4.3 Comparative case studies analysis

As it has been already discussed, the organization is no longer in the pilot phase which means that all infrastructure, environments and vendor management with ensuring licenses are in place. Comparative case study analysis is based on the input of the interviewees. Further, the generalized key findings from the case study analysis will be presented which is more based on researcher's observation and analysis.

Tool selection

The organization is using UiPath as a software provider. At the Proof of Concept phase, the company has selected UIPath, considering overall value of tool capabilities and price. Hence, it is essential to take into account what the tool offers. The solution consists of 3 main products which are:

1) UIPath Studio is a development tool where the robots are designed
2) UIPath Robot executes the processes built in Studio, as a human would. According to their solution, robots can be unattended (run without human supervision in any environment, be it virtual or not) or as attended (a human triggers the process).
3) UIPath Orchestrator is an enterprise architecture server platform which enable the organization to deploy, schedule, monitor and queue workload for the robots. License management is also centralized in Orchestrator.

There are two types of robots that UiPath offers: attended and unattended. Attended robot (also known as a front office robot) is a robot which works with a human side by side and needs to be triggered through human action in a local machine (UiPath, 2019). Unattended robot (also known as back end office robot) is a robot which works in unattended manner without human intervention and can be triggered remotely directly from the server (UiPath, 2019). Across the organization, mainly unattended robots are used. The case studies showed some discussions to pilot with attended robots to assess how many benefits it will bring to the organization.

Infrastructure and support

The Orchestrator is hosted by the parental holding company. It means that the RPA Orchestrator and infrastructure are shared across the organization (across all the case studies). Orchestrator is a tool to manage and monitor all robots in one place. Currently, the Orchestrator is maintained by Case study 1. Consequently, the RPA team members from different business units have aligned with each other, in the form of a Maintenance Board, and have a call every week in order to have a discussion revolving to cooperating and working on the issues related RPA Orchestrator, such as upgrading. Sharing resources (in this case infrastructure) is a classic governance matter. It was mentioned that the maintenance and support of Orchestrator will be governed by the CIO department.

"The Orchestrator is kind of our central environment. So that all robots are running into that Orchestrator. There we have some kind of central governance because we are bringing that Orchestrator now to a centralized CIO department. However, the development of robots is in the teams or in the other business units themselves." (Interviewee 1A, 2019)

The results from the analysis of cases are described in the *Table 12* below. The case study analysis is based on conducted interviews.

	Case study 1	**Case study 2**	**Case study 3**	**Case study 4**
Type of RPA approach/ adoption	Bottom up	Bottom up	Top down	Top down
Operating model (decentralized in a bigger scope)	Centralized	Centralized	Centralized	Centralized
Ownership	Finance Service Center (CFO)	Business Operations	Change and IT	Under efficiency program 2018-2019
Method of working	Agile way of working	Agile way of working	Agile way of working	Agile way of working
Managing robot	-Orchestrator: monitor, schedule and manage -Performance management on robot level and Splunk platform -Incident	-Orchestrator: Monitor, schedule and manage -Performance management on robot level -Incident	-Orchestrator: Monitor, schedule and manage -Performance management on robot level -Incident	-Orchestrator: Monitor, schedule and manage -Performance management on robot level -Incident

	management, Request information about robots and Administrative Change via ServiceNow - Code development standards via "Static Analysis" tool - Documentation	management and Change Management via ServiceNow - Request Management is more informal - Documentation	management, Administrative Change via ServiceNow -Documentation	management, Change Management is not formalized via ServiceNow - Documentation
Approach to manage robots	Falls completely to the hand of the RPA team	Split between RPA team and business	Falls completely to the hand of the RPA team	Split between RPA team and business
Challenges and problems	-Acceptance of robots and understanding what robots are *(Interviewee 1B)* -Extensive logging *(Interviewee 1A)*	-Missing expertise which led to too long design phase *(Interviewee 2B)* - Finding suitable process *(Interviewee 2A)*	- No way of working in the beginning *(Interviewee 3A)*	-Lack of communication between application owners and business *(Interviewee 4A)* - Ensuring a smooth transition and hand over to the RPA project and taking care of where responsibility for this RPA initiative will be taken. *(Interviewee 4A)*
Effectiveness of the current governance	Well aligned	Well aligned	Well aligned	Well aligned (but in transition the ownership phase)
Lessons learned	- RPA is a bit like software development and most of software principles and techniques can be applied back into RPA *(Interviewee 1B)* -Share things with other teams to benefit from each other's experience *(Interviewee 1A)*	- RPA alone does not make the magic, it should be combined with other automation tools *(Interviewee 2A)*	- Robotics are different than other applications *(Interviewee 3A)*	-Having proper documentation *(Interviewee 4B)* -Always to question assumptions to get right functional requirements from SMEs *(Interviewee 4A)*

Table 12: Overview of case study analysis

Type of RPA adoption: The organizational adoption of RPA has been mostly bottom-up, where business operations managers discovered the potential of RPA initially. Initiatives were started from an innovative idea (Proof of Concept) at the operational level and only caught up on a strategic level when the initiators of the RPA became more proactive and outgoing by bringing it up to the senior managers. This bottom-up approach applies for Case study 1 and Case study 2. Regarding Case study 3, initially, there was a sponsor from senior management level who pushed the delivery of software robots. In that project, they were aiming to deliver 22 robots. This can be seen as a more top-down approach. Regarding Case study 4, as it is part of the efficiency program initiated by senior managers, it is formalized as a top-down approach.

Operating model: it depends on the scope of how you are looking at it. For example, it is a more decentralized model in a bigger picture with different RPA teams in different business units when you are looking from the holding parental company's perspective. As in the decentralized model, all RPA capabilities and responsibilities are conveyed to the business units with full autonomy and control over their own decision making, development and delivery. The decisions about the prioritization and maintenance of the robot are not made by some other centralized endpoint. Moreover, the operating model and ownership of the robots are also different from each other. However, it is centralized within its branch company in the sense of one centralized RPA team within that business unit developing their own robots and maintaining them. On the other hand, considering that Case study 1 named themselves CoE, it can be considered that they use a federated model. However, there are just RPA teams from different business units which are aligned, share experience and infrastructure (Orchestrator) between each other via CoE. Currently, the infrastructure (Orchestrator) is maintained by the Finance Service Center, but it will be handed over to the CIO department.

Ownership: RPA was treated as a business project with ownership by business operations since it required process expertise without IT programming skills. However, it has been changed towards IT project in Case 3 once they realized the role of IT in the RPA project.

Method of working/development: From the literature study, it can be seen that the agile way of working is the preferred approach for RPA. Based on the all interviews, it has been said that all cases also follow this agile way of working. The RPA team from Case study 3, which started with the waterfall approach turned to an agile way of working. They underestimated the complexity of the processes and it led to delay in delivery. Currently, all RPA teams in the organization follow the agile way of working (precisely Scrum methodology) with creating backlogs and the delivery of the robot features in sprints to the business. In this agile way of working, they also develop a minimum viable product (MVP) and give information about their progress to the process owners by giving playback (small demo). The intentions of this demo are not to show a wholly finished process but a separate piece of functionalities which gives users an idea of progress and involvement. After each sprint, they have a review session and feedback on how to improve. As a result, this agile way of working creates a continuous improvement mechanism, which is said to be necessary for governing RPA's success factors, such as expectation management and engagement from stakeholders.

Managing robot: All of the cases use a control room (Orchestrator) which offers different features. It is a management console which is helpful and productive for managing the robots. The organization uses the Self-Service Desk implemented via the ServiceNow platform to raise new tickets for a particular request or create an incident. ServiceNow is a workflow management tool which provides service management software as a service. Similarly, for RPA, if the user wants to register an incident, request information or a change, it can be done via the ServiceNow portal used in the organization. Then, the raised tickets by users are directed to the inbox mail of the Robotics team which is used to correlate the corresponding communication. As Case 4 is under the Efficiency program, the change, incident and request management have not been formalized via ServiceNow.

The RPA team applies coding standards to ensure that the robots are built to be maintainable, safe and expandable. These coding standards also ensure that a number of audits can be assessed more easily. The RPA team from Case study 1 developed a tool named "Static analysis" tool in .NET to control whether these coding standards are applied properly (*Interviewee 1B*). This "Static analysis" tool checks the robot code and gives a comprehensive report about every robot being built. Going in the production is done after this code quality control following an intensive internal test round and acceptance test. Once acceptance requirements are met, the robot is in production. After that, the robot is extensively monitored which creates

extensive logging, meaning a large amount of data. On the one hand, it helps to ensure standards but it also creates a challenge to monitor all these logs. To resolve this issue, the RPA team (Case 1) uses the Splunk Platform, which helps to find what the robots have done quickly. Splunk Platform acts as a searchable repository which can generate alerts, dashboards and reports. To always be aware of the status of the robots, the RPA teams use that dashboard based on the logs using Splunk. There are also automatic alerts in order to quickly and proactively respond to any robot incidents. The RPA team from Case study 3 applies screenshot functionality where something went wrong, the robot creates screenshots and deposits them in a folder. The RPA teams agree on their team standards and best practices. They applied a template framework, module building and naming conventions. They have started with reusing components with the library. The teams make the documentation for each process which are requirements document, design document, documents for test cases and runback (work instructions) for the robot.

Approach to manage robots: From the conducted interviews, it can be seen that the approaches used by Case study 1 and Case study 3 are keeping the robot far away from the user which means that the management of the robots falls entirely to the hand of the RPA team. The RPA teams from Case study 1 and Case 3 try to make sure that the user has no issues with the robot. However, in Case study 2, the responsibilities for the robot are split between RPA team and business operations.

Challenges and problems: The problems and challenges in managing and governing RPA will be shown when answering to SQ1 further in this chapter. As those problems and challenges are derived from literature and participation in the workshop in the selected organization. The problems in *Table 12* are described from the responses of interviewees. For instance, problems such as acceptance of robots and understanding what robots are or lack of communication between application owners and business can be generalized and listed when answering for SQ1. However, the problems such as “ensuring a smooth transition and hand over to the RPA project” mentioned by *Interviewee 4A* is more specific for Case study 4, as it is a temporary project 2018-2019. Similarly, the specific challenge with extensive logging folders has been experienced in Case 1 as that business unit works with payments and journal entries for general ledger, it is essential to them to monitor the correctness of the process. However, in comparison Case 2 and Case 4 which have more simple processes, they just monitor their robots in the Orchestrator.

Effectiveness of current governance: According to *Interviewee 2B*, the current governance model works but it is still in some sort of set up phase. As the robots are being introduced in organizational processes, the existing key control framework needs to be updated, as the team members realized that working with robots exposes different risks. Currently, the team members from Case study 3 (mainly) and Case study 1 have been working on setting the base (policy guidelines) for further use of robotics. They work in collaboration with ORM, Security and Control departments to write down RPA guidelines (policy) considering risks. While conducting research, it was in a progress phase and it was expected to have more in-depth written down process and how their governance looks like in a few more months. Moreover, as it was discussed, the infrastructure (Orchestrator) is hosted and maintained by the Finance Service Center, but it will be handed over to the CIO department. *Interviewee 4A* pointed out that management of the team and overall of RPA governance in the organization is well aligned but there is no specific structure. The different RPA teams across the organization meet each week with each other to catch up and know how they are working but they don’t have defined way of working from above to top-down.

Lesson learned: The lesson learned which is shown in the *table 12* are quite self-explanatory. One of the lessons which is essential to highlight is that RPA alone does not do wonders, it should be combined with other automation tools (*Interviewee 2A*). As integrating several automation tools will create a multiplier effect. For example, in Case study 2, RPA is combined with ServiceNow (workflow management tool) to trigger the process. Moreover, RPA works in combination with RAVN Extract (Optical Character

Recognition (OCR) engine tool) to extract key data points from the documents (Interviewee 2A). As integrating several automation tools will create a multiplier effect. For example, in Case 2, RPA is combined with ServiceNow (workflow management tool) to trigger the process. Moreover, RPA works in combination with RAVN Extract (Optical Character Recognition(OCR) engine tool) to extract key data points from the documents.

