Tooling as a Service

Agent Based Scenario Development for IT Services Delivery

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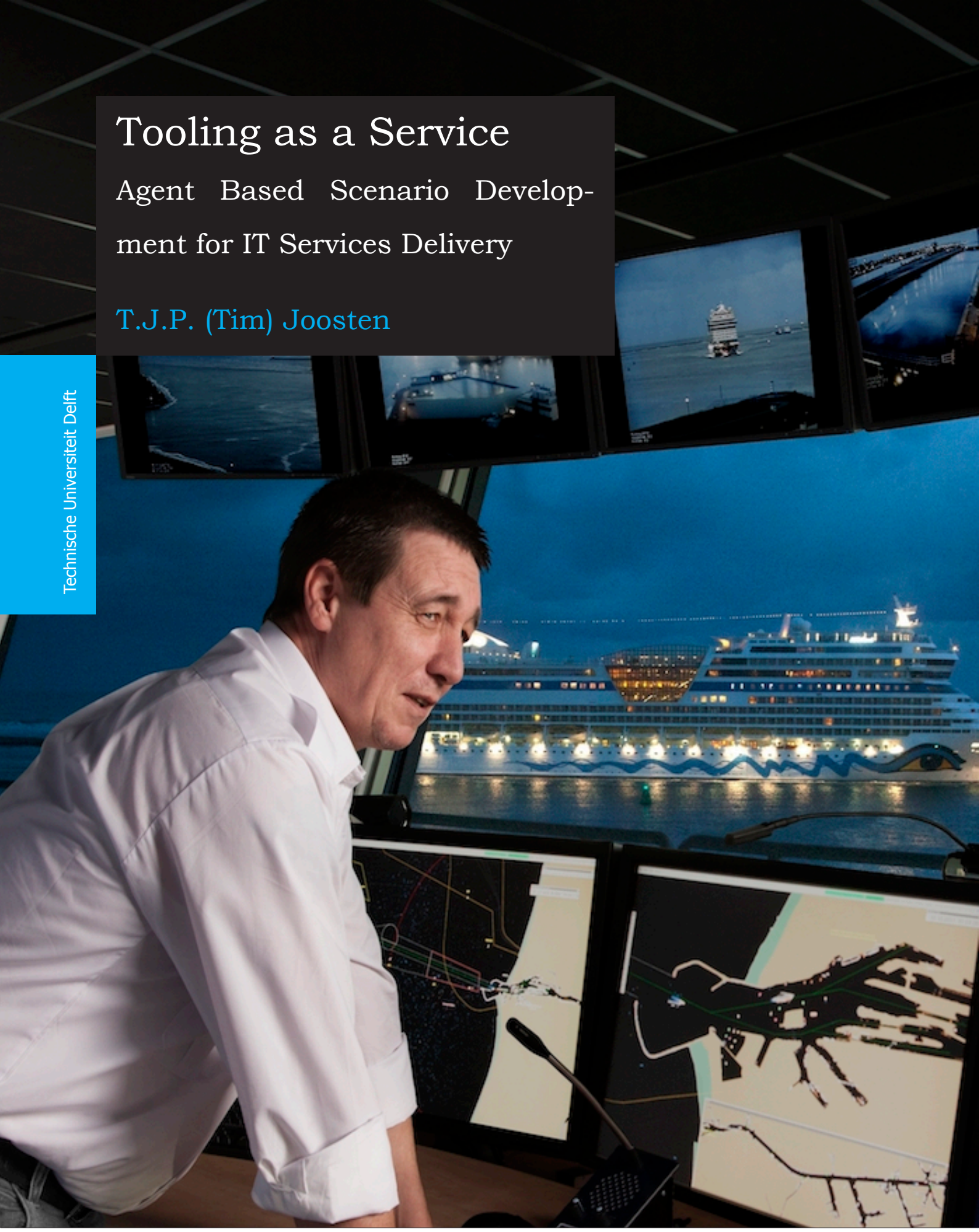

TU Delft Delft University of Technology

Challenge the future

Tooling as a Service

Agent Based Scenario Development for IT Services Delivery

by

T.J.P. (Tim) Joosten

in partial fulfillment of the requirements for the degree of

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Abstract

Information Technology [IT] is increasingly being integrated into the modern society. Novel IT solutions are Cloud based. Cloud solutions from Microsoft Azure and Amazon AWS are examples of services which offer the benefits of cloud computing. For IT providers, leveraging novel IT artefacts may require the development of a new service model. IT services enable new service delivery models and have the ability to disrupt whole industries. Spotify, Airbnb, and Uber are examples of successful businesses using IT driven service models. The academic community researches aspects of IT governance, frameworks, architecture, and business model innovation, management and organisational theories in order to develop a more successful IT service delivery model. The heterogeneous body of these academic theories addresses different parts of the service model development. However, current IT service delivery models lack sufficient support for contextualisation. In a case study at Dutch IT services provider KPN, Agent Based modelling is used to develop future scenario's for the IT services organisation. With a strong focus on the organisation and the agents in the organisation, the Agent Based modelling approach OperA is applied. By Using semi-structured interviews to collect data throughout the services delivery chain, a future scenario with the IT broker as a new role was developed. Consequently, roles facilitating legacy platforms are expected to discontinue. From the future scenario, a roll-out plan using three phases is developed using the social structure of the organisation model. The environments of the OperA model enable the research to focus on the social structure of IT services delivery and the analysis of interactions between roles. The OperA model is a sufficient model for strategic decision making in IT services delivery. Further work could generate tools to fully automated the validation of the OperA model and connect it to real life phenomena with real time adaption to changes.

Preface

This report was written as the final thesis for the master Management of Technology at the Delft University of Technology. It concludes six years of life studying technology. Beginning with the first four years of applied sciences in Building Technology and Wind Energy Project Management, I am grateful for all the education I was able to receive. Multiple times during my study I realised how exited I was that I had the opportunity to study at one of the best universities in the world.

Already in my younger years, I gained my first experience with IT by randomly exploring the internet. My curiosity in this topic grew with the build of several networks for family and friends. After reading about novel IT systems, I decide to explore what IT organisations do to change their organisation and become successful. I always have been curious why a certain company was able to benefit from technology and how they gained competitive advantage.

The contents of the course Technology Strategy and Entrepreneurship, and the course Leadership and Technology Management helped me to understand these phenomena and have been the starting point for the development of the research. A workshop on data analytics gained my attention and so did I started my master thesis with a case study in TelCo and IT services provider KPN.

In the beginning of the research when I was introducing myself in the IT organisation, I collected all my first thoughts and figured that a large IT organisation is complex. I soon had to simplify and conceptualise bodies of the organisation to make sense complex dynamics the systems society. My expectations of IT organisations being small, and effective changed by these first experiences. The first few months I shaped the research project and gradually increased my knowledge in agents modelling field.

Obviously, the completion of this thesis could not happen without support of the people around me. Dr. L. Rook, thank you for helping me finish my thesis preparation and advising me on the research approach. I would like to thank Dr. M.V. Dignum for the supervision and the ideas you have shared. Your dissertation on the OperA model was extremely helpful for analysing the organisation. I would also like to thank Dr. Verburg for helping me to manage my thesis project and giving me the confidence I needed to complete this research. Additional thanks to my colleagues at KPN for giving me the room te develop myself. The interviews within the organisation generated interesting discussion. Special thanks to Boyd de Ruiter for supporting my work and for helping me with me person development within the organisation. I hope that my thesis is considered useful and interesting to read.

T.J.P. (Tim) Joosten

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Introduction

1.1. Motivation

Information Technology (IT) is increasingly integrated into society. For example, in the past century agricultural employment decreased and labour gradually shifted towards manufacturing. The productivity of agriculture increased due to innovation using technology, enabling a small group of farmers to provide food for a larger group of people. Consequently, labour demand shifted from agriculture to manufacturing. In the 1980s, the rise of information communication services rose. In consequence, labour shifted from manufacturing towards a knowledge intensive services industry. Nowadays, in 2017, we live in a service-based economy, menaing that the majority of economic activity is services based. A plurality of Academics have focused on researching sciences from the perspectives of marketing, management, quality, psychology, technology, or economy. According to (Chesbrough and Spohrer, 2006), who wrote a manifesto for research in services science, the growth in the services industry requires academics to share a common mission of understanding services beyond the separate silo's of management, engineering and computer sciences. This research contributes to research in services science as requested in the manifesto.

Science in Services is essential to understand how organisations vary in productivity, and how value in the services industry migrates to other parts of the services stack. To add value to science in services, several approaches can be applied. A systems engineering and design, and a supply chain perspective can be used to increase internal productivity. An organisations perspective using parts of social science is applied in this study, to also forecast the orginasations behaviour. In the next chapter, the research in services is focused on IT services.

1.1.1. IT Services

Information technology (IT) services are services that use computing technologies to, amongst others, create, store, manipulate, study and/or transfer data (Chandler and Munday, 2011). IT services are present in a variety of industries that include computing, electronics, internet, telecommunication, and e-commerce and are increasingly being embedded in more industries, thus creating a digital economy. Although relatively new, IT services share similar characteristics as general services. When trying to understand the services delivery organisation, it is helpful to know and understand those characteristics. The characteristics similar in IT services and general services are as follows:

- Intangibility
- Perishable (produced and consumed simultaneously)
- Inseparability
- Inconsistency (heterogeneous)
- Involvement

However, differences between IT services and general services exist. For one, IT Services differ from general services when it comes to the growth potential. The more successful IT services extensively harness the commercialisation of the internet and the increase in mobile networking to deliver their services to a greater audience. Traditionally, using IT required customers to identify their IT requirements for the upcoming years, obtain a budget, develop the IT system, invest in hardware and software upfront. These systems had to be installed on every location the IT was needed, and eventually needed to be tested, debugged and deployed. The traditional approach to IT services has, however, lost it's attractiveness now that computing technology and networks have become extremely fast and allow IT services customers to apply cloud computing approach.

Cloud computing enables people to access information independent from where they are situated. Because cloud computing is accessible from the open internet, it is possible to work or create information anywhere, provided that internet access is available. The details of Cloud computing are explained more thoroughly in chapter 2. Hereafter, the relation between Cloud computing and IT services are discussed. Cloud computing is a method used to serve IT customers and is mostly offered as a service. Cloud computing is managed by an external party and its architecture is developed as a commodity.One of the advantages Cloud Computing has over the Traditional IT products is that Cloud Computing does not require the user of its services to own or buy any physical components.Traditional IT products require capital investments by the user in order to utilise IT. In order to keep it running, maintenance and operational activities were needed as well. Cloud computing deals with those activities externally, and arranges it as a service. Cloud computing differs from managed IT services in its architecture, since it allows users to share physical hardware components in a resource pool, and applies virtualisation to run its services. The result is computing as a commodity, a service designed to be delivered

to many different customers in an agile way. The Cloud computing services require a change of the existing business model from the perspective of both the service provider and the service user. Cloud computing has become a buzz word in the distributed computing community (Dillon et al., 2010) and can be used to describe a wide variety of technical and infrastructural definitions.

The process of engineering services for complex and dynamic domains like information technology (IT) is becoming increasingly difficult. Technology is constantly changing and rapid developments in a company's external environment require adaptability and a high level of flexibility. While IT customers face several challenges in identifying how IT services might help them add value to their business, IT providers face challenges in having to provide both traditional services while also offering new, cloud based services. The aforementioned challenges impact the internal organisation of IT providers and will be discussed more thoroughly in the next section.

1.1.2. IT Organisations and Strategies

Different kinds of IT organisations (IT providers & IT customers), large or small, emerging or incumbent deal with the dynamics of the IT environment in different ways. However, they all use technological innovation to enable growth of the digital economy. Next to technological growth within the ICT sector, IT services break open traditional markets by digitising business models as well. For example iTunes changed the music industry, followed by Spotify. Airbnb and Uber challenge traditional players in the hotel and taxi services market. Understanding what factors influence the success of these so called disruptions could help other companies become more successful in their market. Several factors could determine a firms' success. One could be the way in which the firm utilises emerging technologies, or the way the firm structures their organisation. These factors can both be used to develop sustained competitive advantage.

An example of the aforementioned is the emerging IT services provider Amazon, that offers cloud computing to the mass market, running in low margin high volume market, using economies of scale, providing a set of standardised services. The incumbent ICT provider KPN however, offers IT services that are far more tailored towards specific businesses, resulting in a low volume, high profit business. The organisational characteristics of these two companies greatly differ from each other. Amazon started as a book store in e-commerce and eventually grew into becoming an IT services provider. KPN originated from being a state owned communications provider which transformed to a TelCo and IT provider.

The challenges and opportunities in the organisation of an IT services delivery differ between emerging and incumbent IT services providers. The latter may have difficulty introducing and adopting new technologies, but their strength lies in the customer relation and experience. Emerging IT Services providers on the other hand are strengthened by their potential to adapt quickly when technical requirements change, however they still need to build their reputation and customer relations. This is one of the aspects in which IT services providers might differ from each other.

Incumbent IT organisations have a history that naturally grew into their current organisational structure. Rapid changes in IT technological innovations, changes in supply and demand and changes in the way of working and organising are difficult to incorporate in large incumbent organisations that have a great amount of legacy technologies, products and services. To cope with the strengths and weaknesses of IT services organisations, an organisational modelling approach can be applied.This approach allows for the design and transition of organisations and is addressed in the next section.

1.1.3. Organisational Modelling

In this research, organisational modelling is used as a method study to the dynamics of an organisation. Information technology plays an important role in new global developments. Digitisation in industries which previously relied on work flows involving human interaction, learning by doing, and decision making based on experience will in inevitably become information driven and automated. IT tools enable information to add value to these business activities. Drivers of these new developments are amongst others Cloud computing and Mass Customisation. Systems become more open, dynamic, flexible and on-demand. The service model should incorporate these IT trends to stay relevant in the future.

To increase the effectiveness of an organisation in the businesses' organisation, (Mensonides et al., 2008) developed an organisational modelling approach called Organisations per Agent [OperA]. OperA is intended to be used by software engineers and developers to support them in the development and documentation of the various aspects of a multi-agent organisation (Aldewereld & Dignum). In their study, OperA is used for model construction, validation and scenario animation to support strategic decision making in an organisation. The OperA model can be used for agent-based scenario planning as well. In this research, the results on agent based modelling using OperA are extended by applying the method to a case in KPN Business Operations,a section of KPN active in the IT services domain. In the next section, the research approach is discussed.

1.2. Research Approach

Service delivery in IT becomes increasingly complex due to the nature of the technological innovation, the complexity of the IT environment, and the dynamics of the IT market. One way to increase the effectiveness of decision making in IT service delivery is by using agent-based scenario development. Agent modelling will be further discussed in chapter 2. In order to design a future IT services organisation, scenario planning is used.

Scenario planning is a method that is used to figure out certain aspects of the future, by trying to apprehend the nature and impact of several uncertain and important driving forces that could affect the future (Mensonides et al., 2008). Agent-based models provide rich scenarios, which can be used for forecasting. An example is the case of maintains provider NedTrain (Mensonides et al., 2008). Scenario planning is used to understand how innovations in services delivery change the organisation. Complex

multi-agent systems can be developed by using scenario analysis.

The practical problem addressed in this research involves the management of IT service delivery operations in an uncertain IT environment. Giving recommendations regarding the organisational model in an IT services company, using a multi-agent scenario development method is novel. This practical problem needs advanced methods like the agent-based scenario development in order to effectively incorporate agents' individual preferences along with global strategic goals. In this research, the OperA model is applied in a new area, namely the development of an organisational model in the IT services delivery domain. The research will emphasise on the development of the OperA model by applying the model in a new case.

1.2.1. Research Objectives

A research objective needs to be useful, realistic and feasible in order to complete the research project successfully within the time scheduled. Being able to utilise research findings in practice is important. As described by (Aken, 2004), utilisation difficulties might occur with academic management research. The academic reputation system rewards rigorous research, and the professional reputation system in place rewards relevant research outcomes. This research applies computational modelling of empirical data and uses data from semi-structured interviews, allowing one to reflect on using existing theories.

When using the agent modelling approach OperA, organisations can be defined as an open organisation in which organisational aims, and the agents who act in it, are explicitly distinguished.

