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Design of a model for assessing accountability in a robotic process automation implementation
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Design of a model for assessing accountability in a robotic process automation system

Master thesis submitted to Delft University of Technology in partial fulfilment of the requirements for the degree of

MASTER OF SCIENCE

in Management of Technology

Faculty of Technology, Policy and Management

by

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To be defended in public on September 26th 2018

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Acknowledgements

I started thinking about this master thesis in Beijing while doing an exchange at Tsinghua University. In November 2017, I found there was an open position at KPMG to do an internship and write my thesis about robotics. I was seduced from the first moment as the field sounded very appealing to me. The lack of academic research and the novelty of the technology made robotics process automation an excellent topic for my research.

I thought about different topics and ideas for six months before officially starting working on it at the beginning of April. I started with many ideas but no precise topic to research about. After the first contact with the job, I realised most of my ideas were not feasible with the knowledge available. I narrowed it down, and after consulting with several people, I kicked off my thesis. I want to dedicate some words to the different individuals that have helped me along the way.

I would like to thank Professor Marijn Janssen for his support and guidance during the development of this thesis. He gave a lot of information and ideas that allowed me to find a direction to follow at the beginning of my research and supported me with insights, expertise and literature to consult. Thank you for the time invested in meetings and reviewing my work. I would also like to thank Professor Laurens Rook for being my second supervisor and for giving valuable feedback.

I give thanks to everyone at KPMG that have assisted me during the internship. Especially to Nathalie Duijvesteijn and Tessa Snels for being my KPMG supervisors, offering to meet whenever I needed it and helped me connect and gather information from different sources. Thank you for the time spent reading my thesis and giving me valuable feedback. I also want to extend my gratitude to everyone that has collaborated in the research: Koen van Raan, Pepijn van Eck and Robbert Sweijen.

I want to send a big thanks to my family. You have given me the chance to study my master in Delft, and you have supported my decisions and believed in me. Finally, I want to thank Lois for being always there and cheering me up when pressure and doubts were making me stressed. Without all of you, everything would have been way harder.
Executive summary

Artificial intelligence is getting more and more advanced. In the future, robots equipped with AI will behave an act similarly as humans do, and this raises concerns about how they are going to be governed. However, scientists are alerting that not enough attention is paid to AI from a sociotechnical point of view. Intelligent systems can already behave in unexpected ways, make unfair decisions or treat data with bias. The consequences of this behaviour can directly harm humans, and researchers agree that much more research should be done.

One of the applications of AI is combining it with Robotic Automation Solutions. RAS is a form of business process automation that combines both AI and software robots. The simplest application of RAS is known as Robotic Process Automation. RPA is the application of technology that allows employees in a company to configure computer software or a “robot” to capture and interpret existing applications for processing a transaction, manipulating data, triggering responses and communicating with other digital systems” (IRPAAI, 2013). RPA is used to automate end-to-end processes in different areas such as human resources, procurement or finance in a fast and reliable way.

More complex RAS solutions are not yet mature enough to be implemented widely. However, research shows that they may be mainstream in less than five years. This research will focus on RPA to be prepared for the more advanced solutions in the future.

Because of the newness of RPA and the multiple challenges currently not solved, it has been neglected the need to have a proper scientific methodology to model an RPA implementation. The objective of this thesis is to develop a model that allows to analyse the roles involved in an implementation of an RPA project and to assess the accountability of the roles involved.

The challenge is highly relevant because the relationship between roles is very complex and hard to model. Furthermore, there is uncertainty during the implementation about assigning responsibility. The purpose of the model is to have a clear understanding of who is responsible for what so people can be held accountable. Having an artefact (model) that facilitates this identification can help reduce the wrongdoings and speed up the implementations.

A scientific research framework approach is followed to develop the model. After the discussion of several frameworks, Action Design Research, a scientific research framework to develop IT
artefacts, has been selected. The phases that it includes are \textit{problem formulation; building, intervention and evaluation; reflection of learning} and \textit{formalization of learning}. The main characteristic of the methodology is that it is highly iterative and allows to modify the artefact as much as needed with new data and insights collected from using it. Action Design Research focuses on creating a \textit{theory-ingrained artefact} with the combination of \textit{practice-inspired research}.

A literature review regarding the fields of business process architecture, accountability and Robotic Process automation has been done. These insights have helped to extract theory and apply it to create the model. The practice-inspired research arises from the hypothesis of the need for a better way to assess accountability in an RPA implementation. This belief has been verified with interviews with KPMG expert RPA consultants. These interviews have also been used to iterate the model, improve it with feedback and gain new insights regarding AI and RPA.

The model is formed of four main phases. (1) \textit{requirements and analysis}, (2) \textit{development}, (3) \textit{testing} and (4) \textit{deployment and governance}. Each of these phases comprises different activities. The activities always have two roles assigned; a requestor and an executor. These roles have also been identified, and their responsibilities explained. Special attention has been paid to the accountability relationship between both roles in each activity. The research also covers a discussion of the types of accountability seen in the case studies.

Finally, the research also contributes to the views on how RPA would change with the increase and improvement of AI technologies. An analysis on how the model would change if AI becomes very advanced is introduced. Besides, in the \textit{formalization of learning} phase, segregation of duties and the effect on accountability is discussed together with how to manage external stakeholders.

The practical contribution of the research has been (i) the creation of an IT artefact to assist and facilitate the implementation of RPA projects by detecting the activities and roles required, (ii) a methodology to identify and assess accountability relationships depending on the characteristics of the roles and activities involved and (iii) a discussion on how AI may evolve in the future and, more specifically, how the IT artefact will have to be modified to cope with it. The theoretical contributions have been (i) the implementation of the Action-Based Design methodology to create a model, (ii) an increase of the existing literature and knowledge about RPA and (iii) the use of
the Action Design Research methodology instead of a more conventional Design Science Research approach.

Recommendations for KPMG and further research are drawn at the end of the research. The section suggests improvements to create more valid and reliable research by acknowledging the limitations presented. Besides, suggestions on how KPMG can improve its practice with the outcomes of the research is laid out. The document ends with a personal note from the author.

Keywords: Robotic Process Automation, accountability, Action-Based Design model, Design Science Research
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## Abbreviations

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<tbody>
<tr>
<td>ABD</td>
<td>Action-Based Design</td>
</tr>
<tr>
<td>AGI</td>
<td>Artificial General Intelligence</td>
</tr>
<tr>
<td>AI</td>
<td>Artificial Intelligence</td>
</tr>
<tr>
<td>ANI</td>
<td>Artificial Narrow Intelligence</td>
</tr>
<tr>
<td>ARD</td>
<td>Action Research Design</td>
</tr>
<tr>
<td>ASI</td>
<td>Artificial Super Intelligence</td>
</tr>
<tr>
<td>BIE</td>
<td>Building, Intervention and Evaluation</td>
</tr>
<tr>
<td>DSR</td>
<td>Design Science Research</td>
</tr>
<tr>
<td>ERP</td>
<td>External Resource Planner</td>
</tr>
<tr>
<td>IS</td>
<td>Information Systems</td>
</tr>
<tr>
<td>IT</td>
<td>Information Technology</td>
</tr>
<tr>
<td>KPMG</td>
<td>Klynveld Peat Marwick Goerdeler</td>
</tr>
<tr>
<td>NV</td>
<td>Naamloze Vennootschap (Public Company in Dutch)</td>
</tr>
<tr>
<td>OE</td>
<td>Operations Excellence</td>
</tr>
<tr>
<td>RAS</td>
<td>Robotic Automatic Solutions</td>
</tr>
<tr>
<td>RPA</td>
<td>Robotic Process Automation</td>
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<td>UAT</td>
<td>User Acceptance Test</td>
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1. Introduction

Automation of the workforce is on the rise in almost all the countries in the world. According to McKinsey Global Institute, 60% of jobs have more than 30% of activities that are technically automatable with the technologies already available (Manyika et al., 2017). However, the implementation of automation systems is not smooth (Muppidathi, Gupta, & Hariharan, 2017). Several companies help deploying an automated process. One of these companies is KPMG. KPMG is a professional service provider focused in advisory, tax and audit. In the unit of advisory services, there is a specific sub-group specialised on Operations Excellence (OE). OE focuses on “helping clients drive not only cost savings that can be seen in the bottom line, but improve business value, mitigate risks and create transparency (KPMG Advisory N.V., 2017)”

One of the areas of expertise of the OE unit is Robotic Automation Solutions (RAS) implementations. RAS is a form of business process automation that combines Artificial Intelligence and software robots. RAS is composed of three sub-categories of robotics: basic process automation or Robotic Process Automation (RPA), enhanced process automation and cognitive automation (Atroley, Tuteja, & Kalpana, 2016).

In Figure 1, the different types of robotic automation solutions are presented. In the first column, basic process automation that addresses significant volume and transactional work activities that are rule-based and repetitive. In the second column, enhanced process automation that allows to recognise unstructured data and adapts it to the business environment. It learns from the data processed to improve future responses using machine learning, which is “the application of computer science to optimise a performance criterion using example data or past experience”. Machine learning is needed where code cannot be written to solve a given problem because data and experience are necessary to solve it (Alpaydin, 2014). In the final column, cognitive automation that helps to make decisions using advanced algorithms that simulate humans’ thinking and learning processes. Technologies such as natural language processing, artificial intelligence and big data analysis support cognitive automation. Artificial Intelligence is defined as “the imitation of cognitive functions associated by individuals with other human minds, such as learning and problem-solving” (Russell & Norvig, 2010). Natural language processing is a sub-area of artificial intelligence, and it is defined as “a theoretically motivated range of computational techniques for analysing and representing naturally occurring texts at one or more levels of
linguistic analysis for achieving human-like language processing for a range of tasks or applications (Liddy et al., 2003).

![Distinction between basic, enhanced and cognitive RPA](image)

**Figure 1: distinction between basic, enhanced and cognitive RPA (copied from Atroley et al., 2016)**

RAS automation is already having a meaningful impact on society and producing essential changes in the way we work. For instance, RPA is being used in customer centres to automate the rule-based enquiries from customers. For instance, enhanced automation is used by banks to detect behaviour pattern to detect fraudulent payment activities. For instance, cognitive automation is used by crop insurance providers by using AI and drones to evaluate crop health from the sky and assess claims with precision (Hamid & Castaño, 2017).

In section 1.1 of this first chapter, the problem to be studied will be covered. After the problem introduction, the scope of the research and the objective of this thesis will be discussed in section 1.2. Section 1.3 will introduce an outline of this research thesis, so it is easier to follow and read.

### 1.1 Problem statement

Research from Forrester found that “today’s integrations with AI to support RPA processing were rare, with a few exceptions” (Forrester Research, 2017). As defined by the Institute for Robotic Process Automation and Artificial Intelligence, RPA is “the application of technology that allows
employees in a company to configure computer software or a “robot” to capture and interpret existing applications for processing a transaction, manipulating data, triggering responses and communicating with other digital systems” (IRPAI, 2013). The term system will be used in this thesis as “the structure in which human participants and/or machines (robots) perform work (processes and activities) using information, technology, and other resources to produce informational products and/or services for internal or external customers” (Alter, 2008).

However, the fact that currently the main implementations are based on RPA does not mean that the future should be ignored. Globally, RPA is getting more advanced and evolving towards more enhanced and cognitive uses. RPA may integrate with other technologies such as cloud services or interconnection of multiple devices (also known as the Internet of Things) are going to be available. In the future, AI will play a more important role than now (Ostdick, 2017). Instead of supporting in the decision making or automating rule-based processes, the robot will be able to make decisions imitating humans reasoning. In the same research by Forrester, it is stated that “AI will start to have a material effect in 2018 and start to scale in 2020” (Forrester Research, 2017).

Several papers explore the problems to be tackled in the field of AI, but most of them do not provide answers. AI is understood as a collection of software and algorithms, and Rob Kitchin argues that “there has been limited critical attention paid in algorithms in contrast to the vast literature that approaches algorithms from a more technical perspective” (Kitchin, 2017). Robots equipped with AI will behave an act similarly as humans do, and this fact raises concerns about the accountability assessments they will deserve. There is a lot of debate on how to deal with AI entities from the juridical point of view. For example, (Doshi-Velez et al., 2017) argues about the importance of getting the right level of explanatory requirements of AI. Too much attention and the developments towards AI may be hampered. Too little attention and AI systems would have a free pass from scrutiny and compliance. Intelligent systems can make unfair decisions, increase biases, and behave in unexpected ways that can directly harm humans. Researchers agree that much more research has to be done regarding AI from a sociotechnical point of view. For instance, what does it mean to act responsibly and being transparent about algorithms? (Diakopoulos, 2016). Research in the field of AI, and especially about accountability, is relevant as it raises the visibility of the situation and provides clarity on how to proceed. Thus, researching about RAS is relevant now, though not because of the effect in the present, but because of the relevance in the future.
Doing this type of research allows the community to be more knowledgeable and more prepared to tackle forthcoming challenges.

KPMG offers assistance during the whole process of RAS implementation. This includes from the early decision of what processes can be automated to the final maintenance and use of the systems. Being involved in the whole process of implementation of a RAS system presents several challenges and opportunities. For example, questions that can frequently be raised are the following. What technology vendor should be selected for the implementation? What type of RAS is more adequate for the process to be solved? How are the people that have been displaced by automation managed? How can be ensured that the governance of the system grants a proper reaction in case of malfunction?

For instance, recently, a robot named Sophia has been granted citizenship in Saudi Arabia (Stone, 2017). This event has raised a lot of debates and discussion about what this means and if this is the way humanity should go. However, it has also raised awareness that a lot still has to be done to ensure a solid and robust way to assess accountability. Is the solution to consider robots as human entities to blame them when something goes wrong? Or this is just a shield for manufacturers, engineers or developers to never be held accountable?

However, the scope of this thesis is not going to cover this regulatory discussion but instead focus on how RPA solutions are being implemented and how the actors during the implementation interact. The motivation to carry out this research is the belief that a better understanding of how implementations are done now will allow being better prepared for the future when AI will be more extended and used. The intention of the research is to be proactive, thus trying to analyse a problem before it is too big. Being reactive in the field of AI may be really dangerous as the technology may be out of control once society realises how important would have been to design methodologies to control it.

Robotic Process Automation is the most implemented technology within RAS (BIS Research, 2017). Although more advanced solutions are expected to increase at a fast rate, their current size is small. Thus, RPA is the field with the most cases, knowledge and data to do research. Locally within KPMG Advisory N.V. all the implementations done until now are RPA, not enhanced or cognitive. Therefore, the focus of this research is going to be on RPA. Having a more detailed understanding of RPA is important to be better positioned to deal with more complex problems.
In the specific field of accountability, understanding how it can be assessed in an RPA system is fundamental to be prepared for the future where more complex types of RAS with (semi-)intelligent entities will be mainstream.

Research and frameworks discussing accountability are abundant. However, in the specific field of RPA, scientific research about assessing accountability is non-existent. Because of the newness of the technology and the multiple uncertainties and challenges currently not solved, it has been neglected the need to have a proper scientific methodology to model an RPA implementation and assess the accountability of the roles involved.

The intricacies of the relationships between actors involved in an RPA implementation makes the problem highly complex. The solution is not as trivial as applying an accountability framework to the settings of an RPA implementation. A clear model of the processes and the relationships has to be developed first to then be able to assess blameworthiness and responsibilities theoretically. Moreover, because the field of RPA is relatively new and not that much formal research has been done about it, it is expected that trying to solve the problem will produce new knowledge and new insights that will be useful for other research. The environment where RPA is being deployed and the methodologies used are very dynamic and may be different in some years. This is why having a solid theoretical ground and a clear understanding of the phenomena is important to be prepared for sudden changes in the technological landscape.

1.2 Research objective

In the problem statement section, the importance of having a solid understanding of accountability in RAS systems has been introduced. However, a solution on how to do this has not been presented. A RAS implementation is a complex set of interactions and tasks done by different actors. Thus, a model will be developed to illustrate and simplify the setting and allow for an accountability assessment. In the first place, implementations already done will be studied to create the model. After that, recommendations on how to use the model in further research will be developed.

In collaboration with KPMG, different cases of implementations will be studied. As the research is limited in both time and resources, it is not possible to analyse all the cases done by KPMG. The cases will be selected trying to maximise the differences between them with two objectives in mind. The first one is to see how accountability relationships between actors vary when you change
the actual actors present in the case. The second is to cover a broader range of industries and practices. By doing so, the intention is to generate as much new knowledge as possible as well as assist in solving current and future problems (Benbasat & Zmud, 1999).

The main objective of this research is to develop a model to assess accountability in an RPA implementation using state of the art design methodology to map a generic case building on use cases in collaboration with KPMG.

This research objective relates to the master’s in Management of Technology in different subjects and ambits. Firstly, social values will be applied when analysing accountability. Different theories are going to be studied and combined to assess the blameworthiness in an RPA implementation. Secondly, Business Process Innovation is essential to understand and draw the process that the system is automating. Thirdly, as the research is focused on breakthrough innovations, most of the knowledge acquired during the master can be applied. How innovations evolve in society since the start until their mass deployment or how technology embedded values may affect the perception of the technology. Finally, the research methods skills acquired during the master will help writing a thesis that has validity and complies with the rigour of scientific research.

1.3 Outline of the thesis

In chapter 2, the research approach is presented. It first covers the research methodology and approach followed during the thesis to give scientific rigour to this research report. It is followed by the research questions that will help achieve the research objective as well as an overview of the data gathering techniques used.

Chapter 3 covers the literature review and all the desktop research used for this thesis. The first part introduces the Business Process Architecture framework that will be used to model the case studies. It is followed by a review on accountability, which is crucial to be understood well to apply this knowledge to the model. Finally, it also covers an overview regarding RPA.

In chapter 4 the case studies are explained in detail, and the use of the model is shown. The main phases of the model are laid out as an introduction of a deep dive into the final model. After that, all the roles are covered and explained. The outcomes of the interviews are separated into two sections. The first one covers the feedback specific for the model and how the insights from the
consultants helped shape it. The second one focuses on validating different assertions made during the thesis.

Chapter 5 focuses on the learnings from the research. The first part is an assessment of accountability of the cases studied and the use of the model together with tables to assess the different actions and its type of accountability. It includes a discussion about how AI may evolve in the future and how can this affect the model.

In chapter 6 the formalization of learning is discussed. Although the research is very much practice inspired, some theory and insights can be extracted and build on the general research community. How to support and manage external stakeholders is covered as well as how segregation of duties helps ensures accountability.