Roles and responsibilities

Table 13 shows an overview of roles in the investigated organization. However, this terminology of provided roles is indicative as it can be seen that every company can change role names. In this case, the names are less important than the essence and ability to make up the role. This overview of roles of key stakeholders have been identified during and after conducting all interviews. The role of Solution Architect is combined with Business Analyst in the organization

Role	Description
Business Analyst	Creates process definitions, process maps from the business side and analyzes data. Also, in charge of assessing which processes are suitable for automation, along with the impact and benefits of doing so.
Solution Architect	Defines the stable and scalable architecture of the RPA solution. Translates the requirements gathered by the business analyst to technical specification documents
Lead Developer/Developer	Designs and builds the process automations followed by testing and fixing any technical issues that may arise.
Product Owner	Owns and defines the product requirements, oversees the implementation roadmap and priorities and acts as the source of truth for both the delivery team and the senior stakeholders within the business.
Scrum Master	The Scrum Master works to help surface and resolve issues to help the team and the organization learn and improve continuously.
Functional maintenance and operations manager	The operations manager from DevOps manages and schedules the tasks which must be completed after the software robots are in place. They assign exceptions and other issues occurred to specific roles to be able to fix it on time.
Process Owner	The final authority who sign off on the process to be automated, which also means that the person involved during UAT and evaluation of that test. Before the process owner assisted in the documentation of the Process Definition Document (PDD).
Subject Matter Expert (SME) / End User	Employees who are experts at the process which is chosen to automate. They play an important role in user acceptance testing. They can be users of the RPA solution deliverable
Sponsors or executives	Provides senior buy-in and protects the progress in business adoption. Often responsible or accountable for funding of the initiative.
Security and control	Complies with security standards, protocols and policies.
Operational Risk Management (ORM)	Help the business to remove or mitigate any risks that arise in its operations.
Team Leads/ Project Manager	People who manage the SMEs, create a change plan and communicate.
Infrastructure support	In charge of infrastructure configuration: servers, databases, VDI's, machines, etc.
Software provider	Provide environment to build robots. They also provide technical and functional service support for software.
Application Owners	Owners of the systems and applications which robotic processes use.

Table 13: Overview of roles of key stakeholders in the RPA with description

Key findings from the case studies

It has been harder to generalize the outcome because the case studies (business units) are independent from each other. Comparing the cases, it can be observed that Case 4 is still more in the setup phase, even though it is said that they are no longer in Proof of Concept phase. In comparison to Case 1 and Case 3, asset management company Case 2 is not moving as fast with the implementation of the robots as it could be expected. Nevertheless, some key findings from the case study analysis are shown below.

Firstly, the organization is mature with developing robots. The organization is quite ahead in terms of applying best practices and code management standards. The different RPA teams have started the practice of sharing knowledge between each other, but applying reusability of the code and using the library are still in progress. However, the organization does not keep track of benefits of RPA after the delivery of the robots. They mainly do performance management on the software robot level by logging and monitoring. Benefits tracking has been done just one in Case 4 as it is a temporary project to measure benefits, but the outcome was not the same as expected.

Secondly, the governance of RPA is implemented in the organization but it is not mature enough yet to scale up. It is observed that the organization has started to work on changing policies for RPA, aligning it with ORM and Security and Control departments. Before it just relied on inherited policies based for normal employees and applications. However, now it has been realized that this organization policy does not fit the software robots. Moreover, the shared infrastructure (Orchestrator) between all business units to be handed over to the CIO department might show the importance of embedding RPA into existing IT governance structure.

Thirdly, it has been observed that it is important to streamline the process to have a more efficient solution before starting implementing robots. Even though the robot can be integrated almost all the infrastructures, a software robot is still part of process automation. Hence, it has been noticed that it is essential for the organization to focus on assessing the suitability of RPA for particular cases. To put some process assessment and selection criteria, and ask if the existing process needs some changes. Due to that sometimes the robot can be misused or selected to the not suitable process and thus wasted (terminated) at the end of implementation.

The presented key findings can be biased as it contains the author's interpretation and observation. The results have not been send to the interviewees and checked with them. However, some interviewees requested the report to see the results and they have not been coming back with any concerns. Moreover, it should be noted that the gathered data can be a bit outdated at the end of the research in comparison when the data was gathered.

SQ1: What are the problems and challenges experienced in managing RPA?

Identifying the problems and challenges of managing RPA were done by the literature review, desktop research and participation at the Hackathon in the organization. The observation was done by short-term participation at the selected case study organization, Hackathon, which involves different RPA teams from the whole organization and representatives from the RPA software provider. At the beginning of April 2019, the RPA teams across the organization gathered to discuss the common challenges and technical insights from each other. At the end of the day of the Hackathon event, the participants demonstrating their results relating to the main challenges. They included (i) the implementation of dashboards for robot management;

(ii) technicalities related to using common libraries to reuse code and robot-activities; (iii) best practices including a summary of lessons learned; (iv) demonstration of a personal attended robot assistant which helps in daily process operations and activities for every user. Furthermore, the participation had contributed to create a connection, identify RPA teams for the case studies and select individuals for the interview.

This observation and participation had led to understand the challenges of the ongoing problem experienced in managing RPA and answer to the SQ1. One of the widely used tools for presenting the causes of problems is the Ishikawa Diagram (also called a cause-effect diagram or a fishbone diagram). It is applied to present the answers for SQ1 in available visual form. It comprises of a main horizontal line representing the problem and associated slanting lines which represent direct problems. These associated slanting lines may relate to additional lines representing the indirect causes of the problem. As indicated in *Figure 10*, these causes are categorized to organizational, executional, technical, functional and human-behavioral.

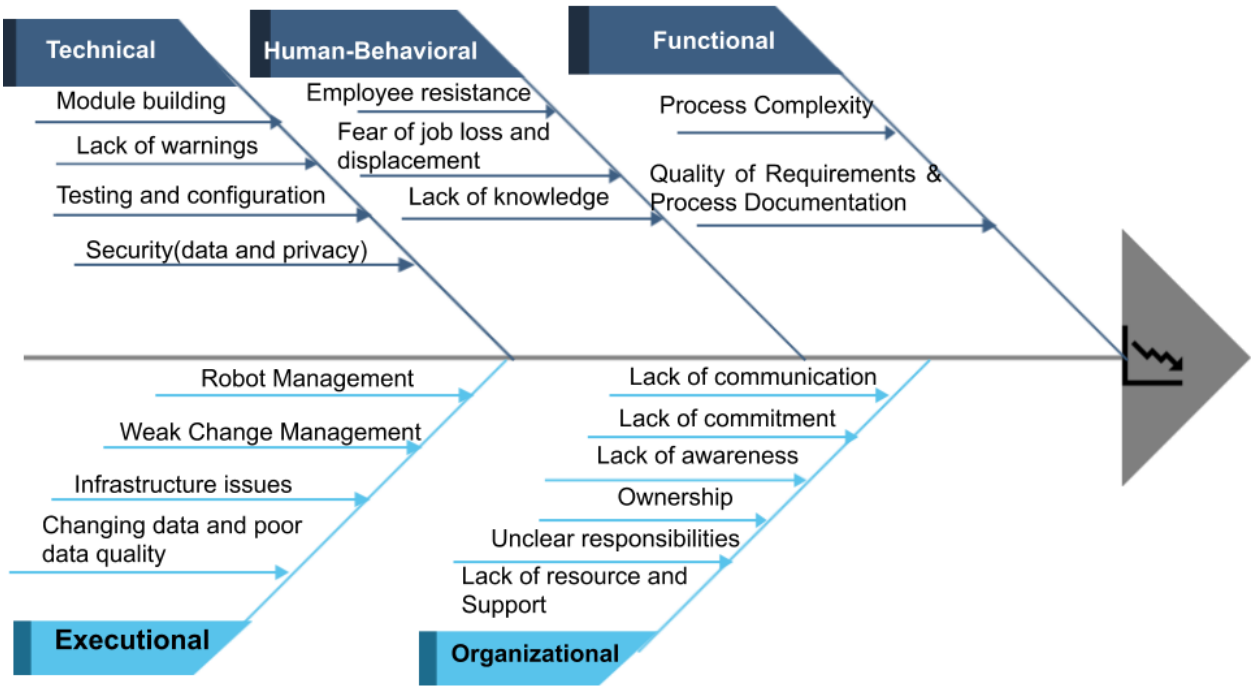


Figure 10: Fishbone diagram with overview of governing and managing challenges in RPA

The explanation of each challenge from above-drawn fishbone diagram are described in *Table 14* below.

#	Problem/Challenge	Description	Category of Problem	Source(s)
1	Lack of communication	Robots and business processes breakdown due to the lack of communication	Organizational	Hackathon
2	Ownership	Segregation of duties issues, decision making and who owns RPA governance	Organizational	Suri et al., 2017
3	Lack of awareness	Lack of understanding of what robot means and its capabilities; how and where it can be applied	Organizational	Suri et al., 2017; IRPAAI, 2018; Hackathon

4	Unclear responsibilities	Unclear division of responsibilities between IT and functional organizations	Organizational	Suri et al., 2017;
5	Lack of commitment	Without commitment, it is hard to be on top of the agenda. Sometimes there are no sponsors on the different levels in the hierarchy.	Organizational	Hackathon
6	Lack of resources, support and budget constraints	Finding the right resources takes time, budget constraints	Organizational	Suri et al., 2017;
7	Process Complexity	Choosing a complex process which has too many sub-processes and exceptions	Functional	IRPAAI, 2018;
8	Quality of requirements and Process Documentation	Forget to describe all cases of the process; Not documented and stored properly; missing rules	Functional	Anagnoste, 2017; Hackathon
9	Robot Management	Maintenance and control of the RPA after the implementation. Scalability issues	Executional	Hackathon
10	Weak Change Management	Weak change management process across the organization, especially in the IT operations	Executional	Suri et al., 2017;
11	Infrastructure issues	RPA tools work on a virtualized desktop environment, problems in connection with the set-up of a solid IT infrastructure and integration with other desktop management tools	Executional	EY, 2016; PwC, 2017
12	Data quality and changing data (test data)	Any changes in upstream and downstream data can affect the functioning of bots. It also relates insufficient definition of business rules	Executional	Accenture, 2018
13	Module building	Poor coding standards within the team, which creates difficulty in integrating different modules.	Technical	Hackathon
14	Lack of warnings	It is related to monitoring and maintaining robots. There is a lack of notifications when robot stops work	Technical	Hackathon
15	Testing and configuration	Poor testing and configuration of robots can cause a bigger challenge after deployment	Technical	Hackathon
16	Security (data and privacy)	Data is misused via the privileges attributed to software robots	Technical	EY, 2016
17	Fear of job loss and displacement	Fear of job loss by employees	Human-behavioral	Suri et al., 2017
18	Employee resistance	Implemented the new technology, brings changes to employee which could demands new skills and change process of working. It is also requires cultural change.	Human-behavioral	IRPAAI, 2018 ;UiPath, 2016; Asatiani & Penttinen, 2016
19	Lack of knowledge	Lack of knowledge of the employees of their work can lead to misdelivery of requirements to develop robots. It is also related to knowledge management when robot stops to work.	Human-behavioral	Deloitte, 2018

Table 14: Key problems/challenges overview in managing and governing RPA

The listed overview of ongoing problems and challenges presented in the above-drawn Ishikawa diagram allows to identify the underlying causes and effects of the problem which can be derived as requirements for the key components in the RPA governance model. The clear and logical relationships between potential causes and effects which are displayed in the diagram enable deeper understanding of their correlation. For instance, the problem of Weak Change Management leads to potential effect of inefficient data change and poor data quality, and this certain challenge can be resolved by appropriate Change Management in the model which stimulates the problem solving process. Moreover, listing challenges is useful by synthesizing it with the literature and relate it to the SQ2 which addresses the question on how to manage RPA in terms of risks and failures. However, it should also be taken into account that this "effect-and-cause" approach to the challenges of RPA management and governance can involve certain limitations such as cause relevance and complexity of interpreting the interrelationships of multiple factors in the fishbone diagram. It should be noted that there are definitely more problem that could be added to the list or some of the problems could be relevant for another organization. Therefore, decreasing the risk of those limitations can be done by discussions focused on the topic and evaluations in the future research.