In the initial search for a suitable case to study IT services organisations, KPN senior manager IT tooling shared that their biggest challenge is to make their organisation ready for the future of IT services. This challenge can be researched using different kind of research approaches. By using reviews of literature, different aspects of the general topic are explored. First off, ways in which a service model can be developed are explored. The way services might be governed are discussed as well. Furthermore, research is pointed towards important technological developments related to the topic. The introduction already confined the research objective by describing the the literature which is explored, and by choosing a practical problem to address. Taking the before-mentioned in mind, the following research objective was established:

The project's research objective is **to make recommendations to the senior management concerning the development of a new service delivery model** by: (1) identifying problem situations and desired outcomes; (2) reviewing extant theories, knowledge and data; (3) applying a agent based model to develop future scenario's ; and (4) testing the scenario's validation to minimise organisational design mistakes.

Based on the research objective, this research project is considered a case study research according to (Verschuren and Doorewaard, 2010). The initial problem is identified and extensively analysed in the

literature review. The main problem encompasses managing an IT services organisation in a transitional period. Emphasis will lie with the organisational model and the interaction of actors within this model.

As mentioned before, the review of literature on both IT services and new IT business models as well marks the beginning of this process. When developing an agent based organisation, a literature review on multi-agent models is the starting point.

- The research could by substantiated by a socio-technical view, since the development of a new services model encompasses more than just a technical description of the system from business and IT perspectives. The development of a new services model is a composition made up off technologies and people greatly influencing the performance of the services model. Thus in order to best address the importance of this reciprocity, a socio-technical view is prefered;
- If the research contributes to strategic problems in businesses, the results from the research should be able to assist top and middle management of IT organisations in the decision making process regarding the development of their organisation when it comes to IT governance and management, by providing both social and technical recommendations;
- Results from the research could build upon existing literature on novel IT artefacts such as cloud computing. Thereby the research provides knowledge that is rigour, relevant, and practically applicable;
- The agent based scenario model should follow the previous work on a agent modelling called OperA to enhance the existing model. This research will also answers if the agent based model OperA is applicable for the development of an IT services organisation;

When accomplishing the aforementioned research objectives, several sub-objectives can be formulated as well. All in all, the research consists of the following components:

- Analysis of KPN's current services delivery model;
- Identified how a multi-agent model could be applied in the problem statement;
- Develop multiple scenario's for agent interaction to effectively deliver IT services in the future;
- Testing the interactions to find the most desirable alternative.

1.2.2. Research Questions

The research question should ensure the research objective is achieved. It explains how the different topics are interconnected and it provides a chronological order for the execution of the research. The objective of this research is to answer the following questions:

Main Question: What approach can a IT services company apply to transform from a traditional services organisation to an organisation which delivers agile IT services, effectively executing business goals, and increasing internal productivity?

1. Current Organisational Model of service delivery
   (a) How is the current service delivery organised?
   (b) What does the current Organisational model look like?
2. How should current organisational resources be developed to remain effective in future scenarios?
   (a) How should resources be allocated in the operation to effectively generate high levels of availability and quality of service?
   (b) How should the organisation be structured so actors can achieve personal goals while collaboratively achieving global objectives?
3. What changes are needed in the organisational model to allow for emerging IT services to be delivered to customers more effectively?
   (a) How could existing human resources in KPN IT operation teams be changed based upon the future scenario developments?

1.2.3. Research Methodology

To identify the current service delivery model within KPN, the OperA Organisational Model [OM] is used. OperettA is used as well. OperettA is a tool which allows for OM to be visualised (Dignum and Aldewereld, 2010). The OperA model is appropriate for the development of organisational models, since it allows for a strong focus on the organisation itself as well as the agents within that organisation. The OperA methodology and framework is therefore used to research the development of an organisational model for KPN. The methodology specifies the existence of an Organisational Model [OM], a Social Model [SM], and an Interaction Model [IM]. These three models are explained extensively further in the research. Hereafter, the chosen research methodology is explained more in depth.

To start, the environment, stakeholders, perceptions and business strategies are analysed. The gathered information results in an OperA organisational model, that explains the operation of the organisation in its current form.

Next, the model validation is executed by evaluating the OM using a traditional case study methodology. Information is gathered in semi structured interviews with key agents in the service delivery chain. In these interviews, the agents' role objectives, plans, and interactions are discussed. Agents representing different stakeholder positions are specified. The before mentioned results in various social models. The model validation is then integrated in the OperA framework.

Finally, the structure and interaction of services in coordination environment are simulated in several scenarios showing the dynamics that occur when changing priorities, weights and negotiation strategies. Thereby, the different social models are used to (further) develop interaction models. The internal validity of this research is increased by applying it in a real business unit. By doing so, the results are based upon observations in a natural business environment. However, the generalisation

might be lower in a single case study since the results are generated in only one case and thus might require extra research in order to apply them to different cases.

1.3. Case Study

1.3.1. KPN

KPN is a Telco and IT services provider, operating for customers and business clients from small businesses to large enterprises. Originally being a state-owned telecommunications company, KPN is now, amongst others, active in the dynamic competitive IT services market. With its competitors being increasingly agile to changes in the IT market, KPN is struggling to be profitable while striving to become the 'Best services provider' in the Netherlands. Achieving this goal requires KPN to increase the novelty of their technology.

Since cloud computing changes the way IT services management is executed, IT innovation in cloud computing and automation demands for changes in the current organisational model of KPN. Novel IT services are multi-tenant and allow for customers to apply self-service. Other legacy services require more human interaction coming from the service provider. Offering customers both legacy and novel IT services thus requires the services providers to enable self service and at the same time keep lagacy systems up and running. This dual purpose might put pressure on the back office of the IT operations.

1.3.2. IT Tooling Services

An IT services provider requires information on technology to become or stay successful. In order to require this information, a wide variety of technological developments need to be monitored. In this research, a new services delivery model is explored. This service delivery model allows for the delivery of tools for maintaining IT systems and infrastructures. Figure 2.1 explains the purpose of 'tools'. IT management and configuration tools directly influence asset utilisation, labour, quality, time to market, and service/after-sales. IT assets can be physical assets such as computers, storage, network devices and many others. These assets operate and are configured using software. Several tools are used to update, maintain and configure these IT assets in an automated and flexible way. Simply stated, without these tools a IT services manager needs to update/configure/maintain all IT assets separately, thus requiring a higher demand for labour. Tools allow for a better overview of the IT assets too. Information about the current state of the IT assets can help IT professionals to make better judgements regarding the management of the IT infrastructure. Novel IT tools are service based (Everything as a Service XaaS) and are increasingly being utilised by Cloud Computing, concepts that are explained further in this research. The aforementioned technologies enable IT operators to work more flexible. They lower or eliminate initial costs as well, thus providing affordable scalability. These IT tools can be used by IT services providers to manage their own infrastructure as well as the infrastructure they manage for their customers. The need for IT services providers' customers to make use of the IT tools increases, since these tools have become more convenient and powerful recently

and their potential keeps increasing. At the same time however the infrastructures delivering these IT services become increasingly complex.

In order to better solve the problems consequently to these recent developments, a redesign of the current service delivery model is required. A preliminary exploration of the existing literature on developing a new services delivery model reveals that a holistic approach to study an IT services organisations is missing. Existing literature explains: how to govern IT services (Joukhadar and Rabhi, 2013), the effects of IT governance maturity on IT governance performance (Simonsson et al., 2010), the business perspective of novel IT artefacts (Marston et al., 2011), and several frameworks for controlling and designing information technology and systems services (Breiter and Naik, 2013b), (De Leusse et al., 2009), (Niemann et al., 2008). However an overarching concept for creating a new services delivery model from an internally used IT service to an externally used commercialised model, emphasis on the organisational model and governance of the service, is lacking.

This research is developed in cooperation with IT service provider KPN Business Operations, which asked for advice regarding the development of the services delivery model. KPN is aware of the role of IT tools, also referred to as 'tooling' in, amongst other, the Industry 4.0. Therefore, KPN is developing these technologies in order to be able to offer new, efficient and more flexible services to its (business) customers.

Tooling and Automation is a Business Unit within KPN Business Operations that is responsible for the technical management and implementation of standardised tooling. Standardised tooling is tooling used by KPN's dedicated customer teams and/or is applied in multiple sections of the IT portfolio (for example Storage and Hosting). In the current situation (January 2017), tooling services are mainly applied on internal purposes to increase efficiency of KPN's staff. Only a small selection of the tools is directly accessible as a service for KPN's customers. The customers of IT services providers become increasingly interested in the use of tools for their own IT infrastructure, which is why KPN is exploring possibilities to provide their currently internally used tools for its 'external' customers. Briefly stated, the IT services provider receives signals from the market that there is a need for a new variety of services not yet currently available in the product services catalogue of KPN. A preliminary review of the service results in a wish to be able to deliver the aforementioned service to 'external' customers.

The senior manager from the technical working team, also known as the Tooling & Automation team, is responsible for the technical and functional management of standardised tools. In other words, he and his team make sure the tools perform well and are available for its users to use.

In an initial interview, the senior manager clarifies that the current technological work team is familiar with working for internal departments elsewhere, however the team has overall little experience in delivering products directly to (external) business customers. A special cloud services team, and a dedicated customer service teams exist. Both teams are familiar with direct business customer interaction, however they have little experience in working with technical work teams for delivering tooling directly to customers. Hypothesis could be that the cloud services team and the tooling and automation team should combine their competences and work together to be able to provide the IT

service to the new customers.

In order to provide a rigid service towards the customers with regard to the tooling as a service, customers need both technical supporting knowledge as well as advice in transforming their business goals into value adding activities and then into technical- and functional requirements of the IT management tools. In order to provide this support, the new services delivery model will most likely require a closer, more intensive collaboration between separate work teams to be able to deliver the solution. The general view is that problems arise when: (1) there are no rules on the creation of the new service delivery model; and/or (2) customers' requirements are not incorporated in the development.

The research project takes place within this project context and should contribute towards shortening the IT business process and generating increasing customer satisfaction by the development of a new service delivery model.

To assess the project context and the scientific relevance, a literature review is executed and documented in the next chapter of this research document. The empirical part of the research project is carried out in the IT service provider KPN Business Operations, where there is a need for developing a new services delivery model, which requires a variety of managerial changes and decisions.

1.4. Thesis Structure

This Thesis Report is structured in three parts. First, the IT Services background and related work are introduced. In the second part, the OperA Agents Model that has been introduced as the applied research method is discussed more thoroughly. Thereafter, the OperA Model is applied in a Case Study at IT services provider KPN. The chapter structure of the thesis is as follows:

- **Chapter 2** introduces the reader to the academic background on IT services delivery and related work.
- **Chapter 3** provides the reader with the basics to the research methodology OperA.
- **Chapter 4** presents the case study and applies the OperA model to present the current services delivery model.
- **Chapter 5** describes the analysis from the case study, the applicability of OperA model to the development of an IT services Organisation, and the insights scenario from the interviews.
- **Chapter 6** presents conclusions and discusses areas for further research.

1.5. Glossary

Agile	A frequently used word in IT for delivery of software in a fast pace using iterations of incremental innovation
Architect	Actor in the IT technical development field that designs the systems architecture
Cloud Services	IT Services that have the characteristics described in Chapter 2.2.1
DevOps Team	A team of Engineers that not only develops software, but also operates and maintains it
Infrastructure as a Service	The physical layer of IT, so components that enable the construction if an IT platform, offered as a Service
IT Aggregator	Actor who acts as contractor of IT services on behalf of the customer
IT Broker	Actor who intermediates between services providers and the customer
IT Customiser	Actor who develops a customer specific IT component based on standardised IT Services
IT Integrator	Actor who integrates several IT Services into simple access and operation components for the customer
IT Tooling	Tools that support the operation, quality, and testing of IT systems
Legacy IT	IT systems that are outdated and planned to be decommissioned
Managed Services	IT Services that include all operational and maintenance activities and is performed by the services provider
Mature IT	IT systems that reached a mature and stable adoption adoption rate without expecting further growth
Novel IT	New IT systems that are emerging and promise to have a high growth potential
Platform as a Service	An IT platform, build up-on IT infrastructure, that is offered as a service to the customer who than can develop it's software on it
Software as a Service	Software application that are offered as a service to the customer
Traditional IT	IT systems that not utilise the advantages of Cloud based services
XaaS	Everything as a Service, a definition to cover PaaS, Iaas, and SaaS

2

Background and Related Work

There is a vast amount of research related to IT Services is available. In this chapter, existing theories relevant for this research are described. It starts with emerging IT services based on 'the Cloud', the governance of IT services, and how emerging technologies change the way to work. In the next part of this chapter, theories related to agent modelling and scenario planning are addressed.

2.1. Introduction

Information Technology is increasingly being integrated into society. The use of new information technologies in for example the manufacturing industry is called Industry 4.0. (Baur and Wee, 2015) defines Industry 4.0 as the next phase in the digitisation of the manufacturing sector, driven by four disruptions: the astonishing rise in data volumes, computational power, and connectivity, especially new low-power wide-area networks; the emergence of analytics and business-intelligence capabilities; new forms of human-machine interaction such as touch interfaces and augmented-reality systems; and improvements in transferring digital instructions to the physical world, such as advanced robotics and 3-D printing. Although a generally accepted understanding of the term Industry 4.0 does not exist (Hermann et al., 2016), McKinsey&Company was able to develop a 'digital compass' (figure 2.1) which visualises the value drivers and the underlying Industry 4.0 levers.

At the same time, a new economic model, the circular economy, increases in popularity. A circular economy differs from the traditional linear economy, by having a circular flow of resources. Without going into details on the principles of Industry 4.0 and a circular economy, these trends allow for the development of new business models. By the use of an example, I will explain the consequences of the Industry 4.0 and the circular economy. Lets say a tradition manufacturing company produces

Figure 2.1: The Digital Compass (Baur and Wee, 2015)

products which involve a high degree of labour and uses a business model of making profits on selling the produced units. A modern manufacturing company produces the same products using robotics which greatly reduces labour, and uses a business model of making profits by delivering the product units as a service together with maintenance and support. The transition from the traditional to the modern company in the above-described example requires the development of a new business model. According to (Johnson et al., 2008) a change in the business model is often required to address the needs of larger groups who find existing solutions to difficult/ too expensive and/or to capitalise on new technologies or to leverage technologies in new markets. In the case of intangible IT products which are provided as a service, the business model is called **a service delivery model**. As of 2017, a few new service delivery models have changed the way people interact with companies and disrupted a few economic sectors. For example, Uber changed the taxi sector by allowing everyone to be a taxi-driver. Airbnb created the possibility to temporarily rent out a part of your room or house, thereby competing with hotels. And streaming services as Spotify and Netflix changed the way people consume music and movies.

As an IT service provider, new developments like the above-described are important to watch since they require information technology to become successful. In this research, a new service delivery

model will be explored. This service delivery model allows for the delivery of tools for maintaining IT systems and infrastructures. Figure 2.1 will be used to explain the purpose of 'tools'. IT management and configuration tools directly influence asset utilisation, Labour, Quality, time to market, and service/after-sales. IT assets can be physical assets such as computers, storage, network devices etc. They operate and are configured, using software. Several tools are used to update, maintain and configure these assets in an automated and flexible way. Simply stated, without these tools, a IT service manager has to update/configure/maintain all assets one-by-one, which requires a higher demand for labour. Tools also allow for a better overview of the IT assets. Information about the current state of the assets helps IT professionals to make better judgements regarding the management of the IT infrastructure. These IT tools are service based (Everything as a Service XaaS) and are increasingly being utilised by Cloud Computing, concepts which will be explained in chapter 2.2.1. These technologies enable working more flexible and lower or eliminate initial costs, therefore, provide affordable scalability. These IT tools are used by IT service providers to manage their infrastructure or the infrastructure they manage for their customers. Since these tools become more convenient and powerful, and at the same time, the infrastructures become more complex, the need for IT service providers' customers to make use of these tools increases. This new development requires a redesign of the current service delivery model. Existing literature explains: how to govern IT services (Joukhadar and Rabhi, 2013), the effects of IT governance maturity on IT governance performance (Simonsson et al., 2010), the business perspective of novel IT artifacts (Marston et al., 2011), and several frameworks for controlling and designing information technology and systems services (Breiter and Naik, 2013b), (De Leusse et al., 2009), (Niemann et al., 2008). But an overarching concept for creating a new service delivery model from an internally used IT service to an externally commercialised model, focusing on the management and governance of the service, is missing. This research will help the development of multi agent models such as OperA and apply it to a case study, a natural empirical setting of an IT service provider. This form of research will create new insights in the applicability of agent models in the development of IT services delivery models.