Finally, chapter 7 covers the conclusions of the research. It gives an overview of how the research questions have been answered. It also provides the contributions of the research to the scientific community followed by the presentation of its limitations. Finally, recommendations and a personal note of the author are discussed.
2. Research approach

The previous chapter presented the current problem and the objective of this research. This chapter intends to provide a structured and organised presentation of the methodologies to achieve the objectives.

Section 2.1 will present the selected research methodology. Section 2.2 introduces the scientific research standards followed during the research. In Section 2.3 an overview of different frameworks of research methodologies will be introduced as well as which one is selected to develop the thesis. Section 2.4 discusses the research questions and merges them with the selected research framework. Finally, in Section 2.5 the data gathering techniques used to support the thesis are laid out.

2.1 Research methodology

The research is englobed in the broad field of Information Technology (IT). IT is the technology used to acquire and process information to support human purposes (March & Smith, 1995). According to (Davis & Olson, 1984) information is "data that has been processed into a form that is meaningful to the recipient and is of real or perceived value in current or prospective actions or decisions" while technology is the “practical implementation of intelligence”. Following this definition, the representation of a process can be reduced to a collection of data that after being processed becomes information.

One of the subfields of IT is Information Systems (IS). IS are “Interrelated components working together to collect, process, store, and disseminate information to support decision making, coordination, control, analysis, and visualisation in an organisation” (Laudon & Laudon, 2012). The objective of this thesis is to develop a model that is a collection of processes with the purpose of studying accountability assessment. Specifically, the model allows processing information to help visualise relationships between actions and actors. Thus, this research and the model belong to the IS subfield.

In the field of IS, a state of the art methodology to support research is Design Science Research (DSR). Simon, H. A. (Simon, 1997) articulates that design science supports practical research that focuses on the production of new artefacts to solve problems. Much research has already been
done proving the added value of using Design Science Research in the field of IS. For example, papers like *Design Science in Information Systems Research* (Hevner, March, Park, & Ram, 2004), *Design and natural science research on information technology* (March & Smith, 1995) or *Building an information system design theory for vigilant EIS* (Walls, Widmeyer, & El Sawy, 1992). Thus, for the realisation of the research a **design science research methodology** is selected.

Inspired by the concept of wicked problems first introduced by (Rittel & Webber, 1973), (Hevner et al., 2004) presents the idea of design science research as a methodology to solve wicked problems in the field of IS. A wicked problem has the following characteristics.

- unstable requirements and constraints based on ill-defined environmental contexts,
- complex interactions existing between subcomponents of the problem,
- inherent flexibility to change design processes as well as design artefacts (i.e., malleable processes and artefacts),
- a critical dependence upon human cognitive abilities (e.g., creativity) to produce effective solutions, and
- a critical dependence upon human social abilities (e.g., teamwork) to produce effective solutions.

As introduced in *Problem statement*, the problem dealt with in this research is how to assess accountability in an RPA system. The interactions between actors and elements on an RPA system is highly complex. Both creativity and teamwork are required to define an RPA system. The specifics of the RPA system will affect the accountability assessment of it. However, this system is highly modifiable, and it accepts changes. Finally, the requirements before, during and after the implementation can vary a lot because of contextual reasons. The problem has all the characteristics of a wicked problem, and this makes Design Science Research even more suitable as a methodology to tackle it.

The problem also complies with the Design Science Research Guidelines. In *Table 1*, the different guidelines are presented with their descriptions. The compliance of our problem with the guidelines is also introduced.
<table>
<thead>
<tr>
<th>Guideline</th>
<th>Research compliance</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Design as an artefact</td>
<td>Development of a model to assess accountability in an RPA system</td>
<td>Design science research must produce a viable artefact in the form of a construct, a model, a method, or an instantiation</td>
</tr>
<tr>
<td>2: Problem relevance</td>
<td>The model (technology-based) will tackle the problem introduced</td>
<td>The objective of design science research is to develop technology-based solutions to important and relevant business problems</td>
</tr>
<tr>
<td>3: Design valuation</td>
<td>Case studies will be executed that will validate and evaluate the artefact</td>
<td>The utility, quality, and efficacy of a design artefact must be rigorously demonstrated via well-executed evaluation methods</td>
</tr>
<tr>
<td>4: Research contributions</td>
<td>By exploring a new field, new knowledge is expected to be created during the case studies</td>
<td>Effective design science research must provide transparent and verifiable contributions in the areas of the design artefact, design foundations, and/or design methodologies</td>
</tr>
<tr>
<td>5: Research rigour</td>
<td>Use of design frameworks as well as state of the art theory in the required fields</td>
<td>Design science research relies upon the application of rigorous methods in both the construction and evaluation of the design artefact</td>
</tr>
<tr>
<td>6: Design as a search process</td>
<td>Literature research, interviews and case studies will be used as a means to achieve the objective of the research</td>
<td>The search for a useful artefact requires utilising available means to reach desired ends while satisfying laws in the problem environment</td>
</tr>
<tr>
<td>7: Communication of research</td>
<td>Publication of the research as an academic master thesis as well as an internal KPMG publication</td>
<td>Design science research must be explained effectively to both technology-oriented and management-oriented audiences</td>
</tr>
</tbody>
</table>

*Table 1: guidelines for DSR research (copied from (Hevner et al., 2004)) and how the research is going to be complaint*

2.2 Scientific research standards

Before continuing with the introduction of the research frameworks, the principles that guide general science research are going to be laid out. Moreover, the actions to make the research compliant with them are going to be discussed. The Chapter 3 of the book Scientific Research in Education is the source of these principles (Council, 2002).

*Pose Significant Questions That Can Be Investigated Empirically.*
The research relevance and the questions that will help reach the outcome have been presented in previous chapters. The data gathering techniques intend to support with analytical input the process of answering the research questions.

*Link Research to Relevant Theory.*

One of the methodologies to gather data is literature review and desktop research. The intention is to cover all the relevant state of the art literature to reinforce the importance of the research objective as well as finding information that can support the answers to the research questions.

*Use Methods That Permit Direct Investigation of the Question, Replicate and Generalize Across Studies and Provide Coherent, Explicit Chain of Reasoning.*

The three points are going to be discussed as one. The concepts of reproducibility and replicability may be trivial for some of the readers, but they are going to be explained further to give context. Lively discussion about the terminology is relevant today (Plessner, 2018). Some may argue that the words are so similar that is confusing and hard to remember what they mean. Thus, for this thesis, it is going to be used the terminology introduced by (Goodman, Fanelli, & Ioannidis, 2016).

- Methods reproducibility: focus on clarifying the procedures and the data so it is clear how to repeat them.
- Results reproducibility: focus on obtaining the same results if the previous procedures are followed by an independent study.
- Inferential reproducibility: focus on drawing the same conclusions once the results have been obtained following the same procedures by different studies.

In order to maximize transparency and allow other scientists to validate the research, the details on how the interviews have been held and how the data has been collected is presented in *Data gathering*. The information gathered is discussed, and the outcome is presented during the *Building the model* chapter. The objective of providing a clear and transparent overview of the methodology is to allow the readers to validate by themselves the three types of reproducibility. Furthermore, the limitations and some concerns regarding the interpretation of the data are introduced at the end of the report. Following this structure and disclosing what has been done will allow the reader to follow the chain of reasoning for this research.

*Disclose Research to Encourage Professional Scrutiny and Critique.*
The research is going to be published in the public repository of TU Delft, and everyone is free to access it and criticize whatever they consider inconsistent.

2.3 Research framework

2.3.1 Overview

Different frameworks have been developed to carry design research in the IS field. Three highly cited and relevant frameworks are Three Cycle View of Design Science Research (Hevner, 2007), a Design Science Research Methodology for Information Systems Research (Peffers, 2007) and Action Design Research (Sein, Henfridsson, Purao, Rossi, & Lindgren, 2011).

Building on its work, Alan R. Hevner publishes in 2007 a framework to tackle design research from a three cycles perspective. In Figure 2 the circles are presented. These are relevance cycle, design cycle and rigour cycle. The process is iterative through the cycles uniting the three main areas. These areas are the environment, the design science research and the knowledge base. The environment is the space and the context where the research is applied and tested. The design science research is the whole process of development and evaluation of the IT artefact. The knowledge base is the space with the scientific knowledge and the data used for the research. The relevance cycle iterates over the environment and the DSR. Inside DSR the process of building the artefact and evaluating it iterates over the design cycle. Finally, the iteration between DSR and the knowledge-based is done when executing the rigour cycle.

![Figure 2: Three Cycle View framework of DSR (copied from (Hevner, 2007))](image)

The methodology introduced by (Peffers, 2007) focuses on six phases: problem identification, objectives, design and development, demonstration, evaluation and communication. As shown in
Figure 3, the model suggests four possible research entry points to start the cycle from different points, and the iteration of the different steps is constant during the whole development.

![Figure 3: Design Science Research Methodology (DSRM) (copied from Peffers, 2007)](image)

The third framework is Action Design Research (ADR), introduced by (Sein et al., 2011). It introduces four phases that have inspiration from the two previous methods. Firstly, the problem formulation, based on both practice and theory inspiration. Secondly, the process of building, intervention and evaluation. The second phase allows that the artefact to be rebuilt as many times as necessary. During this phase, it may even be spotted that the problem formulation is incoherent with what is being built, and the model allows to jump back to phase one. Thirdly, reflection and learning is the phase to think about the problem of framing and the theories chosen to ensure that new knowledge is identified and can be used in broader cases. Lastly, formalisation of learning allows generalising the findings into theories to be used for general cases. A copy of the model drawn by Sein et al. is attached in Figure 4
2.3.2 Selection

For this thesis Action Research Design (ADR) will be used. The framework has been selected as it places much importance on the relationship between the IS artefact (the model to assess accountability in an RPA system) and the organisational context where it emerges (KPMG for the cases studied and the clients the company has served) (Sein et al., 2011). The model views “technology as structure” which means that structures of the organisational context are considered and reflected in the artefact during its’ use and development (Orlikowski & Iacono, 2001). The previous methods introduced have a sequential approach of build and then evaluate. ADR proposes doing both at the same time; the artefact to be developed has to emerge from the combination of use, design and continuous modifications. Evaluating the model at the same time as building helps design and modify it faster than if it is sequential. As put by (Sein et al., 2011) “while the researcher may guide the initial design, the ensemble artefact emerges through the interaction between design and use”. ADR tries to address a problem found in an organisational context by evaluating and intervening as well as constructing an IT artefact that addresses the problems found in the organisational setting (Sein et al., 2011). To support the research, literature that has already used ADR methods will be used to see the real-case application of the methodology and get guidance.
and clarification. For example (G Maccani, Donnellan, & Helfert, 2014), (Meum, 2014), (Tate & Furtmueller, 2013) or (Keijzer-Broers, Florez-Atehortua, & De Reuver, 2016)

As shown in Figure 4, ADR is based in four phases that have several principles. It is important to note that most of the phases are reciprocal as indicated by the arrows. Some explanation of the framework was given in the previous chapter, but now it is going to be discussed with more detail as it is the final tool that is going to be used for the research.

**Problem formulation:** definition of the scope and the formulation of the initial research questions. Identification and conceptualisation of the research opportunities (Hevner et al., 2004).

**Principle 1: Practice-Inspired research.** The problems found in the field are seen as opportunities to create knowledge. The focus of ADR is to create knowledge that can be generalised from solving the specific problem found (Giovanni Maccani, Donnellan, & Helfert, 2014).

**Principle 2: Theory-Ingained Artefact.** The use of theory is essential to give validity and relevance to the model. As (Gregor, 2006) presents it, theory are “statements that allow generalisation and abstraction”.

**Building, Intervention and Evaluation (BIE):** the phase where the IT artefact is created, by simultaneously iterating on the building and evaluation phases. There are two focus areas of the design: the IT or the organisation. While IT focus on creating an innovative technological design, the organisational focus on generating a design where innovation comes from the organisational intervention (Sein et al., 2011). This research is going to be organisation-dominant. The primary source of innovation will come from each different RPA project that is very contextual for each organisation implementation.

**Principle 3: Reciprocal Shaping.** Mutual influence of the IT artefact and the organisational context even if one is more dominant than the other.

**Principle 4: Mutually Influential Roles.** Mutual learning between practitioners and researchers allows building on previous research.

**Principle 5: Authentic and Concurrent Evaluation.** As introduced before as one fundamental approach of ADR, this principle remarks that evaluation and building are not separate stages.
Reflection and Learning: a self-critical approach to the theory, methodologies and IT artefact to detect new knowledge creation, this is reflecting on the solution from a particular problem to the conceptual solution of a broader range of problems.

Principle 6: Guided Emergence. It emphasises that the first design and research questions are modified and shaped by the use of the model, the people involved and the new knowledge created.

Formalization of Learning: the final stage to develop the specific ADR problems to general solution concepts. The outcome of the research is considered a design principle, and with more reflection, it can be converted into general theories to support other researches in the field.

Principle 7: Generalized Outcomes. In order to generalise the outcomes, three level stage to generalise the outcomes (1) generalise the problem, (2) generalise the solution and (3) from the design research outcomes generalise design principles (Sein et al., 2011).

The author is aware that ADR is a more recent and not as standardized and universal as other methodologies and during the Limitations chapter it is going to be discussed what drawbacks this approach has.

2.4 Research questions

The phase of ADR methodology problem formulation focuses on formulating the initial research questions. The two principles that cover this phase are the practice-inspired and theory-ingrained research. The research is going to cover the problem that has been presented in the Introduction, while the specific theories and literature used in the research are going to be laid out in the next chapter.

Q1 – How is accountability assessed in an RPA implementation?

This question is englobed in the first phase, problem formulation, and the principle of practice-inspired research. Before starting the research, there is uncertainty on how accountability is assessed by practitioners. Identifying the problems faced with the current system of assessing accountability will give guidance on how to develop a methodology that solves them. This insights will be then incorporated into the model and will give guidance on how to improve it.

Q2 – How can accountability be reflected in the artefact?
The focus of the question is on the second principle of the first phase, theory-ingrained artefact. A solution on how to improve the methodology and fix the problems detected in the first question has to be found. It is required to find a theoretical solution on how the model can help solve the drawbacks.

To do so, it is required to find an architecture to create the model, theory about accountability and knowledge about RPA. From a theoretical point of view, most of this information will be analysed in the Literature review chapter. Some modifications of the literature and creativity may be necessary in order to present the results and adapt the terminology to the needs of the research.

**Q3 – What roles and activities should be included in the model?**

This question already focuses on what elements are going to be part of the model. Hence, it belongs to the second phase of the ADR methodology, Building, Intervention and Evaluation of the IT artefact. The main components of the model will be the roles involved and which activities they carry. The methodology that will be followed to define them is to create an initial artefact with the expected roles to then submit it to the thorough analysis of the experts. The feedback from the experts is going to be applied to achieve the most accurate and valid model.

Solving this question will give guidance on how to start building the model. Difficulties are expected in trying to find all the roles and activities. One of them will be deciding the level of detail to use.

**Q4 – How does the continuous evaluation of the model help improve itself?**

One of the core values of the ADR methodology is the iteration over the model to improve itself. As the ADR methodology is quite new, the intention is to validate if there are any improvements in the IT artefact when it is applied to different cases. Therefore, proving ADR actually works.

The methodology followed will use the same source of data than the previous question. Thus, the input collected from the interviews on each case will be evaluated with detail to assess if it is helping improve the model. This evaluation will affect the on-going process of building the artefact. The specifics of the methodology followed is presented in the chapter Building the model.

**Q5 – How will advances in AI and technology affect the model in the future?**
As presented in the introduction of the problem at hand, the main reason why the research is being carried is how to handle accountability in a future with AI. The question belongs to the third phase by trying to extend the scope of the specific solution to a broader set of situations and problems. As ADR is reciprocal, answers to this question may suggest further modifications to the artefact. The second part of *Learning and Reflection* will try to answer this and provide insights on how to be prepared for the disruption AI will bring.

In *Figure 5*, an illustration with each question allocated to a phase is shown. The position and reason to allocate each research question have already been discussed. However, it is noticeable that no research question covers phase four. The final phase is focused on the creation of theories to be applied in broader cases. However, due to the very linked organisational nature of the artefact, generalising the knowledge and models developed in this research to general theories would be quite hard for the scope of this research. Although at the end of the thesis a discussion covering this phase will be done, it is expected that the outcome is not going to be as satisfactory as in the other three.

*Figure 5: Action Design Research framework with the research questions mapped (modified from (Sein et al., 2011))*
2.5 Data gathering

Although ADR is going to help guide the research, so the model is scientifically relevant, the method is a meta-framework, with no details on how to build the artefact. It gives indications on the phases that will be used during the development of the research but does not guide on how to do it. The use of the model per se does not provide input to identify the problem, create the model or verify if it is designed appropriately.

Because of the lack of guidance, having a solid strategy to gather data to create new knowledge, verify the advances made and reach the objective of this thesis is crucial. Different methods have been selected to collect and analyse different types of data sources. In Figure 6, a model reflecting how information is going to help define the final model is presented.

![Diagram](image)

*Figure 6: simplified model that illustrates how the reference model is created and refined through iteration*

2.5.1 Literature review and desktop research

The paper *Analysing the Past to prepare for the Future: Writing a Literature review* (Webster & Watson, 2002) has been used to build a reliable and broad literature review. Research search portals have been scanned for interesting articles. Google Scholars and Scopus have been the main search engines. Both engines allow to see a number of citations of the article, and thus, to know how relevant the paper is. They also allow doing forward citing, as the articles that cite the paper are also accessible. Back citing has been done reading the references of the papers and then searching for the papers of interest manually. For some specific relevant authors, back research to see what they did before has also been done to see if previous research was interesting. Three main
fields have been explored thoroughly. The first one is research on accountability. What does the concept stand for and what is going to be analysed when implementing the model are questions that require to have a deep understanding of the topic. Secondly, model theory is necessary to decide which approach and methodology are going to be used to create the problem-solving model. Lastly, and already discussed, theory to back the scientific relevance of the research. Finally, some articles and journals are also used as general knowledge to support the research. For example, knowledge and theories about the future of work and how AI is going to affect the relationship between humans and machines.