SQ2: How to manage software bots in terms of risk and failures?

As in any program and automation technology, there are many risks. With the project size of RPA and increase of complexity, there is an increase of the risks. Willcocks and Griffiths (1998) have discovered three critical sources of risks on ICT deployment which are related to the deployment of service automation tools. These recurring sources include: project management disciplines are not in place, low experience with the generic technology and the larger the size of deployment, which raises the risk. As the scope of the research is more focused on operational and management level, we will not dive into business risks associated with RPA. Another reason is that the questions asked during the interviews were also mainly in an operational and technical context. The significant risks are that the robots do not function as intended and stopped working because of new business rules evolving or Graphical User Interface (GUI) changing in different system applications.

Firstly, one of the main considerations of RPA is security and privacy risks. Security has been stated as a technical challenge in *Table 14*. The security risk is related to software robots, by nature, being required to having access and dealing with business data, hence data can be misused via the privileges attributed to software robots. In many cases, this business information will be kept confidential and must be protected in accordance with the rules of the General Data Protection Regulations (GDPR). In addition, software bots use the organization's credentials to log in to different system application (e.g. SAP, Aladdin), so the robots need to have access to the passwords. However, the robots are not ultimately smart yet and in the end a robot will not do anything which has not been programmed by humans It might indicate that a robot will not misuse the assigned credentials and roles. Interviewees (2A, 1A, 3A) mentioned that even assuming that robots will never misuse privileges assigned and have extensive authorizations in all kinds of application, does not mean that developer cannot benefit from the process and fraud. Hence, it emphasizes the importance of having the controls and checks on the development process of the robot.

For instance, during the Hackathon, one of the mentioned practices was having an automated testing where machine executes checks and test cases automatically or file integrity check where you can see if the configuration file for the robot has been modified or not. Also, security controls regarding access management and controlling robot credentials can be implemented to address these security risks. Moreover, regular assessment of segregation of duties and restricted access to bot configurations and its code are also important.

Secondly, another ongoing challenge is the lack of warnings mentioned in *Table 14.* If notifications are not in place, the failure might occur and consequently the robot will stop working, which might be noticed at a later stage. In this case, it is important to have an element of notifying (notifications, screenshots) dedicated individuals (e.g. DevOps team) via email for instance. As was discussed before, the robots could not function as intended because IT interfaces change, changes in the configuration files or new business rules evolve. RPA requires detailed business knowledge of the process in which it is used. However, it has been noticed from lessons learned by Business Analyst (Interviewee 4A) in Case study 4 that most users (SMEs) typically tell about a "happy path", therefore exceptions sometimes were not properly identified during the requirement gathering phase or there were just new exceptions which can lead to further errors. In this case, it is important to have a human element that can handle an error and validate further steps.

Thirdly, in order to solve the issues when the robot stops its work, it is important to have proper logging for debugging, auditability and monitoring. Proper logging should be practiced to know what things go well or wrong. It is also important to be compliant and show an audit trail for external regulators. Extensive logging folders are practiced in Case 1 and Case 3 and then dashboards are created based on that to monitor software robots. Moreover, in Case 3, the team has implemented top screen functionality. So, in sight of any possible errors the robot will perform a task of creating a screenshot and depositing it into a designated folder. The team can check the screenshots later on and see what exactly the problem is about. The problems with interface change or some other structural changes are visible from screenshots. If not, the team representatives log into the virtual machine and try to execute what the robot does. One of the well-proven generic practices was pointed out by *Interviewee 2A*, where there is no Application Programming Interface (API) connection between application systems, it is considered a better option to produce upload files instead of entering data via a Graphical User Interface (GUI) interface. In this case, it is obvious what and how it was sent by the robot due to the generation of log files.

SQ3: What is the difference between managing RPA and managing IT applications?

It was established by all respondents that RPA significantly differs from software applications. Therefore, it was concluded that the robot cannot be compared with an application because their initial characteristics are not on the same level and a robot is something in between an application and a human being. However, with regard to managing it, some of the interviewees do not have experience in managing software applications other than RPA and therefore some of them are not capable of software comparison. Even so, the clear answer from respondents was that there is a difference between those factors. As the supporting evidence to this statement, some of the responses from conducted interviews are illustrated below:

"Yes, definitely. The difference is that the robot is also a user. Sort of. An application that normally does not have its own accounts. But robots do. So, there is a whole scope of not only technical applications in the sense that 'How do you make the user which is not a user, work in a system that is designed for users?' , but also a lot of risks because of robot...." (Interviewee 3A, 2019)

"A robot is a bit of both in the sense that it's doing human actions but it is also a software. So, if we tried to write the whole robotic solution into the software guidelines and standards it doesn't work. If we tried to do it the same for humans. It also doesn't work." (Interviewee 1B, 2019)

Hence, it can be deduced from the case study analysis that a software robot is a virtual worker (digital workforce) which means that it needs to be governed by managing everything including scheduling and interactions with other applications by a human being. Hence, the software robots need oversight and to be managed as a digital workforce. This certain digital workforce product also requires robotics developers

to create an initial new process, and therefore they need to examine the process improvement and managing the development of the robot.

In order to achieve a distinguished understanding of the distinction between software application and robot, all mentioned examples of difference from carried out interviews can be divided into three main categories which are change management, access management with password control and segregation of duties.

First of all, the main distinction lies in the root of the change management. According to the term, change management is a crucial component of a computer system addressed to the management of software applications. However, in comparison with the robot, there are only requirements changes over time meaning that the change management does not require to be radically changed in the root in order to be used efficiently unlike the robots. In RPA, there are also required changes where users want to change the process. In addition to that, there is a presence of environmental changes in RPA with updated versions and in which applications that interact with robots have started to look different in its GUI. As the robot touches and interacts with many different applications, it means that the RPA team also needs to manage not just the robot but also the relationship with other applications.

"The managing software applications focused on their own application whereas you need to consider every change in every application because it's going to hit your robot. If some new pop up appeared and it not considered, your robot is going to break" (Interviewee 4B, 2019)

Furthermore, from the maintenance perspective, if something goes wrong with the software, it can be fixed because the problem is mostly in the code. However, if something goes wrong with the robot, it is not necessarily the code problem but it can also be the program, a role which was not properly assigned and so on (*Interviewee 3A*).

Second, as the robot is a virtual user which is autonomous in some level of intelligence, access management and password management should be taken into account because robots can have access to the use of organizational credentials to log in to different system applications. To login into software applications, many individual accounts require unique identifiers like a corporate key, insurance ID and other personal information. However, it is not pertinent for a software robot due to the designation of roles and rights to the robot. Currently, in the organization, the robots are employed as a regular employee, thus the company needs to request roles for the robot, as it is usually done for a new colleague. The staff makes up all data required to give the robot an account and fills up related compliance form. However, sometimes a robot requires more roles to be capable to execute the processes which usually takes a fair amount of time and progress of finishing the business process implementation. If the organization gets more robots, more time will be spent on adjusting passwords (Interviewee 4A, 2019). The importance of the password management was also highlighted as a difference by Lead Developer of CoE:

"Password management because this software needs a human kind of roles. The robot needs to be able to enter something into SAP or in some other system. But humankind of roles come with audit trails in software." (Interviewee 1B, 2019)

For example, the access to the software raised on a human account can be monitored but with the robot, it might be quite problematic to find out a person who has made certain changes because it could have been anyone who has access to that robot account. This issue is mostly related to the segregation of duties, identity and access management that lead to the arising risks.

Thirdly, segregation of duties (SoD) where the concept lies in having more than one person to complete a task. The purpose of segregation of duties is "to ensure that failures of omission or commission within an organization are caused only by collusion among individuals and, therefore, are riskier and less likely, and that the chances of collusion are minimized by assigning individuals of different skills or divergent interests to separate tasks" (Gligor, Gavrila, & Ferraiolo, 1998, p.1).

Especially in financial transactions, companies tend to create restrictions for the users in the system. For example, with the segregation of duties, one person will not be able to get permission to set up a new vendor in the accounting system, and then approve accounts to pay this vendor. It is related to the so called four eyes check principle in financial services which adds security element in any significant decision. Such kind of element of controlling potential fraud works with human as there are split between creation of payments and approving payments. However, it is different with the software robots as this aspect of segregation of duties cannot be solved by having two separate robots. The one of the insights from interviewee is shown below:

"A robot can more easily violate segregation of duties because it can be used from multiple accounts. In theory, the segregation of duties would be separated by building one robot and another robot. But that's not how it would work in practice because you can still have both of the robots executed by the same person." (Interviewee 1B, 2019)

With the software applications, the system administrator is entitled to provide a set of authorizations and the necessary package to the user based on the role. However, with the robotics, members of the team should be able to access the production environment of the robot (robot accounts) to fix and adjust possible malfunctions. It means that the person who has access to those robots accounts also has access to all the underlying systems where a robot can log in. This issue is associated with the security and privacy risks.

As it was mentioned, managing RPA is combination of managing employee and its application, the development of the RPA solutions can apply the most of software engineering principles and techniques. For example, Lead Developer (Interviewee 1B) from the Finance Service Center with programming experience, has had an experience of applying some of the principles and techniques from software engineering. Besides, they also applied a tool which runs, checks the code for a fixed set of rule standards (something similar to code-review but automatically) and looking at the development pipeline (CI/CD practice), reusability of the code for the custom activities using a library system. Similarly, in software engineering the robots are built, tested and deployed in separate environments. However, in this case software robots are not as tolerable as IT applications. If the development environment differs from production, the robot will not work meaning all the scenarios should be verified.

4.4 Conclusion: Case study analysis

This chapter presents comparative case study analysis which is presented in the *Table 12* and key findings related to the studied organization are presented. Moreover, this chapter covered answers the sub research questions which gives practical and more detailed knowledge to develop the artifact.

From the case study analysis, the organization were found mature with developing robots from an operational perspective by applying best practices, code management standards and extra tools to monitor software robots. However, the governance of RPA has found to be not mature enough yet to scale up.

An explicit answer was given to the sub research question SQ1 for the ongoing problems and challenges being recognized for managing RPA in the form of the table (See *Table 14*) and the Fishbone diagram.

The response to SQ2 outlined the management practices associated with risks and failures from operational and technical context. It includes having the controls and checks on the development process of the robot, security controls for managing access and credentials, have an element of notifying in case of errors and proper logging.

Regarding the answer to SQ3, from the respondents, it was concluded that RPA should be considered as a hybrid of worker and software. On one hand, software robots are part of the workforce and it needs to be managed like a normal employee. On the other hand, software robots are also IT products which need to be managed as a software application. This combination of hybrid worker requires a different kind of management, policy and standards which have just started to be encountered in the studied organization. It can be concluded that from a managing perspective, the software robots need continuous oversight.

5 Design and Development: RPA governance model

In previous chapters, the literature review and case study analysis have been studied which is the foundation to design and develop the model. This chapter will start with answering to sub-research questions SQ4 – *"What are the high-level requirements for a comprehensive RPA governance model?"* and SQ5 – *"What elements will be addressed in the RPA governance model?"*. It leads to the design and development of the RPA governance model in *section 5.1*.

SQ4: What are the high-level requirements for a comprehensive RPA governance model?