The remainder of this document will further explore the project context and related problem; the research problem which is used to develop the research objective, framework and questions; the conceptual model to help the user to understand the different concepts and how they relate to each other; review literature of the concepts explains the context of the research in a detailed way; explain in detail the methodology for executing of the research.

2.2. IT Trends

As introduced earlier, Information technology [IT] plays an important role in new global developments. Digitisation in industries which previously relied on work flows involving human interaction, learning by doing, and deciding based on experience will increasingly be information driven and automated. IT tools enable information to add value to these business activities. Drivers of these new developments

are among others: Cloud computing, Mass Customisation. Systems become more open, dynamic, flexible and on-demand. The service model should incorporate these IT trends to stay relevant in the future.

2.2.1. Cloud Computing

Cloud computing enables people to access information independent from where they are situated. Because it is accessible from the open Internet, it allows for working, playing and the creation of information anywhere as long as you have Internet access. Before going into the details of the topic, the relationship between cloud computing and IT service will be explained. Cloud computing is a service, it works differently from traditional methods since the facility is managed by an external party. It does not require the user to own or buy any physical components to enable cloud services. Traditional IT products require capital investments by the user in order to utilise IT. Next to these investments, the user also had to arrange maintenance and operational activities for their IT to keep operating. With cloud computing, those activities are dealt with externally and arranged as a service. Those services require a change of the existing service model. Cloud computing has developed as a buzz word in the distributed computing community (Dillon et al., 2010) and covers a wide variety of technical and infrastructural definitions. Therefore, specification can help to understand the technical challenges in the Business Operations Department. The U.S. National Institute of Standards and Technology [NIST] defines Cloud computing as follows: ”Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model is composed of five essential characteristics, three service models, and four deployment models.” (Mell et al., 2011)

Characteristics are:

- On-demand self-service;
- Broad network access;
- Resource pooling;
- Rapid elasticity;
- Measured service.

Now that the definitions and the model of cloud computing are clear, the scope of the problem of the new service model can be defined. For the above-described characteristics, the ’On-demand self-service’ is seen as one of the benefits a new service model for IT tooling can provide. According to the senior manager/problem owner of the research, business customers are increasingly interested in accessing services themselves on demand.

Service Models are:

- Software as a Service (SaaS);
- Platform as a Service (PaaS);
- infrastructure as a Service (IaaS).

Everything as a Service (XaaS) covers there three models. Tooling enables management of services on all three levels. For example, configuration management can update a SaaS, and monitoring can provide insight in the IaaS.

Deployment Models are:

- Private Cloud;
- Community Cloud;
- Public Cloud;
- Hybrid Cloud.

IT services organisations that move from offering traditional IT services to Cloud based IT services tend to apply a hybrid cloud deployment model. In the hybrid cloud, tools currently accessible for internal service management teams will be accessible for the IT service providers' customer. This does not necessarily require the tools to be hosted in 'The Cloud'. The technical execution of the new service delivery model will be discussed in the research only to the extent in which it is required for understanding the business aspects of the technology. This research does not intend to solve the technical challenges in building this service model.

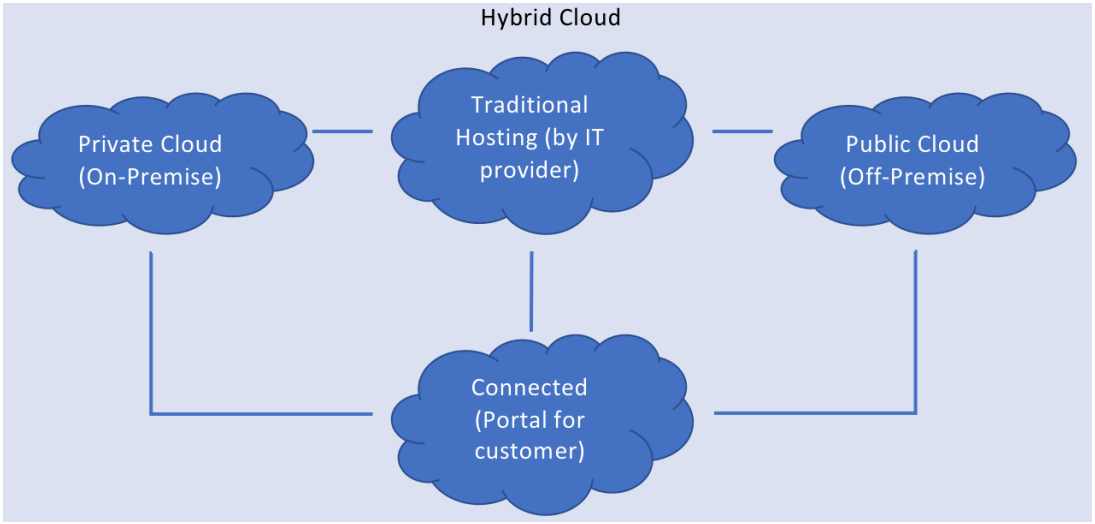

Figure 2.2: Representation of the Hybrid Cloud Deployment Model

Figure 2.2 shows how the managed hybrid cloud connects to both the private and public cloud. Providing scalability of the public cloud and security of the private cloud and making it accessible using a single portal.

Marston, 2010 (Marston et al., 2011) came up with a definition that tried to capture the benefits of cloud computing from a business perspective. Their definition is as follows: "It is an information technology service model where computing services (both hardware and software) are delivered on-demand to customers over a network in a self-service fashion, independent of device and location. The resources required to provide the requisite quality-of-service levels are shared, dynamically scalable, rapidly provisioned, vitalised and released with minimal service provider interaction. Users pay for the service as an operating expense without incurring any significant initial capital expenditure, with the cloud services employing a metering system that divides the computing resource into appropriate blocks."(Page 177)

This definition focuses on the utilisation of IT resources, using vitalisation to run systems, enabling users to apply self-provisioning of resources, and dynamically scaling resources as well. Now that the definition of cloud computing is captured, hereafter a more detailed view on the developments of cloud computing in businesses is addressed. With the focus on the Hybrid cloud, since this deployment model is attractive for IT services organisations that currently deliver traditional IT services to their customers.

2.2.2. Hybrid Cloud

A popular IT service for large enterprises and corporations is the hybrid cloud. This IT service adds value to a business by composing both the on-premise services and IT resources of a customer and integrating them with off premise cloud based services. Thereby traditional IT services which allow storing sensitive data on a designated physical location can be combined with modern IT cloud services for scalability and efficiency. To successfully utilise a hybrid cloud service, several challenges must be addressed: **Maintaining uniform control and keeping an overview of all the resources; managing workload monitoring, metering and SLAs centrally; moving from a traditional IT environment to a hybrid environment while maximising service availability and performance**. (Breiter and Naik, 2013a) described the challenges of the adoption of the hybrid cloud and developed an architecture framework which allows creation, modification and management of the hybrid cloud. Different integration patterns of the hybrid cloud are based on different desired types of integration. Integration can be characterised as horizontal or vertical. In a horizontal integration, both on- and off-premise components continue to perform if one of them is unavailable. In a vertical integration, the cloud services are structured in a hierarchy and top-level components depend on low-level components. Independent of the type of integration are the IT management tools. They are active in both off-premise and on-premise services to successfully govern the service. Simply stated, the architecture and framework of creating a hybrid cloud consists of three components. The connection between off- and on-premise services is called the Hybrid cloud management layer. This component enables control and management and provides simplicity and security. The other two components are the off- and on-premise clouds and they are accessible using the management layer. In (Breiter and Naik, 2013a), the realisation of the hybrid cloud is explained using the example of IBM's hybrid cloud

solution. Plug-ins are deployed in a hybrid cloud integrator which runs on a platform. This particular platform exists in physical servers, virtual servers and services deployed in the cloud.

Figure 2.2 captures the essence of the hybrid cloud service and shows the connection between the components. An interview with an engineer and/or product owner in the IT services delivery of the hybrid cloud will be executed in the research, to gather empirical evidence of the current governance and architecture of the service. The architecture of the hybrid cloud delivery platform allows for enterprise tailored solutions using components since both on- and off-premise cloud services are available in this deployment model. One of the biggest challenges in moving from one IT service to another is the cost of transition, not only financially but it is also a time heavy activity. A possible future extension of the paper of (Breiter and Naik, 2013a) could incorporate the challenges of the transition cost to the hybrid cloud. Secondly, more research on the application of this architecture by other IT service providers could allow for better generalisation of the theory. IT service management tools exist in many forms [cloud, on-premise, off-premise] and are used by both IT providers and consumers. My research will investigate the current governance of standardised tooling and automation and the governance of hybrid cloud services together with current theory and knowledge in the academic field of IT management and governance. This topic deals with the integration of management services and (Breiter and Naik, 2013a) states the following regarding this topic: "For management services such as monitoring and metering of hybrid cloud services, information from the components needs to be gathered and aggregated. The aggregated information can then be subjected to further processing such as event-correlation or report generation. In such types of composition of management services, individual component services can be monitored and metered by the corresponding service provider and that information can then be aggregated to create the required monitoring or metering of the integrated service."

The business perspective of Cloud Computing

A review of (Marston et al., 2011) states that Cloud computing will change the way IT services are invented, developed, deployed, scaled, updated, maintained and paid for. It represents two major trends in information technology; (1) IT efficiency (computer power is utilised more effectively) and (2) business agility (rapid deployment, parallel batch processing, mobile interactive real time response). Key advantages offered by cloud computing are: (a) Lowering cost of entry; (b) Lowering IT barriers to innovation, (c) Easy for enterprises to scale; (d) Immediate access to hardware resources; (e) New classes of application, new delivery services possible. Cloud computing consist of three core technologies: (1) Virtualisation; (2) Multitenancy; (3) Web services. Virtualization is the technology that hides the physical characteristics of a computing platform from the users, instead presenting an abstract, emulated computing platform (A Vouk, 2008) Multitenancy, whereby a single instance of an application software serves multiple clients, allows for better utilisation of a system's resources (in terms of memory and processing overhead). A Web service is defined by the W3C as "a software system designed to support interoperable machine-to-machine interaction over a network" (Haas and

Brown, 2004), Page 7. The biggest impediment to utility computing will not be technological but attitudinal (Carr, 2005). Businesses applying cloud computing are exposed to some of its weaknesses. Some of them are (1) Wary of losing physical control of the data that is put on the cloud; (2) wary of the quality of service (QoS) of mission-critical applications. Opportunities are (1) Its opportunities to help developing countries reap the benefits of IT without significant capital expenditure (CapEx); (2) Giving SME's access to exploit high-end applications like ERP and Business Analytics; (3) Reducing an organisations carbon footprint (Green IT). Threats are: (1) Larger corporations have concerns about handing over their operations to another company; (2) Cloud providers could go bankrupt; (3) Security is the primary concern; (4) The lack of standards; (5) Performance and reliability concerns. Although these findings fit the existing literature on cloud computing from a business perspective, since technologies and implementation of technologies in IT companies are ever changing and exist in a rapid moving market, the relevance of the recommendations decreases over time. For example the addressed challenges might be tackled and today's cloud provides are confronted with new challenges. Therefore, this research will focus on the development of a design for a new organisational model, not the execution of the actual new model since this is up to IT professionals that can use the findings to make judgements in the development of the organisation.

Strategies for Cloud Implementation

The previous sections made clear that cloud computing has some challenges that need to be addressed. When moving to cloud computing, one important first step is to identify which applications are prime candidates for the movement to the cloud. Think of general purpose applications such as Office, Mail etc. The amount of legacy components in the current system should also be a criteria for prioritising the movement to cloud computing. With regard to large enterprises, they can implement "private clouds" which do still require capital expenditure but can provide higher server utilisation by learning from best practices. CIOs and CTOs should develop a Cloud Strategy, a time-based plan which states which applications can move to cloud computing first. By the use of a Cloud Committee, a small separate group that is distinct from the current IT setup, to continually evaluate the developments in the area of cloud computing. Sharing best practices will increase cross-fertilisation's which helps the adoption of cloud computing. From a cloud providers perspective, thinking of the end customers and how their needs will be met is more important than developing cloud applications just because they can. Their task also implies the development of migration strategies for existing applications. (Marston et al., 2011) also states that a "dived-and-conquer" strategy, whereby potential customers can be enticed to try some of the novel characteristics of the cloud-based application, with the hope that increasing familiarity would lead to a greater degree of acceptance in future, is a more pragmatic approach than migrating all existing applications at once. Finally, regardless of the strategy, it is important to manage the end users' expectation so that cloud computing does not become a victim of its own hype.

The paper of (Marston et al., 2011) concludes by providing a suggested broad IS research agenda in cloud computing which can be divided into categories: (1) Cloud computing economics; (2 + 3)

Cloud computing and IT strategy/policy issues (including security); (4) Technology adoption and implementation issues; (5) Cloud computing and green IT; and (6) Regulatory issues. Cloud computing and the IT strategy for an organisations perspective contribute to number 2 and 3 of these categories.

The suggested research topics can by classified under two fundamental domains: Technology, and Business. In this thesis, the focus and scope are in the business domain of the in cloud computing used IT tools and the IT tools which are deployed in 'non-cloud' environments. The in the literature described current state of the IT landscape is ever changing and therefore outdated. However, the challenges (security, privacy, reliability) described in the paper are still relevant for current IT transitions. Cloud computing is proposed as a tool to reduce IT management from the perspective of the user. The proposition of providing IT management tooling directly to customers does not comply with this vision. Delivering tools for the management of the infrastructure to the business customers will complement the experience of control and direct feedback. In other words, the new service model enables IT tools to be used directly by customers irregardless of the technological artifact it is build on.

2.2.3. Mass Customisation

Mass customisation refers to the process of delivering a customised object (product or service) to a mass. (Tseng and Hu, 2014) defines mass customisation as delivering customised products with near mass production efficiency. It has gained much attention from both academia and industry since its emergence (Tseng and Hu, 2014), Page 1. The paradigm of mass customisation is imperative for many companies to survive in the fragmented, diversified, and competitive marketplace. Its relation to the development of the new service model is that the shift from tailored IT services to standardised, composable objects is happening in IT organisations. Mass customisation in the IT sector can result in having standardised objects, like an app or just a small software component which enables a simple functionality. Combining those objects allow for complex automated solutions. Thereby, IT solutions can be tailored to an individuals specific requirements, and at the same time by standardised to ensure quality and safety with reasonable prising. For mass customisation to work, objects need to be able to interact with each other. New IT products and services to provide these linkage by the use of API's. Application programming interfaces [API] is a set of protocols and definitions to connect systems or data. It allows for IT systems to use data from other systems and it can help a developer to quickly build a new functionality. API's can be open to the public (open API) so that for example a developer can make his/her app work with data gathered by the API of an other app. Next to the technical implications, mass customisation can impact the development of a service model. IT users can customise their IT portfolio using different standardised objects. Thereby the service can be modular and tailored to the consumers' needs. Depending on the characteristics of the service, objects can be supplied by one provider or a collaboration of objects from different service providers which together enable one IT solution. In the development of the new service model, extant theories which discuss mass customisation in services will be a part of the heterogeneous body of literature for the construction of

the organisational design.

2.3. IT Governance

The second part of the review will focus on IT governance and all aspects which help to govern IT and IT services. IT governance is a subset of Enterprise/Corporate governance and focuses on IT performance-, risk-, and quality management. IT governance is defined as the structures, processes and relational mechanisms for the IT decision making in an organisation (Van Grembergen et al., 2004). Governance of IT is studied extensively and several approaches, models, frameworks, architects, and theories are developed. In this part, some key papers on the topic of governance in IT will be discussed. When searching for governance in IT services, papers on governance in service-oriented architecture are saturating the academic field. (Erl, 2008) describes SOA as an architectural model that aims to enhance the efficiency, agility, and productivity of an enterprise by positioning services as the primary means through which solution logic is represented in support of the realisation of the strategic goals associated with service-oriented computing.