2.5.2 Case studies

The arguments on why to do a case study and how it is going to be carried have been decided following the paper by Kathleen M. Eisenhardt (Eisenhardt, 2007). This research approach has been chosen as the topic is new and not much research has been done around it. Thus, a case study will be a suitable method to create novel, testable and empirically valid theory. A case study is very iterative, jumping backwards and forward to the different steps. These eight steps are: getting started, selecting cases, crafting instruments and protocols, entering the field, analysing data, shaping hypothesis, enfolding literature and reaching closure. By getting started, the research question has been introduced as well as how the research is intended to be carried. The case selection is not necessary or preferable to be random. The main criteria to choose the cases is the availability of the data. The initial idea was to interview both consultants at KPMG and clients. However, clients did not show interest in participating in the research. Moreover, due to the specifics of the research regarding implementation where the client was mainly guided by KPMG consultants, the information that they could provide has been deemed not important. According to Eisenhardt, doing between four and ten cases is usually appropriate. Five different cases of implementations of RPA will be studied. The methodology to select the cases wanted to maximize the differences in Table 9 when choosing the cases to study. Furthermore, it also tried to englobe the maximum number of RAS solutions. However, due to the lack of knowledge about RPA and its implementation, most clients do not feel comfortable doing it all in-house. Nevertheless, they also do not want to fully externalize the process because that means giving full access to the external consultant. Thus all the projects available were categorised as a mix collaboration. The second approach of finding cases different than RPA also failed. It was not possible to find cases
different than RPA because the market is not mature enough and clients are not asking for it. Thus, KPMG did not have any RAS project using different robotics than RPA. The cases done are summarized in the following Table 2.

<table>
<thead>
<tr>
<th>Case number 1</th>
<th>RPA implementation in a commercial bank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case number 2</td>
<td>RPA implementation in a logistics company</td>
</tr>
<tr>
<td>Case number 3</td>
<td>RPA implementation in an energy company</td>
</tr>
<tr>
<td>Case number 4</td>
<td>RPA implementation in a coffee producer company</td>
</tr>
<tr>
<td>Case number 5</td>
<td>RPA implementation in a dairy producer company</td>
</tr>
</tbody>
</table>

*Table 2: an overview of the case studies*

2.5.3 Interviews

An interview is a “conversational practice where knowledge is produced through the interaction between an interviewer and an interviewee” (Brinkmann, 2014). In this research, the objective of the interviews is two-fold. The specific type of information regarding the model and feedback on how to improve it is wanted. At the same time, new insights are welcome as they will add new knowledge about the practices in the field of RPA. Thus, the semistandardized interview methodology has been selected. The characteristics of a semi-standardized interview are the following. It has a structure, but not very rigid and formal. It allows for a flexible wording of the questions, and the level of the language can be adjusted. In case some concept is not clear, the interviewer can intervene to clarify questions. It is allowed that the interviewer asks a follow-up question, known as a probe, to know more about a story because the interviewer may find that a specific point introduced by the interviewee is especially interesting (Berg, 2001).

The sampling approach selected was *purposive sampling*. Purposive sampling aim is to select a specific target group because of a specific set of criteria (Sekaran & Bougie, 2016). Because the expertise regarding RPA is quite scarce, a big factor regarding whom to interview was their availability. The first criterion was that the experts were reachable within KPMG. Around ten people met that criteria. The second criterion was that they were involved in the projects selected in the Case studies section. The final criterion was their availability and eagerness to be interviewed. With all these criteria at hand, five experts, one for each case, were selected.
The qualitative tool to analyse the data from the interviews is **NVivo**. NVivo is a software that allows to organise, categorise and visualise the data obtained from the interview. It allows to store the different transcripts and code them. Coding is a subjective methodology, and it can be used to see how different interviewees refer to the same thematic or to make sense of what is being discussed in each interview. It also allows to organize each section and facilitate the access to information. The software can visualize the relationships between themes and interviewees using graphics. The methodology on how interviews have helped develop the model and details on how NVivo has helped organize the interviews is laid out in the chapter *Building the model*. 
3. Literature review

The purpose of the literature review is to give a theoretical base with which the model can start to be built. The artefact should be based on theory as well as in practice, as introduced in the ADR methodology. However, the process is also highly iterative, and some knowledge may be created during the development and use of the model, or it may be acknowledged the need for further theory during one of the iterations.

In section 3.1, the concept of Business Process Architecture framework is introduced, and the specific methodology of Action Based Design chosen for this research is described. Section 3.2 is an overview of current theories about accountability and a selection of the concepts that are interesting for this research and how they can be incorporated into the model. Finally, in section 3.3 how RPA is implemented by KPMG is introduced.

3.1 Business Process Architecture framework

A Business Process Architecture (BPA) is an “organized overview of business processes that specifies their relations, which can be accompanied with guidelines that determine how these processes must be organized” (Dijkman, Vanderfeesten, & Reijers, 2016). The paper Business Process Architectures: Overview, Comparison, and Framework gives an extensive analysis of the approaches to develop the business process architecture. These are goal-based, action-based, object-based, reference model based or function-based.

The approach that will be used in this thesis research to achieve the objective of this thesis research will be action-based business process architecture or action-based design (ABD). The reasons behind this selection are that action-based approach is the best for identifying, delimiting and diving a process into smaller sub-processes (Lind & Goldkuhl, 2003). During an implementation, a lot of processes and interactions between actors happen, and mapping them is essential to create a model that allows visualizing how reality looks like. Different papers differ in the types of activities and the phases that comprise them. As a reference for the research, it is going to be used the terminology and methodology of The action workflow approach to workflow management technology (Medina-Mora, Winograd, Flores, & Flores, 1993).
The basic unit of the business process structure model is an action workflow loop, illustrated in Figure 7. For each action workflow loop, there are always two roles, the customer and the performer. The customer asks for something to be done and evaluates the result, while the performer does the action. Specifically, the loops consist of four phases, with extra actions in any given phase.

1. Proposal: the customer requests or the performer offers the completion of a specific action with conditions for its successful realisation.

2. Agreement: both parties agree on the terms that will mean the task has been completed.

3. Performance: the performer informs the customer that the action has been done.

4. Satisfaction: the customer informs the performer about the satisfaction of the performance. (Medina-Mora et al., 1993).

This approach is different from previous business process architecture in the fact that shifts from a task structure to a coordination structure.

The combination of the loops allows representing the complex events of organisations. The links between tasks allow assessing which actor is carrying which action. Therefore, it eases the allocation of responsibility once the potential sources of problems have been identified in the complete process. Although the architecture is illustrative and helps visualise the processes, the detection of the problems that may arise still depends on the person analysing it.

In the original paper of (Medina-Mora et al., 1993), it is emphasised that this detection of specific problems can be used to “identify places where breakdowns may occur on a recurrent basis and to see what additional steps or workflows can be put in place to anticipate and cope with them”. For
this thesis, it will be used the methodology not only to detect places where breakdowns can happen but to detect where an assessment of accountability is necessary and how to cope with it in case of failure. A breakdown is understood as an event that stops a loop to continue and hence, the process breaks.

An example of how the ABD framework is applied in the modelling of a process has been illustrated in Figure 8.

![Diagram](image)

**Figure 8: Action-Based model of the process to decide which process should be automated**

Two modifications of the framework are necessary to model the implementation of an RPA process. The first one is the need to add a new type of arrow to identify activities that may not always have to be carried. Especially when referring to software development, the number of iterations of testing cannot be determined. The same happens with exceptions handling. A protocol is necessary in case that happens, but if it does not happen, those actions do not have to be executed. Thus, to add this detail to the model, a dotted line is introduced. This line means that the action will only have to be executed in the case that the preceding action requests this to happen. For example, in the general sense, if the testing requires the development to be iterated again (because a modification in the software is necessary), it is going to be represented with a dotted line.

The second addition refers to the elimination of roles assigned to the higher layers of the model. A higher layer contains several sub-activities. Each of this sub-activities may have different
requestors and executors. Therefore, it is not very precise to assign a requestor and executor of the highest layer if the ones in the sub-activities are actually different.

3.2 Accountability

The complexity in the relationships between stakeholders makes the problem of assessing accountability complex. It is a case of “the problem of many hands” and “the problem of many eyes” (Bovens, 2005), which states that there are many acountees and accountors. Moreover, some actors act as both and the roles keep changing. For example, a manager may hold accountable an employee, but the manager is held accountable by the board of directors. Thus, a detailed analysis of the relations between actors and processes is essential to clarify this analysis. Examples of situations where accountability is necessary are the malfunction of a system in a critical situation, fraudulent use of the system or poor maintenance of the solution.

The current approach of KPMG regarding the assessment of accountability for an RPA system is the creation of a RACI matrix. RACI stands for Responsible, Accountable, Consulted and Informed and it “is an approach used to identify where ambiguities may exist related to accountability and responsibility … (RACI matrix) is a grid showing the activities or tasks down the left hand side and the functional roles across the top.” (Paulette & Jacka, 2009).

*Responsible* is the person in charge of doing the action. Accountable is a more discussed term. In the matrix, the definition of accountable may be quite general and very business focused. *Accountable* is the role with authority to proceed or not with the activity. Is the person with the last say on the action and sometimes may also be the one carrying it. *Consulted* should be asked before executing the action. Finally, *Informed* are those individuals that need to know the process is being done but are not required to do anything.

The term accountability is quite vaguely defined in the RACI matrix. The person that has the final say in the execution of the process may not always be the one to be blamed. For example, the process may have problems because a consulted role has lied or a responsible (doer) role has not performed it accordingly. Furthermore, RACI matrix tries to assign roles but does not pay that much attention to actions. Therefore, it is clear that to assess accountability more thoroughly during in an RPA system more than just a RACI matrix is necessary. Moreover, RACI matrixes
do not require that all the four roles have to be filled with each activity. So it is not uncommon to see activities where no accountable responsible is established.

A more formal definition of accountability is going to be used in this thesis. Scholars agree that the original term of accountability is associated with the process of having to account for one’s actions to some specific authority (Finer, 1941). Accountability has three main characteristics. Firstly, it is external in a sense that the person gives account to another individual. Secondly, it involves interaction between the person asking for an account and the one giving it. Finally, there is a right of authority, that means that the one asking for someone to account has the power to hold him accountable and sanction if necessary (Mulgan, 2000). This view on accountability will be used for the research. It will not include the concept of internal responsibility, which lately has also been incorporated as a type of accountability. Internal responsibility refers to the personal morality of the person doing an action (Romzek & Dubnick, 1987)

Most of the scholars that worked on the different forms of accountability agree that any type of accountability shares the following essential elements (Lindberg, 2013; Philp, 2009).

1. An agent that must give account or accountee for an action (A). Depending on the project, different stakeholders may be accountable. Employees, consultants, the company or vendors for example.
2. A principal to whom A must give account or accountor (P). For example, regulators, company clients, suppliers or society.
3. The domain subject to accountability (D). In our case, the RPA implementation, and more precisely, the activity being analysed.
4. The right of P to ask A explanation on decisions made regarding D.
5. The right of P to sanction A if the last fails to explain why decisions regarding D were made

Two comments regarding point five have to be made to clarify the focus of this research. At its core, a sanction only can be done if A does not provide the information to explain the reason behind a decision, but the outcome of the decision cannot be sanctioned. Some authors like (Schedler, 1999) argue that the outcome of the action could also be the reason to sanction. For this thesis, it is considered this a crucial point. If, for example, a script fails to automate a process as expected, the client can hold the developer accountable for the mistake even though the latter can explain why the decision that led to the mistake was made. Second, to measure accountability, there have
to be a clear set of criteria to evaluate if a sanction is necessary (Knouse, 1979; Schedler, 1999). It is argued that using the model ABD to map the processes presented in the previous section sets this conditions in the phase of agreement of the workflow in an implicit way. The five elements present in every accountability analysis will depend on the process studied and the actors involved.

The paper *Mapping accountability: Core concept and subtypes* (Lindberg, 2013) analyses relevant papers about accountability and finds common traits to the more than a hundred sub-groups of accountability. Building on three dimensions, the paper categorizes the sub-types of accountability in twelve sub-groups.

The first dimension is the *source of accountability relationship*, where the principal can be internal or external from the organisation (Radin & Romzek, 1996; Romzek & Dubnick, 1987). The construct of the organisation is contextual and varies regarding in each case. For this thesis, it is going to be considered the context of the organisation the roles directly involved in the implementation of the RPA project. This includes KPMG consultants, the company that is implementing the automations and any external party that plays a role in the implementation (for example, an IT services provider). For this thesis research, the focus is going to be set in the internal relationship during the use of the model and the case studies, but the external relationships will be kept in mind if in specific situations they are relevant. To give some context, an internal source would be the relationship between a project manager and a developer, independently if this developer is an employee of the company or a KPMG consultant.

Secondly, the *degree of control* of the principal over the accountee can either be high or low (Romzek & Dubnick, 1987). A high degree of control implies that the principal has an important control over the range and depth of the actions the accountee can do. Oppositely, a low degree means that the accountee has a high degree of freedom and liberty to operate as he finds fit. A low degree of control means scarce information and difficult access to it, while a high degree means information is abundant and easily accessible. For the analysis, it is going to be considered that all the roles being done by actors belonging to the company that is implementing the automation have a high degree of control. They are going to be classified as internal roles. A lower degree of control is going to be assigned to external actors, for instance, KPMG or external IT suppliers. The logic behind this reasoning is that as an external actor it is harder to exert control over the internal actors.
An internal project manager that can fire or give a bad recommendation of an employee has more degree of control than a KPMG project manager trying to coordinate internal employees.

This substitution of terms of the *degree of control* (internal, external or collaboration) should not be confused with the internal and external concepts of the *source of control*. As a reminder, for this thesis, the only reference to the internal *source of control* is going to be done. Thus, whenever a discussion of the internality or externality of a role happens, it will be referring to the *degree of control*.

Finally, the last characteristic is the *spatial direction of accountability relationships* (upward, downward and horizontal) (Schedler, 1999). This characteristic covers the directional relationship between actors with different power in the organisational hierarchy. For instance, a boss-employee relationship can be both upward and downward. When the boss holds the employees accountable, the relationship is upwards. However, if the boss allows the employees to ask for information and judge them, the relationship is downward. Finally, a horizontal relationship is given between equal power actors, like two employees of the same project group.

The combination of the three characteristics creates a set of twelve sub-groups of accountability. They are introduced in *Table 3*.

<table>
<thead>
<tr>
<th>Source of control</th>
<th>Strength of control</th>
<th>Vertical</th>
<th>Downward</th>
<th>Horizontal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Upward</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal</td>
<td>High</td>
<td>Business</td>
<td>Bureaucratic</td>
<td>Audit</td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>Client–patron</td>
<td>Patron–client</td>
<td>Peer Professional</td>
</tr>
<tr>
<td>External</td>
<td>High</td>
<td>Representative</td>
<td>Fiscal</td>
<td>Legal</td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>Societal</td>
<td>Political</td>
<td>Reputational</td>
</tr>
</tbody>
</table>

*Table 3: table with the types of accountability (copied from (Lindberg, 2013)) that synthesises it from ten other sources*)

As explained before, the scope when mapping the process is going to be the study of **internal accountability**. Thus, it is not going to be discussed how the government, for example, would hold the company accountable. Instead, the thesis is going to focus on the relationship one to one for each action, as proposed in the action model. Therefore, the unit of accountability analysis is going to be each action.
If the definitions provided are applied, two employees of the company would have an internal source of control and high strength of control and a horizontal spatial direction. This would mean, their accountability type is *audit*. As an exception to the theory just introduced, this situation is going to be judged as *peer professional* type of accountability.

Limiting the number of actions excludes seven sub-groups of accountability. The following *Table 4* provides examples of the five sub-groups that will be used.

<table>
<thead>
<tr>
<th>Sub-groups of accountability</th>
<th>Accountor</th>
<th>Accountee</th>
<th>Short description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business</td>
<td>Employee</td>
<td>Manager</td>
<td>Employees can hold managers accountable if they do not deliver</td>
</tr>
<tr>
<td>Bureaucratic</td>
<td>Manager</td>
<td>Employee</td>
<td>Managers can hold their subordinates accountable for their actions</td>
</tr>
<tr>
<td>Client-patron</td>
<td>Client</td>
<td>Advisor</td>
<td>The client for a project can hold the external employees accountable for their actions</td>
</tr>
<tr>
<td>Patron-client</td>
<td>Advisor</td>
<td>Client</td>
<td>The opposite to client-patron</td>
</tr>
<tr>
<td>Peer professional</td>
<td>Employee</td>
<td>Employee</td>
<td>Peer review performance would be an example of accountability</td>
</tr>
</tbody>
</table>

*Table 4: examples regarding the sub-groups of accountability*

For instance, the situation where an external consultant develops an RPA script that does not function as expected. In this case, the client would be the accountor and the consultant the accountee. The source of control would be internal, the strength of control low and the spatial direction upward, hence the accountability would be client-patron.

Using the action workflow proposed in *section 3.1*, the whole RPA system with its’ processes for the cases studied are going to be mapped. For each process in the workflow, there is a requestor and an executor. Analysing each of the processes in detail will allow drawing a clear visualisation of who is accountable for what and to what degree. For example, using the example introduced in *Figure 6*, an example of how that process would be analysed is presented in *Table 5*. 
3.3 Robotic Process Automation overview

This section is going to give an overview of RPA and give more information than the introduction. This includes a more detailed definition of what is RPA, an example of a use case and an overview of the providers of RPA solutions used by KPMG.

As presented before, the formal definition of RPA by the Institute for Robotic Process Automation and Artificial Intelligence is “the application of technology that allows employees in a company to configure computer software or a “robot” to capture and interpret existing applications for processing a transaction, manipulating data, triggering responses and communicating with other digital systems” (IRPAAAI, 2013). In simpler words, RPA is similar to a sophisticated Microsoft Excel macro that accesses and modifies data from different systems and performs tasks several times faster than a human.

However, the difference with just the definition of RPA compared to traditional automation is not trivial. The working layer, programming skills, complex systems integration, test and development
time, scalability, cost and maintenance are going to be compared in Table 6 (Bhukan, 2017; Morphy, 2017).