Requirements can be seen as building blocks for the RPA governance model. Johannesson and Perjons (2014) define requirements as a "property of an artefact that is deemed as desirable by stakeholders in a practice and that is to be used for guiding the design and development of the artefact" (p. 103). Requirements Engineering (RE) is a broad area where various topics have been studied for a long time covering multiple activities such as requirements domain analysis, elicitation, negotiation and agreement, specification, analysis designations, documentation and evolution (Van Lamsweerde, 2000). Moreover, a set of guidelines and tutorials were written in developing requirements (Sommerville & Sawye,1997; Pohl, 2010).

Vershuren and Hartog (2005) in their "Evaluation in design oriented research" defined three types of requirements: functional, user and conceptual. The functional requirements contain all the functions that the artefact should enable to perform. User requirements should be fulfilled on behalf of future users and their needs. The conceptual requirements are established by the political, economic, legal and social environment. Requirement standards and textbooks usually classify requirements for functional and nonfunctional requirements, which is commonly used in software development. The focus will be on non-functional requirements due to that developing a model does not include functional requirements.

It is hard to get relevant requirements from stakeholders as it was not clear from the beginning how a governance model will look like. Therefore the high-level requirements were decided to be selected mainly by a literature review. Moreover, some requirements derived from the gathered challenges and problems in the Fishbone diagram *(Figure 10).* The high-level requirements were chosen and adapted from Johannesson & Perjons (2014), where the authors suggested generic qualities (structural and environmental). Structural qualities are coherence, consistency, modularity and conciseness (Johannesson & Perjons, 2014). Johannesson & Perjons (2014) separated environmental qualities are into usage qualities (e.g. usability, comprehensibility, learnability, suitability, elegance), management qualities (maintainability, flexibility and accountability) and generic environmental qualities(e.g. expressiveness, correctness, generality, interoperability). The qualities applied only for instantiations and methods excluded. The remaining generic qualities were selected by subjective judgement and by observing the other governance model's design. From these generic qualities, consistency, modularity, usability, comprehensibility and flexibility are remained for designing the model.

Table 15 presents a selection of the high-level requirements for developing the RPA governance model in this thesis:

Requirement	Description
Consistency	The degree to which a RPA governance model is consistent and free from conflicts is important for key stakeholders in the RPA project.
Modularity	Modularity refers to the degree to which the RPA governance model is divided into separated components, that can be recombined and replaced, with no major effect as an outcome. This is important for RPA, because different roles may have an isolated focus or processes may change for the RPA stakeholders.
Usability	Usability can be understood as the ease of use for the RPA governance model to reach a particular purpose. When RPA stakeholders experience high ease of use, the RPA governance model will face less usage resistance.
Comprehensibility (also called understandability)	The RPA governance model should be easy to interpret and understandable for the key stakeholders. A combination of key concepts and layman's language may be used to increase the comprehensibility.
Flexibility	The proposed RPA governance model needs to have the quality of being able to change with relatively easy. The model should be designed in expectation of adaptation, or in other words should be able to deal with changes, which is likely to occur

Table 15: High-level requirements for RPA governance model

For the governance model, the other derived requirements can be used, which might depend upon the gathered challenges and problems in the Fishbone diagram (*Figure 10*). It means that the requirements for developing the model needed to solve and address those challenges. It is vital as one of the objectives of the RPA governance model is also to help solve practical problems by working in a systematic way via guidelines and procedures. Developing a model is chosen and outlined as a solution for the governance problems from operational and management perspectives, requirements related to the problems can be defined in *Table 16* below. Some problems from the Fishbone diagram (*Figure 10*) have been grouped in order to derive requirements on how to solve those problems with the help of RPA governance model.

#	Problems	Requirements
1	Lack of communication / Lack of awareness/ Lack of knowledge	The RPA governance model should have a component where communication between different stakeholders will be addressed. A proper mechanism of creating awareness of RPA capabilities and providing knowledge can be done via communication.
2	Ownership/ Unclear responsibilities/ Lack of commitment	The RPA governance model should have properly designated people or domains for tasks in the RPA project.
3	Lack of resources, support and budget constraints	The RPA governance model should have a component to manage resources and budget.
4	Process Complexity	The model should have an element which shows that traditional RPA automates well-streamlined processes.
5	Quality of requirements and Process Documentation	The model should have an element in which appropriate templates, procedures for process documentation to be used.
6	Robot Management	The model should address a component to manage and monitor high-density robots.

7	Weak Change Management/ Fear of job loss and displacement/ Employee resistance	The RPA governance model should have a component where the change management takes place to upskill FTE to the next level when their tasks are automated.
8	Infrastructure issues	The model should have a component in which IT infrastructure takes place to set up an environment for the robots.
9	Data quality and changing data (test data)	The model should have a component in which an input data should be formatted in a way so that a robot can read and process it easily. A proper template should be used as input data.
10	Module building	The model should have an element in which the developers should create reusable components or modules so that they can be used for further implementation of other similar processes for fast delivery.
11	Lack of warnings	The model should have a component which should state a proper exception handling mechanism in order to avoid incorrect execution of processes and should notify the responsible individual with error's screenshots and description.
12	Testing and configuration	The model should have a component where the developed software robots are being tested before going to production.
13	Security (data and privacy)	The RPA governance model should ensure having security and control in place while sensitive data is being exchanged.

Table 16 Requirements for the governance model derived from Fishbone diagram

SQ5: What elements will be addressed in the RPA governance model?

The key components to be addressed in the RPA governance model from operational and management perspectives derived from the literature review and through analyzed data from the case studies.

From an operational perspective derived from the literature on RPA, the investigated life-cycle implementation methodologies and development phases will be addressed in the RPA governance model. The implementation methodology phases of the deployment software robots for the desired governance model are requirements gathering, analysis, solution design, development, testing, deployment and maintenance. From lessons learned of the implementation of RPA, agile methodology has found to be a better approach regarding RPA literature. Moreover, the studied financial services company also follows an agile methodology to deliver software robots, thus the model will also address the agile way of working.

Regarding IT governance literature, it can be said that the RPA can be managed on the existing IT governance process mechanisms. It was also pointed out by *Interviewee 1A* that there were many cases where robots can be leveraged on the already existing IT management ways of working for applications. For instance, *Interviewee 1A* mentioned that typical incident and administrative change management processes can be applied in the RPA. The model provided by the ITGI aligned with the COBIT framework are the ones being focused on management perspective with the core domains plan, build, delivery and evaluate. The key objectives from ITGI such as risk management, resource management and performance management will be relevantly addressed in the model. However, during the study, it has been observed that the main input for building robots is predefined rules and sequence of actions related to business processes. This RPA characteristic involves automation of processes which can be a part of the process management and improvement, hence control mechanisms and decision making to apply software robots to automate business processes in comparison with other solutions should be taken into account.

The main elements in the governance model for managing RPA derived from the interviewees are: orchestrator to monitor, schedule and manage robots, standards, proper documentation, incident management, change management, performance management, communication, and infrastructure. For instance, the program manager of CoE has highlighted the importance of having standards in building robots as RPA team in their organization in order to not be dependent on the software robot developers. It means that the robot code should be standardized where any random developer can read and understand it (Interviewee 1A, 2019). Therefore, the independence of robotics software enables key stakeholders to have proper documentation which is used as the base by whoever needs to execute the activity when the robot is not able to run or a responsible individual needs to continuously understand what the robot is doing (Interviewee 1A and 4A, 2019). All the respondents have emphasized the importance of having the proper change management and communication between all stakeholders.

Based on the analysis of the case studies, it was observed that code management and best practices are applied within the organization which is important to solve “module building” and “testing and configuration” problems presented in the Fishbone diagram. Another insight gained from answering SQ2 was to have proper logging and monitoring to manage failures. Regarding security concerns and discussed the difference between managing software robots and IT applications, the element of identity and access management with segregation of duties can be highlighted.

5.1 Developing the governance model for managing RPA

To construct the RPA governance model, the inputs from the analysis were used to be applied in a first draft of the model. However, it should be noted that the design phase has been done using an iterative approach. Firstly, some of the elements have been identified during the literature review. In the beginning, just the implementation methodology of RPA was incorporated from the operational perspective. From the design insights of the COBIT 4.0 framework, the cycle was used with the box of resources in the middle. Moreover, the key components are also shown in a box (block) similarly to the management processes for each domain (plan, build, deliver and evaluate) from overall COBIT framework representation. The key objectives of ITGI (risk management, performance management and resource management) are used as the basic elements in a block. With more understanding about RPA and gained knowledge from the case studies, the model has been adjusted with elements and details during the research.

The overall goal of this model is to present a clear overview on how to regulate RPA on an operational and management level with the use of a cycle diagram which shows the correlation between the main cycle and the implementation cycle. On the top level side, the blue box presents the minimum components to be addressed in the proposed RPA governance model.

The first draft is presented in *Figure 11* below. The description of the model will be characterized in this section with adjustments made from evaluation interviews feedback.

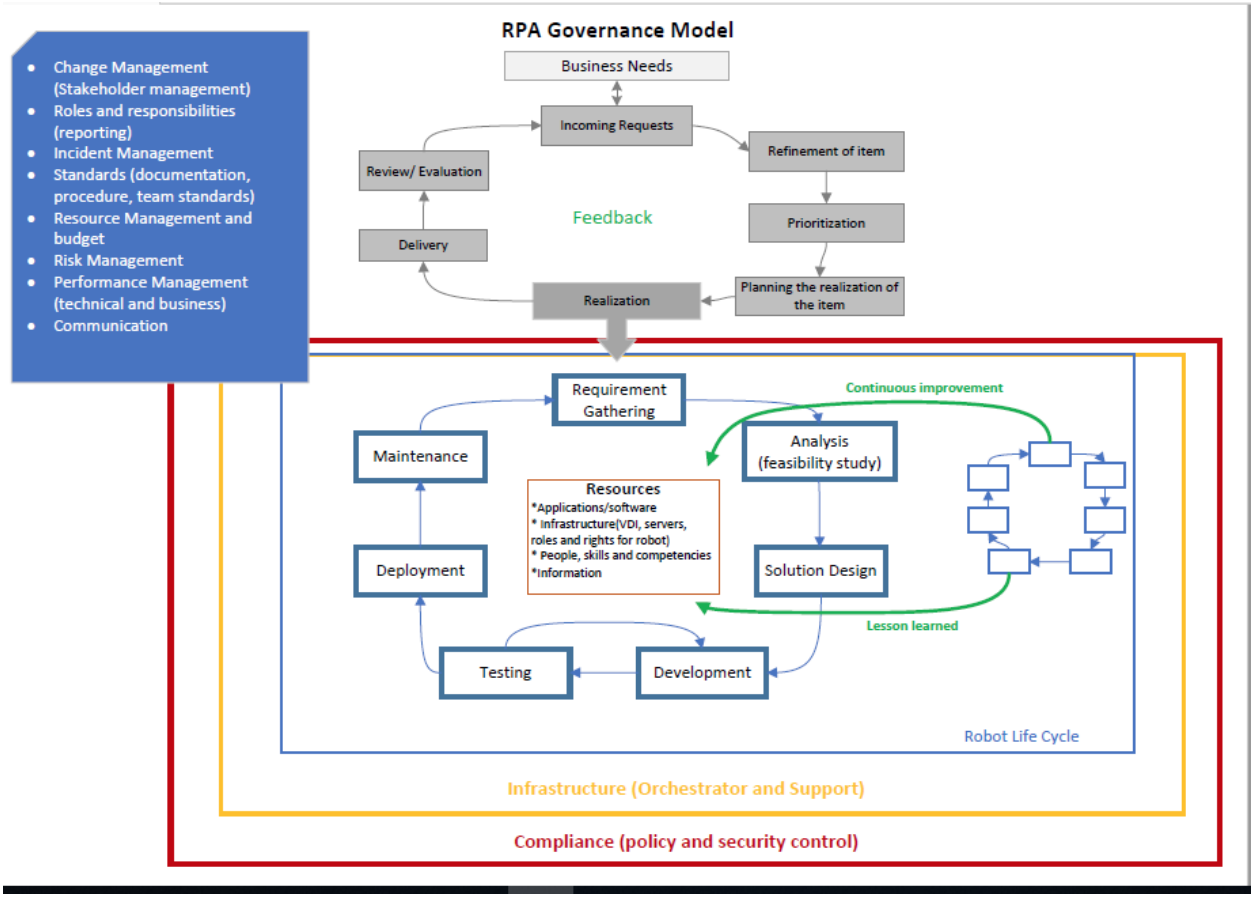


Figure 11: The developed model for RPA

As it is stated earlier, the model is based on the main cycle. As it can be observed from the model, the main cycle is located on the top of the diagram and it represents the agile workflow of receiving requests and delivering according to service that has been practiced in the organization. It starts with an incoming request (demand) for the automation of the processes with a software robot from the business or different departments.