2.3.1. Service-oriented Architecture Governance

(De Leusse et al., 2009) proposes a governance model for service-oriented architectures in three sections. An operational model; Object model; and Management model. The elements of the model are characterised under these three sections and they describe what a service needs in to successfully implement a service-oriented architecture. The article of (Bieberstein et al., 2005) shows how service-oriented architecture [SOA] can be leveraged beyond IT transformation to meet corporation's on demand needs in the 21st century. They argue that **initiatives in IT business transformations are needed to create an on demand business and an IT environment that is nimble, robust, and less expensive.** These three aspects are recognised by the industry and require a IT transition that supports them. Next, (Bieberstein et al., 2005) states that in the coordination of the IT directives, the collaborative relationship between the CIO's office and the business units must be explicitly defined to ensure an integrated end-to-end approach. The article also states that IT activities of the business units must be coordinated at an enterprise-wide level to maximise service reuse and eliminate redundant implementations. The reuse of common IT services (both inter- and intra- business units) is a critical success factor for an SOA. This part of the IT coordination is implemented in the KPN corporate strategy. With a few exceptions, the tooling and automation department of KPN provides and maintains Enterprise wide standardised tooling. These exceptions are now on the agenda to be migrated so that all the standardised tools are maintained centrally. Reuse of standardised tools promotes consistency of key business operations and reduces costs. Common enterprise services must have owners with defined ownership and governance responsibilities. Each service ownership is associated with a business scope. Examples are: Customer relationship management [CRM]; or Order management. The ownership and the responsibilities are aligned with the overall enterprise. Some preliminary interviews

with key owners of security and orchestration result in a preliminary statement that the organisational governance of KPN business operations meets these requirements.

IT governance is defined by (Weill and Ross, 2004) as 'specifying the decision rights and accountability framework to encourage desirable behaviour in using IT'. For efficient SOA deployments, it is critical to streamline SOA-related project controls to the bare essentials and promote service reuse, technical consistency, and interoperability. What this means for for IT organisations will be clear from the the generated organisational model, presented in chapter 4. Furthermore, the article gives recommendations to the governance of IT and uses a few practical cases to support the recommendations.

Frameworks have been developed to structure IT governance. Some of them are well known, such as: ITIL; Six Sigma; PRINCE2; and ISO 38500. They provide hands-on tools for managing IT processes and they each are tailored towards a unique specific goal. IT project management is related to this research since the new service delivery model can be characterised as a project of transformation. A transformation from the current service delivery model to the new service delivery model. From this moment it is not clear if this new model will replace the current model or is an addition to the existing model. The multi agent model will allow IT professionals to support the design of a new organisational model, but it does not exclude them from building upon the existing organisational model and refine it.

2.3.2. Combining SOA with ITSM

(Izza and Imache, 2010) states that misunderstanding exists when people refer to service-oriented architectures and information technology service management [ITSM]. To gain IT agility, the paper provides an approach to combine SOA and ITSM. ITSM is a set of specialised organisational capabilities for providing value to customers in the form of services. SOA can be defined as an approach to designing distributed computing infrastructures that considers applications as services on a network. Both approaches are service oriented and are necessary within an enterprise (Izza and Imache, 2010). Combining them in a framework may address both business and IT in its scope so that it exposes aspects of the enterprise that need to work together and identifies the gap between business activities and the IT systems that support them. The combined approach results in a unified perspective with main principles, a service governance approach, and a service meta model. What makes this topic interesting in the development of a new service model is how the paper combines the two approaches. They put the approaches in the perspective of the overall aspect of service orientation. Then, the different approaches are linked and merged into one model. Service governance means establishing and enforcing how a team agrees to work together. In content of (Izza and Imache, 2010), service governance guides the development of reusable services, establishing how services will be developed with infrastructure and/or IT solutions and how those services will be costed and offered to the internal and external consumers. It also establishes agreements between the providers of services and the consumers of those services, telling the consumers what they can expect and the providers what they

are obligated to provide in terms of QoS and in turn in terms of SLA. This is what the service model for tools used by external costumers should cover as well. It should be clear for both the service provider as for the consumers what to expect from the service.

2.3.3. From Internal to External Services

IT Services can be designed for use inside a organisation to structure and interconnect an organisations internal IT systems (Henkel et al., 2006) or to automate work flows, increasing efficiency, and reduce human failure. These internally used services can be used externally to connect to external organisations and resources. When moving from internal to external, new requirements show up. These requirements are functional requirements such as a systems behaviour or function, and non-functional requirements such as scalability, security and quality. These non-functional requirements are sometimes called the Ilities (Filman et al., 2002) and are a somewhat overlook part of the swift to external use of services. The move from internal to external services delivery becomes important when acknowledging that cloud services make services into self-services. Integrating business processes and automation relies on the integration of the organisation's IT system. This requires contact patches between the systems. In order to make the service available externally, only a selection of the functionality needs to be open to external parties. The rest of the paper of (Henkel et al., 2006) introduces a new programming method called aspect oriented programming to implement non-functional requirements without doing a major redesign of the existing system. This part is less relevant for this study since it focuses on the technical part of software development, while IT tooling is a subset of IT service management.

2.3.4. IT and SOA Governance effectiveness

IT and SOA are increasingly discussed in literature when it comes to aligning Business and IT agility. The review of IT and SOA governance shows that there are conflicting claims and inconsistency in the literature concerning the role of SOA governance (Joukhadar and Rabhi, 2013). Various IT governance frameworks exist and they address different governance aspects. SOA Governance aspects can be categorised under Business aspects and Technical aspects. (Joukhadar and Rabhi, 2013) states that there are no guidelines to adopt these frameworks and no evidence regarding their implications and success rate. In their research they perform a preliminary empirical study to examine the importance of each governance aspect by interviewing three IT experts who have decision-making roles in their organisations and they have experience with SOA governance. As a result, Business- and technical aspects are rated based on their in importance in practice. This research is an important source when developing a service model, since it involves effectiveness in practice. To actually improve business outcomes, a theory build by academics to govern service to indirectly improve business outcomes should be ultimately tested in practice.

2.3.5. Effect of governance maturity on governance performance

In (Simonsson et al., 2010), the correlation between the quality of the internal structure of an IT organisation, and the external impact of the same IT organisation on the business is validated. In this paper, the internal organisations efficiency is called the governance maturity. The external effectiveness of the services which this organisation is providing is called the IT governance performance. Control objectives for information and related technology (COBIT) is a well known framework for assessing the IT governance maturity and can be used to audit IT governance. COBIT uses four domains namely Plan and organise PO; Acquire and Implement AI; Deliver and Support DS; and Monitor and Evaluate ME. To assess the performance, four objectives of (Weill and Ross, 2004), namely cost-effective use of IT; effective use of IT for asset utilisation, growth, and business flexibility. They linked COBIT to objective metrics in order to perform a quantitative analysis. From the business point of view, the IT processes which strongly correlate with IT governance performance are: improved activities; documentation; monitoring and role assignment, and quality management. From the academic viewpoint, the results can be used to refine IT governance frameworks.

2.3.6. Critical Success Factors

Like the previous two papers, this paper includes a study done in the business view. (Pollard and Cater-Steel, 2009) performs an exploratory study on the implementation of ITIL using critical success factors. Critical success/failure factors (CSFs) are factors which determine the success or failure of a project in this business context. Usually a combination of many factors at different stages of the project life cycle, result in project success or failure (Belassi and Tukel, 1996). A projects success or failure can be perceived differently from both the project manager, the project members and the customers. This ambiguity exists because (1) it is not clear how to measure CFSs and (2) the list of critical success factors differs among existing literature. Several studies have put effort in structuring CSFs into different lists (Belassi and Tukel, 1996). The concept of CSFs was first proposed by D. Ronald Daniel in 1961 and redefined and popularised by John F. Rockart 1979 (Pollard and Cater-Steel, 2009). In the research of (Pollard and Cater-Steel, 2009), four organisations that had ”successfully” implemented the ITIL framework.

2.3.7. Technology Adoption

In technology adaption, the inter-operable system of services is created by technology guidance. For technology providers, more specifically IT services providers, it is helpful to define standards and conditions under which specific programming models and protocols must be used. Having a common set of tools and protocols can minimise the level of training needed and maximises the pool of available developers. To encourage technology adoption, technical efforts involving community portals and developer interest groups within the organisation allow to share, learn, and increase intellectual capital. IT standards can be represented in declarative format, which then can be used by the design models to

enforce compliance. Within IT services organisations, tools are used to stimulate active learning. Some organisations apply Share-point and the internal social networks that allow for knowledge creation, collaboration, and discussion to increase the overall quality of the human capital. In the search of extant theory for the development of the new service model, these corporate internal platforms will be used to acquire knowledge on the currently executed governance practices.

3

Methodology

3.1. Research Strategy

The approach to reaching the earlier stated research objective is explained in this section. A research strategy is the coherent body of decisions concerning the way in which a researcher is going to carry out a research (Verschuren and Doorewaard, 2010). The research objective is in this case a small domain and more in depth than broad. The sample is selective and the number of research units is small. The objective is successfully achieved using qualitative data and research method(s). The research is opted to be empirical and uses theoretical phenomena to not only describe them, but also uses theory and applies it into the business. A good research strategy fits the concept of Action Research, emphasis on scientific study, which is to say the researcher studies the problem systematically and ensures the intervention is informed by theoretical considerations. Much of the researchers time is spent on refining the methodological tools to suit the exigencies of the situation, and on collecting, analysing, and presenting data on an ongoing, cyclical basis. Theory informs practice and practice refines theory, in a continuous transformation. In any setting, people's actions are based on implicitly held assumptions, theories and hypotheses, and with every observed result, theoretical knowledge is enhanced. The two are intertwined aspects of a single change process (O'Brien, 1998). These characteristics fit best with a case study research strategy. Applying a case study research strategy as proposed by (Yin, 2013) will allow a researcher to study a phenomenon in a real-life context. However, using a case study method is not without criticism. Compared to other research strategies, a case study lacks a systematic handling of data. This can be minimised by structuring the collection of evidence. Next, there is a low degree of generalisation possible since the collected data is embedded in the case or cases. On the other hand, a case study can generalise theoretical propositions. The emphasis will

be on comparing and interpreting results and not on the basis of counting and calculation. The case study is the preferred strategy in this research proposal. A case study has the advantages of possibly offering a general picture of the practice-oriented research objective. The general picture is useful in the change of an existing situation. The case study captures the richness of the natural phenomenon, yet is specific to the particular organisation and can be hard to generalise. As described in the introduction, the research strategy of this research will involve agent based modelling using the OperA model. The research problem in the IT services delivery can be viewed from multiple perspectives. Hereby you can think of a supply-chain process perspective, a resources perspective, or a market analysis perspective. To be able to support the research problem with new knowledge, a organisational models' perspective is applied. Looking at a problem from an organisations point of view allows for research on objects in the organisation to come up with recommendations for the organisation. This organisations view is best suitable for this research in solving the IT services problem since IT services delivery is the core business of the IT services organisation. The applicability of OperA will be discussed in the next section.

3.2. Agent Based Modelling

Agent based modelling is an approach to model systems comprised of autonomous agents. Agent based models can be used by businesses to support decision making. Agents are autonomous decision-making entities. Agents can be used to provide natural way to view and characterise intelligent and/or reactive systems (Weiss, 1999). Agent based modelling can be used in cases were an ongoing interaction in some coordination environment is taking place. These characteristics make it difficult to design and implement such a system. Agent systems can broadly be divided into: Open systems, Complex Systems, Ubiquitous systems. The analysis of theory on IT governance in chapter 2.3 shows that the class of 'complex systems' applies to the situation in IT organisations. The roles within the services delivery change dynamically. "Agent-based models enable to connect the (heterogeneous) micro behaviour of individual entities to different patterns of macro, or organisational, behaviour (Mensonides et al., 2008)." Thereby, heterogeneous micro behaviour of individuals, small groups, and small systems, can be viewed as part of macro, organisational, behaviour. The agent organisation or agent society

3.2.1. Multi-Agent Systems

Multi-agent systems [MAS] add interaction and communication to single agent systems. MAS are characterised by the following (Huhns and Stephens, 1999):

- Are typically open and have no centralised designer;
- Contain autonomous, heterogeneous and distributed agents, with different 'personalities';
- Provide an infrastructure to specify communication and interaction protocols.

MAS perform social complex operations in which they communicate, negotiate and simply exchange information. In the organisational engineering of MAS, some kind of rules, norms, or social structure is required to ensure that agents act according to the system design. Coordination is an important aspect of both social engineering as well as systems engineering and can be perceived from both ways. In this case study, the Organisation per Agents [OperA] model is used as a framework to design the IT services society with it's objectives and structure.

3.3. OperA

OperA is a model that, in an abstract way, specifies how agents should act in according to the social requirements (Dignum, 2004). The main function of an agent is to act in a role to contribute to the goals of society. Agents perform a role described in the design of the society. The agents own preferences, capabilities and personal goals determine if and how it enacts its role. However, the society is often not concerned which agent enacts a role, as long as it gets performed. Several authors have advocated role-oriented approaches to agent society development, especially when it is manifested to take an organisational view on the application scenario (Chaib-draa and Dignum, 2002), (Zambonelli et al., 2001).

OperA is an organisational modelling approach which includes a graphical environment called OperettA for specification and analysis of organisational models. In OperA organisational structures, requirement and objectives are specified while at the same time individuals have the ability to act according to their preferences, capabilities, and demands. With OperA, people can create organisation structures which solve their coordination problems. This is the reason why OperA was chosen to be the applied model in this case study. The advantages of OperA are that the model is understandable in a way that interviewees in the IT services organisation can use it without knowing the details on agent theory. OperA consists of three interrelated models, starting with the organisational model [OM] which consists of roles and interactions in the society. Secondly, the Social Model [SM] connects roles to agents using contract clauses. Finally, the Interaction Model [IM] describes interactions between the agents. The main contribution this model adds to the research is the ability to design an organisational multi-agent system in which both the individual and the organisation are accepted. The OperA model results in the organisational model for an agent society. The building of the OM consists of three levels. Each level refines the OM, starting with the coordination level. The OM is one of the three components of the OperA model.

3.3.1. Coordination Level

In the first level, the coordination level, the coordination structure is defined. The structure of the society is defined using three different modes of coordination between roles. These modes are hierarchy, market, or network dependant. When a hierarchy dependency is present, the dependant is hierarchically on the dependee, meaning that there is a social contract relation. Market dependencies are

defined as relations in which a request is made public and different market parties can respond. The dependent can then choose the party to interact with. In a network relation, both parties are equally interested in interacting and the relationship is not imposed by a social contract. An open society can be characterised by market dependencies, a closed society by hierarchy and a semi-open / semi-closed society by a network dependency.

3.3.2. Environment Level

In the next level, the environment level, the interaction between the society and its environment is analysed. Analysis of the stakeholders and their requirements then lead to the identification of roles with specific functionality in the society. The environmental level results in the specification of the stakeholders into roles presented in the Social Structure [SS].

3.3.3. Behaviour Level

In the third level, the behaviour level, the internal behaviour of the system is analysed. This analysis is based on the outcomes of the coordination- and environment- level. Results from this last level are: the identification of objectives assigned to the roles; the specification of interaction scripts, and the refinement of the interaction scenes.

3.3.4. OperA and Case Study Research

OperA fits to the case study since it allows the research to view the challenges from aspects of the organisation, systems, and culture. However, developments in organisations are too often concentrated on technical aspects of systems, that result in agents complaining about ineffective organisational designs, budgets spend on unused systems, and ineffective communication and delegation structures. The OperA model enables analyses of the social environment of the IT services delivery, and is thereby chosen to be the appropriate model for this case study.

OperA is used in the case study to first identify the current organisational model. This model differs from the organisational diagram presented by the corporate communications department since this diagram is developed with totally different purposes in mind. Next, the interviewees for development of the future scenario's are selected based on a set of criteria. These interviewees will be asked to explain their interactions, objectives, dependencies and the type of dependencies. This data is used to refine the OM. For future scenario's the interviewees are asked to identify the changes they observe in the IT environment both organisational internally, as well as the external environment. These findings are validated using the existing academic theory on IT services analysed, and described in chapter 2. This results in scenario's effecting the current organisational model, its roles, objectives, and dependencies. For this case study, emphasis is on the OperA organisational model OM since this part is able to present the gathered data more adequately compared to the SM and IM. The SM and IM are used to validate the OM but they are not the result of the analysis.