<table>
<thead>
<tr>
<th></th>
<th>RPA</th>
<th>Traditional Automation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Main usage</strong></td>
<td>Automate end-to-end processes</td>
<td>Each piece of code has a purpose</td>
</tr>
<tr>
<td><strong>Working layer</strong></td>
<td>It mimics user actions</td>
<td>It does NOT mimic user actions</td>
</tr>
<tr>
<td><strong>Programming skills</strong></td>
<td>Low to medium</td>
<td>High</td>
</tr>
<tr>
<td><strong>Complex systems integration</strong></td>
<td>Low dependency on previous software architecture</td>
<td>High dependency on previous software architecture.</td>
</tr>
<tr>
<td><strong>Test and development time</strong></td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td><strong>Scalability</strong></td>
<td>Technically easy to scale</td>
<td>Technically hard to scale</td>
</tr>
<tr>
<td><strong>Maintenance</strong></td>
<td>Technically easy to maintain</td>
<td>Technically hard to scale</td>
</tr>
<tr>
<td><strong>Cost</strong></td>
<td>Short time – expensive</td>
<td>Short time – cheap</td>
</tr>
<tr>
<td></td>
<td>Long time – cheap</td>
<td>Long time - expensive</td>
</tr>
</tbody>
</table>

*Table 6: differences between RPA and traditional automation*

As the main differentiator, RPA is usually used to automate end-to-end processes while traditional automation usually automates specific tasks. For clarification about the term, an “end-to-end process” refers to all the work required to be done in order to achieve the process objective. Each department of an organisation (Finance, HR, Procurement…) has several end-to-end processes. A map that illustrates all the end-to-end processes required in the finance department to convert an order to a payment is attached in Appendix A.

The programming skills to develop RPA are very low. Most of the vendors organize their software as a diagram where every box is an action the bot will execute. These actions range from mouse clicking a window, writing a cell in excel or copying the information in a website. Thus, RPA allows mimicking what users do instead of hard-coding the whole process. On the one hand, because the software imitates user actions, RPA easily integrates with legacy system and other software. On the other hand, because the programming skills are low, it is easy to develop, scale and maintain. Finally, the cost is low in the short time because vendors have to be paid upfront
before realizing the potential of RPA. However, in the long term, it is usually cheaper because it’s ease of use requires less labour force to maintain and scale. An interesting point regarding RPA is that it does not need a lean or six sigma project to make the process to be automated smoother. Because the robot is executing the process and not an employee, it does not matter much in terms of time saved if the process is optimized or if it has some waste.

To provide more context, an exemplification of the end-to-end process automated using RPA to create an invoice is going to be explained in steps (KPMG Nederland, 2017).

1. Open ERP and log in.
2. Open an email with an invoice template attached send by the invoice requestor.
3. Perform checks to determine the quality of the data.
4. Transfer data from the Excel to the ERP.
5. If necessary, send a request using email to the invoice requestor to modify data.
6. Create the invoicing document.
7. Send an email to the requestor with attachment and confirmation and close everything.

The example also serves to show the difference between RPA and enhanced or cognitive automations introduced in Figure 1. Enhanced automation would be the next level, where RPA is actually able to categorize any information provided from any type of invoice, not only the one following a template. Cognitive would be able to imitate human thinking, and one in many examples of functionality could be the assessment of the sentiment of the requestor’s message and act accordingly. For example, if the requestor seems desperate for early payment of the invoice, the bot could assign that invoice to a human agent, so he can call the requestor, find a solution (for example, offering a discount on the invoice in exchange of early payment) and increase his satisfaction. A high-level cognitive robot would even be able to handle this negotiation himself.

A vendor of RPA is a company that develops software that allows integration, development and governance of RPA. The interface is user-friendly, and knowledge of coding is not necessary. A report written by Forrester, an important market research agency, categorized and analysed the twelve leading RPA vendors (Forrester Research, 2017). For the interest of this thesis, only the vendors used by KPMG Netherlands to help their clients are going to be presented. These are Blue Prism and UiPath. Both are in the top three in the classification. The graphical interface of each software vendor is shown in Appendix B.
Blue Prism was founded in 2001, and it is one of the market leaders for RPA. Most of the projects developed in KPMG Netherlands have been done using Blue Prism. Blue Prism has expanded working together with partner collaborations. KPMG is one of these partners. The access to the software and the training if you are not a partner is not available. During the first years of RPA implementations, Blue Prism was a clear leader and was chosen by most of the KPMG early clients.

UiPath was founded in 2005 and although not yet a market leader, it is gaining a lot of momentum because its license price is lower than the competitors. UiPath team offers access to the platform for free, and there is also an online academy that allows people to receive training in the Software. Most of the functionalities are based on C#, and it allows to support more complex and demanding projects than Blue Prism. It has a very interesting tool that creates the workflows by recording the actions of a human and transcribing them to code. UiPath has been incorporated in the offer of KPMG quite recently, around the beginning of 2017. Therefore, there are not many implementations and projects done using UiPath.

Both vendors offer two environments, the Studio and the Control Room. The Studio is the software that allows to design and develop the scripts to automate the process. The scripts can be run locally from the Studio. Thus, the purpose is to verify that the development is going well and that the automation actually does what the developer wants. However, once the script has been developed and tested successfully, it is uploaded to the Control Room. The Control Room allows to schedule the processes and check their performance. In case some process needs to be modified, this is going to happen in the Studio and then updated again as a new version of the process into the Control Room. This functionality allows integrating segregation of duties. Roles that develop should not have access to the Control Room, and the roles that monitor should not have access to the Studio.
4. Building the model

In previous chapters the problem to tackle, the research approach to solve it and the literature review that is going to be the foundation to create the model have been covered. The model is not going to cover the negotiation between a client and KPMG when drawing the contract and its terms. It will focus on the instant when the implementation of the RPA project starts.

There is no international standard for the life-cycle of an RPA implementation. KPMG uses a general governance framework to implement RPA solutions (Juttmann & van Doesburg, 2018). While the framework is compelling, it lacks detail on the specifics during the implementation of an RPA project, and the interdependences between the phases are not defined. There are other models of governance more focused on the approach to develop, test and deploy software. One of this is the DTAP methodology which stands for Development, Testing, Acceptance and Production (Evans, 2009). The RACI matrix cannot be used as an RPA implementation tool as it lacks the workflow characteristic of a model. Therefore, an actor may be aware he is responsible for an activity but does not know what actions have to be done before he can execute his actions. This may also generate a situation where assigning accountability may be easy but enforcing them hard. Each actor can use as an excuse that it is not clear when it is time for him to act. The lack of an appropriate system to govern an RPA implementation can lead to situations where it is hard to assess accountability.

As introduced in section 2.2.2, two principles are the base for the problem formulation of the ADR approach.

- Practice-inspired research. Problems in the field are opportunities to create new knowledge. For the scope of this thesis, these problems are the lack of methodologies or resources to assess accountability in the field of RPA implementations.
- Theory-ingrained artefact. It is required to use theory in order to give validity to the model. Thus, the theory that is going to be used to give relevance to the artefact is presented in section 3.

The process is highly iterative and during the creation of the model new insights may be discovered that affect how the problem is perceived. In order to start conceiving a model, how KPMG usually tackles an RPA implementation project is illustrated in Figure 9.
• Preparation: it mainly includes the set-up of all the IT systems required for the proper development of the RPA system as well as the selection of which vendor is going to be used.

• Process analysis: research and analysis about RPA fit within the company, and which highly repetitive processes are valuable to automate.

They are both complimentary as usually when setting up the IT systems required and deciding which vendors are appropriate; the processes are being selected.

• Proof of Concept: the specific selected process is developed to prove the viability of RPA to the client. Usually, exceptions of processes are not included. An exception is any situation where the process does not follow the rules and where the automation would not function. For example, an exception would happen when automating an invoice and in a field where an integer is expected, a string is inputted. Moreover, the automation is never brought to the production environment. Thus, it would be a demonstration of what RPA can do.

The production environment is the setting where the script goes live. This means that the automation will interact with real situations and will have a direct impact on the business. The Proof of Concept is an exploratory phase to identify the viability of RPA, where the script does not go to the production environment. Therefore, some clients only want to do the Proof of Concept phase to decide then if continuing with RPA on their own, with external help or not continue at all.

Other clients have already experienced RPA, or they feel prepared to implement RPA in the large scale, and they reach to KPMG for help.

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Figure 9: typical RPA journey inside KPMG
• Implementation: the implementation phase is based on including all the exceptions to the process, making it more robust and integrating it into the production environment of the company.

• Governance: scheduling the processes automated to run and check that no issues are happening. In case they happen, report them and solve them.

The iterative nature of the ADR methodology makes it hard to show the evolution of the artefact. In general terms, the steps followed were, firstly, the creation of an initial model using secondary sources and the experience of the author. This was followed by interviews that allowed to tweak the model and gain insights on how to improve it. The improvements to the model were sequential. Thus, the insights of the first interview were applied to the model and then introduced to the second interviewee. As a consequence, a final model evolved from the first model applying the new information. There is no added value in presenting and discussing the first model as it has changed a lot in terms of the actions, the roles and the distribution.

The methodology followed during the interviews focused on collecting information on three main categories from RPA consultants at KPMG. These categories are introduced in the mind maps created with NVivo and can be consulted in Appendix C. The categories are the discussion about the model, the validation of concepts and new insights about RPA. The NVivo mind maps show all the codes used and how they relate to the main categories. These codes helped capture all the insights and realize the full value of the interviews.

The first area relates to the discussion of the model. Each interviewee was presented the most recent version of the model and asked to provide feedback on the phases and the roles involved. The model was modified with their feedback and presented to the next interviewee. Therefore, not all the interviewees evaluated the same version of the model. The objective was to validate and correct the model, as well to experience how well the model adjusts to each case. In case there was a disagreement with feedback from previous cases, it was asked why the interviewee had that specific feedback. In the end, the criteria to decide if one insight overruled another one was the explanation from the interviewee and their seniority in the organization.

After the discussion about the model, the interviewees evaluated each phase on its impact and if the roles involved were internal, external or a combination of both. An example is shown below.
in Table 7, where the information in red was provided by the interviewees. Then, the author was able to fill the type of accountability.

<table>
<thead>
<tr>
<th>Process description</th>
<th>Accountor</th>
<th>Accountee</th>
<th>Type of accountability</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyse the RPA vendors</td>
<td>RPA Project Manager</td>
<td>Business Analyst</td>
<td>Bureaucratic</td>
<td>Low</td>
</tr>
</tbody>
</table>

*Table 7: resource used to assess the impact and role belonging during the interviews.*

After the five interviews, the results of this last part were grouped and presented as a single table in Appendix D. The table lays out each phase and the classification each consultant gave for their project. To provide clarity, a portion of the table is going to be introduced in Table 8. In this case, for the process “analyse the RPA vendor”, four interviewees said the accountor role was internal and one said it was external. Three interviewees said the accountee role was internal and two said it was a collaboration. Finally, one interviewee said that the impact was high while four said it was low. These results are going to be used in the *Assessment of accountability using the model* section.

<table>
<thead>
<tr>
<th>Process description</th>
<th>Accountor</th>
<th>Accountee</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyse the RPA vendors</td>
<td>I E C 0</td>
<td>I E C 2</td>
<td>High</td>
</tr>
</tbody>
</table>

*Table 8: collection of evaluations of the phases by consultants*

The second part of the interview focused on verifying and validating knowledge and information the author gathered during his experience inside KPMG. Some constructs and assertions have been made during the research and needed validation. During the interviews it was asked the interviewees for feedback and confirmation.

The final part focuses on the additional knowledge that is generated by some insights the interviewee may mention. Some of this insights are asked while some are sporadic. Because of the conversation type of interview, a very concrete model could not be defined. Instead, a semi-structured approach was followed. The questions have been designed having in mind the principles of avoiding double-barrelled, complex and affect (Berg, 2001).

In the following Section 4.1, the main phases of an implementation are introduced. Section 4.2 presents the final version of the model and is followed by Section 4.3 where the roles involved are explained in detail. In Section 4.4 and Section 4.5, the cases and interviews are laid out. The first section explains the modifications to the model using the feedback of the experts in the field so it allows having a representation on how proper implementations of RPA should be carried. It also covers where and what the project was about. The second section validates the assertions made during the thesis and presents new insights that add value to the research.
4.1 Main phases

A model that illustrates quite well the phases followed during a project is the waterfall model, introduced by Winston Royce. Since then, multiple authors have added modifications to the model as well as the same author. Some references that have worked on it are (McConnell, 2010; Royce, 1970; Takeuchi & Nonaka, 1986). The names of the phases have been modified to adapt to the terminology that KPMG uses.

- Requirements & analysis: the phase is mainly focused on having all the requirements prepared to start automating and knowing what is going to be automated.
- Development: in this phase, the focus is on writing the script to automate the process.
- Testing: testing to make the solution reliable and secure from failures. It focuses on ensuring that all the exceptions are covered and that the process is successfully automated.
- Deployment & governance: this phase is composed of the integration of the automation in the production environment and the governance of the process.

An illustration of the four phases has been drawn in Figure 10.

![Figure 10: modification of Waterfall model on how KPMG develops RPA projects](image)

The model is another way to structure the typical journey of KPMG presented in Figure 9. The “Proof of Concept” is not represented explicitly in the generic model. If it is required to model a “Proof of concept” using the model, the first two phases would be simplified and the last two eliminated. The four phases just introduced will englobe smaller subsets of activities. The meta-model representing these phases is shown in Appendix E.
A characteristic of each case is the involvement of internal and external actors as discussed in Section 3.2. Depending on the case, the company may decide to externalise the life-cycle or do it in-house entirely. It is also frequent to see a mix. This mix may be differentiated or collaboration. On the one hand, mix differentiated means that some phases are *exclusively* done by internal or external actors. On the other hand, mix collaboration means that some phases may be done collaboratively between actors. The final option would be expertise, where the development is done in-house with the assistance of consultants. This analysis will be very insightful in the case studies as it affects the relationships between actors. In *Table 9* a visual image on the insights of the analysis is introduced.

<table>
<thead>
<tr>
<th>Requirement Analysis</th>
<th>Development</th>
<th>Testing</th>
<th>Deployment &amp; Governance</th>
</tr>
</thead>
<tbody>
<tr>
<td>All in house</td>
<td>![employees]</td>
<td>![employees]</td>
<td>![employees]</td>
</tr>
<tr>
<td>All external</td>
<td>![external consultants]</td>
<td>![employees]</td>
<td>![employees]</td>
</tr>
<tr>
<td>Mix differentiated</td>
<td>![OR]</td>
<td>![OR]</td>
<td>![OR]</td>
</tr>
<tr>
<td>Mix collaboration</td>
<td>![OR AND]</td>
<td>![OR AND]</td>
<td>![OR AND]</td>
</tr>
<tr>
<td>Expertise</td>
<td>![employees]</td>
<td>![employees]</td>
<td>![employees]</td>
</tr>
</tbody>
</table>

*Table 9: analysis of collaboration between employees and consultants*

### 4.2 Final version of the artefact

As already mentioned, the high-level overview of the model is presented in Appendix E. The more detailed phases are laid out in Appendix F. The model presented is the final one after the feedback and improvements from the interviews that are covered in Section 4.4.

The following subsections include all the actions belonging to each phase.
4.2.1 Requirement & Analysis phase

**Analyse the RPA vendors.** The process to select the software that is going to be used to implement the RPA solution. Different vendors have different products, functionalities and pricing. Depending on the type of processes that want to be automated and the investment that wants to be made, an RPA vendor is going to be more suitable than the others.

- Gather required functionalities and characteristics. The business analyst executes and the RPA project manager holds him accountable. The activity includes the analysis of the RPA vendors landscape and the presentation of this results in an understandable format.
- Assess technical capabilities of the vendor. The developer executes and the RPA project manager holds him accountable. The developer is going to make sure the capabilities of the vendor are enough to satisfy the technical requirements of the processes to be automated.
- Assess IT requirements for each vendor. The technical architect executes and the RPA project manager holds him accountable. The activity includes assessing the platforms and software of the RPA vendors and analyse if the integration and compliance of the software with the systems of the company is possible.
- Organize live presentations of the vendors. The business analyst executes and the RPA project manager holds him accountable. As the title says, the business analyst invites the most suitable vendors for a live presentation.

**Decide the RPA vendor.** With all the information about the previous phase, the decision of what vendor to select has to be made.

- Request specific pricing and offers. The business analyst executes and the RPA project manager holds him accountable. Requesting to the top selected vendors pricing deals.
- Decide about the offer. The RPA project manager executes and the section manager holds him accountable. The final decision about what RPA vendor is going to be used to implement RPA.

**Prepare IT architecture.** In order to support the new RPA infrastructure, the IT architecture has to be developed and implemented. This usually includes setting up a server with an SQL database, decide which machines are going to run the automations and grant different level of access and rights to the different platforms and systems.
• Determine IT infrastructure needed. The technical architect executes and the RPA project manager holds him accountable. The technical architect needs to develop a solid plan for what resources are needed and how to implement them.

• Implement the requirements. The IT support executes, and the technical architect holds him accountable. The action is the implementation of the previous phase where what is required was drafted.

These first three phases, “Analyse RPA vendors”, “Decide the RPA vendor” and “Prepare the IT architecture” are done only once per project. If several processes are automated, these phases would be skipped.

Select processes to be automated. The processes that will be automated have to be selected. It is an iterative phase of each project. Several processes are going to be selected, and each one is going to be developed, tested and governed in a separate stream.

• Assessment of suitable processes. The business analyst executes, and the RPA project manager holds him accountable. Depending on the requirements and the objectives, some processes are more suitable than others. Several factors may make a process not suitable. For example, it is affecting a department that does not want processes to be automated yet.

• Assess the feasibility of the automations. The developer executes, and the RPA project manager holds him accountable. The developer will assess if the automations are technically possible.

• Prioritize and accept the process to be automated. The section manager executes, and the RPA project manager holds him accountable. This activity decides which of the previous process are going to be developed.

• Write Process Definition Document. The process owner executes, and the RPA project manager holds him accountable. A document has to be written detailing all the sub-activities the process is composed off. The level of detail is high, explaining every action so once delivered, a person with no knowledge of the area should be able to understand the activities explained.
4.2.2 Development phase

*Creation of the technical document.* The developer receives the documents written before and from that creates a technical document. This technical document is similar to the PDD but focusing on the script that will have to be developed in order to automate the activity. For example, the PDD would say “Open Internet Explorer” while the technical document is going to say “Invoke the block/action that opens Internet Explorer”.

*Develop the script to automate the process.* The script is built and re-build if required.

- Write the script. The developer executes, and the DevOps lead holds him accountable. The developer writes the script necessary to automate the end-to-end process.
- Modify the script. The developer executes, and the DevOps lead holds him accountable. If required and while testing it in the development environment, the developer may decide to change the script.