MAIN CYCLE

Incoming requests. The incoming requests appear in demand for business needs. This list of requests can be considered as a backlog which goes to the next step “refinement of item”.

Refinement of the item (streamline the process), including process assessment of applicability of RPA and impact. Here, it is vital to make sure that this coming request delivers some value or that business has a clear view on it. If not, it will not go to decision making (prioritization). First, it is also essential to assess the applicability of the process to RPA. As it has been observed from the literature, the process should be structured, rule-based and routine. Considering that selection criterion, it should be assessed if existing processes need changing. However, it is also hard to make without prior requirements gathering and analysis of the process, thus analysis here is more high-level. Hence, it will be extended in the Realization part.

Decision-making (Prioritization). Once the decision is made, it is important to choose a part of the processes which are stable and do not present technological challenges. Decisions for RPA enabled processes has to be checked on a case and on a case by case.

Planning the realization of refined item. The goal of this step is to have roughly plotted releases and timelines. From the project management perspective, active steering on deliverables on time is essential.

(On the bottom of the diagram, there is an RPA implementation phase that shows the steps of development processes of software robots)

Realization

It is evident from the literature study (lessons learned from other case studies) and interviews, the better approach for RPA implementation is agile. This part focuses on iterative development and incremental improvement of the developed robots. In the first developed model, this agile approach was shown as a cycle which was a bit confusing. Therefore, it was replaced with an image picture of agile approach(sprint). However, some companies can still follow a waterfall approach, especially during the proof of concept stage. The realization steps are derived from the implementation methodology provided by software vendors (UIPath, BluePrism) from the literature background.

Requirement gathering: At this stage, all the requirements for the entire process need to be determined. Sometimes it can be called user stories, and this step can be confused with incoming requests. The identification of these problems and activities are being analyzed and documented. It is crucial that the as-is process descriptions and work instructions are complete and unambiguous. Getting proper insight from process owners and SMEs into the details of the as-is situation (the process map) is especially relevant when the process is not or properly documented as RPA require the detailed knowledge about business processes.

Analysis: At this stage, the analysis of the process automation and feasibility of the study is done in more details. It is also important to conclude that efforts to realize the software robots outweigh other alternative solutions.

Solution design: A specific document is studied at the previous stage in order to make the solution design. Formulation design for a future state is done in this stage. As the RPA solution could require a combination with other systems and automation tools, the appropriate solution architecture is important for further software robots deployment.

Development: The output of the solution design is the input of the development. The development of the software robot can be divided into modules/units for different developers and actual coding is started.

Testing: all developed modules will undergo testing. Errors and failures are corrected so that the robots work properly. Similarly to the software development, unit testing, functional testing and user acceptance testing are done in this phase. User acceptance testing is important to be able to “go live” and then sign off in the later stage.

Deployment: after successfully passing all testing processes, the software robotics process is deployed and released into the business environment. In this stage, the user guides, work instructions and RPA training are provided for business and IT users. Some monitoring of software bots can happen after the deployment (so-called Hypercare phase) to ensure the proper execution.

Ongoing maintenance and operational excellence. Providing ongoing supervision, constant monitoring and maintenance. It is important because software robots are vulnerable to problems when the underlying business processes, application or interfaces change. A process to resolve problems should be in place by having an exception and error handling, issue identification and dashboards.

Evaluation/Decommission of the robot. After the evaluation, the business could make a decision to remove any particular robotics processes after realizing that they cannot support the business function. Thus, the decommission stage here is closing the process down and removing the outdated redundant software robot processes from the working environment.

External layers:

Infrastructure and Support. IT Infrastructure ensures the platform for RPA runs on scalable and secure hardware, servers and the environment is backed up and runs similar to other enterprise technology services. Infrastructure support is required for the configuration of the physical and virtual server for the robots. Infrastructure and IT support should also consider Business Continuity and Disaster Recovery.

Compliance. Compliance means that the solutions are configured and applied in conformation with legislative requirements, security is appropriate and data is held in an appropriate way. Compliance comes earlier and later in the RPA projects. The output data for the designed software robot should be stored for regulatory compliance in a desired format. Security control needs to be altered for robots. Risk management also need to be incorporated and considered everywhere.

Resources. The model shows resources similarly to the COBIT 4.0 framework which needs to be managed by resources management processes and budget constraints.

- Applications and software
- Infrastructure such as servers
- People, skills and competencies
- Business data (information).

Key components that should be addressed in the RPA governance model:

1) Request Management: managing and recording formal requests from business departments or employees to automate their processes with software robots.
2) Resource Management and budget: It is essential to ensure the availability of sufficient resources and budget to carry out a project on time. Resource management allows gaining control over the core resources (shown in the middle of the main cycle) needed for projects.
3) Code Management: after developing the functionalities for the robot, peer review and code review should be applied. In the peer review step, developers will look at exceptions, code reliability and the application of best practices. Additional code review checks are done to ensure the correctness of each functionality and to check the variable's scope. It should meet developing standards.
4) Incident Management: when the software robots do not perform as expected, incident management should be in place.
5) Logging and Monitoring: it is important to ensure the auditability of the robots. The accountability and responsibility Also, it helps to provide performance management and benefits tracking
6) Performance Management: this performance management is more focused on the software robot level.

7) Benefits Tracking: Benefits tracking after each deployment in order to see how many values and benefits the software robot provides for the organization.

* This asterisk sign presented in the blue box means that these components named next to the sign are applied everywhere.

- Change management (people, process, technology) evolves changes for a software bot including a new release and managing requests for changes. It is managing the change of the organization and processes. The change management also should be integrated with other processes such as incident management or infrastructure change control. Change management must involve the environment, the whole IT landscape changes and stakeholder management. Moreover, communication helps to remove employee resistance in the change processes in the organization.
- Roles and responsibilities: Clearly defined roles and responsibilities of stakeholders involved in to implement and apply RPA solutions are important.
- Standards (Documentation, procedure, team standards). Documentation has been found as an essential component to keep updates, as it makes easier to manage changes in later stages.
- Identity and Access Management: establish the rules for a robot's access management. Management of access privileges assigned to software robots.
- Communication: Having communication plans between different stakeholders in the RPA project. Here, it is important that any changes to and in other applications and business processes should be an integral part of the communication plan. Both IT and business should be involved at an early stage and throughout the process as opposed to typical software development lifecycles where business kind of walks away after sharing the requirements.
- Knowledge management. It is related to loss of knowledge and non-accurately documented processes. If robots stop, no one knows what to do, some people do not know what robots are doing. In this case, knowledge management also includes shared experience and learning. Usually, the software robot development might be outsourced or done by external party, in this case knowledge on software bot creation has to be passed to internal employees. Thus, the ability to capture, transfer and share knowledge(lessons learned) is important.
- Best practices/training: For instance, the recommended approach for developing robots is a defined strategy for reusable components and apply naming conventions (variables which have meaningful names).

5.2 Conclusion: Design and Development

High-level requirements such as coherence, consistency, modularity, usability, comprehensibility and flexibility were defined in order to embed it in the desired RPA governance model. The problems identified in the Fishbone diagram (*Figure 10*) have been grouped in order to derive requirements on how to solve those problems with the help of RPA governance model which is presented in *Table 16*. These requirements were also created the basis for the development of the governance model. The answer to SQ5 outlined the components that are applied in the artefact. The main elements addressed in the RPA governance model are The governance model was designed with the use of a cycle and blocks to present key elements and external layers. This activity gave the clarity how the components are being used in practice and embedded by describing the artefact. However, it is better to take into account that the description of the RPA governance model was provided with adjustments incorporated from the next Demonstration and Evaluation phase.

6 Demonstration and evaluation

This chapter will cover the demonstration and evaluation phase. The developed RPA governance model is demonstrated and evaluated. Consequently, this chapter will answer to the last sub research question SQ6 - "*How well does the RPA governance model fulfil the defined high-level requirements?*". *Section 6.1* will discuss the evaluation approach. Then *section 6.2* describes the evaluation results, suggestions gathered from evaluation interviews and what changes are made for the developed RPA governance model.

6.1 Evaluation approach

Evaluation is needed to check the usefulness and clarity of the RPA operational governance model. It is also essential to have an idea of what needs to be emphasized, corrected or deleted in the developed RPA governance model. To achieve it, the opinion (evaluation interviews) can be asked to gain additional insight into the developed model. Semi-structured interviews were conducted to evaluate the RPA governance model. This open and flexible approach allowed both the interviewer and the interviewee to continue sharing new ideas regarding the RPA governance model. The main objective of the evaluation interviews to obtain perception and interpretation regarding the developed model.

Selection of the interviewees

Due to time limitations, three interviews conducted to evaluate the developed governance model. However, there was some informal communication feedback and a demonstration of the model for field experts that was taken into account. For instance, ideas and elements of developing the model have already started to be discussed with some interviewees from the first round of sampling at the end of the interview.

Therefore, rather than using double sampling to evaluate the RPA governance model, another round of sampling was performed. The interviewees were selected on the basis of management or governance knowledge at the financial service company. Two interviewees were selected who have a senior position at the asset management company, and one interviewee was reached who has the function of director in governance position in an external company.

Profile of the interviewees

The overview of evaluation interviews is shown below in *Table 17*. The interviewees represent the senior management level and possess good knowledge and experience from different management perspectives. All of them have some background related to RPA and its implementation. Interviewee X has more knowledge in program management and is experienced in delivering projects and IT solutions with over 20 years of working for some leading asset management companies. Interviewee Y is experienced in IT governance area who is certified professional over 14 years of experience and is leading IT service management teams across diverse industries. The last Interviewee Z is experienced in defining architecture, strategy and operating model for operations and technology with over 25 years of working experience.

#	Person	Organization	Function and knowledge	Date/time	Type of contact
1	Interviewee X	Case study 2	Program manager and Product Owner of automation tools (RPA, RAVN, ServiceNow) *(process knowledge)*	11 June 2019, 11:30 - 12:00	Personal Face to face
2	Interviewee Y	Privately held company that provides consulting services on technologies	Director in Governance and Innovation *(process knowledge*)	12 June 2019, 12:30 - 13:00	Skype video call
3	Interviewee Z	Case study 2	Head of Enterprise Architecture and Innovation (*process and technical knowledge)*	19 June 2019, 10:00 - 11:00	Personal Face to face

Table 17: Overview of evaluation interviews

The first draft of the model (*Figure 11*) presented in the previous chapter requires proper evaluation. The goal of the evaluation interview was to gain insights on whether the developed RPA governance model was clear to understand and consistent with or without a background in RPA. The interview protocol with the evaluation questions which were asked during the interview can be seen in *Appendix E*. Interviewees were asked to provide feedback on the model. Since it is a semi-structured interview, those questions serve as a guide and the actual interview may deviate a bit, but the interview was in the context of an established interview protocol. Unlike previous semi-structured interviews from case studies, evaluation interviews are not transcribed due to the fact that the last two interviews could not be recorded. Recording via Skype call crashed while exiting the application and technical issues with smartphone accordingly. However, the specific information and feedback from evaluation interviews were noted and taken into account.