4

Case: KPN IT Services

In this chapter, the OperA model is applied to a case study of an IT services organisation, KPN Business Operations. KPN Business Operations is an IT services provider with customers ranging from SME's to corporate enterprises, and is owned by Dutch TelCo and IT services provider KPN. KPN Business Operations maintains and operates the enormous IT systems of thousands of servers for hundreds of customers, employing approximately 14.000 employees. Clients range from the Dutch railway company 'Nederlandse Spoorwegen' (NS) and the Municipality of Amsterdam to many smaller organisations. Traditionally, these customers requested detailed, tailored and specific IT products as well as advice regarding the operating of their IT systems. KPN's services delivery was capable of providing this since they had all resources present to provide managed services. Managed services are described by IBM as: "services beyond traditional application and infrastructure management to include networks, storage, desktop and communications as well as managed services for security, data backup and recovery, disaster recovery, mobility, help desk and technical support." These are the core components of IT operations (IBM, 2013)(Page 4). Since technology changes over time, the way IT services are organised changes as well. This is one of the driving forces of this case study on IT services delivery and is extensively explained in this chapter.

4.1. Overview

The company studied, KPN, houses business departments that together facilitate telecommunications, information technology [IT] and additional services. The IT department, KPN Business Operations, is responsible for the IT services delivery. KPN Business Operations originated from being an externally acquired company. With the acquisition of what is now called KPN Business Operations, KPN was able to deliver both telecommunication and IT to its medium, large, and corporate enterprises. However, integration of these business components was challenging due to differences in historical background, experience, and - most importantly - company culture. This section provides an overview of the case company and its business model. The business model that is currently applied business model will be described in terms of customer segment(s), value proposition, core activities and cost structure. To start, the IT services delivery target market is geographically focused on the Netherlands. The companies' customer portfolio consists of customers that mainly operate in the dutch market. With the majority of those customers being governmental or semi-governmental organisations, the customers of KPN Business Operations focus on the Dutch market as well. Next to the geographical characteristics of the customer segment, the type of customers for IT services are businesses, ranging from small and medium enterprises [SME] to large corporations with shareholders. The value added by KPN Business Operations to the customers differs per customer. Modular composable IT services are developed to serve SME's with standard IT solutions such as digital work-spaces, networking, and communications. These services are build using the nations wide network infrastructure and the wide portfolio of IT software partners. Specific customer tailored IT services are developed for the medium to large enterprises, with dedicated resources allocated to the top 60 customers. These resources consist of dedicated IT support staff members who maintain and operate the IT services for the customer. The activities carried out to deliver IT services to the customers are specified in services level agreements [SLA]. These contracts determine the quality, availability and responsibility of all aspects in the services delivery. Activities carried out by KPN Business Operations are generally described as to develop, maintain, and operate IT infrastructure, platform, and services for customers. More specifically, KPN adds value to existing IT components or developing them in house to serve customers with their specific business processes. Major costs in IT delivery consist of development and operations costs of IT including equipment, software licences, and labour. These costs are covered by revenue streams from customers that pay according to specific services packages. KPN Business Operations applies metered services [pay-per-use], subscription based, and managed services depending on the preferred contract per customer.

4.2. Collecting the Data

Building an Organisation in OperA requires data from the IT services organisation. In this case study, a semi-structured data collection approach is applied. Herewith, a set of standard questions is used to build the Social Structure (SS) including roles, objectives, and dependencies in the OperettA environ-

ment. These structured questions are then supported by unstructured questions tailored towards the interviewees function in the services delivery. This approach is applied to gather data on the services delivery from an organisations point of view. The semi-structured approach allows for the interviewer to build upon answers given by the interviewee and allow the interviewee to explain their role specific knowledge more extensively. For the selection of interviewees, a set of criteria is developed and presented in table 4.1.

Rule	Description
Involvement Services Delivery	The interviewee must be involved in IT Services delivery, this can be both actively participating as well as advising- or depending on IT Services Delivery.
Interaction	The interviewee must interact with others.
Completeness	All Interviewees combined must be able to represent the IT Services delivery. Either from the role they currently act in, or by the roles they interact with.

Table 4.1: Interviewee Selection Criteria

The interviewees are selected by setting up an initial list of potential interviewees using KPN's organisational diagram. This list is updated by asking the initial interviewees which people could provide additional insights in this research. Based on the rules of table 4.1 and using the network of the senior manager of IT tooling, the following interviewees participated:

#	Interviewee	Department
a	Manager Customer Operation	Customer Team 'Utilities'
b	Technical Consultant 'Utilities'	Customer Team 'Utilities'
c	Product Developer	Products 'Corporate Market'
d	Architect	Tooling & Automation
e	Architect	Cloud Services
f	Service Level Manager	Tooling & Automation
g	Technical Consultant 'Automation'	Services Orchestration
h	Engineer 'Automation'	Services Orchestration
i	Engineer 'Tooling'	Tooling & Automation
j	Department Manager	Tooling & Automation
k	Product Owner	Service Ticketing

Table 4.2: List of Interviewees

The case study consists of in total 11 interviews, giving the researcher the possibility to develop a

general view on the entire services delivery process. By using the data collected from the interviewees, all key actors in the Services delivery are represented, ranging from the technical back-office to the agents who are in first contact with the customer. Figure 4.1 plots the interviewees on a two axis chart. The interviewees are asked to position themselve in the this two axis chart.

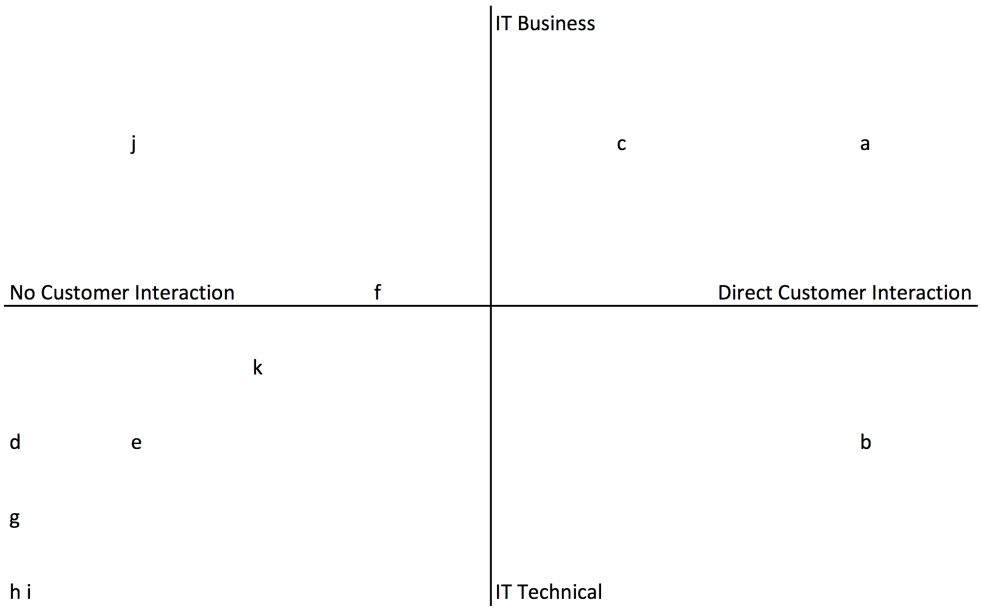

Figure 4.1: Interviewee Quadrant

The graph presents the 11 interviewees and shows that most interviewees in the back-office of IT services delivery, the agents who interact the least with the external customers, are considered to be mostly IT technically focused. In the direct customer interaction, both IT business focused as well as IT technical focused agents interact with the customer to effectively deliver the services. In this case, IT business refers to roles in which the agent has to understand the business of the customer in order to effectively execute their role. An IT technical role can execute objectives without knowing the business which are supported by the IT service.

Data from the interviews is structured in the following order:

1. Information regarding roles, agents, interactions, and hierarchy;
2. Data on the way of working, changes in the way of working, and consequences regarding these changes;
3. Identification of trends and patterns regarding and interviewees external (market) environment;
4. Knowledge on dealing with mature and emerging IT technologies.

This first two items are discussed in this chapter.

4.3. The Organisation Model

After Data Collection, the organisational model (OM) is constructed. The organisational model consists of the Social Structure (SS), the Interaction Structure (IS), the Normative Structure (NS) and the Communicative Structure (CS). The Organisational Model thereby represents the roles, norms and policies that apply in the organisation. To answer the research questions and increase effective use of the parts of the OperA model, the emphasis in this research on the first part, the social structure of the model. The social structure is consequently the main component for analysis. In the next section, the Social Model is presented. The Social Model connects the roles to the agents and adds contract clauses to the roles.

4.3.1. The Social Structure

Based on the interviews the roles, objectives, interactions and dependencies enabled the creation of the Social Structure which is applicable to the current organisation of the IT services delivery. This social structure is developed in the OperettA framework that allows organisations to be displayed in universal modelling language (UML). Figure 4.2 presents the SS in it's current form.

In the social structure diagram, the IT services customer is presented on the top, whereas the roles that are more in the background of the services delivery are placed more towards the bottom of the figure. Depending on the phase in which the services delivery is (bidding, negotiating, transforming, operating or ending) the objectives of and between the roles differ. To simplify this presentation of the social structure, the objectives presented are part of the operating phase.

The formal organisation is structured in a functional matrix structure, meaning that labour and activities are grouped based on there function (Products, Sales, Services, Tools, etc.). Each function consists of sub-functions that each have a manager, resulting in >3 management layers. Since the formal organisation structure is not part of the Opera Model, the social structure is continued to be used in this research.

Role	Abrv	Type	Objectives
Business Customer	BC	External	Get Managed Service, Storage, Security, Hosting, Digital work space; Negotiate Services Requirements
Customer Operations	CO	Internal	Deliver managed Service (decrease incidents); Request Connectivity, technical, and functional advise; Get storage, security, and hosting; Deliver digital work space; Operate Storage, and hosting; Provide security
Sales	Sa	Internal	Sell Services (Sales Targets); Request product Details; Negotiate Services Requirements
Product Development	PD	Internal	Develop Service Products; Analysis Market; Explain product contents;
Cloud Platform Provider	CP	Internal	Deliver Infrastructure; Develop service products; Enable tool on platform; Provide connectivity, security; Operate Storage, Hosting; Analyse market
Mature Platform Provider	MP	Internal	Deliver Infrastructure, and Platform; Develop services products; Analyse market
Tooling Development	TD	Internal	Develop tool, Enable tool on platform, Increase tooling adoption, Educate tool users

Table 4.3: Roles in the Social Structure with Objectives, Phase I

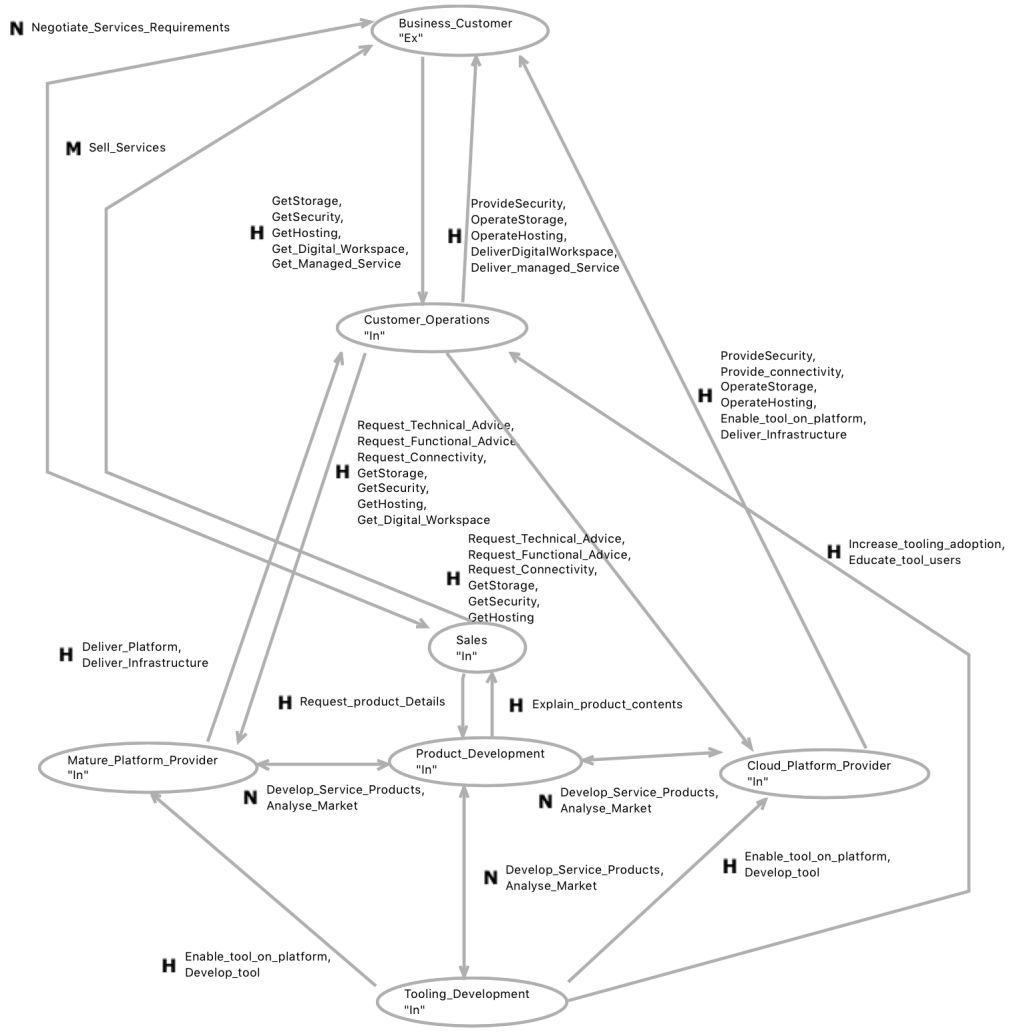

Figure 4.2: Social Structure Phase I

4.3.2. The Interaction Structure

In the interaction structure, scenes present interactions between roles to achieve services delivery. As described in chapter 3, the methodology, the Interaction Script and it's related scenes help constructing the norm structure. For constructing of the social structure, the tool OperettA is used. For readability, the interaction structure and norm structure are built using tables. The focus in the research is on the creation of the organisational model with its social structure. The scenario development implies changes in the social structure. Thereby, attention is put on the organisational social structure.

Scene	Role	Landmarks
(New customer / Contract renewal) tender	Business Customer; Sales;	Establish customer requirements; Tender offer public; Negotiation; Contract agreement;
Technical Realisation	Customer Operations; Cloud Platform Provider; Mature Platform Provider; Tooling Development;	Contract analysis; Technical exploration; Customer No boarding / Migration; Technical Realisation
Operations	Customer Operations; Business Customer; Cloud Platform Provider; Mature Platform Provider; Tooling Development;	Operational incremental improvement; Incidents managed

Table 4.4: Scenes Overview

4.4. Normative Structure

The normative structure of the organisational model consists of all the norms that apply to the scene's. The norms are expressed in the OperettA tool in the form of partial state description. In this research, the normative structure is expressed using tables. Table 4.5 presents a scene script example of a scene in which a new IT services contract is due for either a new customer or an existing customer with an expiring contract.

Scene (New customer / Contract renewal) tender	
Roles	Business Customer; Sales
Results	Contract Agreement; or No Contract Agreement
Patterns	BC informs Sa and CO regarding tender offer; Sa places tender bid; BC reviews tender offers; BC and Sa negotiate tender details;
Norms	BC is obliged to provide tender details to all bidding parties; Sa is permitted to deliver offer to BC; BC is obliged to review offer; When offer is reviewed, BC is obliged to inform Sa regarding review result;

Table 4.5: Example of a Scenes Script

4.5. The Social Model

The Social Model [SM] fills the roles by active populations of agents. In the following section, the roles (r) and agents (a) in IT services delivery from KPN are described. The norms between the Roles (r) and agents (a) are described in the contract clauses (CC). From Figure 4.3 a matrix organisational structure can be identified. KPN applies a matrix organisational structure to its operations, sales, and products teams by dividing them according to the market type (SME, Enterprise, Corporate) Thereby, different teams execute the same role depending on the customers' size.