4.2.3 Testing phase

*Delivery of completed script.* The tester will require the developer to hand in the final version of the script to start the testing.

*Verification Test.* Technical test that requires a tester with technical knowledge to check if the technical requirements of the script are compliant and the solution is robust. There is a set of good practices that are always standard despite the process that is being automated that have to be respected.

- Execute the test. The tester executes, and the developer holds him accountable. The tester examines the script and assesses if the proper practices are followed.
- Evaluate the results. The developer executes, and the tester holds him accountable. The developer is responsible for evaluating the feedback received from the tester and sending it back to development if required.

*User Acceptance Test.* The script is tested with data and situations of the production environment where the outputs are known. If this test is successful, the section manager signs off the release to the production environment.
• Determine requirements for UAT. The process owner executes, and the tester holds him accountable. The process owner is responsible for writing down the exceptions that the process should cover and what requirements are needed to be met.

• Execute the test. The tester executes, and the process owner holds him accountable. The tester executes the testing creating scenarios to test if the requirements drawn in the previous step are met.

• Evaluate results. The process owner executes, and the tester holds him accountable. The process owner evaluates if the requirements are met and decides if it should be redesigned or if it is ready for production.

Sign off the release to the production environment. The section manager executes, and the RPA project manager holds him accountable. The section manager has the last responsibility during testing to sign off the release to the production environment in case both tests are successful.

4.2.4 Deployment & Governance phase

Scheduling management. The tasks can be executed manually, or a schedule can dictate when they should execute. Scheduling requires a dedicated analysis about when it is interesting to run the processes.

• Decide schedule for the process. The functional application manager executes, and the DevOps lead holds him accountable. The schedule has to be decided by the functional application manager.

• Configure the process to be scheduled. The functional application manager executes, and the DevOps lead holds him accountable. The schedule has to be configured in the Control Room.

Work queue management. Supervising that the automation is working as expected as well as managing the exceptions. Report the exceptions to the person that can solve them and work together to fix it.

• Detect and report exceptions. The functional application manager executes, and the DevOps lead holds him accountable. The correct functionality of the script has to be evaluated and continuously revised. In case everything is going well, actions are not required. However, if something is wrong or an exception happens a lot, this should be logged.
Analyse data outputs and evaluate results. The business analyst executes, and the DevOps lead holds him accountable. The benefits of the automation can only be realised if the data is analysed and understood. The expected business case may be lower than the expected, and this has to be taken into account.

**Change management**

- Assess responsible for solving exception. The functional application manager executes, and the DevOps lead holds him accountable. Once the exceptions are logged, they have to be assigned to a responsible that is going to fix them.
- Solve process related issues. The process owner executes, and the functional application manager holds him accountable. In case the problem is process related, it is handed to the process owner to fix it.
- Solve script and software related issues. The developer executes, and the functional application manager holds him accountable. In case the problem is process related, it is handed to the developer to fix it.
- Solve integrations to systems issues. The IT support executes, and the functional application manager holds him accountable. In case the problem is process related, it is handed to the IT support to fix it.

The entire “Deployment & Governance” phase is iterative. That means that per each process automated this phase will be done every specific period. The process needs to be rescheduled, the output has to be managed, and new input may require modifications to the script.

4.3 Roles

Once the phases are established, it is essential to identify the roles involved in them. The identification of the roles has been made in collaboration with KPMG consultants during the interviews.

Firstly, a stakeholder analysis was done. Stakeholders are “individuals, groups and organisations that have an interest and the potential to influence the actions and aims of an organisation, project or policy direction” (Brugha, 2000). Once different stakeholders were identified, their roles were extracted. The same role may be carried by different actors depending on the phase. Thus, the
business analyst that analyses what processes are viable for RPA can be a different person that the business analyst that analyses and reports the data during the governance phase. Sometimes the same actor may carry different roles. For instance, in a small company, the developer and the business analyst can be the same person. Also, consultants are very versatile and can also have different roles during the project.

Tracking each actor is a very complex task and out of the scope of this thesis. For each different implementation, different personal names would have to be identified and analysed. Instead, the approach that is going to be used is identifying the roles and assess the interaction between them.

The roles during an RPA implementation are the following.

- The **business analyst** is in charge to analyse data. During the implementation, the role is in charge to assist in the analysis of the different RPA vendors and interact with them regarding offers and live demos. The second responsibility is the assessment of suitable processes to be automated. Finally, he is also in charge of analysing the data and the outputs of the automation and reporting the benefits.

- The **process owner** is the responsible for the proper execution of the process. Before starting the automation project, he was in charge of ensuring that the process was doing what it was supposed to do. The process owner knows what activities form the primary processes. He assists in the development of the Process Definition Document as he has the expertise regarding how the process is executed. He is also involved during the UAT, and he is accountable for writing the requirements for the test and then evaluate the output.

- The **technical architect** decides and evaluates the IT requirements that the process to be automated needs. He is also responsible for ensuring the correct set up of the software provided by the RPA vendor.

- The **development and operations lead** is the contact role that coordinates the development and governance of the RPA solution. He ensures that the RPA project from a technical point of view is developed successfully.

- The **developer** writes the script to automate processes. Each type of vendor has different layouts and platforms, so a level of expertise is required to be a developer. He also fixes
performance problems discovered during the script testing and has a saying about the technical requirements of the vendor and the synergy between the process to be automated and RPA.

- The **tester** is in charge of testing the scripts to prove its robust functionality. He records the issues, and problems found, and if required, they send it back to the development phase in order to fix the bugs or malfunctions. He is involved in both the verification test and the UAT.

- The **IT support** is the role responsible for setting up and maintaining the IT infrastructure required to govern and run the RPA solution. Furthermore, he may also be responsible for fixing IT problems if they appear when the solution is already in the production environment.

- The **functional application manager** is in charge of governing, managing and scheduling the tasks to be executed once the RPA solution is already implemented. They report how the tasks are being performed and assign exceptions and issues to specific roles so they can fix it.

- The **RPA project manager** is the coordinator of the RPA project and usually assigns and supervises the implementation as a whole. He reports to an upper manager, that can be the section manager or higher management in the company. Besides controlling and holding actors accountable, he is also responsible for the final selection of the RPA vendor.

- The **section manager** is responsible for specifics areas of the business. Depending on the process and area the RPA is automating, the area will change. For example, areas like procurement, finance, human resources or information technology. They usually report to higher management that is not directly involved in the RPA project but is interested in the outcomes and the evolution of the project. He usually holds accountable the RPA Project manager and his responsibilities include the decision of what process are going to be developed and the signing off of the approval to incorporate the automation in the production environment.

4.4 Case analysis

The cases selected are all full implementations of RPA projects, not “Proof of Concept”. Interviews have been used to analyse implementations done by KPMG at different clients. Each interview focuses on a different client managed by a different consultant.
The following subsections cover each case and the main insights collected regarding the phases and subphases of the model. For each case, a brief anonymized introduction of the expert interviewed is introduced. The interviews are ordered chronologically. Thus the RPA implementation in a commercial bank was the first case, and the RPA implementation in a dairy producer company was the last. To add more insights on what was discussed in the interviews, the statements made by the interviewees are presented in italic and centred style.

In the following chapters, the main findings each interview provided are going to be discussed. For a copy of the full transcripts and the NVivo file with the analysis, contact the author. The mind map for the model modifications can be seen in Figure 16. The map capture all the codes used to organize the ideas and analyse the content of the interviews.

4.4.1 Study of an RPA implementation in a commercial bank

The client is a commercial bank based in the Netherlands, but operating in different European countries. The client needed to reduce costs and to do so they first fired several FTEs. However, the remaining employees had to absorb the tasks the previous employees were doing, and that meant an important increase in their workload. The company approached KPMG in order to automate some processes using RPA in order to ease the workload of the remaining employees. One of the processes automated consisted of the reconciliation of clients portfolio reports by copying the data of the reports into a different analysis template to then reconcile internal data of the bank. The client decided to use Blue Prism as the vendor for implementing RPA.

The consultant interviewed has a background in economics, and she has been working in the consulting world for more than two years. The feedback from the consultant on how to improve the model can be seen in Table 10

<table>
<thead>
<tr>
<th>Requirements &amp; Analysis phase</th>
<th>Development</th>
<th>Testing</th>
<th>Deployment &amp; Governance phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>The document where the technical steps are described is non-existent. Instead, suggested another approach</td>
<td>Suggested changes in which roles carry what activities</td>
<td>Discarded the use of the smoke test and approved the others</td>
<td>Agreed, added that governance is an endless process, not only once per implementation</td>
</tr>
</tbody>
</table>

*Table 10: feedback from RPA implementation in a commercial bank regarding the model*
The main insights were regarding the first phase where the technical document was not done in the project. However, the consultant mentioned that it should be done before the development and that usually the process owner and the developer sit together to discuss it. Regarding the testing, the consultant said that the smoking test is not used or done in the standard projects. Only the UAT and the validation test. Also regarding testing, the consultant mentioned that the section manager usually signs off the release to the production environment without actually knowing how the solution is performing. The section manager trusts another role although if the process fails he is the role accountable for it. The consultant reflected this point with an example.

So, let's say we automated a process of finance, then Jimmy is the finance worker but his manager, Anika, should sign off. But Anika does not have time to see it, so she completely trusts Jimmy.

This type of trust without controls may be risky. In the example given by the consultant, what if Jimmy decides to send to production an automation that is not beneficial for the company? The comment also raises the concern that maybe the sign off of the section manager may be not necessary at all.

Finally, the consultant suggested that the governance of the process is not a one-time situation but a continuous loop.

4.4.2 Study of an RPA implementation in a logistics company

The client studied is a logistics company based in Germany but operating all over the world. The objective of the client was to reduce manual work in order to reduce cost and professionalise the service. One of the targeted processes was the automation of the new supplier's data introduction in the External Resource Planning (ERP) vendor. As a vendor of RPA, the client decided to use Blue Prism.

The senior consultant interviewed has a background in finance and three years of experience at KPMG. Her main focus is on RPA and operational excellence and she has done numerous RPA projects in multiple industries.

The feedback from the consultant on how to improve the model can be seen in Table 11.
Table 11: feedback from RPA implementation in a logistics company regarding the model

The consultant introduced the idea that if the model was representing the implementation of a whole project, the actions regarding preparing IT and selecting an RPA vendor should not be done more than once. An RPA vendor is selected once per project and it is used to automate all the processes.

The consultant also suggested that how the model was representing the development phase was only including Blue Prism, and thus, excluding UiPath or other vendors. Regarding the testing, she explained with more detail what the validation test and the UAT meant and how the testing was organised. The consultant provided the following insight why both tests are important.

For example, he (the process owner) would not see from the code or from the process this script is actually going to send a thousand euros to the developer on each item (the consultant laughs). And this is something that the second developer can assess.

The example shows that while the UAT is focused on assessing if the outcome of the automation is the one expected, it does not pay attention to the script itself. The verification test is an analysis of the script in order to prevent malpractice. As the consultant mentioned, a script that automates the process successfully, but it also executes other actions that are not beneficial for the company, can only be assessed by a technical expert and not by the process owner.

The consultant explained the different roles involved in the testing process and suggested that the last phase should include an exception management sub-phase. She added that once errors or changes are required, there is a process of assigning each of them to different roles to solve them.

Exceptions could have different causes. So it could be related to the design of the process. And then would be something that the developer could solve but could also be that the input of the data, the quality is not right. Could also be that there might
be a technical problem with the application for example that we are working in. So depending on the cause of the exceptions there would be different actions.

4.4.3 Study of an RPA implementation in an energy company

The client studied is an energy company based and operating in the Netherlands. It provides an affordable and reliable energy distribution and transport to their clients. The client was interested in RPA, so the employees did not have to do repetitive and boring tasks. Also, they were looking to reduce mistakes while executing the processes. Cost reduction was not the main driver. However, the company has realized the potential cost savings attached with RPA and is studying starting to implement more projects with this objective in mind. They would continue the implementation with the same RPA vendor they started with, which was Blue Prism.

The position of the expert interviewed is a senior consultant. His background is in international financial management and has been consulting for more than three years in the area of Robotic Process Automation in combination with LEAN methodology.

The feedback from the consultant on how to improve the model can be seen in Table 12.

<table>
<thead>
<tr>
<th>Requirements &amp; Analysis phase</th>
<th>Development</th>
<th>Testing</th>
<th>Deployment &amp; Governance phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduced the role of “process owner” and specified how different it is from BA</td>
<td>Suggested to represent the phase differently to also include different vendors</td>
<td>Clarified UAT and validation test. He also suggested important changes in roles.</td>
<td>Suggested the addition of benefit management at the end</td>
</tr>
</tbody>
</table>

*Table 12: feedback from RPA implementation in an energy company regarding the model*

The consultant suggested that the role business analyst was doing too many things and that some of them were actually done by the process owner. Until this point, this role was not used in the model.

Someone who is managing the process that is going to be automated now, so the process owner. He is the responsible for this process although it is going to be automated by a robot (…) He is responsible from a business perspective on how the solution must look like. But in the beginning, you do not know what processes you will automate because you have not selected the processes, so you need to have someone from the business who represent the whole of the business.
The process owner was incorporated into the model thanks to these insights. The consultant raised a similar point from the case of the logistics company and suggested that the development phase should be simplified in order to englobe more generic vendors and not only Blue Prism.

*Objects and processes relate to Blue Prism. Perhaps you could change the name to activities or processes, sub-activities or building blocks, so it also relates to other RPA tools.*

The consultant explained better how the criteria for the UAT and the validation test were decided.

*(Regarding the UAT)* So you commonly create criteria with the two of you. You have to make a list of these the criteria that we are going to expect out of that test. Then you are going to execute the test, and then you will show the results and log them. *(...) And for the verification test, the technical test you already have the criteria in place. That is already created as part of the governance. You have let's say three or four criteria in which you are going to test every process. The scripting standards are rules to check if the script is doing exactly what it has to do.*

Therefore, the interviewee contributed with the insight that for the verification test there are standards that KPMG brings as part of its expertise and that the criteria of the UAT are decided for each project.

Finally, the consultant added a similar addition than the previous interview regarding the change management.

*So depending on the results of the processes that were run it is either a business exception or a system exception or a script related exception. And based on any of these types of exceptions it is going back to the developer, it is going back to the IT or going back to the RPA team.*

Both insights from this case and the study of a logistics company helped to create the change management phase in the model.
4.4.4 Study of an RPA implementation in a coffee producer company

The client where the RPA implementation took place is a coffee and tea producer based in the Netherlands. The company wanted to automate the end-to-end process regarding cash applications. For example, one of the processes automated was the preparation of the bank deposits. The objective of the client when using RPA was to reduce cost related to labour and automate mundane and boring tasks. The vendor selected by the client was Blue Prism.

The senior consultant interviewed has a background in finance and has been working in the field of RPA for more than three years. He is an expert in governance and management of the overall RPA project.

The feedback from the consultant on how to improve the model can be seen in Table 13.

<table>
<thead>
<tr>
<th>Requirements &amp; Analysis phase</th>
<th>Development</th>
<th>Testing</th>
<th>Deployment &amp; Governance phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Segregation of roles. The process owner cannot suggest alone what processes to do because he is blind.</td>
<td>Clarification on the development phase and suggested that KPMG tries to be agile</td>
<td>Explanation regarding sign-off and that the requirements of the UAT have to be decided</td>
<td>Change some wording and insight about why IT integration not required</td>
</tr>
</tbody>
</table>

Table 13: feedback from RPA implementation in a coffee producer regarding the model

The consultant gave an interesting and important insight regarding accountability and the segregation of duties. When the model was presented, the whole selection of processes to be automated was made by the process owner.

So where you ask the process owner, please assess suitable processes. But I think there is more. I think if you do this, what you are getting in real life are issues that this process owner has. So the process owner may have a full end to end process where in one part he is in control it is all fine. There are twenty people doing manual work, repetitive stuff. And there are five people that are doing work he or she does not really understand; he is not in control. This person will always point you towards these five people and not towards the twenty that are doing repetitive stuff. This person will always try to solve his issues rather than go for the stuff that he or she is in control. So, if this works and you are going to make this person happy but what
you need on top is an analysis of where are the people in these teams and where are the processes that we can automate.

Thus, this comment allowed to understand the importance of adding different roles to the process selection to make it open and as efficient as possible. The same role that was assessing what processes were suitable for automation could not be the same that was prioritizing and accepting them.

He also suggested that KPMG tries to develop agiler, but it still follows the waterfall model. Regarding testing, he gave more explanation on how the sign-off works and that while the verification test has a set of guidelines that have to be followed every time the UAT is decided every time with the process owner. He will draw the requirements to consider the script finished and ready to be integrated into the production environment.

Finally, the consultant added a comment regarding a phase of the original model. The phase was integration with IT systems, and he suggested that if the model tries to be a generic representation of an ideal process, IT integration should not be required. If IT is done correctly since the beginning, that step would not be necessary.

No, I think this should not be there. At least not in a model. It may happen in real life but if your model early on failed, because then your sort of IT infrastructure or setup, something in development or testing has gone wrong. If you have a testing environment and a live environment and you release you should not be doing anything with IT support.

4.4.5 Study of an RPA implementation in a dairy producer company

The client is a dairy producer based in the Netherlands but with a presence in different countries. They approach KPMG seeking support to learn how RPA worked and to implement processes. KPMG trained resources in the company on how to implement RPA processes and carried training on the job where multiple processes were automated. Some of these processes were related to the modification of data in an ERP system or the creation and printing of invoices. The company wanted to continue with their RPA efforts after KPMG left. This was the first implementation where KPMG used UiPath as a vendor, and it is the only case in this research that used that tool.
The consultant interviewed has a background in Business Information and Financial management. He has been working as a consultant for almost four years, and he has been involved in RPA projects for about a year.

The feedback from the consultant on how to improve the model can be seen in Table 14.

<table>
<thead>
<tr>
<th>Requirements &amp; Analysis phase</th>
<th>Development</th>
<th>Testing</th>
<th>Deployment &amp; Governance phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suggested different roles involvement, specially project manager and section manager</td>
<td>Agrees that PDD should be very detailed but was not the case</td>
<td>Insight that they were testing without script finished. Hard to do code review because there were no other experts</td>
<td>Change wording of exception handling and grant access to process owner to see results</td>
</tr>
</tbody>
</table>

Table 14: feedback from RPA implementation in a dairy producer regarding the model

The consultant comments about the first phase were mainly around the role of the section and project manager. During the development phase, he agreed that the PDD created in the previous phase should be very detailed, but was not the case in the case of study. Regarding testing, the main insight was that during the project they started testing with the script functioning but not finished. This may raise awareness on the validity of a test done on a not completed script.