The evaluation was only conducted with interviewees from case study 2, due to the limited time and accessibility of the interviewees. Therefore, the insights may not be as representative for the evaluation across other 3 case studies. However, considering the fact, it is still one parental company which follows same standards and RPA teams in the organization are aligned with each other, the adjustments made with the feedback from interviewees are assumed to be acceptable.

6.2 Evaluation results and final version of the RPA governance model

According to high-level requirements for the model, the responses from evaluation interviews were quite positive. From asking evaluation questions, it can be said that the developed RPA governance model is presented in an understandable and logical way. It fulfils coherence and comprehensibility requirements. The developed model provides general impressions on the RPA implementation in the organization. All interviewees said that the developed RPA model makes sense. Two interviewees (X, Z) mentioned the usability of the model as it follows a fairly standard process in the organization. It can be said that the model might be customized according to the development methodologies or extension of the key elements regarding to organizational perspective. However, it is difficult to change and restructure the main cycle to blocks, which changes the overall view of the RPA governance model completely.

However, the main limitations that have been discussed during the interviews were that the RPA governance model does not show communication, roles and responsibilities. Communication and roles are present in the model by just mentioning them in the blue box. The blue box's function where key elements are addressed were not too clear in the beginning. Moreover, interviewees (X, Z) mentioned that displaying the developed model could have been done in some other way, for instance, showing as blocks where the stages are presented. Interviewees gave feedback on how to improve the developed model which are described below.

Suggestions and feedback gathered from the evaluation interviews and informal communication.

Regarding the first step (incoming requests), Interviewee Y outlined that it is essential to have Request Management in place as reengineering is a part of the automation process. It is essential to keep track of all possible processes from the incoming requests to be automated for further reference, because in the future that processes could be automated with some another automation solution. Interviewee X makes another fair point, that sometimes incoming requests may not be appropriate for a software robot. Hence, this list of incoming requests needs to be assessed functionally first whether in fact the robot should be used in that particular situation. Similarly, another external feedback from informal communication (workshop by UIPath) was that sometimes when trying to automate an existing process, it could end up changing the business process fundamentally which is not aimed by RPA. Hence, it should be assessed if the existing process needs some changes by asking the question "Why are we doing it in this way and not in another?". Interviewee X pointed out that between prioritization and refinement of the item, there is decision-making step. This step is also related to what is the business value that the robot adds and is there actually a business case to put in a robot.

According to the realization parts, both interviewees (X, Y) said that there is always a degree of ongoing maintenance with the robots. As it has been already known the maintenance of the robot is an ongoing process, but it was a bit confusing to show it with the agile development. Maintenance is external, however, the team still needs to maintain the Minimum Viable Product (MVP) after implementation. Interviewee Z pointed out that two cycles in the Realization are not given a clear overview.

Concerning the evaluation part, what has also been mentioned by Interviewee Z is decommission of robots (so-called retirement of the robot) which might happen after the evaluation. The business takes a decision to shut down a particular robot or robotics process which has been identified to be outdated, redundant or no longer supported the business function.

According to the blue box (minimum components to be addressed in the RPA governance model) in the top left side, the suggestions were to put those components in order with some logical flow. Interviewee Y emphasized the importance of change management in RPA, and that it should not be focused just on IT changes on the robot level or other changes in the system but also more on aligning processes, technology and people together.

The model has modified accordingly with the use of the feedback obtained through the evaluation and demonstration phase. *Figure 12* presents the final version of the RPA governance model. The adjustments that were made are as follows:

- In the main cycle, refinement of the item has been elaborated more by streamlining the process. Moreover, the decision making phase has been added and combined with prioritization. Decommission (retirement) of the robot has been added to the evaluation phase connected with Business needs.
- The RPA implementation in the realization part has been adjusted. Instead of showing it with two cycles, the picture of agile methodology (sprints) has been added. As it has been already known, in agile methodology, the delivery of small functionality is always supported by review and continuous delivery. To make it more understandable, in the realization part, the phases have been shown in sequential order because agile can be considered as a waterfall approach presented in small iterative steps.
- The key components to be addressed in the RPA model have been extended and ordered in a logical way. The components with asterisks mean that those components apply everywhere. Risk management was moved to the external layer as a part of compliance.

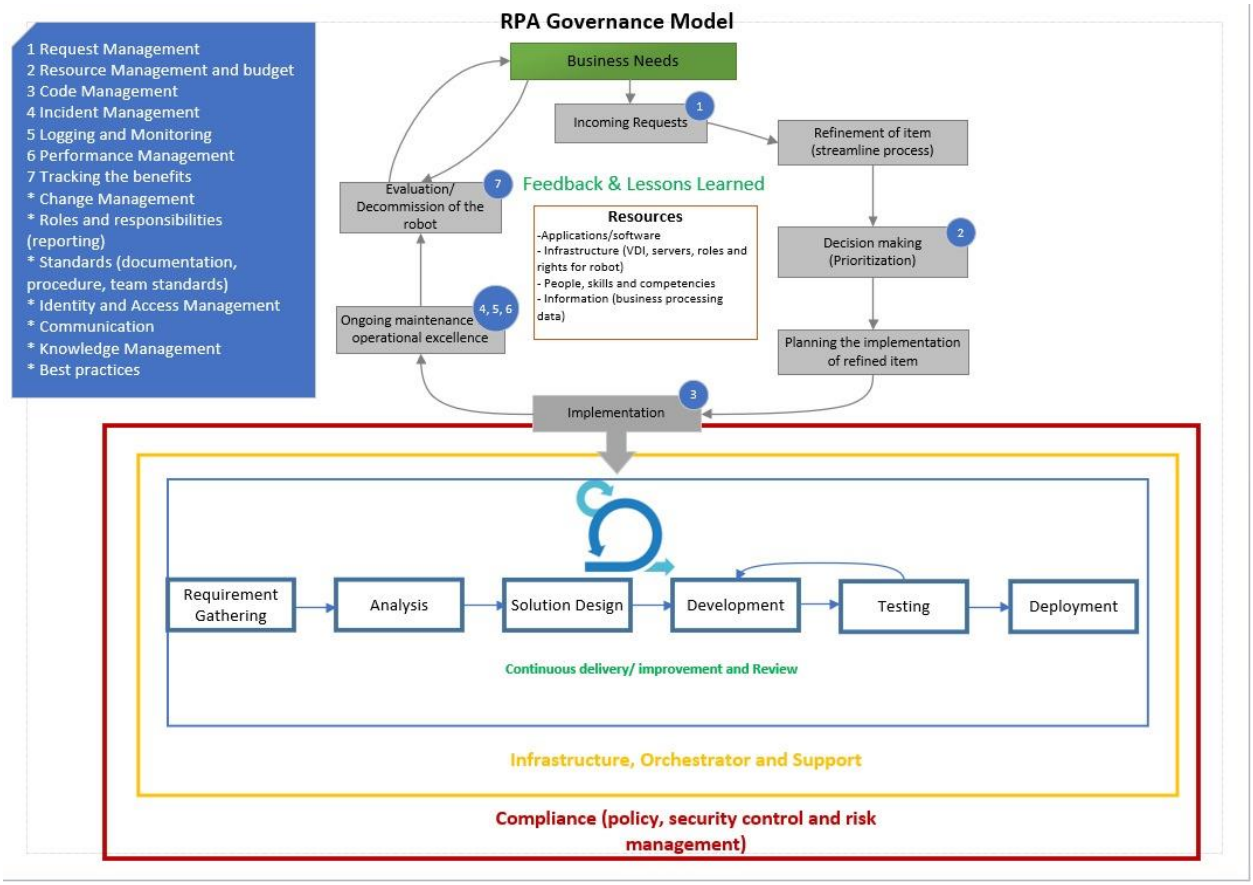


Figure 12: The final version of the developed RPA governance model

6.3 Conclusion: Demonstration and Evaluation

The RPA governance model have been demonstrated and evaluated via three interviews and informal communication. With the gathered feedback, the model has been adjusted accordingly and the final version of the developed RPA governance model is presented (See *Figure 12*).

Regarding strengths and weaknesses of the evaluation approach, it can be established that the strength of the evaluation approach via semi-structured interviews has given chance of getting deeper insights by having the feedback and opinions on how to improve the model. On the other hand, the low number of participants and the evidence that two interviewees are from one company leads to some weak picture of the evaluation. This has some implications to the developed final governance model, as some elements of the model have been adjusted according to the feedback given by interviewees. Moreover, two of the conducted interviews failed to provide a transcript as the proof of evidence which lowers the reliability of evaluation approach. However, the evidence is presented by showing the roles of interviewees and gathered feedback from them. To resolve the main implications of the demonstration and evaluation step, it is suggested to do another iteration with more interviewees.

On the subject of evaluation of the developed governance model, there are some strengths and weaknesses which need to be undertaken. The strengths of this model include, first the model has been found presentable in an understandable and logical way both for technology-oriented and business-oriented audiences. It has been found that the model can be used as it follows a standardized way of working in the organization. The listed key components can be used as a template and guidance for the new adaptors of RPA considering that this list can be extended and modified in accordance to the organization. The developed governance model can solve some problems which are listed as the requirements by applying elements to the model. On the other hand, the weakness of the developed model can listed as: the creativity of designing the model has been grasped from the COBIT 4.0 framework where layouts of the framework presented as a cycle, thus other ways of displaying the model have not been taken into account. For instance, using stages of different blocks for decision making has not been considered. Second, the developed model does not show roles and interaction between stakeholders involved in the RPA projects. Moreover, the listed key elements in the blue box may not be clear without the proper description from the first look.

7 Conclusions and discussions

This chapter presents the conclusions of the main research objective and the sub-research questions. The scientific and practical contributions will be highlighted in this chapter. The limitations of the research will be presented in *section 7.3* and recommendations for further work and the investigated case study in *section 7.4* accordingly. Lastly, this chapter ends with the reflection in regard to the link of MoT master programme and a personal reflection of the research.

7.1 Conclusions

The main objective of this thesis was to develop a model on how to govern RPA from an operational and management level. From the literature review, it found that little attention is given to the topic of "the governance of RPA" in the academic papers.

This thesis followed a design science research methodology adopted from Peffers et al. (2007) in order to achieve the main objective. By executing all steps of the DSRM, the main objective of the research is accomplished by presenting the developed RPA governance model. The RPA governance model based on the synthesis of the literature (RPA, IT and BPM governance) and the findings from the case study analysis. Considering RPA characteristics, it is assumed that RPA governance can be perceived as the combination of IT and BPM governance, which created the selection of those topic areas to construct the knowledge base.

To achieve the research objective of this thesis, the sub-research questions were formulated which supported the development and evaluation of the final RPA governance model. Six sub-research questions were introduced in *section 2.2.1* and answered during the research. A short recap of answers for the sub-research questions will now be presented.

SQ1 – What are the problems and challenges experienced in managing RPA?

The current academic literature has been discussed some problems and challenges associated with RPA. The problems and challenges in the literature mainly are an unclear division of roles, lack of user know-how about RPA, security issues, poor change management, lack of communication and not having proper documentation. The problems identified in the case studies are many. Some problems are similar to that found in the literature, such as lack of communication and security, but some problems were found only in the case studies, such as lack of warnings, lack of commitment, low-quality requirements and more. List of ongoing problems and challenges related to governing and managing RPA were presented (*Section 4.3, Table 14*). The analysis shows that they can be grouped into five categories: organizational, executional, technical, functional and human-behavioral. Based on the literature and the case studies, these problem categories are found essential and are used as requirements for the design of the RPA governance model.

SQ2 – How to manage RPA in terms of risk and failures?

From an operational management point of view, risks and failures related to the problems and challenges of RPA can be characterized into three main management practices. First, it is imperative to have more management controls for security and privacy issues. Checks are needed in the development process of

robots and continuous access of the software robots are to be monitored and checked. This is because data can be misused by the credentials attributed to the robots. Second, it is essential to anticipate the failure of robots, which can occur quite frequently — having an element of notifying dedicated individuals (e.g. notifications, alerts sent to the email) in case of for example interface changes, new business rules, or other exceptions to programmed robot's rules. To follow up notifications, it is important to have enough capacity for exception handling by a dedicated individual. Thirdly, proper logging ensures auditability, monitoring or ability to debug when robots stop to work. Dashboards can be created based on logging to monitor software robots and used for performance management of the bots. These established management practices can ensure stability in the operations of the software robots for the other companies who are trying to move on the wave of bots as a digital workforce.