ID	Roles (r)	Agents (a)	Contract clauses (CC)
1	Business Customer	IT services customer	Are the only one's fulfilling this role; do not fullfill other roles
2	Customer Operations	DCO Dedicated customer operations teams	Fullfill this role in duty of the top 60th largest (IT services cutomer) agents
3		General customer operations teams	Fullfill the role in duty of all (Business Customer) role agents except the top 60th largest one's
4	Sales	SME Sales team	Responsible for sales for the sme market
		Large entreprise sales team	Responsible for sales for the large entreprise market
		Corporate Sales Team	Responsible for sales for the corporate market
5	Mature Platform Provider	Mature Platform Operations team	Responsible for the operation and maintainance of the mature IT platform
6	Product Development	SME Products development team	Responsible for the product development in the SME market
		Large entreprise products development team	Responsible for the product development in the large entreprise market
		Corporate products development team	Responsible for the product development in the corporate market
7	Cloud Platform Provider	Cloud services team	Develop, test, maintain the cloud based services and cloud platform
8	Tooling Development	Tooling and Automation team	maintains and develops standardised tools for automation and continious delivery

Figure 4.3: KPN's Current Social Model

4.6. Conclusion

In this chapter the case study is introduced. Interviewees throughout the services delivery chain are asked to share their role and interactions within the services industry. The current organisation of IT services delivery is represented in OperA using the data from the interviews. After having build the Organisational Model and the Social Model, the analysis and scenario development takes place in the next chapter.

5

Analysis

The previous chapter showed the case of KPN and answered the first research question by identifying how the current services delivery is organised, and by showing what the current organisational model looks like. In this chapter, the remaining research questions are answered using the interviews, together with theory from chapter 2.

Data from the interviews is structured in the following order:

1. Information regarding roles, agents, interactions, and hierarchy;
2. Data on the way of working, changes in the way of working, and consequences regarding these changes;
3. Identification of trends and patterns regarding and interviewees external (market) environment;
4. Knowledge on dealing with mature and emerging IT technologies.

The first two items are used in the previous chapter, the last two items are used in this chapter.

5.1. Scenario Development

First ideas for the development of the scenario's started in collaboration with two key services delivery agents in the role of Technical Architect (d) and Service Level Manager (f). These agents do, as part of their role, interact with the entire IT services delivery chain. The agents follow the trends regarding IT services delivery from both the market suppliers as the demand perspective as well. In an interactive session, they were introduced to the research scope and problem statement. From this session it can be concluded that both interviewee d, and interviewee f expect the role of KPN in services delivery is going to change on short term (1 to 5 years) due to the following aspects:

- Customer Requirements
- Offered Products and Services
- Price and Quality
- Business Models
- Resource Requirements

These aspects have been discussed in the interviews and will be used to develop the future IT services organisation.

5.1.1. Customer Requirements

In order to come up with predictions of future IT services delivery, a good starting point is to keep an eye on the customers requirements and by analysing general shifts in these requirements over time. The first and most mentioned requirement by all interviewees is the request to deliver services on a higher frequency and to deliver them faster. IT Services customers expect to be served in a matter of days, sometimes even seconds. This in contrast to the current roll-out time of, for example, a new server which can take up to several weeks.

Next to the change in the demand is the change in the type of requirements by customers. Customers' requests are increasingly more of a functional nature instead of a technical one. While the customer previously described the requirements in technical specifications. This change is related to the recent change in the customer requirements, being able to use cloud platforms.

Customers are aware of the increasing popularity of cloud based platforms and are consequently planning to increasingly make use of such platforms. The advantages are described in chapter 2. Using such a platform makes customers specify their requirements in a more functional way. Currently an IT customer of KPN wants an E-mail server with, amongst others, capacity, networking andload balancing. In a cloud based services platform, a customer just wants E-mail. The way in which the e-mail is operated or the technology used for it is less important.

A growing concern in digitisation of business processes is the vulnerability of these processes to viruses and other security concerns. Recent global security incidents using malware confirmed the importance of security in IT services and products. In consequence, customers' demands for security services increase.

5.1.2. Offered Products and Services

First, offered IT products and services are decreasingly single purchase licenses. Software as a Service is becoming popular and is paid periodically, sometimes offered with the ability to use the resources at unlimited capacity. Think of unlimited music listening with Spotify. Next to the changes on the demand side regarding cloud based services are the increased offerings of cloud based services. These services

allow the customer to order, install, use, and decommission each of services from remote locations. No human interaction is required between the cloud provider and the customer in order for the customer to use the service. Cloud services can be fully managed, meaning that the customer who uses the service only carries the responsibility to input its preferences and its business contents while the cloud provider provides services such as security, back-up, monitoring, and all other secondary services.

5.1.3. Price and Quality

In the interviews, interviewees were asked to share their findings regarding changes in the price / quality ratio of IT services from the perspective of both demand and supply. From the demand side, customers focus on quality measures on **availability, speed, scalability and security**. They demand better performance on all of these measures. The enormous capacity of some of the public cloud providers have pushed quality performance to an extend that customers expect higher quality of their IT services.

5.1.4. Business Models

When asking interviewees about the business models used by IT services providers, they refer to the changes in the pricing structure. Due to the technical architecture of cloud computing, providers of these services can deliver their services at large volumes and are consequently very cost effective. Advanced metering technologies enable cloud providers to automatically meter IT services consumption very precisely, thus enabling them to let customers pay for what they actually use. A customer of cloud storage can thereby pay for the average use of gigabytes on an monthly basis, while traditional managed services credit an entire, physical hard drive. Another frequently applied pricing structure is the annual/monthly subscription allowing you to utilise the service unlimited. Music streaming services applied this pricing structure which enabled them to rapidly expand their businesses. Although pricing itself is not ingrained within this research scope, it is important for the current IT services organisation to think of ways to generate revenue in line with the cost structure. From the interviews' data on the topic of business models, it can be concluded that public cloud providers use aggressive, market penetrating pricing structures that allows customers to use their services at lower costs than traditional services. This phenomena leaves non public cloud providers in a position in which they should either copy this behaviour, or find a niche market to utilise their resources.

5.1.5. Resource Requirements

Based on the answers provided in the previous subsections, the required resources can be discussed. This subsection presents the results from the interviews.

One of KPN's strengths in their services delivery is using their current 'mature' IT platform is to help a customer with very detailed and specific technical requirements to provide them with solutions tailored towards this customer. This however, created a wide range of products and services. This

heterogeneous product portfolio stands at odds with their corporate strategy of Simplification and growth. Simplicity and growth in the IT sector comes down to standardisation, repetition, being able to build modular components and reusing previous work. An example of the execution of this strategy is the development of cloud IT services. KPN decided to develop services based on cloud technology to serve customers with a modular, dynamic, and flexible platform. The addition of the hybrid cloud solution makes it easy for existing business customers to transition from their mature legacy platform to a cloud based platform.

What kind of role can KPN fulfil in the future of IT services delivery?

Simply looking at customers requirements and increasingly popular types of offerings of IT services won't give a sound recommendation regarding KPN's role in future IT services delivery. To answer the aforementioned question, the interviewees are asked what they think the added value of KPN can be compared to the existing competition. First thing to notice is that, although public cloud services are the fastest growing IT services, this is not the area in which KPN can be competitive. Being competitive in public cloud services requires enormous investments in data-centres globally, something that would not fit the corporate strategy of KPN. Looking at reasons why KPN is successful (being a reliable partner, understanding customers specific needs; having a large adoption rate in the Netherlands) would suggest that they could use their excellent customer relations to give them the best IT services experience without being a global public cloud provider.

The traditional IT internal organisation is described in (Feeny and Willcocks, 1998), the Core IS Capabilities Framework. This framework describes nine core capabilities categorised in (1) Business and IT Vision, (2) Design of IT Architecture, and (3) Delivery of IS Services. The latter is most applicable to the current IT providers' organisation and contains the following core capabilities:

- Leadership
- Informed Buying
- Making technology work
- Contract Facilitation
- Vendor Development
- Contract Monitoring

IT solutions are increasingly being built using a mixture of several different Cloud based IT services. The importance of contract facilitation increases since each of cloud services all have their own contracts.

There are several ways to approach a new role that can be created based on expected changes in the IT services industry. First, the IT services delivery role could be advisory based, helping the customer to migrate from traditional services cloud based IT services. But thereby they would cannibalise their own services by making there own existence obsolete. Another approach would be to add a role to the

existing services delivery which functions as a broker, helping customers to select the right IT services for their needs, and helps them realising their IT solutions, independent from who offers these services. In this role as broker, several different platforms and services could be integrated and responsibility for the integrated service could be embedded in this broker role. The roles' details are discussed in the next section.

5.2. New Role: IT Broker

In the previous chapter, a new role in IT services delivery is identified. The name IT Broker (in literature sometimes referred to as Cloud Broker) is established because the agents in this role should act as intermediaries to service the customer. The IT Broker role contains three different sub-roles and can thereby function according to three different levels of outsourcing. This is presented in table 5.1 and is explained below.

Cloud services brokerage [CSB] is a services organisation that adds value to multiple cloud services on behalf IT customers.Gartner (Gar), defines three primary roles including aggregation, integration and customisation brokerage. The CSB uses their knowledge and technology to manage cloud services for its customers. The existence of three primary roles (Aggregation, Integration, and Customisation) within the broker role is recognised by many scholars. In this research, the three primary roles of IT Brokering are presented as levels of outsourcing, since each next level requires the customer to outsource the sub-role of the previous level. Table 5.1 presents these outsourcing levels in relation to the sub-roles of IT Brokering.

The first role an IT Broker can fulfil is the Integration Role. In this role, different public cloud services are made available to the customer that can access them easily using a single sign-on system. The objective of integration is to make sure that the operating of the several cloud services runs smooth while the customer gets the best fitted mix of cloud services from different third party providers. This first level of outsourcing requires the integration between the IT Broker and the tool development to properly deploy tools for integration.

The second role is the aggregation role. The IT Broker than not only integrates different cloud services, but holds responsibility to purchase the services as well. A 'managed' services contract between the customer and the IT services provider 'in this case KPN' increases the importance of the IT Broker since the customer does not contract different services themselves based on the intermediaries advice.

The third primary role is customisation of IT services. At first sight, this contradicts the trend towards standardisation. However, cloud services can be seen as standardised, composable micro-services that need a small layer of customisation in order to be suitable for business use. For this reason, the IT Broker could offer services tailored towards each customer, simply by composing different micro services and integrating them.

This IT broker role is further explained in this section. First, the roles objectives are discussed. Next, the activities are identified, followed by the responsibilities, and interactions.

Sub-Role in IT Broker role	Level 1	Level 2	Level 3
Integration	X	X	X
Aggregation	-	X	X
Customisation	-	-	X

Table 5.1: Outsourcing levels in IT Brokering

5.2.1. Purpose

The purpose of the IT broker role is to help the customer with their IT solutions. The growing amount of public cloud based IT services enables an IT customer to shop their services together in order to serve their businesses. It is important to note that most business, if they move to cloud based services, have to order these services from different cloud providers in order to create their preferred IT solution. The IT broker helps the customer in the development of an IT solution that involves a mix of different services that possibly are offered by different services providers. This purpose is closely related to the traditional purpose of the customer operations role, but it differs in the approach. The IT broker gathers customers requirements by discussing how IT solutions can add value to the business processes. The customer operations role uses the customers' technical requirements to identify his next steps. In interviews with employees from the customer operations team the purpose of this new role was agreed upon. However, they notice that customers that are moving towards cloud based services assign their sourcing activities to their internal IT department. Thereby, the IT brokers' role purpose would be obsolete in the IT providers' organisation.

5.2.2. Objectives

If this new role needs to fulfil the purpose described above, role specific objectives are necessary. The roles' objectives are listed as follows:

- Directing the customer towards a best fit IT solution;
- Providing accurate knowledge regarding the available IT solutions;
- Being competent in integrating IT components to serve the IT customer.

Guiding the customer towards the best IT solution should be the main objective of this role. This however, requires the IT broker to be knowledgeable when it comes to the available IT products and services portfolio as well as knowledgeable regarding the characteristics and futures of this portfolio. How this knowledge is obtained, either via a group of special advisors or by the use of a knowledge database, is insignificant. The last objective, integrating IT components is technically speaking the most challenging. Interviewees expressed their concerns regarding estimating the difficulty of integrating IT components to serve customers' business/IT requirements in the early negotiation phase.

5.2.3. Activities

To succeed in the role of IT broker, reach the objectives and fulfil the purpose, role specific activities have to be performed. The roles' activities are listed as follows:

- Supply Management;
- Demand Management;
- Negotiating.

Directing the customer towards the best IT solution entails Supply- and Demand- management. Besides being able to understand IT technical specifics, one should also be able to value these products and services and figure out a way to find the optimum service / cost ratio. As previously stated, IT services increasingly become more like commodities, making it easier for customers to judge these services on price.

5.2.4. Responsibilities

In the first outsourcing level, the responsibilities towards the customer are: Aligning Business demand with IT supply; Helping the customer to define its IT requirements. Responsibilities towards the IT services provider are: Maintaining a healthy relationship with the customer and third party services providers; General responsibilities are, to make sure projects run on time and within budget and to keep all parties updated regarding projects' status and informing them about impediments.

With the second outsourcing level, the Role of IT broker also responsible for the contracting of cloud providers. The customer outsourced the contract management by committing to only one contract that connects the customer to the organisation of the IT Broker.

In the last outsourcing level, the IT Broker becomes technically and functionally responsible for customising the integrated cloud solution to an extent in which the customer gets a unique solution tailored towards its business requirements, delivered by an all-in-one IT provider.

5.3. The Phases Setup

After discussing the scenario's on an abstract level with two key players in the IT services delivery chain, a three phase scenario based on the technology diffusion pattern comes to mind. Research on breakthrough technology adoption generated evidence on the existence of an S-curve diffusion of new technologies in the market stabilisation phase (Ortt and Schoormans, 2004; Ortt, 2010). Ortt and Schoormans discovered that the perfect S shape curve in the pattern of adoption of new breakthrough technologies can be distinguished between:

1. The innovation phase: Starting with the first invention up to the first market introduction;
2. The Market adaptation phase: From first introduction to the start of market diffusion;
3. The Market stabilisation phase: Starting when market diffusion takes off, and ends when the life-cycle of a technology is ending.

Of these three phases, phase number three (Market Stabilisation) occurs in Cloud based IT services (Pettey and Goasduff, 2017). The mature IT services are already in market stabilisation phase. Using this last phase in the paper of (Ortt and Schoormans, 2004), it was enabled to plot the traditional (mature) IT services and the emerging Cloud based IT services on an adoption to time graph. This graph presents three phases that are used to distinguish three organisational models.

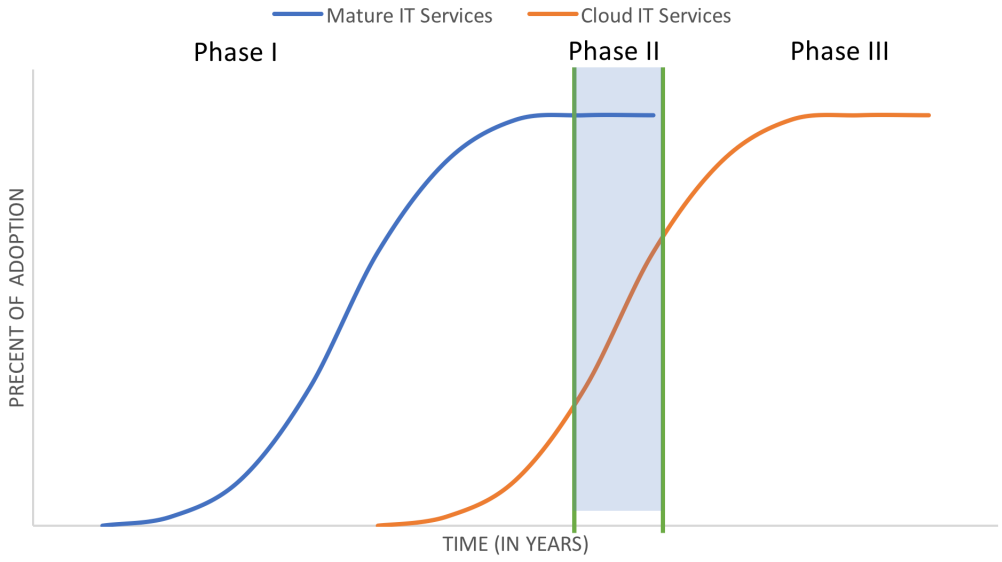

Figure 5.1: Mature- and Emerging- IT Services adoption

Figure 5.1 Presents the S-curves of adoption rate of mature and cloud IT services. The current organisational model applied in KPN, and documented in chapter 4.3 is situated in the phase I of the figure. In phase III, KPN will have to organise their OM to service cloud IT services. The interesting transformation phase in between those two phases is phase two, were the organisational model should be able to provide customers with both mature as well as cloud based IT services. The data in this

Scene (New customer / Contract renewal) tender	
Roles	Business Customer; Sales; IT Broker
Results	Contract Agreement; or No Contract Agreement
Patterns	BC informs Sa and IB regarding tender offer; **OR** BC requests Business / IT advice from IB; Sa places tender bid; **OR** IB delivers initial technical advice; BC reviews tender offers **OR** technical advice; BC and Sa negotiate tender details; **OR** IB negotiate technical execution
Norms	BC is obliged to provide tender details to all bidding parties; Sa is permitted to deliver offer to BC; IT broker is permitted to deliver technical advice; BC is obliged to review offer; When offer is reviewed, BC is obliged to inform Sa regarding review result; **OR** BC is obliged to review technical advice, BC is obliged to deliver review to IT broker.