So we deliver the complete script. Maybe not complete because sometimes you just wanted to test in another environment, so we thought it was ready, but we did not know for sure it was. Here is 90% script and we just see what happens.

He suggested the rewording of some phases to adhere to the terminology used in the field. Specifically, he suggested that the “exception handling phase” was renamed to “change management”.

When I think about exception handling, I think that it is done in the script already. So you implement exception handling to make sure you can make your change management easier. The better exception handling you have, the less change management you need to do.

As it can be seen in this last case, the main insights provided regarding the model were mismatches of the case versus the model instead of improvements to the model. Due to the general improvements by previous interviewees, this last interview was more about how the process did
not adjust to the model and not the other way around, which can be considered a proof that the model is better than when the research started.

4.5 Validation of information and new insights

Several assumptions and affirmations have been made during the thesis and needed to be validated. During the interviews, a group of six questions were asked in order to clarify the insights and add new information to give more relevance to the thesis. The results and what each interviewee said is laid out in Appendix G.

The first question was to know about The type of robotics implemented at KPMG is mainly RPA. Some of the consultants said that some governance frameworks of more advanced solutions had been done. Also, they commented that the possibilities of enhanced RPA are being explored and some projects may start to try proofs of concept to implement them.

As far as I know, it is a one hundred per cent RPA. At least in our team. I know that there are some developments towards enhanced and cognitive. So cognitive from more data analytics type of projects are running. And then the enhanced part is chatbots. (...) But I think it is really development phases.

The fact that almost all robotics projects are focused on RPA supports the statement that it is a very relevant topic. Although it may evolve rapidly in the future, right now there are not that many implementations of advanced robotics.

The second question asked about the opinion of the interviewees regarding the capability of KPMG to assess accountability during an implementation. The opinion was dispersed. Some suggested that there was no problem but risks.

I do not think we have had specific problems, but there is a risk. So far it is going well, but I do see that it will be good if people are aware of the accountability they have and where the risks are.

Others expressed a high level of concern and doubts regarding the actual efficiency of a RACI matrix as a methodology to enforce accountability.

We define RACI models, and we use side models to sort of describe the process, the suppliers and the customers of the process. But there is a difference between
assigning responsibilities, so just writing down that someone is responsible, and a person actually taking responsibilities.

A follow-up question was if they knew about any methodology KPMG uses to assess accountability. Almost all the interviewees identified the RACI matrix as the main tool used in every project.

The interview continued with a question regarding the main phases of an implementation of RPA. The interviewees were presented with both Figure 9 and Figure 10, and they were asked to provide feedback. All agreed it was correct, but they provided different insights. One of them suggested the creation of a fifth main phase to capture the value of the automation.

I think there is a fifth one which is more of value management. So, benefit tracking and how better the process is now. And revising periodically whether the benefits are still there, whether the process has to be reconfigured. So it is more about the long term. And I think this ends at deploying. So once you have the process in production and you have done the governance around it, I think there is this fifth step.

The insight was taken into account, and instead of a fifth phase, a loop in the deployment and governance phase was added where the data of the output is analysed, and the results are evaluated.

Another suggestion is that the model looked very sequential and it is not always like this.

People are developing in the local laptop, and at the same time, they are trying to get the IT environment ready because they do not want to wait for the IT environment. Because it can take time. (...) So it was a little bit more parallel I think.

The insight was acknowledged, however, with the structure of the ABD methodology it is hard to reflect. In fact, what the consultant introduced may be a usual situation, but it is not the ideal one. The model tries to represent the perfect implementation of RPA, and each specific case should be treated separately.

A question regarding the roles and involvement followed. The feedback was very diverse and allowed to discover new roles that were later added to the model. After the collection of all results, there were some discrepancies between interviewees on the level of involvement of roles. The methodology followed to decide the final level of engagement was to ask the interviewee that
disagreed last about the reason and then evaluate the explanation to decide on the final level of engagement. The final result is presented in *Table 15*.

<table>
<thead>
<tr>
<th></th>
<th>Requirements &amp; analysis</th>
<th>Development</th>
<th>Testing</th>
<th>Deployment &amp; governance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business Analyst</td>
<td>High level of engagement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Process Owner</td>
<td>High level of engagement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technical Architect</td>
<td>High level of engagement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DevOps Lead</td>
<td>High level of engagement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Developer</td>
<td>High level of engagement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tester</td>
<td>High level of engagement</td>
<td></td>
<td></td>
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<tr>
<td>IT Support</td>
<td>High level of engagement</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Functional Application Manager</td>
<td>High level of engagement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RPA Project manager</td>
<td>High level of engagement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Section manager</td>
<td>High level of engagement</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Table 15: assessment of implication of actors depending on the phase.*

The results are in synchrony with the final model. Some of them may not be present in a specific phase of the model and still be represented by a “low level of engagement”. This is done to symbolize that the actor does not have an active part in the phase but is interested in the outcome of the actions.

The final question was *regarding the type of project*. All the consultants agreed that their project was mixed collaboration. That means that some roles were done by KPMG, some by the client and some as a collaboration.
5. Learning and Reflection

As presented in the model of ADR in Figure 4, the third phase of the method is learning and reflection. This phase is a critical approach to the methodology followed, the theory presented and the model created to detect new knowledge that spans further away from a specific solution and allow to solve a broader range of problems. The principle involving this phase states that the first design of the model and the research questions are modified by the new data collected and the use of the model.

In this chapter, the assessment of accountability using the model and the information of each case if going to be presented in Section 5.1. Section 5.2 covers an introduction into AI and how it may affect in the short and long term. Finally, Section 5.3 is a discussion about how the model would be modified in case AI becomes mainstream.

5.1 Assessment of accountability using the model

ADR allows the modification of the IT artefact as a fundamental part of the methodology, and as a consequence, the table to assess accountability keeps changing. As introduced, the table is formed by the activities and roles. If they change, the table also changes. This makes the comparison between cases harder than if the table was static. The hypothesis followed to carry the analysis is that after all the iterations the final model is better than the first. The modification of the model should not have affected the classification the interviewees made of the roles. For instance, if an interviewee commented that the business analyst was external, the fact that the actions carried by the role have changed due to feedback provided by another interviewee should not modify his externality. The same holds for the assessment of the impact of the activities.

In order to be able to assess accountability as it has been presented theoretically in Section 3.2, the hierarchy between the roles is represented in the following Figure 11.
The hierarchy will be followed when assigning the different types of accountability. Roles in the same layer will be considered to have the same level of strength of control. Several hypotheses have to be made. The first one is that the hierarchy between the roles does not change independently of the externality or internality of the role executor. Therefore, the RPA project manager will always be above the developer, independently if the RPA project manager is internal (the client) or external (KPMG consultant). The second hypothesis is that all companies name their roles the same way. Even though some corporations may define these roles differently, it is going to be assumed that there is a similar role and that it can be called with the names used in this report.

In Appendix D, the results collected in each interview are presented regarding the belonging of each role and the impact of each phase. In this section, the methodology to select what activities are going to be discussed was that at least three out of the five interviewees agreed on high impact. The focus will be on the type of accountability as well as what happens if the process fails.

The activities are selecting the RPA vendor, prepare and implement the IT architecture, selecting the processes to be automated, the development of the script, the User Acceptance Test, the work queue management and the change management.
Failing in selecting the right RPA vendor is relatively important. As some consultants noted, at the end RPA can always be developed independently of the vendor. However, the decision may not be the best regarding the safety requirements or the capabilities of the company. For example, selecting a vendor that does not offer the security certificates and compliances that the auditor requires could be a problem. The project manager will be held accountable by the section manager in case of a failure. The type of accountability between them is going to be bureaucratic, as they usually are both employees of the client where RPA is implemented. The section manager is higher in the chain than the project manager, and thus, has the power to control and impose accountability.

The preparation and implementation of the IT architecture is quite complex. If the IT fails, the automation is not going to work and may produce delays and increase the expected cost. There are two points to be discussed. The first one is the responsibility of the technical architect to design a robust IT infrastructure. The second one is the role of the IT support in setting it up. The technical architect has a double position: he is held accountable by the RPA project manager, and he holds accountable the IT support. In case the three roles are internal, the accountability type would be bureaucratic. However, the consultants mentioned that in several cases the IT support was an employee working for an external IT supplier company. In this case, there is still an upward relationship, but the strength of control is now low. This type of accountability is client-patron. Not delivering on what has been promised may suppose a breach of contract and the loss of trust. However, as explained by (Lindberg, 2013) “A client can request information and hold the patron accountable for the delivery of the kind of benefits promised as part of the bargain but is usually limited to that”.

Selecting the processes to be automated is crucial as the automation may not fail, but the benefits obtained from automating may not cover the costs. For example, deciding to automate a process that is not very repetitive and highly complex may lead to an underperforming automation that has taken a lot of time to be developed. Different roles are involved, but the one that decides what is prioritized is the section manager. This creates an interesting situation where the RPA project manager is holding him accountable. Regarding the hierarchy, the section manager is above him. Therefore, the type of accountability is business. Because of this, it may be hard for the RPA project manager to hold the section manager accountable in case of a mistake and there should be some regulations or good practices available to avoid this situation.
The development of the script is important to ensure a reliable automation of the process. Doing it correctly the first time may save money and time. Nevertheless, some interviewees had the insight that in fact, it is not that important because that is why the testing is there. If the script fails, it can always be rebuilt. The DevOps lead holds accountable the developer. The DevOps lead has always been a KPMG consultant during the projects. The developer has been both KPMG and employees. The type of accountability if both the DevOps and the developer are from KPMG is bureaucratic. However, if the DevOps is from KPMG but the developer internal, the relationship is patron-client. Although the accountor has more hierarchy than the accountee, the fact that the accountor is external diminishes his power. Usually, companies wanted KPMG also to train their resources so in the future they can do it themselves. So it is not unlikely that in the future the role of DevOps lead may also be carried in-house. This would mean the accountability type should be assessed again.

Regarding the testing phase, the consultants considered that the verification test was not as important as the User Acceptance Test. In case the User Acceptance Test fails to prevent a failing script from hitting the production environment, the results can be quite catastrophic. The script is interacting with real data of the business. If something is modified or changed, there is not an employee to hold accountable and only a robot. Thus, the tester is held accountable by the process owner in a relationship of peer professional.

There is a last safeguard before hitting the production environment. The sign off of the release has to be done by the section manager. However, two things may trump this situation. The first one is that the one holding the section manager accountable is the RPA project manager, and their accountability relationship is business. As explained before, this means it is hard to enforce accountability by the accountor. The second one is that insights from interviews suggested that this process was not that useful and that at the end what happens is after the approval from the process owner of the UAT, the section manager signs without verifying if the information is true or doing a double check.

Regarding the work and queue management, all the interviewees agreed it was highly important to ensure their proper functionality. In case there is an exception that is not properly handled, the process can keep failing or making mistakes and having a real impact on the business. An external KPMG DevOps manager is supervising the internal functional application manager. This situation
is similar than in the development phase, with an accountability type of patron-client. Again, it may be hard for the external actor to enforce accountable the internal actor.

Finally, the change management has also been considered by all the interviewees as highly important. This phase is determined as important because if the client is able to detect scripts that need change, but then it does not fix them well, it is like they were not detected. The DevOps lead holds the functional application manager accountable, which is a similar situation than in the work queue management. However, the functional application manager is also holding accountable the developer, IT support or process owner depending on the type of change. The relationship is peer professional, for the activity of fixing the exception and bureaucratic for the activity of assessing who has to solve the exception.

5.2 A look to the future: an introduction to AI

The research has covered until now mainly RPA without much advanced artificial intelligence. As has been discovered in the interviews, KPMG has only implemented basic RPA. In this chapter, more detail about AI will be discussed as well as its implications for RPA and specifically how the processes and roles in our model would change.

The interviewees had several suggestions regarding the future of AI and RPA. The consultants had different views on how AI will impact RPA. One of them mentioned that the different vendors are partnering with giants in the technology industry such as Microsoft to add functionalities to their current offering.

_It is done throughout the supplier itself. In this case, Blue Prism is going to work together with companies having AI included in their products, and they are going to partner. For example, Blue Prism is partnering with Microsoft. Microsoft has some products with AI included, and since they are partners, they can include it as part of their product._

This could speed up the rate of adoption of AI as important technology companies are backing it up. The specific functionalities of AI discussed that the consultants believed may produce a big impact are separated into two groups. The first one is machine learning and natural language processing to allow the RPA script to understand exceptions and learn autonomously how to solve them.
I think there will be some machine learning. It will be an interesting part. Is there some way to improve the robotic process by learning from exceptions automatically instead of the developer always going back and forth and adding exceptions or improvements to the process? This is something that you maybe can do with machine learning. Well, and also natural language processing.

The second one is the integration of RPA with process mining. Process mining is a technique that uses data mining in order to identify trends in the process and to get insights on what can be improved and will reap the maximum benefits.

Yes, I think if you can transfer that way the process mining capability will be integrated into RPA causing that you will not have to develop the process. I think that there is perhaps the most sort of easy integration with RPA and I think there is, you know, the workflow that is going to combine the tasks and manage basically the RPA side with AI type of activities. So I see a lot of value in combination.

AI was introduced at the beginning of this thesis. Nils Johan Nilsson, one of the founders of the research field in artificial intelligence, presents in his book a more broad definition that the one given before. “Artificial Intelligence (AI) is concerned with intelligent behaviour in artefacts. Intelligent behaviour, in turn, involves perception, reasoning, learning, communicating and acting in complex environments” (Nilsson, 1992). Thus, for Nilsson AI is capable of acquiring information from the real world (complex environment), understand it and act accordingly to achieve a goal previously programmed. AI can be better than humans at doing this tasks. For example, Watson, a software created by IBM Corporation beat the champions of a TV quiz show “Jeopardy!” (Markoff, 2011). Watson uses natural language processing to understand and answer questions.

Watson would be categorized as an Artificial Narrowed Intelligence. A lot of books have been written about the three main levels of Artificial Intelligence. One of those is (James Barrat, 2013) where Artificial Narrowed Intelligence (ANI), Artificial General Intelligence (AGI) and Artificial Super Intelligence (ASI) are introduced.

ANI is an Artificial Intelligent software specialized in a specific group of tasks. In fact, all the AI currently existing is ANI. While Watson may be really good at answering questions where the knowledge is already created, ask it to draw and design a house like an architect would do, and it
will fail miserably. AGI is the next level after ANI. It is the artificial intelligence capable of doing any task at least as well as a human will do. Experts in AI classify that AGI is going to be reached when consciousness can be attributed to machines (O’Rourke, 1993). Finally, ASI proceeds AGI and is the moment where AI will surpass the brightest minds of humanity in all fields. (Good, 1966) puts it forward in the following statement, “The first ultra-intelligent machine is the last invention that man need ever make”.

Experts surveyed regarding the timeline of the transitions believe that there is a fifty per cent probability of achieving AGI in 2040 and a ninety per cent probability to do it in 2075. The same study shows that experts believe with a seventy-five per cent likelihood that ASI is going to happen thirty years after AGI. Thus, being quite conservative on the opinion of the experts this would situate ASI around 2100. (Muller & Bostrom, 2014)

This introduction to the future of artificial intelligence has been presented to give an overview of how a lot of things may change and the future is highly uncertain. There is a lot of discussion about ethics on artificial intelligence and that if not managed well, artificial superintelligence could be a potential threat to human life and lead to extermination (James Barrat, 2013). However, it is out of the scope for this thesis how AGI and ASI could be reach and the consequences of their arrival. Therefore, only the effects and consequences of ANI will be covered in this thesis. Therefore, how the evolution of current ANI systems and an improvement on its integration with RPA may affect the implementation of the later will be discussed.

An easy to integrate and better ANI means that the cognition inherently unique of humans can now be achieved by a machine. ANI is specific, so probably multiple systems will have to be integrated to do the different parts. In fact, some vendors are already experimenting designing they own AI software or implementing the RPA software with renowned AI software producers like Microsoft or IBM.

Two horizons can be distinguished. The short term, which means the next ten years and the long term, covering developments in the next thirty years.

5.2.1 Short term

In the short term, it is expected that the current functionalities of RPA will be enhanced and eased by the implementation of AI (Le Clair, O’Donnell, McKeon-White, & Lynch, 2018). The use of
AI will allow to tackle more complex processes and ease the implementation of them. However, the decision making of humans and intervention will still be as necessary as it is now. In this sense, AI will be more like a supporting and enhancing tool than an autonomous one. Some improvements that AI already can bring to RPA but are still not fully integrated are the following.

- Improvement of data and text mining of unstructured contents. This will allow automating processes where the data is not presented in a structured way. Moreover, the increase in performance of algorithms to read and understand data will reduce the errors produced by RPA, and this will decrease the time invested in work queue management.
- Improve in analytics merging better visualization for an easy understanding as well as processing of huge amounts of data. This will again decrease the time spent on this task.
- Merge with other information technology management solutions such as process mining. Process mining is a subfield of process management that allows analysing the business process currently executed in a company by checking the reports and logs in the information system of specific processes. Data mining and algorithms are applied to detect trends and frequency. A currently discussed application of process mining is to integrate it with the development cycle of RPA to facilitate the analysis of highly repetitive and simple task to automate or to allow to detect the ones that may be less repetitive but very time consuming when have to be done.

It is not expected that in the short term the development and testing phase will be highly disrupted by AI. Furthermore, it is not expected that this type of improvements will change the cycle of accountability. As stated before, this first wave of AI facilitates the work to employees but does not make decisions for them. The final decision still relies on the employees. Thus, the model may change in terms of new activities and roles, but there would still be an accountor and accountee for each action. For instance, the role “data provider” is quite likely to be in the model once machine learning is used. This role would have severe accountability issues as several papers have proven that machine learning algorithms are as good as the data they are inputted (Diakopoulos, 2016).

5.2.2 Long term

It is really hard to estimate what is going to happen regarding AI in the next thirty years. A discussion could continue on the potential advancements of AI and speculation on incremental or
radical improvements to come. However, the most tangible advancements have already been discussed in the short term section.