SQ3 – What is the difference between managing RPA and managing IT applications?

It was found from the conducted interviews that RPA should be considered as a hybrid of worker and software. Software robots need to be governed by managing everything including scheduling them and control their interactions with other applications meaning that the software robots need oversight. This combination hybrid worker requires a different kind of management, policy and standards. The main distinguishing factors of managing RPA from IT applications divided into three categories: change management, access management and segregation of duties. First, with the managing software robots, not only requirements change over time, but also the changes in the process or incorporating changes in any applications which bots have access.

SQ4 – What are the high-level requirements for a comprehensive RPA governance model?

High-level requirements were established in order to be able to develop and evaluate the RPA governance model. High-level requirements such as consistence, modularity, usability, comprehensibility and flexibility were selected from qualities presented by Johannesson & Perjons (2014) in the literature. Moreover, other requirements have been derived in addition to high-level requirements by analyzing the problems and challenges in the Fishbone diagram in s*ection 4.3*, as can be seen in *Table 14*. These two lists of requirements combined, were used to design the developed RPA governance model from an operational management perspective.

SQ5 – What elements will be addressed in the RPA governance model?

The key elements for RPA governance model were established. First, key elements have been derived from the literature review. From the RPA literature, the implementation methodology to develop robots obtained. From the investigation of IT governance literature, IT governance mechanisms (*Appendix A*) have been investigated in where ITG process mechanisms was the focus for establishing elements. Second, more elements for governance model were derived from the constructed case study analysis via interviews in *Chapter 4*. Based on these findings, the base RPA governance model were developed, and the following elements are found important for the develop of the RPA governance model: security and control, infrastructure, risk management, change management, performance management, communication, compliance, roles and responsibilities, incident management, standards, documentation, resource management and RPA implementation methodology.

SQ6 – How well does the RPA governance model fulfil the defined high-level requirements?

Evaluation of the model is a last part of the design science methodology. In this study, evaluation interviews were conducted from 3 interviewees and feedback from informal communication helped to finalize the model. The final RPA governance model was presented in *Figure 12*. From the evaluation, the developed RPA governance model has been found understandable and presentable in a logical way. It follows a standardized way of working in the organization. The developed RPA governance model solves some of the problems of managing software bots by established process mechanisms and key components to ensure consistency in RPA projects. However, there are some shortcomings of the developed RPA governance model. Some elements are presented such as roles and responsibilities, communication and change management, but the interaction between the elements are not all clarified in the model.

Conclusion

The developed RPA governance model is found to be a combination of IT governance and BPM governance aspects. Based on insights gained during the research, it can be concluded that current IT and BPM governance models individually are not suitable for the RPA governance model due to the following reasons discussed below.

Using literature from IT governance, the RPA governance model has elements of an IT infrastructure, support services, code management, incident management and more in order to support implementation, maintenance and management of software robots. From the process management perspective, elements such as communication, people change management, assigning responsibilities, assess and control mechanisms for process and other are adopted from relevant concepts of BPM governance.

The insights gained from this research have showed that RPA management is more than just traditional software development. While the associated management processes fit within known IT management and governance processes (e.g. COBIT framework), the developed RPA governance model shows that this is only useful for the management of the lifecycle of RPA development. The developed RPA governance model also accounts for process modeling and process improvement for automation, which known IT management and governance processes model lacks. Moreover, there are managerial implications from the nature of RPA characteristics which might not be noticed from the first look to the developed RPA governance model. Firstly, the process to be automated needs to be streamlined (process identification, assessment and prioritization) before the implementation. Secondly, the deployed robots need oversight (scheduling by assigning tasks, continuous maintenance and support) and the need of applying more controls for security risks and vulnerability for failures.

7.2 Scientific and practical contribution

This research contributes to scientific literature and provides practical contribution.

At the moment, researches on RPA governance are a novel research area. In the literature review, it was recognized that there is barely any academic literature found regarding the topic of RPA governance. In **scientific contribution,** this thesis can be considered among the first studies which will be contributing to the existing RPA governance literature in the form of creating a RPA governance model. The scientific contribution of this thesis is mainly the developed RPA governance model which was based on combination of IT and BPM governance elements and insights gained from empirical research. It was concluded that the investigated current IT and BPM governance models individually from the literature do not fulfill the key elements for the RPA governance model. However, this conclusion still should be verified with the follow-up studies on top of this research, so more conclusions can be drawn. The conducted interviews were a valuable addition in gaining up-to date knowledge to the rapidly evolving RPA field. As RPA is using in accelerate rate, the thesis also creates an awareness of conducting research on RPA and its governance to the scientific community. Besides, the empirical study analysis contributes to the enrichment literature on RPA by enlisting the problems and challenges of governing and managing RPA. Moreover, for other researchers, the thesis may function as a reference point to grasp and create new insights regarding RPA. There is still a lot of space within the RPA governance topic to investigate for the next researchers which would enhance this research area.

In **practical contribution**, this thesis provided an overview of comparative case study analysis in the financial services company by providing current situation and practices of governing processes for software robots. Hence, this thesis provides valuable practical knowledge. The developed final deliverable (the RPA governance model) establishes the components and steps for building and managing software robots practically. Another outcome of this thesis is that even if most of the large organizations have already been employing robots, the research provides guidelines in the form of a model for enterprise-grade RPA implementation and adaptation. More broadly, the designed final deliverable of this study defines a model for governance, implementation, operation and maintenance of RPA projects. Due to that life cycle of governing and managing RPA are shown in one page and thus this research can also be beneficial to any organization who intended to implement RPA. Similarly, to the scientific contribution of this thesis, the organization can use and enhance the developed RPA governance model in order to provide a better model and new insights in the future.

7.3 Limitations

As with any other research, this thesis has limitations which should be considered. In this section, these limitations of this research are explained.

One group of limitations refer to the external validity of the findings. The main limitation of the study is related to the extent to which the results can be generalized.

The research findings are drawn from a large organization in a single financial industry, although this large organization consists of different business units and four cases have been investigated. The general applicability of the developed RPA governance model should be further investigated to other types of organizations and industries. Even, the developed RPA governance model is consisted of generic processes and elements understandable in white-collar environments, it has not been validated with real-life cases for its usability and applicability. It is also important to point out that there is no single ideal governance model which would always suit all organizations. This research does not take a stand that the

developed model is best suited for the governing of software robotics. Due to that the appropriate level of details that need to be conveyed to design and develop the model is differentiated. However, the key components and implementation methodologies that are commonly used in the business and literature were applied.

The second group of limitations refer to the literature review which focused on three different areas (RPA, IT governance and BPM governance). As the IT governance and BPM governance area have a large knowledge and scientific basis, it has been only used the high-level concepts, which is mainly expressed in a minimal form of elements and mechanisms from the governance topic. The more focus was in IT governance literature due to that BPM governance covers a broader scope where different software solutions, methods and techniques are used as a toolset for managing organizational processes.

Another group of limitations refer to the conducted interviews and more on how it could have performed differently in order to improve the quality of research.

For constructing the case study, analysis and developing the model, there were eight respondents from the entire organization where two respondents were interviewed per business unit which gives some reliability of the data. As those interviewees have aligned with each other, their responses gave the consistency supporting the reliability and internal validity of the findings. However, not all the role of key stakeholders involved in RPA projects were covered in this thesis. There was no representative interviewed from security, risk and process owners. Nevertheless, the findings and results have found to be acceptable for this type of research as the selected interviewees had direct involvement in the RPA projects and have knowledge about managing software robots. The interviewees were able to explain the roles and involvement of other stakeholders. Even so, it would have been valuable to interview process owners and SMEs, as this could provide more insight from their (end-user) perspective. Moreover, the requirements for developing and designing the RPA governance model might be derived or validated with the involvement of key stakeholders.

Evaluation of the model can be questioned as to the low number of interviewees which paints a weak picture of the evaluation. Two interviewees for evaluation were from one business unit of the parental company, so the evaluation has not been distributed across the different case studies. Moreover, with various feedback from different individuals might have another impact and adjustments on the final model. For instance, interviewing process owners could provide feedback on the applicability of the designed model from the end-user perspective of software robots. Moreover, even having the evaluation interviews, the designed model has not been validated by RPA experts or showed the actual working evidence. This affects the validity of the evaluation results. Therefore, the evaluation must be accompanied by future researchers in a larger population of experts and more iteration rounds of evaluation. Besides, it has to be noted that the conducted interviews were transcribed as evidence, but the interviewees were not asked to double-check the provided information. The interviews supported with confirmed evidence would increase the quality of the thesis.

Although this section presents limitations, this research has become a step into a RPA governance research field by combining IT governance and BPM governance areas together which creates a new insight for science and practice. Moreover, the developed RPA governance model still can offer a reference model on how to proceed with RPA management for practitioners.

7.4 Recommendations

In this section, the recommendations will be given for potential future research and then for the analyzed case study. These recommendations are extracted from limitations and findings from the case study analysis.

7.4.1 Recommendations for further research

For further research, more extensive research is needed to fully design the governance model for managing RPA in large organizations.

Firstly, the designed RPA governance model should be applied and tested in real-life cases for its effectiveness and usability. The theoretical knowledge gained from the developed RPA governance should be investigated further.

Secondly, as the designed artefact focused more on the operational and management level, further research from a strategic (executive) level could make a more significant contribution in improving the RPA governance model. The high-level requirements for the developed RPA governance model were not composed with the involvement of any RPA stakeholders. It would be nice to validate them with experts involved in the Governance and RPA knowledge domain.

More broadly, scientists could not just focus on RPA, but in general on the process automation landscape at an organizational level. It has been observed that integrating several automation tools can create a multiplier effect and lead to end-to-end automated services, thus for further research focusing on the bigger picture of automation can be suggested. Especially when the integration of RPA with other cognitive solutions and computer vision capabilities are accelerating.

7.4.2 Recommendations to the case study company

From the case study analysis, it was observed that the current RPA governance structure in the organization is well aligned. The advantage of the decentralized governance structure between different business units is sharing knowledge and experience. However, there are some recommendations which could be taken into account.

Firstly, the organization should work on the strategic solution of implementing robots as service automation solution. Thinking of the RPA as a tactical solution could involve the risk of missing the value and potential of RPA. As there are already more than 50 robots involving hundreds of different processes, it is no longer a tactical solution. The researcher suggests seeing RPA (automation in broader scope) as an enabler of a broader enterprise-wide strategy by pushing and driving it forward from the executive level. This top-down approach will allow better business strategies, more resources invested and produce value. The strategy formulated to RPA projects from the group level for all business units might lead to utilize experiences faster.

Secondly, to produce a value and see benefits, the organization should apply performance metrics in order to measure the business value and impact of the implementation of RPA after delivery. Even for the organization, it might be helpful to track what kind of business value RPA delivered in terms of financial, operational and strategic value.

Thirdly, to expand RPA across the enterprise and scale up quickly, a number of practices that just have been started in the organization such as reusing components of RPA robots and sharing it between RPA teams from different business units should be extended. It is essential to continue to integrate different automation efforts and initiatives to automate services end-to-end.