Table 5.2: Scenes Script with new role

graph represents the global adoption of IT services. Regional differences are not taken into account. The technology performance S-curve is related to the technology adoption S-curve but part of this research. Figure 5.1 helps to understand the shift in types of IT services, and shows how a sudden shift towards being a cloud only IT provider would decrease the customer portfolio and leaves the majority of customers with unsupported IT systems. The second purpose of this graph is to explain what the situation in the second phase will be. Demand for both systems requires the IT services provider to be able to service both systems at the same time.

5.4. Transitions (Phase II)

In this phase the IT organisation introduces the IT Broker. Challenges arise in the interaction structure when servicing customers who demand cloud based services as well as mature IT services.

5.4.1. Interactions

The roles' main interaction is with the external customer. The IT Brokers dependency is contract based and thereby a hierarchical dependency exists. The second most important interaction is with the IT Brokers' services operating and delivery partners. These interactions are market dependent since every IT services provider available in could be involved, thereby interacting in a semi-open society.

To further explain the interactions in the society when the role of IT broker is added, the previous mentioned scene script is redesigned.

The scene script in table 5.2 becomes challenging to achieve since they practically involve two ways

of executing services initiation. The difficulty is to manage interactions between roles who both offer services to the same customer.

5.4.2. Social Structure

In this section, the new role of IT broker is integrated in the current IT services delivery social structure. This new Social structure is expected to be of a temporarily state in which adoption of customers using emerging platforms is low, and customers running mature platforms are still existing. Figure 5.2 presents the social structure in it's transition phase.

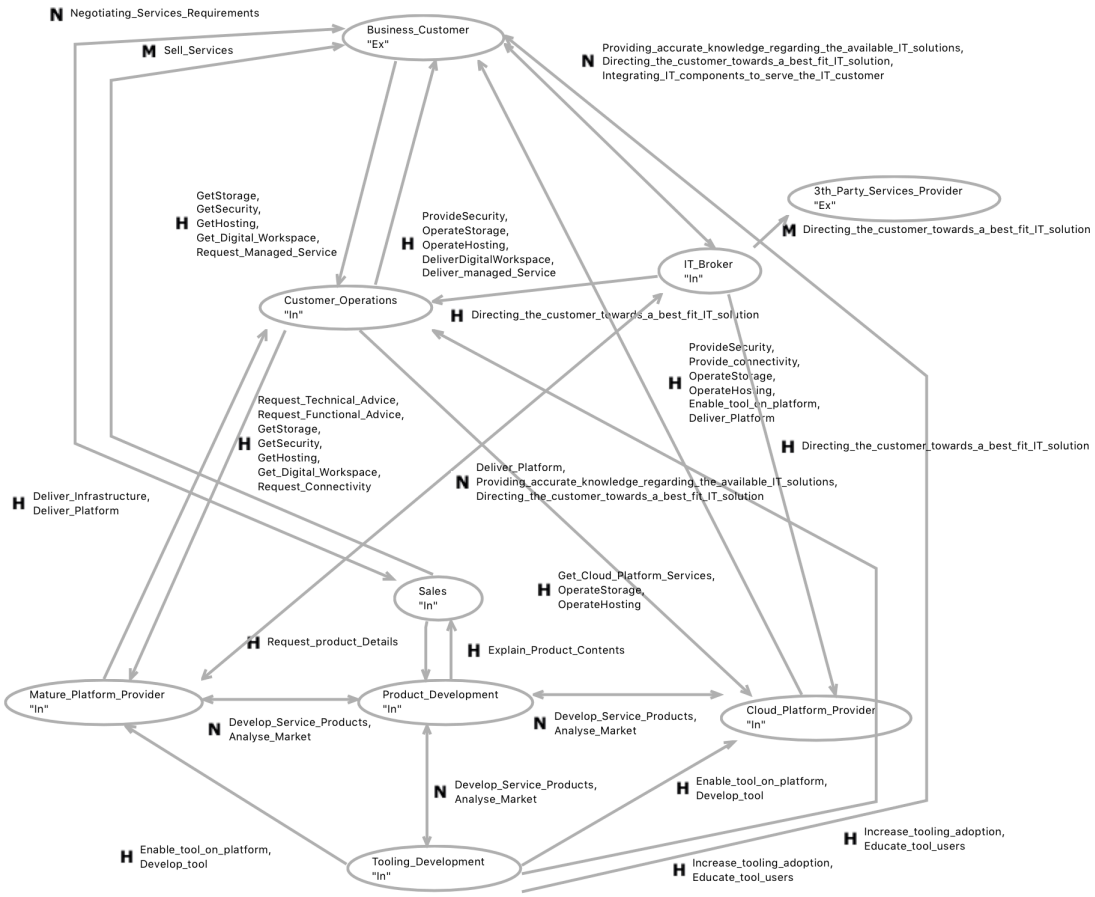

Figure 5.2: Social Structure in Phase II

The changes to the Social Structure SS Figure 5.2 are mostly visible between the customer and the platforms. The IT broker role acts as a deal-maker for the customer and interacts with different platforms depending on the customers requirements. As a result of this new role, 3th party external Services Providers become part of the social structure. In this transition phase, the roles and objectives of each role are dependent on the type of customer. If a customer is still using services that only rely on the mature platform provider role, the current SS will be maintained. If the customer is applying for emerging, cloud based platforms, the new SS and its objectives will be applied.

Role	Abrv	Type	Objectives
Business Customer	BC	External	Get Managed Service, Storage, Security, Hosting, Digital work space; Negotiate Services Requirements; **Provide accurate knowledge regarding available IT solutions; Directing customer towards best fit IT solution;Integrating IT Solutions**
IT Broker	IB	Internal	**Provide accurate knowledge regarding available IT solutions; Directing customer towards best fit IT solution;Integrating IT Solutions; Deliver platform**
Customer Operations	CO	Internal	Deliver managed Service (decrease incidents); Request Connectivity, technical, and functional advise; Get storage, security, and hosting; Deliver digital work space; Operate Storage, and hosting; Provide security
Sales	Sa	Internal	Sell Services (Sales Targets); Request product Details; Negotiate Services Requirements
Product Development	PD	Internal	Develop Service Products; Analysis Market; Explain product contents;
Cloud Platform Provider	CP	Internal	Deliver Infrastructure, Platform; Develop service products; Enable tool on platform; Provide connectivity, security; Operate Storage, Hosting; Analyse market
Mature Platform Provider	MP	Internal	Deliver Infrastructure, and Platform; Develop services products; Analyse market **Deliver Platform**
Tooling Development	TD	Internal	Develop tool, Enable tool on platform, Increase tooling adoption, Educate tool users

Table 5.3: Roles in the Social Structure with Objectives, Phase II

5.5. Discontinuity of Roles (Phase III)

Previous sections have discussed scenario's based on changes in the external environment. A new role was introduced to support the customer in their next technological challenges. However, with these changes, demand for tradition services will decrease over time. This section presents the consequences for the agents performing these roles.

5.5.1. Mature Platform Provider

In a platform as a service [PaaS] environment, traditional operations and maintenance becomes obsolete. As mentioned in chapter 2, activities in cloud based platforms are different and so are the required competences. Automation in the IT services industry eventually erases traditionally routinised work. This, off course, affects labour (agents) that enact this role. The discontinuity of this role won't be instant, however there will be a gradual decrease since customers' cloud strategy and time-line varies. In the mean time, the work force enacting this role can find a different role or, since average age of agents enacting this role is relatively high to the overall labour population, retire.

The objectives and interaction connected to this role are distributed over the remaining roles. Some of these objectives (deliver managed service) are replaced by the IT Broker role or become obsolete due to the nature of cloud based services.

5.5.2. Customer Operations

Interviewees in the customer operations role do already experience a stabilised demand for:

- Technical OS management
- Technical application management
- Functional application management

These tasks are currently operated by the customer operations team. In this role, specific knowledge and experience is built to execute these tasks. New agents in this role are trained to become more of a technical generalist and less of a specialist, since novel applications and systems are easier to manage. Currently, agents enacting the customer operations role do regularly attend educational events to study how to manage cloud technologies. These agents, as well, are aware of the demand for labour with different competences. In human resource management, new employees are recruited to become skilled in programming. An employee that can programme software can apply this skill in a wide variety of operational activities.

5.5.3. Sales

The sales role is, and will remain, an important role in the services organisation. Cloud computing however, changes the opportunities for the sales role to effectively execute its role. Cloud services

allow for easier initial testing of the service simply by subscribing online and try the product for a certain period of time. Since cloud services present themselves as a commodity, negotiations objective emphasise more on the volume of discounts and less on technical requirements. No longer will the standardised products be tailored towards the customer. The discontinuity of the mature platform leaves the Sales role with only the cloud platform as the main technical system that can be sold both internally to the IT Broker as well as externally to other IT Brokers or directly to other IT customers. Complexity increases when the societies' objectives are conflicting. For example the sales targets in the internal cloud platform could conflict with the objective of the IT Broker to find the best fit for the customer. To overcome these conflicts, the organisation can apply an internal market structure so that both objectives can exist within the organisation.

5.5.4. The Social Structure

The changes to the Social Structure SS Figure 5.3 are the absence of the mature platform provider, the Customer Operations and it's dependencies. One of the key results from this change is the increased importance of this new IT broker role. The IT Broker maintains a close relation to the customer, and in the same time is vital for the Cloud Platform. It is important to focus on the quality of the interpretation of this role. Figure 5.3 is presented in table 5.4.

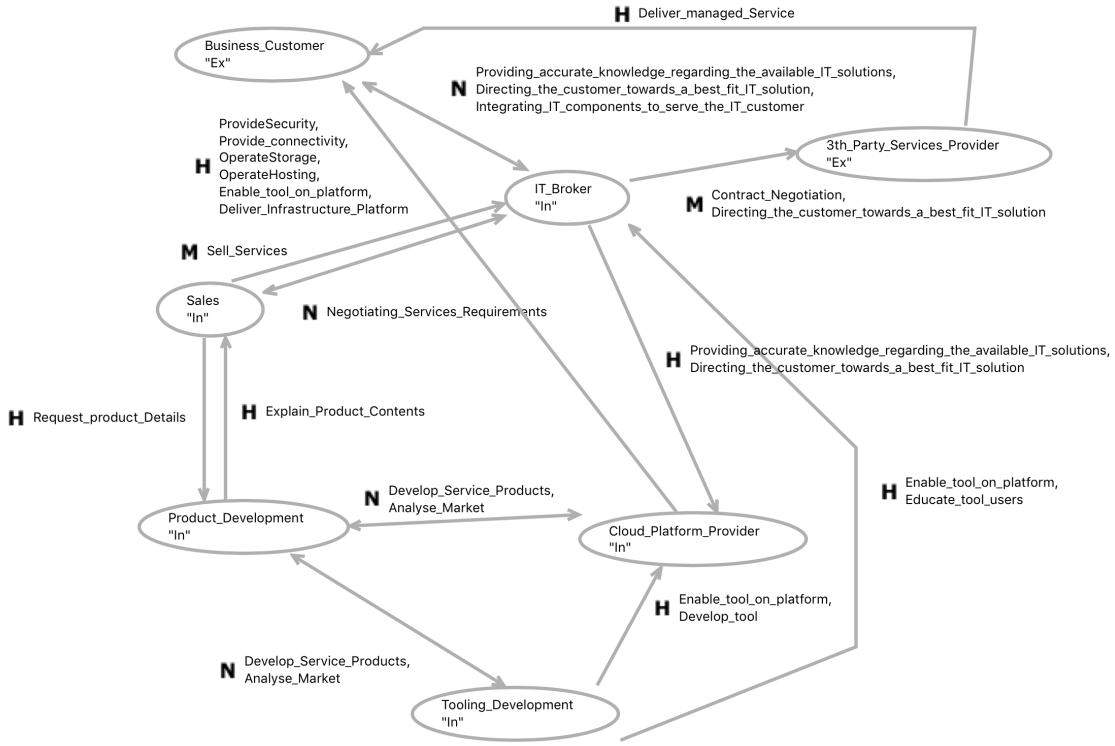

Figure 5.3: Social Structure in Phase III

Role	Abrv	Type	Objectives
Business Customer	BC	External	Get Managed Service, Storage, Security, Hosting, Digital work space; Negotiate Services Requirements; Provide accurate knowledge regarding available IT solutions; Directing customer towards best fit IT solution;Integrating IT Solutions
Third Party Cloud Provider	TPCP	External	**Deliver Managed Service**
Sales	Sa	Internal	Sell Services (Sales Targets); Request product Details; Negotiate Services Requirements
IT Broker	IB	Internal	**Provide accurate knowledge regarding available IT solutions; Directing customer towards best fit IT solution;Integrating IT Solutions; Deliver platform**
Product Development	PD	Internal	Develop Service Products; Analysis Market; Explain product contents;
Cloud Platform Provider	CP	Internal	Deliver Infrastructure, Platform; Develop service products; Enable tool on platform; Provide connectivity, security; Operate Storage, Hosting; Analyse market
Tooling Development	TD	Internal	Develop tool, Enable tool on platform, Increase tooling adoption, Educate tool users

Table 5.4: Roles in the Social Structure with Objectives, Phase III

5.6. Conclusion

In this chapter, the current organisational model is used to build scenario's. Interviews resulted in forecasting customer requirements, changes in the services portfolio and other characteristics that influence the future of IT services delivery. Next, the role of the IT services provider KPN within the IT services industry is analysed. This resulted in a new role within the OM. The transition towards the future scenario is presented in a three phases graph using the theory on technology adoption S-curves. The last third phase presents the future IT organisation of KPN with its OM, build upon the future scenario for IT were two roles become obsolete.

6

Conclusion and Discussion

This thesis focused on the design of an organisational model of an IT services delivery company. The organisational model used in this thesis was designed with the society objectives as well as agents individual preferences in mind. The motivation for this choice was that the IT services organisation is a complex semi-open organisation with autonomous agents, striving to succeed in their societies' objectives. The methodology applied in this thesis used modelling in an agent-society and the development of future scenario's in a traditional case study. Interviewees throughout the services delivery chain shared their experiences and theory regarding services delivery. This resulted in a scenario for the future IT services organisation. In this final chapter, those results are interpreted and explained; research questions are answered in the text; the use of OperA is justified and the thesis is evaluated.

6.1. Discussion of Results

With the competition being increasingly agile to changes in the market, KPN is struggling to be profitable while striving to become the 'Best services provider'. Modern IT services allow IT customers to apply self-service, a change that affects KPN's required resources for services delivery. Offering customers both traditional and novel IT services puts pressure on the services delivery organisation. The challenges faced by KPN can be summarised as followed:

- Going from slow roll-out of services requests to agile on-demand services delivery;
- From customer tailored heterogeneous services to the availability of standardised connected services components;
- From rigid departmentalisation to flexible agile DevOps teams;

- From reactive service incident management to proactive customer centred incident reduction;

The transformation of the organisation to react to these challenges is made possible using the agent modelling method. The use of an agent-based model makes it possible to develop rich scenarios. The OperA model enabled the development of the society that incorporates agents preferences and system goals to stay relevant in the future IT services market. The approach to answer the first research question, was to apply the OperA model to the IT services delivery organisation. This resulted in the design of the organisational model that described the intended behaviour and overall structure of the society. To present this model, the OperretA environment tool created the social structure displayed in figure 4.2.