Hypothetically, if different ANI become really good at the specific tasks discussed in the model required to select, develop, test and govern the automation of a process and the integration between the different ANI is doable, RPA implementations could happen without human intervention. Even the development or testing of the new software would be able to be done by the ANI itself. Although this may seem not possible, the field is advancing, and Google has already developed a limited AI capable of writing new software (Simonite, 2017). For the following discussion, the hypothesis that ANI will be able to do all task involving an RPA implementation in the long term future will be accepted.

Nonetheless, the situation in which the software alone governs a company and does not need any input from humans feels quite unrealistic when thinking of only ANI systems. AGI and ASI probably would be able to do so, but they are out of scope for this research.

5.3 AI governance using the model

Looking at the short term, it is likely that the tasks will remain the same but with new functionalities. For the long term, things could be very different. For both long and short term, the hypothesis to govern AI in an RPA implementation using the model is that the AI was developed following ethical principles. AI being ethical means that the software replacing tasks previously done by humans would consider how a human would judge a task when executing it. The main attributes relatable to this are responsibility, transparency, auditability, incorruptibility and predictability (Bostrom & Yudkowsky, 2011).

- Transparency. The process to reach outcomes and decisions should be understandable and available.
- Auditability. Related to transparency, besides the outcomes being available, it should be easy to track them and corroborate they actually did what they said they did.
- Incorruptibility. Manipulating and modifying the AI should not be possible. It also should not be possible to allow the software to modify itself without humans being aware of it.
- Predictability. The outcome of the AI agent should be predictable within a certain range.
• Responsibility. Someone should be responsible for the outcomes of the ANI and avoid blaming the AI software if something goes wrong.

In the short term, the model would not change. If some of the actors are implementing AI to facilitate the tasks humans are required to carry; someone still would be held accountable for the wrong-doing of the algorithm.

However, in the long term, the situation would be different. As discussed, ANI is not able to govern a company alone. However, it is not that unrealistic to believe that only a person could be in charge of ordering to implement RPA and then the software would do all the tasks necessary to do so. It is, however, not ideal. This would mean that assigning the fifth point of ethics development of AI would be hard. Moreover, the other points would not be important because there would not be anyone to check them. The following model in Figure 12 is proposed for the future.

![Figure 12: meta-model with ANI agents](image-url)
This structure allows assigning responsibility at each level. The section manager orders the project manager to implement RPA. The project manager coordinates the different roles that will supervise each subgroup of processes to achieve the automation. Each of this roles requires a different level of expertise, and hence, they have been categorized differently. However, a sufficiently skilled actor could execute more than one role. The new phase is an assessment of the responsibilities of each responsible. Thus, each responsible can be held accountable for the performance of the AI agent. However, the responsible cannot hold the AI accountable. In this sense, the model would not be perfectly accurate as all the actions where a responsible and an AI agent are involved would not be representing a relation of accountor-accountee but instead of only requestor-executor.

The first four characteristics of an ethic AI agent allow the responsible of each area to have full access to the decision making cognition of the algorithm and understand it. The fifth one, responsibility, is achieved by adding the last step where the project management has the power to hold each responsible accountable. Even if the hypothesis that the AI agent can do all the tasks is proven wrong, the model still will hold for those specific tasks the AI can carry while for the others the original model could be used.
6. Formalization of learning

The final stage of the ADR methodology is the formalization of the learning. The scope of this research was very much practice focused and not enough abstract reflection can be made to create a general theory to support other research.

Although new theory cannot be created, the results from the research can be shared so other researchers that find it interesting can build on it. The model has already been discussed, but not the results from the table used to collect the severity and type of accountability of the relation between the different external and internal roles.

6.1 Managing the external roles

In the cases that have been covered, an external party besides KPMG has appeared recurrently. The role that this outsourced party carried was the IT support role. A specific IT services provider appeared twice. Managing the relationship with these parties is important regarding accountability because the strength of control is low.

The first thing to analyse is the reasons behind outsourcing IS services. When a company wants to outsource something it has to evaluate why and what is going to be outsourced. Information Systems has three main tasks: ensuring technical capability, delivering on the business requirements and governance of the IT systems (Feeny & Willcocks, 1998). A fourth task would be managing the external suppliers if they exist. Most of the companies cannot fulfil these tasks on their own, and that is when they decide to outsource.

Two solutions are presented to increase the governance of the external suppliers.

The first one is trying to minimize the company dependence on their services. (Willcocks, Reynolds, & Feeny, 2007) propose a group of capabilities that allow accomplishing the four main tasks of the IS department. The capabilities and how they interrelate is presented in Figure 13.
The same authors propose three areas that should be improved in order to build and improve the capabilities. These are culture, structure and process. Culture refers to how the company sees IS infrastructure, process refers to how problems are defined and solved and structure focuses on how the company is organized and roles assigned. By balancing the mechanisms just introduced, prioritizing which capabilities the organisation is missing, putting effort in developing its own IS capabilities while outsourcing the low-risk services the company has a good opportunity to increase the development of this capabilities in-house.

The second solution is to be more aware of the current situation regarding the IS external actors and take advantage of the position. Most of the times, contracts are drawn without paying enough attention to who is responsible for what in case unexpected situation happen. Defining different scenarios can be a tool to have bargaining power over the external actor. It is important to remember that the strength of control over the external party is low. Hence, most of the time you
may be able to enforce a contract by law, but not more. Handling these actors accordingly is important to build trust and ensure a more transparent accountability relationship.

6.2 Segregation of duties

Consultants were asked during the interviews to provide insights on the view of auditors regarding RPA. In all the cases the auditors did not consider necessary to evaluate the RPA script thoroughly. In one case, the external auditor checked how the implementation was done but did not evaluate the script. In another, the auditor considered that RPA did not have enough effect on the business and that it was not necessary to analyse.

'We had a meeting and basically our conclusion is that it is not material, so the impact of the RPA solution at this point with the scope does not hit materiality. And basically that means that the platform does not have to, from an external audit point of view, comply with GITC standards yet. (...) But then if it becomes material, then they would audit it.'

However, most of the clients discussed that they were aware the auditors would want to know more and scrutinize the scripts in the future. Being ready for when this happens was a concern.

'At this point no (they are not doing it), but they are aware that at some point the auditor wants to know. (...) At this point, they are kind of pragmatic. Like, we want to get some bots running, and we will deal with the auditors later.'

One of the practices that auditors appreciate regarding software development is ensuring the segregation of duties. Segregation of duties purpose 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 chances of collusion are minimized by assigning individuals of different skills or divergent interests to separate tasks” (Gligor, Gavrila, & Ferraiolo, 1998). Although the model presented assigns roles and not actors to each task, it is argued that it can be used to compare what was planned during the implementation and what actually has been done. The model would act as a reference to compare reality versus what was planned. If reality differs too much from the model, then a throughout analysis would be necessary to check if the steps followed during the implementation were still compliant. In case the implementation already follows the model, then audit would have an easier time checking if their requirements were met.
If the implementation is done following the model and assigning a different actor to each role, then the segregation of duties is ensured. Nevertheless, especially in small implementations, it is common to see an actor doing several roles. For instance, an employee may be the developer, the tester and the process owner.

It is hard to enforce the segregation of duties if the human resources available are limited. However, it is strongly suggested that the critical actions are protected by the segregation of duties. Those actions that may have an influence on the normal operations of the company are considered important. Thus, both testing and governance phase should be enforced.

If because of not respecting segregation of duties there is a failure in the requirements and analysis phase or the development phase, the failure can usually be fixed in expense of time and delays. For instance, if because the process owner and the business analyst are the same actor and he favours a process of his interest, the business at the end is not going to suffer greatly from this action. It may be the case that the RPA efforts are not placed in the best process to be automated, but it is not likely it goes further than that. Regarding development, any malpractice should be detected during the testing. That is the reason why segregation of duties should be enforced during testing.

Regarding the deployment and governance, the argument is similar. In case there is malpractice, someone different needs to hold that role accountable. In case this is not done, the consequences can be that a process that is not working as expected keeps being defective and no one takes responsibility to fix it.
7. Conclusions

Robotic Automation Solutions are a very relevant topic in the corporate world right now. RAS allows to improve efficiency, reduce cost and increase quality. Almost all of the projects carried until now are Robotic Process Automation, the simplest version of RAS. However, it is expected that in the future AI will be more present enabling enhanced and cognitive robotics. Several papers have covered the concerns regarding the assessment of accountability of systems that use AI. These papers present several situations and concerns, but fail to provide a solution.

The hypothesis for this thesis is that a better understanding of RPA implementation processes will allow humanity to be prepared and ready for AI in the future. Thus, the objective of this research has been the following.

The main objective of this research thesis is to develop a model to assess accountability in an RPA implementation using state of the art design methodology to map use cases in collaboration with KPMG.

The principal outcome of this research is the model for an RPA implementation, the roles and activities involved and a methodology to assess the accountability between the roles. The final version of the model can be consulted in Appendix F. The following sections will cover with more detail what are the contributions of the research and specifically of the model.

In section 7.1 an overview of how the research questions to support the main objective have been answered. The practical and theoretical contributions of the thesis, as well as the limitations, are laid out in Section 7.2. Section 7.3 covers recommendations to KPMG and further researchers. Finally, a personal reflection of the research is presented by the author in Section 7.4.

7.1 Overview of research questions

Five research questions were introduced in section 2.3. This section is going to review them and present how the research has answered them.

Q1 – How is accountability assessed in an RPA implementation?

It was found that at KPMG, the most frequent way to assess accountability during an RPA implementation was using the RACI matrix. The drawbacks regarding the use of the RACI have
been presented compared to the final model. Firstly, RACI matrixes fail to define accountability clearly. Thus, accountable in RACI means making sure the responsible carry their task. However, it is not clear to whom the accountable answers to. The methodology fails to establish who is the accountor that will hold accountable the role in case they fail in their task. Secondly, RACI introduces the four roles, but it is not mandatory that all of them are filled. Thus, in some situations, it is common to see a responsible for a task but no one that holds them accountable. The identification of the methodology used by KPMG during an RPA implementation and the drawbacks associated with it allowed to reinforced the relevance for a new tool to assign responsibilities during an RPA implementation.

Q2 – How can accountability be reflected in the artefact?

The research has discussed accountability from a theoretical point of view, and then a practical use of the theory has been introduced. This practical used is based in a table to identify the different types of accountability depending on the impact if the activity fails and if the roles are carried internally or externally. The results have been drawn, and the consequences of each type of accountability presented. It is specifically of interest that the model allows detecting bottom-up relations of accountability and management of external roles. Firstly, someone with a lower hierarchy may have to hold accountable someone above him. This produces a situation where a low power role may have to enforce accountability on a boss or a superior. Secondly, sometimes external roles may have to hold accountable internal roles or vice versa.

In this type of situations, the accountability relationship is weaker than, for instance, a boss holding an employee accountable. Special measures discussed in the research such as how to manage the external roles and how to ensure segregation of duties are introduced to give guidance on how to carry a more robust RPA implementation project.

The conclusion is that the model together with a table to process the data is useful in detecting this weak spots as well as analysing all the roles and activities involved during an RPA implementation. It proves to be a solution to the problem presented in the previous question.

Q3 – What roles and activities should be included in the model?

This question was englobed in the phase of building, intervention and evaluation. The solution to the question was reached via literature review and expert insights from the interviews. Having the
right activities and roles was very important in order to have an accurate model. A first iteration of the expected roles and activities was presented to the experts. They provided feedback and suggested new additions.

The final results are ten roles and four main phases with different activities in them. The roles involved in an RPA implementation are the business analyst, the process owner, the technical architect, the development and operations lead, the developer the tester, the IT Support, the functional application manager, the RPA Project manager and the section manager. The different activities are under the main phases of requirements & analysis, development, testing and deployment & governance. The complete details of what each activity and role does has been discussed in the section Building the model.

Q4 – How does the continuous evaluation of the model help improve itself?

The evaluation of the model is an essential part of the ADR methodology. However, it is not trivial how to do that. In this research, the continuous evaluation of the model has helped improve itself in the following ways. Firstly, the artefact has been used to model each case. Mismatches on what actually happened and what the model was telling were analysed to decide if the artefact needed modification or if instead, the case studied was presenting an exception to the rule. Secondly, the experts provided feedback on all the aspects they considered necessary to improve and this allowed to apply continuous new insights into the model.

After the execution of the research, it has been proved that the point of the ADR methodology in the use and iteration of the artefact as a system to improve it is valid. The artefact was better after each iteration. In fact, the early model and the last one have very little in common. The continuous use of the model increased its complexity and the number of roles and activities that compose it.

Q5 – How will advances in AI and technology affect the model in the future?

The literature introduced regarding AI assume that the evolution and mainstream use of AI will happen and the question that could be asked is when. Both perspectives from a long and short term have been laid out.

In the short term, the functionalities of RPA that may be enhanced and improved by AI have been presented. Both theoretical and practical information has been collected regarding how AI will affect RPA. The theoretical discussion has been based in state of the art literature while the
practical discussion has been added thanks to the insights of the interviewees. The two phases that are more likely to be disrupted in the short term because of, for instance, project mining or machine learning are requirements & analysis and deployment & governance. Some new roles and activities may appear as a consequence of the disruptions.

It is very hard and highly speculative to try to guess how the long term future of AI is going to be like. Assuming that the long term development of AI follows the ethical principles for design (transparency, auditability, incorruptibility, predictability and responsibility) a discussion on how it would affect the model is developed. It is argued that each phase should be supervised by a responsible while carried by a superior type of AI. A new final phase would be necessary that would ensure the supervisors of each previous phase are held accountable for any wrongdoings.

7.2 Contributions and limitations

7.2.1 Practical contribution

The development of the research followed a design science research methodology using the action design research framework. The main purpose of this methodology was the creation of an IT artefact to assist in the process of implementing RPA projects by facilitating the identification of roles, activities and the identification of accountability.

Firstly, until now a methodology to create a model of an RPA implementation was non-existent. No clear overview of the activities and roles when implementing an RPA project could be found in the literature. The task was challenging as it required to capture information from multiple information resources. The data existed, but it was difficult to capture it. Sometimes, inconsistent data was found that required to be validated further. For example, different names for the same roles depending on who was asked. The artefact can help corporations, and other entities have a better understanding of the implementation process and speed up their implementations.

Secondly, the exercise to identify accountability relationships between roles can be used by companies when deciding their implementation strategy. To do so, a mix between the literature about accountability and practical experience learned during the research have been used. The relationships with more risks can be detected. Having them in mind and knowing they exist is the first step to make the implementation and the organization more resilient. In the section Formalization of learning some aspects that can be tackled to improve the strength of
accountability between relationships has also been discussed. The model can be used to analyse accountability in the design phase, during the implementation and when the implementation is already implemented. Most of the time, other models fail to carry an assessment of accountability during the design phase. This happens because the concern about accountability is reactive instead of proactive. An auditor can use this model to make its practice easier and faster. Audit departments can look at the roles and activities and check if the actual implementation has followed the model.

Thirdly, the discussion and contribution on how AI may affect the future, and RPA specifically, has been developed. This can be used in practice to be more resilient and prepared for what is to come. Especially, acknowledging that there may be things out of control and that trying to model them can help simplify and understand what is within our reach. Following this reasoning, a discussion on how the model may evolve in the future was provided. Practitioners can use it as an inspiration in case a more advanced model is needed in the future.

7.2.2 Theoretical contribution

Although the focus of the research is on creating an IT artefact, theoretical contributions have also been made by this research.

The main outcome of the research is the creation of an IT artefact using the ABD methodology. The literature using this methodology is not very detailed. Specifically, in the field of RPA, there was no artefact to model an implementation project using this methodology. The addition to the scientific community is that the challenging task of collecting information from multiple sources and creating the artefact has been done in this research. There is a lot of data and information around, but until now no one put it together and tried to figure out how to create this type of model in the specific field of RPA. Even though the model developed is specific for RPA, the scientific community can build on it to abstract a generic methodology to build artefacts for other areas of interest. The theoretical contribution would be the approach followed on how to build IT artefacts using the ABD methodology.

Moreover, the field of RPA has not much literature research available. RPA is expanding quickly, and it is being used more and more. However, the scientific community seems not to be paying attention to the trend. Thus, this research also intends to raise awareness of the need for increasing the resources dedicated to research about RPA. New insights regarding RPA are presented. They
were produced when inquiring experts about their thoughts or using the literature in different and new ways. For instance, these insights are the roles and activities involved during an implementation.

Finally, the use of the ADR methodology is quite unseen in the literature. ADR is a relatively young framework, 2011. Using it gives more reliability and validity to the framework. The seven principles that form the ADR methodology are useful in the creation of the research questions as well as guiding the research process. Scientists can check the research and learn from the mistakes done as well as the strong points detected. They can use the experience of this thesis to reinforce their research. The limitations are presented in the next chapter *Limitations*.

### 7.2.3 Limitations

The first group of limitations refer to the use of ADR instead of more accepted and tested methodologies for design science research. ADR was chosen because it goes one step further than DR in recognizing that the artefact emerges from the interaction with the organizational context. Because the research was practical and very linked to the organization, this methodology felt more appropriate. Although the methodology has proven solid and worked well, some weaknesses have been detected compared to more known methodologies such as Design Research. The author of the methodology, (Sein et al., 2011), suggests that the introduction of stages allow reducing the weaknesses of the methodology. Although it may be true, the following difficulties have still been found.

During the problem formulation phase, the methodology focuses on how researchers and practitioners bring different knowledge to the table. In the field of RPA, existing literature and research is very small, and thus, this distinction is hard to enforce.

Regarding the stage *building, intervention and evaluation*, sometimes the guidelines have been too generic regarding the steps to follow to construct the artefact. Other methodologies put more attention on providing guidance to do it.

In reference to the last two phases, *reflection and formalization of learnings*, the main issue found is how to actually abstract and generalize the knowledge. The example provided in the paper from the author (Sein et al., 2011) is quite abstract and does not help establish a set of rules to follow.
This may be the hardest part of all the research: transferring specific findings to general ones. Because of the practical nature of this research, it has been quite hard to do this.

The second group of limitations focus more on how some activities could have been done differently in order to increase the quality of the research. Having detected these limitations before would have helped define better methodologies and approaches to tackle the issue at hand.