7.5 Reflection

This section presents the thesis relevance with Management of Technology program and a personal reflection in *section 7.5.2.*

7.5.1 MoT curriculum alignment

The master thesis corresponds to the Master of Science study followed by Management of Technology (MoT) program at Delft University of Technology. The MOT program is based on the premise that industries need professionals who are familiar with both technology and management practices more and more. The MoT curriculum is a study of how technology can be used to manage and leverage the processes in organizations. As organizations struggle to manage emerging technologies, compliance with the master's program is expressed in investigating the governance of the RPA from an operational and management perspective. The multidisciplinary aspects of this thesis which includes technical and organizational analysis perfectly illustrate the type of study that the MOT alumni should demonstrate. Moreover, the study addresses various courses studied in the MOT curriculum such as Research Methodology, Business Process Management and ICT management specialization courses (e.g. I and C Architecture Design, I and C Services Design and Digital Business). Even, we had only one quarter to master these subjects, in general, the knowledge gained from each of the courses have been set the basis for the research. Thus, it can be said that this research reflected the knowledge and values provided by the curriculum of the Management of Technology program.

7.5.2 Personal reflection of the research

To reflect on the more personal experience and time spent on the research, I learned how to conduct a qualitative study and analyze it in an individual manner. By looking back, I can say that interviews could be done in a better way and organized differently. As the conducted interviews were focused more on constructing case study and management of RPA, some concepts of governance part could be clarified with interviewees. It has been quite challenging the writing part of the thesis. Especially, making everything consistent and structure the research by integrating all of the pieces of work in one flow . Moreover, balance the design and knowledge base have found difficult. For instance, the developed RPA governance model I had some difficulties in assessing and applying the appropriate level of details to the developed RPA governance model (to make it high level or too detailed), which then will be hard to generalize. Taking into account that RPA governance model is context dependent and perhaps should be adjusted depending for each company. However, the conducted single embedded case study and the developed model are already some result of my learning and experience.

Besides, I learned a lot about the RPA and governance topic. Even the governance part is still a bit of a black box as it can be interpreted in a different way and level. I participated in the workshop provided by UIPath Academy in Amsterdam on the 20th of June and built a robot for the first time. The workshop consisted of building two robotic processes (data entry and data extraction). Both lessons of building robots

showed an overview of RPA challenge which I have studied during this research. It was related to the issues that appeared when the interface and environment are changing. Consequently, the software robot could not enter or get data. Overall, the workshop gave the foundations and feelings about the use and potential of software bots. Despite the massive hype around RPA, cognitive automation and AI, I see that it is becoming more real and impactful within the organizations. Therefore, I believe that the research helps to get some light into an RPA governance topic and contribute from a theoretical and practical perspective.

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Appendices

Appendix A: IT Governance Mechanisms with definition

	Name	Definition	Reference
Structures	Integration of governance/alignment tasks in roles and responsibilities	Documented roles and responsibilities including governance/alignment tasks for business and IT	Duffy, 2002; ITGI, 2003; Weill & Ross, 2004; De Haes & Van Grembergen, 2006
	IT organization structure	Structure how the IT function is organized and where the IT decision-making authority is located	De Haes and Van Grembergen 2004; Lunardi et al., 2009; Weill and Ross, 2004
	IT steering committee(s)	A committee at executive or senior management level responsible for determining business priorities and evaluating IT investments	ITGI, 2003; Luftman & Brier, 1999; Weill & Ross, 2004; De Haes & Van Grembergen, 2006
	IT strategy committee	Committee operated at the board level ensuring that IT is regular item on the board's agenda	ITGI, 2003; Nolan & McFarlan, 2005; De Haes & Van Grembergen, 2006
	CIO on Board	CIO is a full member of the executive committee	Peterson, 2004; Van Grembergen and De Haes, 2009; Weill and Ross, 2004
	CIO on Executive Committee/CIO reporting to CEO and/or COO	CIO can directly report to the CEO and/or COO	ITGI, 2003; Weill & Ross, 2004
	Architecture steering committee	A committee from business and IT professionals who provide architecture guidelines and advice	Broadbent and Weill, 2003; Van Grembergen and De Haes, 2009; Weill and Ross, 2004
	Security/Compliance/Risk Officer	A function responsible for security, compliance and/or risk	De Haes & Van Grembergen, 2009
Processes	IT performance measurement(Balanced Scorecard)	IT performance measurement in domains of corporate contribution, user orientation, operational excellence and future orientation	Kaplan & Norton, 1992; Van Der Zee and De Jong, 1999; De Haes & Van Grembergen, 2009
	Strategic Information System Planning	Process of aligning IT with business strategy, directing management of IT resources and developing technology policies	Earl, 1993; Rockart, 1979; Hammer & Champy, 1993; De Haes & Van Grembergen, 2006
	IT Governance frameworks (COBIT, ITIL,COSO/ERM)	Process based IT governance and internal/external control framework	ITGI, 2006; De Haes& Van Grembergen, 2006
	Portfolio Management	Prioritization process for IT investments and projects in which business and IT Is involved (including business cases, information economics, ROI, payback)	Parker et al., 1998; De Haes& Van Grembergen, 2006

	Service Level Agreements (SLA)	A formal contract between business and IT about IT operations or IT development projects	Weill&Ross, 2004; Van Grembergen et al., 2003; De Haes&Van Grembergen, 2006
	ITG Maturity Levels (IT governance assurance and self-assessment)	A self-diagnosing tool that assess ITG effectiveness and to identify opportunities for improvement	ITGI, 2003; Peterson, 2004
	IT budget control and reporting	Processes of monitoring and reporting on the budget of IT investments and projects	Van Grembergen and De Haes, 2009
	Chargeback arrangements	Mechanism for allocating IT costs to business units to enable an understanding of the total cost of ownership	Weill&Ross, 2004; De Haes& Van Grembergen, 2006
	Project Governance/ Management Methodologies	Methodologies and processes to govern and manage IT projects	Van Grembergen and De Haes, 2009
Relational mechanisms	Partnership rewards and incentives	Offering financial rewards and promotions to employees who help company achieve performance goals	De Haes & Van Grembergen, 2009
	IT governance awareness campaigns	Campaigns to explain to business and IT professionals the need for ITG	De Haes & Van Grembergen, 2009
	Knowledge management(on IT governance)	Systems for sharing and disseminating knowledge about the structure of ITG, responsibilities, tasks, etc.	Weill & Ross, 2004; Luftman, 2000; Reich & Benbasat, 2000; De Haes &Van Grembergen, 2006
	Job-rotation	IT people working in the business units and business people working in IT	Luftman, 2000; Reich & Benbasat, 2000; De Haes & Van Grembergen, 2006
	Co-location	The physical location of business people and IT professionals are close to each other	Luftman, 2000; Reich & Benbasat, 2000; De Haes & Van Grembergen, 2006
	Cross-training	Training of business people in IT and / or training of IT professionals in business	Luftman, 2000; Reich & Benbasat, 2000; De Haes & Van Grembergen, 2006
	IT leadership	The ability of a CIO or a similar role to formulate a vision of the role of IT in a company and to ensure a clear understanding of this vision by managers	Monnoyer & Willmott, 2005; Smith, 2006

Table 18: IT Governance Mechanisms with definition. Adapted from (De Haes & Van Grembergen, 2009) and (Almeida et al., 2013)

Appendix B: List of interviews

#	Business Unit	Person	Function and knowledge	Date/time	Type of contact
1	Case study 1	Interviewee 1A	Manager RPA *(process knowledge)*	16 April 2019, 10:00-11:00	Personal Face to face
2	Case study 1	Interviewee 1B	Lead Developer *(technical knowledge)*	4 June 2019, 15:00 - 16:00	Personal Face to face
3	Case study 2	Interviewee 2A	Business Analyst *(process knowledge)*	27 February 2019, 16:00-17:00	Personal Face to face
4	Case study 2	Interviewee 2B	Head of RPA *(process knowledge)*	21 May 2019 16:00 - 17:00	Personal Face to face
5	Case study 3	Interviewee 3A	DevOps engineer *(process and technical knowledge)*	30 April 2019, 11:00-12:00	Personal Face to face
6	Case study 3	Interviewee 3B	Product Owner *(process knowledge)*	17 May 2019, 11:00-12:00	Personal Face to face
7	Case study 4	Interviewee 4A	Business Analyst *(process knowledge)*	30 April 2019, 09:30-10:30	Personal Face to face
8	Case study 4	Interviewee 4B	Business Analyst and Developer *(process and technical knowledge)*	23 May 2019, 15:00 - 16:00	Personal Face to face

Table 19: Overview of the conducted interviews

Appendix C: Interview protocol

The following general set-up was used to ask interview questions. Since the interview is semi-structured, the real question asked by respondents may vary depending on the flow of the interview, but it will still comply with the protocol.

1. Introduction

a. Interviewer introduce herself
b. Research background and goal of the interview session are introduced
c. Ask for consent on recording the interview and start recording the interview

2. Personal: The questions concerning the role and responsibilities of the professional within the organization.

- Could you briefly describe your position in the company? Role and responsibilities?
- How long have you been involved in the activities regarding to RPA project?
- Could you tell more about the RPA team?
- In what kind of RPA implementations have you been involved?
- At which stage of RPA journey the company is currently at?

3. RPA team and robots description: These types of questions provide us with an ability to construct case description and understand the way of working in a team and the type of implemented robots in the company. As there were 2 interviewees from one RPA team, the first interviewee was used to construct case description, and the second one was used to validate and get more details.

- How does the organizational structure of the team and collaboration look like?
- Offshore RPA team? Effects of that?

4. Managing robots: The questions to understand the process of managing robots and the life cycle in the case studies. Moreover, these types of questions provide understand the roles and responsibilities in developing robots.

- How do you manage software robots?
    - Control report
    - Performance indicators
    - Risks
    - Standards and policies
    - Governance processes
    - The main stakeholders. Authorities and roles (Who decide and prioritize?)
    - How is the communication between them look like?

5. Challenges and problems in RPA journey: It were identified different problems and challenges. These types of questions can confirm the aforementioned challenges in practice.

- What challenges and problems arise in RPA implementation?

6. Governance in RPA

- What is the difference between managing RPA governance from software applications?
- What will be addressed in the RPA governance model?
- Is applied governance in the organization effective?

7. Lesson learned and opinions to highlight

- What are the lessons learnt? The best practices of RPA governance?
- Do you have other remarks and opinions that you would like to highlight?

8. Presentation of Draft or Ideas for model (only applied for few interviewees after the first scratch was designed)

9. Closing the Interview

Appendix D: Internal documents

Some internal documents relating to the organization and its structure, way of working have been carefully analyzed which has been investigated in organization intranet. It helped to understand how the organization works and fulfil the research as a secondary resource to support. See the table below for a review of internal documents.

Name	Description	Type of document	Year
Agile Language and Agile Learning Road	A practical introduction of working Agile in the organization including the essence and need of Agile approach, introduction to frameworks such as Scrum, Lean and Kanban.	Internal Document	2019
Portfolio Process	One page document of visualization of the portfolio process steps(9) starting with strategic schemes to the implementation.	Internal Document	2019
Organizational Structure	Overview of organizational structure including business units and support functions presented in charts	Internal Document	2019
Governance Manual	The document describes the key structures, organization and operating principles of organization. It also contains integrated control framework and operating model.	Internal Document	2018

Table 20: Overview of internal documents

Appendix E: Evaluation interview protocol

The following general set-up was used to ask interview questions. Since the interview is semi-structured, the real question asked by respondents may vary depending on the flow of the interview, but it will still comply with the protocol.

1. Introduction

a. Interviewer introduce herself
b. Research background and goal of the interview are introduced
c. Ask for consent on recording the interview and start recording the interview

2. Personal background of interviewee

- Could you briefly describe your position in the company? Role and responsibilities?
- How long have you been involved in the activities regarding to (IT Governance, management)?
- Is the RPA implemented in your organization?
- If yes, is there an RPA governance model in your organization?

3. Expectations

- What do you expect from RPA governance model?
- Which issues does the RPA governance model solve in your opinion?

4. Show the model

5. The developed model evaluation questions

- Is the presented model logical and consistent?
- Can you understand the model?
- Do I miss certain components?
- Do you think that certain elements are relevant/overlapping?
- Will you use the model? Why?
- What are the benefits of the model?
- What are the limitations and weaknesses?
- Do you have suggestions regarding framework?

6. Closing Interview