Firstly, the model has been created with past data, and that may have consequences in the validity for assessing future implementations. What is a best practice today may not be as good tomorrow. The model should be adapted if some phases and processes change. Similar to this idea, one of the main assumptions of the model is that the KPMG practice is a good practice. Because its leadership in the field of RPA implementation, this can be assumed as true. However, that does not mean it is the only correct way of implementing an RPA project. The intention of the model is to offer a reference for how to proceed, but it is flexible to add different actions and phases if required.

Secondly, the model only allows identifying requestors and executors. In reality, these actors may seek help and consult other actors. In this specific aspect, the RACI matrix offers more flexibility. One of the insights from interviews was that the RACI matrix was easy to draw, but hard to enforce. However, one question that arises from that insight is if the model makes this easier and if positive, how does it actually help enforce it.

Thirdly, the methodology of changing the model after each interview may produce changes in the model that later actors would not agree or not find important. It is true that the ABD methodology needs modifications to represent reality, as explained in Section 3.1. Nevertheless, it may be argued that this will subtract validity to the output of the research.

Lastly, the model fails to identify that different roles may be done by the same person. This could have a clear impact on the accountability assessment. If the DevOps lead and the developer are the same actor, who is actually going to enforce accountability? A discussion about segregation of duties is presented regarding this point, but the model actually does not enforce it. Moreover, it is difficult to assess the responsibility of an accountee and accountor of a first layer.

The last group of limitations refer to the procedure to assess accountability and its impact. This process is very time-dependent, especially the internality or externality of roles. KPMG is a consulting company, so most of the time the company is just present at the client's site for the
specific duration of a project. Once it is over, if the client decided to proceed with the implementation of RPA, all the roles will be internal. Thus, the analysis of accountability fails to reflect this aspect. Furthermore, several hypotheses have been made to adjust the theory to the case at hand. These hypotheses should be verified further, and experts in accountability field should add their insights on how to improve them. Besides, a generic assessment of accountability is not easy to make because, for each project, the roles were allocated differently. Presenting the assessment of accountability for that specific phase was difficult when the five interviewees did not agree.

7.3 Recommendations

7.3.1 Recommendations for KPMG

KPMG is one of the leaders in implementing RPA solutions to automate processes for his clients. Thus, KPMG is doing a lot of things well to be different from competitors and deliver a satisfying solution. However, through the research process, some areas have been identified where KPMG can use the outcomes of this research to improve its performance.

Firstly, it would be recommended to standardise the process of collecting data. It would be good to streamline the process of reporting and establish guidelines on how to do it. It has been quite hard to find the right data, and sometimes even the same consultants that were involved in the project did not remember well.

Secondly, KPMG should ensure that the implementation respects the segregation of duties. Currently, most of the projects are in the early stages and are being developed by a small team. Hence, some actors have to develop more than one role. This has a direct effect on the likelihood that accidental and premeditated wrongdoings would happen. For instance, what if the developer and the tester are the same actor? In case the sign-off is not very thorough, it could happen that a process in production has a small hidden script that sends money to the developer each time it is run.

Finally, it would be recommended to try and use the artefact in new implementations. Although the value from RACI is indeed indisputable, some drawbacks of the methodology have been explained. The artefact tries to cover the weak spots of the RACI matrix, and the use of both would be recommended. The artefact has been designed so it can cover the design, implementation and
post-implementation phases. By using the model, it would increase the validity of the model as well as increasing the awareness of who is accountable for what since the early stages.

7.3.2 Recommendations for further research

Firstly, the artefact developed should be applied to more real-life cases to give validity. The model is flexible to modifications depending on different applications. As done in this research, different cases studies have shown that modifications to the model were necessary because not all the cases are equal. Thus, broadening the scope of the application of the model would be useful to generalize the findings. This can mean using it to model other implementations done by other consulting companies or apply directly to companies where the development had been done in-house. Setting a standard with the expected drawbacks could be the next step for research.

Secondly, the upcoming evolution of AI will bring a lot of new challenges and perils, and there is a lack of research about the field. In the specifics of the research, scientists could focus on analysing how AI will modify the model and do a thorough analysis of what new roles and activities may be added to the artefact. On a more generic approach, scientists could try to find new areas of investigation of AI from a sociotechnical point of view. This research proves that AI will effect fields that are not researched intensively. It is important to ensure that research is also done in this more unexplored areas.

Thirdly, more efforts should be put into general research about RPA. A lot of articles by consulting experts can be found online, but they lack scientific grounds, and they do not follow scientific methodologies. A lot of reports by consulting companies can be found sharing what they have found to be best practices, successful cases and interesting facts, but none of them is proper research. It is hard to capture the important information as there is no standardised name for roles and activities. Sometimes, inconsistent data is found that requires to be validated further. For example, different names for the same roles depending on who is asked. Research about RPA would give more visibility to the field and would allow building on previous research to broad the cumulative knowledge. The fact of only having received feedback from consultants at KPMG may subtract validity to the research. It may be a little biased, and the source of primary information could be increased in further research.
Finally, the research has been based in the ADR science research approach to building the model. The model has proven useful in the meta-design on how to structure the research but has failed to provide detail on how to execute this task. The author has proceeded as he has thought to be reasonable according to the model. Research could focus on building a more detailed ADR framework where successful cases of application of the framework have produced sound scientific research. This would allow authors to have a more standardized guideline that would facilitate the analysis of proper and reliable ADR research.

7.4 Personal reflection of the research

After this research, the question that remains in my mind is “does full accountability exist?” and if so, can it actually be modelled? Several times during the research, I have struggled to capture what I wanted to show with the model. A model at the end is a simplification of reality, but in a topic like accountability, the details that are simplified in models matter a lot. Different small activities that seem irrelevant on the big picture effect greatly the accountability of an actor. I have the suspicion that full accountability may actually not exist. In the specific field of the implementation of an RPA project, so many actors are involved that is extremely hard to assess with accuracy who did what in each case. Then, how would it be possible to assess with precision who is accountable for what? Even if you were able to model everything, is not the model itself loaded with the subjectivity of the author that drawn it?

Even though this reflection may seem like a pessimistic one, it is not. I believe the research helps to throw some light into a topic that has been ignored by the community. Full accountability may not exist, but the research gives guidance on how to minimize the impact of wrongdoings and how to follow practices that mitigate them.

On more a personal level, I learned a lot about RPA and the whole process behind an implementation. I clarified some concepts that did not understand. I also realized how important is to verify the information and validate your sources. I got some information wrong, and I even wrote it down. By interviewing and asking the right questions, I was able to get the facts right.

I realized how important it is to have a good set of research questions and a clear direction. It is otherwise too easy to get lost in the huge amount of information available. The selection of the
cases to be studied was harder than expected. Companies were not as eager as expected to share
data and it was harder to receive a positive response from them.

It has been challenging to assess the correct level of detail of the model. When to stop was not
trivial, and it may be argued that more or less detail was necessary. I have tried to illustrate with
the maximum precision all the actions but trying to avoid entering the trivial area. If not done like
this, the model would have been extremely long, and I may argue, not more insightful.

It has also been challenging to interview consultants. I never carried an interview before, and I
could have organised them differently. After analysing the transcripts with NVivo, I realised I
talked too much, and sometimes I cut what the interviewee was saying. Some concepts or ideas
were not clarified in a simple way and required to be explained in each interview. Moreover, the
assessment of accountability and impact was quite tedious to do and could have been asked in
another way.
References


BIS Research. (2017). *Global Cognitive Robotic Process Automation Market, Analysis & Forecast 2017-2026 Focus on Type (Services and Platform) and Industry (Finance and banking, Telecom and IT Services, Insurance and Healthcare)*.


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Appendix

Appendix A: end-to-end processes map

*Figure 14: End-to-end processes in Order to Pay (KPMG©)*
Appendix B: illustrations of different RPA vendors

Figure 15: visualization of workflows using UiPath (left) and Blue Prism (right).

The images are extracted from (https://www.uipath.com/blog/your-blog-post-title-here) and (https://valeriovalrosso.blogspot.com/2017/04/a-simple-blue-prism-multi-robot-example.html)
Appendix C: mind maps of the coding used in NVivo

Mind map regarding the model discussion

Figure 16: mind map regarding the model discussion
Mind map regarding the validation of information

Figure 17: mind map regarding the validation of information
Mind map regarding the new insights about RPA

Figure 18: mind map regarding the new insights about RPA
Appendix D: assessment of roles and impact

<table>
<thead>
<tr>
<th>Process description</th>
<th>Accountor</th>
<th>Accountee</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Requirements &amp; analysis phase</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analyse the RPA vendors</td>
<td>1 4 E 1 C 0</td>
<td>1 3 E 0 C 2</td>
<td>High 1 Low 4</td>
</tr>
<tr>
<td>Gather required functionalities and requirements</td>
<td>1 4 E 1 C 0</td>
<td>1 3 E 0 C 2</td>
<td>High 1 Low 4</td>
</tr>
<tr>
<td>Assess technical capabilities of each vendor</td>
<td>1 4 E 1 C 0</td>
<td>1 3 E 0 C 2</td>
<td>High 1 Low 4</td>
</tr>
<tr>
<td>Assess IT requirements for each vendor</td>
<td>1 4 E 1 C 0</td>
<td>1 3 E 1 C 1</td>
<td>High 1 Low 4</td>
</tr>
<tr>
<td>Organize live presentation of the vendors</td>
<td>1 4 E 1 C 0</td>
<td>1 3 E 0 C 2</td>
<td>High 1 Low 4</td>
</tr>
<tr>
<td>Decide the RPA vendor</td>
<td>1 5 E 0 C 0</td>
<td>1 4 E 1 C 0</td>
<td>High 3 Low 3</td>
</tr>
<tr>
<td>Request specific pricing and offer</td>
<td>1 4 E 1 C 0</td>
<td>1 3 E 0 C 2</td>
<td>High 3 Low 3</td>
</tr>
<tr>
<td>Decide about the offer</td>
<td>1 5 E 0 C 0</td>
<td>1 4 E 1 C 0</td>
<td>High 3 Low 3</td>
</tr>
<tr>
<td>Prepare IT architecture</td>
<td>1 4 E 1 C 0</td>
<td>1 3 E 1 C 1</td>
<td>High 5 Low 0</td>
</tr>
<tr>
<td>Determine IT infrastructure needed</td>
<td>1 4 E 1 C 0</td>
<td>1 3 E 1 C 1</td>
<td>High 5 Low 0</td>
</tr>
<tr>
<td>Implement the requirements</td>
<td>1 3 E 1 C 0</td>
<td>1 3 E 1 C 1</td>
<td>High 5 Low 0</td>
</tr>
<tr>
<td>Select processes to be automated</td>
<td>1 4 E 1 C 0</td>
<td>1 5 E 0 C 0</td>
<td>High 3 Low 2</td>
</tr>
<tr>
<td>Assessment of suitable processes</td>
<td>1 4 E 1 C 0</td>
<td>1 3 E 0 C 2</td>
<td>High 3 Low 2</td>
</tr>
<tr>
<td>Assess feasibility of the automation</td>
<td>1 4 E 1 C 0</td>
<td>1 0 E 1 C 4</td>
<td>High 3 Low 2</td>
</tr>
<tr>
<td>Prioritize and accept process to be automated</td>
<td>1 4 E 1 C 0</td>
<td>1 5 E 0 C 0</td>
<td>High 3 Low 2</td>
</tr>
<tr>
<td>Write Process Definition Document</td>
<td>1 4 E 1 C 0</td>
<td>1 5 E 0 C 0</td>
<td>High 3 Low 2</td>
</tr>
<tr>
<td><strong>Development phase</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creation of the technical document</td>
<td>1 0 E 5 C 0</td>
<td>1 0 E 1 C 4</td>
<td>High 4 Low 1</td>
</tr>
<tr>
<td>Develop the script to automate the process</td>
<td>1 0 E 5 C 0</td>
<td>1 0 E 1 C 4</td>
<td>High 3 Low 2</td>
</tr>
<tr>
<td>Write the script</td>
<td>1 0 E 5 C 0</td>
<td>1 0 E 1 C 4</td>
<td>High 3 Low 2</td>
</tr>
<tr>
<td>Modify the script</td>
<td>1 0 E 5 C 0</td>
<td>1 0 E 1 C 4</td>
<td>High 3 Low 2</td>
</tr>
<tr>
<td><strong>Testing phase</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delivery of completed script</td>
<td>1 0 E 1 C 4</td>
<td>1 0 E 1 C 4</td>
<td>High 1 Low 4</td>
</tr>
<tr>
<td>Verification test</td>
<td>1 0 E 1 C 4</td>
<td>1 0 E 1 C 4</td>
<td>High 1 Low 4</td>
</tr>
<tr>
<td>Execute the test</td>
<td>1 0 E 1 C 4</td>
<td>1 0 E 1 C 4</td>
<td>High 1 Low 4</td>
</tr>
<tr>
<td>Evaluate results and bugs</td>
<td>1 0 E 1 C 4</td>
<td>1 0 E 1 C 4</td>
<td>High 1 Low 4</td>
</tr>
<tr>
<td>User Acceptance Test</td>
<td>1 5 E 0 C 0</td>
<td>1 0 E 1 C 4</td>
<td>High 4 Low 1</td>
</tr>
<tr>
<td>Determine requirements for UAT</td>
<td>1 0 E 1 C 4</td>
<td>1 5 E 0 C 0</td>
<td>High 4 Low 1</td>
</tr>
<tr>
<td>Execute the test</td>
<td>1 5 E 0 C 0</td>
<td>1 0 E 1 C 4</td>
<td>High 4 Low 1</td>
</tr>
<tr>
<td>Evaluate results and bugs</td>
<td>1 0 E 1 C 4</td>
<td>1 5 E 0 C 0</td>
<td>High 4 Low 1</td>
</tr>
<tr>
<td>Sign off release to production environment</td>
<td>I</td>
<td>4</td>
<td>E</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td><strong>Deployment &amp; Governance phase</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scheduling management</td>
<td>I</td>
<td>0</td>
<td>E</td>
</tr>
<tr>
<td>Decide schedule for the processes</td>
<td>I</td>
<td>0</td>
<td>E</td>
</tr>
<tr>
<td>Configure the process to be scheduled</td>
<td>I</td>
<td>0</td>
<td>E</td>
</tr>
<tr>
<td>Work queue management</td>
<td>I</td>
<td>0</td>
<td>E</td>
</tr>
<tr>
<td>Detect and report exceptions</td>
<td>I</td>
<td>0</td>
<td>E</td>
</tr>
<tr>
<td>Analyse data outputs and evaluate results</td>
<td>I</td>
<td>0</td>
<td>E</td>
</tr>
<tr>
<td>Change management</td>
<td>I</td>
<td>0</td>
<td>E</td>
</tr>
<tr>
<td>Assess responsible to solve exception</td>
<td>I</td>
<td>0</td>
<td>E</td>
</tr>
<tr>
<td>Solve process related issues</td>
<td>I</td>
<td>4</td>
<td>E</td>
</tr>
<tr>
<td>Solve script and software related issues</td>
<td>I</td>
<td>4</td>
<td>E</td>
</tr>
<tr>
<td>Solve integration to systems issues</td>
<td>I</td>
<td>4</td>
<td>E</td>
</tr>
</tbody>
</table>

*Table 16: assessment of roles and impact*
Appendix E: generic meta-model of an RPA implementation

Figure 19: model representing the implementation of an RPA system.
Appendix F: layers of the RPA implementation model

First layer: Requirement & Analysis phase model

* If only one process is automated in the process the model is correct. In case the project involves automating more than one process, then the phases “analyze the RPA vendor”, “Decide the RPA vendor” and “Prepare IT architecture” have to be done only once.

*Figure 20: first layer of the model: Requirement & Analysis phase model*
Second layer: Analyse the RPA vendors

Figure 21: second layer of the model: Analyse the RPA vendors
Second layer: Decide the RPA vendor

Figure 22: second layer of the model: Decide the RPA vendor
Second layer: Prepare IT architecture

Figure 23: second layer of the model: Prepare IT architecture
Second layer: Select processes to be automated

Figure 24: second layer of the model: Select processes to be automated
First layer: Development phase

Figure 25: first layer of the model: Development phase
Second layer: Develop the script to automate the process

Figure 26: second layer of the model: Develop the script to automate the process
First layer: Testing phase

Figure 27: first layer of the model: Testing phase
Second layer: Verification Test

Figure 28: second layer of the model: Verification Test
Second layer: User Acceptance Test

Figure 29: second layer of the model: User Acceptance Test
First layer: Deployment & Governance Project

This phase of the model has to be iterated continuously to govern the process automated. It is not a one time event.

*Figure 30: first layer of the model: Deployment & Governance Project*
Second layer: Scheduling management

Figure 31: second layer of the model: Scheduling management
Second layer: Work queue management

Figure 32: second layer of the model: Work queue management
Second layer: Change management

Figure 33: second layer of the model: Change management
Appendix G: table with validation of concepts

<table>
<thead>
<tr>
<th>Type of robotics implemented at KPMG</th>
<th>Nathalie Duijvesteijn</th>
<th>Koen van Raan</th>
<th>Tessa Snels</th>
<th>Pepijn van Eck</th>
<th>Robbert Sweijen</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPA</td>
<td>RPA and framework for implementation of cognitive robotics</td>
<td>RPA and InvoiceSharing (automation of invoices)</td>
<td>RPA, however he mentioned that developments are happening in enhanced</td>
<td>RPA, however propositions using chatbots are being explored</td>
<td></td>
</tr>
</tbody>
</table>

| Assessment of accountability | High importance | Relative importance. | High importance. Although nothing has happened, there is risk | RACI after exiting the project and hard to actually enforce RACI responsabilities | High importance KPMG is doing better than before. |

<table>
<thead>
<tr>
<th>Current methodology to assess accountability</th>
<th>None</th>
<th>RACI and stakeholder management</th>
<th>RACI</th>
<th>RACI</th>
</tr>
</thead>
</table>

| Implementation methodology of RPA | Agreed, but gave feedback on how to make it more visual | Agreed, but suggested a last phase, value management | Agreed | Agrees | Agrees, but comments that the model is waterfall and KPMG tries to be more agile |

| Roles and feedback | Agrees and provides feedback regarding new roles | Agrees and provides a lot of feedback regarding roles and add new ones | Agrees and provides a lot of feedback regarding roles | Agrees and provides a lot of feedback regarding roles involvement |

| Type of project | Mix collaboration | Mix collaboration | Mix collaboration | Mix collaboration |

*Table 17: table with the validation of concepts*