6.1.1. Future of IT

The research into the systems context and architecture of novel IT services resulted in one uniform answer, IT services are becoming Cloud based. Investments show the growth potential of cloud services and emerging organisations apply a cloud only IT investment strategy. Several scholars have advocated the emphasis on the development of a cloud strategy. When asking the interviewees about their expected growth area's in IT services the cloud services, in particular, were mentioned by all of the interviewees.

After recognising the growth area in IT services, it is important to analyse how existing IT services companies can benefit from this growth. This is how research question two, *'How to develop current organisational resources to stay effective in future scenarios?'* is answered. KPN has to figure out a way to position themselves in the industry. Building their own public cloud service to compete with the big existing players in public cloud services won't be profitable. The companies core strengths do not match the requirements for being a public cloud provider.

6.1.2. The Role of KPN

Interviews with agents in the IT organisation of KPN confirm that customers are willing to move their IT assets towards cloud based solutions. In this movement, customers experience several difficulties. These difficulties vary from business/IT translation issues to technical migration issues. To solve these problems, KPN could step in. With their strong customer relationship and understanding of customers' existing IT systems, KPN can help them in their journey towards the cloud. How KPN should do this is the answer to the third research question, *What changes are needed in the organisational model to allow for emerging IT services to be delivered to customers effectively?*

To support the existing customers with their migration towards cloud computing IT solutions, a new role for KPN is born. There is a heterogeneous portfolio of public cloud services available and each of these services has their own advantages and disadvantages. In the role of the IT Broker, the services delivery organisation of KPN can support the customer by acting as an intermediary in the supply- and

demand- management of different IT services provided by any services provider. In this role, the IT Broker translates function business challenges into technical IT solutions and helps the customer to find the right set of IT partners to solve their challenge. The new role is added to the social structure in figure 5.2. Thereby, research question three is answered.

With the addition of the IT Broker, the IT services organisation increases competitive advantage since they position themselves as telecommunications, IT and IT advisory organisation. The added value here is that customers have an experienced, trusted advisor that can direct the customer towards the best fit IT solution. Interviews with two key agents in the services organisation resulted in the development of the intermediary role to serve the customer with new technologies.

6.1.3. Ways to move forward

Now that a new role in the IT services organisation of KPN is designed based the future scenario for customers willing to move to cloud solutions, the way to get to that future is designed. Changes in the IT demand and migrations from traditional to novel IT systems can take years to be fully completed. Interviewees addressed the need for a plan to go from the current organisation to the future organisation of IT services delivery taking into account the important characteristics of the OperA model. The analysis of background theory in chapter 2 delivered the following interesting connection: The technology adoption of traditional IT services and cloud services follow the S-curve graphs that are identified by several scholars. With the use of figure 5.1, the transition towards the new organisational model of the IT Services organisation of KPN can be split into three. The first phase represents the existing situation and the organisational model in its current form. With the organisation focusing on servicing mature IT services and having little to no customers active on the cloud platform. In the second phase, the new role will start to function while the existing roles are still active. The organisation can then serve a broad range of customers and learn to adapt to the upcoming new situation presented in phase three.

In the current organisational model of KPN's IT services delivery, the social structure of figure 4.2 represents the agent society. The business customer presented at the top, interacting with customer operations, sales, and the cloud platform provider. The goal of the society here is to manage the customers' IT services and deliver according to the customers' requirements.

Following the logic of the three phases, the social structure in phase two adds the new role IT Broker to the OM. New customers, or customers that express their whish to move to cloud based solutions can use the intermediary role of the IT Broker to design the best fitting IT solution for their business needs. This second phase that involves both mature and cloud it services can take years. In phase II, the Tool development role develops tools for the mature platform, and the cloud platform as well. Interviewees have expressed their concerns regarding the progress some customers make when it comes to decommissioning legacy IT systems. Some systems are >20 years old and are critical to some customers' core business. If and when these systems will migrate towards cloud based services

is hard to predict. The changes from phase I to phase II and from phase II to phase III are expected to not occur suddenly but follow a smooth path. In the third phase, the discontinuity of some of the roles active in the first two phases is effectuated. The core business of the IT services provider is to add value to existing cloud services. Human resources in the services delivery require different competences to execute the new services delivery model. Integrating, services require in depth knowledge of the global available public cloud services. Cloud aggregation is best executed by agents with strengths in contracting IT services. Integration requires the agents to translate the business questions into technical solutions and applying software programming skills to successfully execute this sub-role. The Tool Development role can, with their skills and objective, provide the IT Broker with integration and customisation related software tools. The findings from this thesis can help to generate awareness within the organisation concerning the expected role changes in the future. This awareness can be used to generate consensus among strategic actors in the services delivery and thereby increase the effectiveness of strategic changes.

The challenges of IT services organisation in KPN occur industry wide. IT services organisation, in the long run, all transform in order to survive in a post-traditional services area. The findings from this research can, in fact, be used by other IT services organisation to start a discussion on their strategic direction of their organisation.

6.1.4. The OperA Model

The beginning of this thesis motivated the applicability of the OperA model, and in general, agent-based modelling to answer the research questions. This section reflects upon this decision and discusses findings when applying the OperA model. First, it is important to note that the OperA model is a generic model for designing multi-agent systems. However, it is not yet applied in an IT services organisation problem. The dissertation of (Dignum, 2004) suggests further work to apply the OperA model in e-organisations, such as e-market, institutions, and virtual enterprises. In this thesis, the model is applied in an IT enterprise with the focus on the services delivery. From the experience with the model in this thesis, the OperA model is a sufficient way to construct recommendations on organisational changes in the IT Services industry.

The OperA models' ability to present heterogeneous autonomous entities relates strongly to the natural phenomena in an IT organisation. Using the elements in the organisational model made it easy for interviewees to understand the methodology applied in the case study. They can present multiple points of view and it also enabled the discussion with practitioners in the IT services delivery on their expectations regarding the future in the IT industry. However, the simplification of the OM generated difficulties in the application of other OperA elements such as the norm structure. These difficulties did not affect the development of future scenarios since the norm structures support the social structure in this research, but the social structure does not necessarily depend on the norm structure. OperA design tool OperettA supported the design of the OperA model, although tool support is outdated.

The automatic verification in the OperettA tool did not generate the desired verification result. The collected data enabled the construction of the social structure of the current and future IT services delivery organisation. For example, the goals of sales (get more customers on the internal cloud platform) can conflict with the IT Brokers goal (find the best cloud service). Novel to this application of OperA is that it supports a strategic change in the organisation based on the agents' society and a market analysis.

6.2. Conclusion

This section is finalised by showing how the research question is answered and how the findings are interpreted. First, the main research question "what approach can an IT services company apply to transform from a traditional services organisation to an organisation which delivers agile IT services, while effectively executing business goals, and increasing internal productivity?" can be answered by stating that an agent based view on the organisation does indeed result in an effective approach to analyse the transition of an IT services organisation. The case study showed that applying the OperA model for the generation of scenario's resulted in specific recommendations regarding new role requirements and other changes in the organisational model. The IT trends of chapter 2.2, Cloud Computing, the Hybrid Cloud and Mass Customisation are identified by the interviewees in the case study as well. The development of the IT Broker does fit into the rise of the aforementioned trends since IT brokering can only work when IT services of build as modular cloud based components. IT governance, and more specifically service level management as discussed in chapter 2.3 will be part of the IT brokers cloud aggregation level of outsourcing. Delivering IT services in the future requires the IT services provider to manage contracts of multiple public cloud providers to deliver the services as a single solution to the customers. This involves a mature governance model. The temporary state of the second phase in the transition towards the future of IT services delivery requires extra attention and strict demarcation of responsibility. The effects of bureaucracy on the strategic decision making in IT organisations is missing in the results from the case study. In other words, the organisation is modelled in the way that roles enacted by agents present how the organisation interact but they don't include actual processes of how organisational changes are executed. So depending on way an organisation governs their decision making with regard to organisational changes, the organisation could be too slow in their transformation. This involves organisational politics and requires further research. The model data and the findings from the case study presented in this thesis can be used to increase the effectiveness of decision making in IT organisations when it comes to their organisations, requirements, and the future of IT services.

6.2.1. Recommendations to Case Company

From the overview of the case company studied, presented in chapter 4.1, it can be concluded that the current services portfolio of the case company contains a high level of customised services that require

a high degree of labour to maintain and operate. Firstly, simplifying the services portfolio and allowing no new customers onto the traditional IT platform would increase the transition towards phase III of IT services delivery. Developing a transition plan per customer that at least includes an end date for the traditional services' support would force customers to rethink their IT landscape. Although agreeing to build services according to customers' specific requirements might increase customer satisfaction in the short term. Having a set of standardised IT services available for all customers will, in the end, result in a portfolio that is manageable, coherent, up-to-date, and thereby more secure. The transformation phase II can only be completed when the agents in the organisation are aware of the importance of transformation of the IT services portfolio. Furthermore, the currents sales agents should be encouraged to increase customer adoption on the emerging platform. Having KPI's that support the IT transition would be more beneficial than simply measuring sales revenue.

Most importantly, the rearrangement of labour due to the changes is the social structure. The social structure will require special attention. Continuous learning projects and the internal knowledge sharing projects should help the majority of agents active in the mature platform teams to retrain themselves and work on either cloud platform development or IT brokering. However, not all IT support staff will be capable of developing programming skills needed by the new roles. With the transformation to agile autonomous teams in software development, KPN would have to rethink the relation between IT technical advisory in the IT brokering role, and the IT development in the development teams. This section will be finalised by summarising the recommendations:

- Simplify the IT Services Portfolio;
- Develop Transition Plans per Customer;
- Specify end date for support on the traditional platform;
- Reward Sales Teams for increasing emerging platform adoption;
- Encourage retraining throughout the organisation, especially for mature platform developers and customer operators;
- Increase programming skills of IT technical engineers.

6.3. Scientific Relevance

The findings from this research have important theoretical implementations. Theory has revealed the boundaries for IT customers to move to cloud based services. The case study executed in the research has contributed to the existing literature on IT strategic decision making by showing that strategic planning is important for IT organisations, to provide their customer with novel services in the future. Furthermore, the agent based modelling methodology (OperA) applied in this research shows that it is suitable for analysis of IT organisations. At the same time, aspects of an IT organisation like internal and external politics are not explicitly presented in the model. This is a limitation of modelling

an organisation using agents and interactions, because underlying motives of actors are not directly visible in the interactions.

6.4. Practical Relevance

From a practical point of view, this research could be relevant for a wide variety of IT services organisations. The changes in customers' requirements and the offered services affect the IT industry and with it many IT services organisations. Strategic decision making within IT organisations can be model driven by applying an agent based model such as OperA. This case study showed that the OperA model is suitable for building future scenario's and for applying an agent and role based perspective resulted in the development of new roles and discontinuing other roles. Making the IT organisation future proof resulted in the presentation of the organisation into three phases. These three phases are realistic and practical since the transition towards the future organisation requires time.

6.5. Limitations

When researching IT services organisations using agent based modelling, some theory-, and methodological limitations are involved. First of all, the time for conducting a master thesis limits the thesis scope and data set. The execution of a single case study in an IT organisation, limits the generalisation of the study across a large group of IT services organisations. Secondly, although the eleven interviewees in total represent the services delivery from customer related to technical knowledgeable actors, the retrieved data is still limited to the findings of these eleven interviewees, which might effect the result of the developed scenario's. The use of interviews for collecting data results in the risk of collecting data that is biased, since, for example, the information given by the interviewees could be selective or exaggerated. Comparing the results of different interviewees with each other and with literature helps to partly overcome these limitations.

Next, there are some limitations related to the methodology. All modelling techniques apply a certain level of simplification of the real observable phenomena studied. So when a modelling method such as agent based modelling is applied, the organisation, its purpose, activities and interactions are consequently simplified in order to manipulate the model and develop predictions. The simplified model, however, is validated by the use of the information given by the interviewees. The simplification also increases the contribution of the interviewees to adjustments in the model. Interviewees could easily understand their role within the model and simplification did not lead to interviewees in the organisation feeling misrepresented. The method of forecasting unavoidably involves a degree of uncertainty. However, this is reduced by comparing forecasts of different actors and by using expert data from literature to back up claims about these forecasts.

Finally, the case study in the KPN IT organisation revealed the existence of politics in the organisation. The OperA model does not explicitly address power, influence and other political characteristics. Further research could explore how the existence of politics in organisations affect the results of agent

based modelling in OperA.

6.6. Further Work

In the future, applying OperA in other domains would help to draw better conclusions. The application of OperA and the case study in an IT services organisation could result in the development of a novel execution of OperA using advanced technologies. Like OperA, technologies such as deep learning are applied to systems and agent societies to simulate and predict future scenario's. Constructing a new tool for OperA using deep learning technologies could not only generate and validate the model in real time, but it also enables accurate predictions by training OperA to predicts individuals behaviour.

Applying the OperA model to multiple cases of IT organisations will help to generalise across more IT organisations. Further work of the OperA model in the services industry must take place in order to improve the applicability of the model for a wider range of organisations. Exploring the possibilities for further development of the design tool OperettA could supplement a proactive analysis tool to instantly assess the effects of disjoints in the organisation. If agents behaviour and its dissatisfaction regarding their role could be monitored, the OperA model could dynamically provide suggestions for objective and norm restructuring.

Next, research in IT organisations and their strategic decision making when it comes to changes in the organisation involves not only planning, forecasting, and modelling, but also politics. This last aspect of the organisation can be further researched using the OperA model.

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A

Appendix: Interview Protocol

The Interview Protocol is applied in the eleven interviews for the semi-structured case study of KPN Business Operations and included in this appendix. The purpose of the document was to ensure that the structure of the interviews was identical and that all main topics were discussed. The document was also used to write down ideas and was not intended for interviewees to be filled out themselves.

Interview Protocol Tooling as a Service

Version 1.2 : 22-06-2017

Interviewer T.J.P. (Tim) Joosten, M.Sc. Student TUDelft

Interviewee _____

Introduction

The 40min interview will be semi structured, meaning it consists of two parts. Part one contains structured questions addressed to all the interviewees formulated in the exact same way for every interviewee. The second part allows the interviewee to answer role specific questions. The interview will preferably held in person and will be audio recorded and transcribed word-by-word.

Purpose

The interviews are part of the case study **"Tooling as a Service"** in the Thesis project **"Agent Based Scenario Development for IT services delivery"** by **T.J.P. (Tim) Joosten**, in partial fulfillment of the requirements for the degree of Master of Science in **Management of Technology** at the **Delft university of Technology**

Goal

The goals of the case study is the test the applicability of Agent Based Scenario Development for IT services Delivery by answering "What organisational strategy can a IT services company apply to transform from a traditional services organisation to an organisation which delivers agile IT services, effectively executing business goals, and increasing internal productivity?" using a computational model called OperA.

Assumptions

In order to execute this case study, an extensive literature review is executed using a vast amount of related theories. Next, a desk research study is used to identify KPN's current challenges in their business, the IT trends in their external environment and, KPN's mission and goals. The following assumptions form the basis of the questions asked in the interviews:

- IT services are increasingly utilized using Cloud platforms
- IT services follow a S-curve regarding the adoption of user
- Labour required to operate, maintain, and update IT services is increasingly automated
- Components in IT services delivery become more interconnected, allowing IT services to be increasingly modular, and flexible.

Organisational Questions:

1) How would you describe your role in the service delivery?

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2) What are other roles you interact with?

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3) How would you define relation between you and every other actor in the services delivery?

4) Who initiates actions for you, who do you activate?

5) Where in the service delivery would you place your role?

a) Communication with KPN's customer:

i) To what extend do you stay in contact with external customers

ii) To what extend are interactions with customer proactive / reactive

b) Operation vs commercialization

c) IT technical vs IT Business

d) General vs Specified

Way – of – working Questions:

1) How would you define the way of working?

2) What changes did occur in your way of working?

3) What consequences does that have?

External Environment Questions:

1) To what extend do you following the changes in the external environment?
   a) Daily
   b) Weekly
   c) Monthly
   d) Quarterly or less

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2) What changes do you see in the industry?
   a) The requirements of the customers?
   b) The products and services offered?
   c) The price / quality?
   d) The business models applied?
   e) The resources required?

Emerging and Mature Services delivery questions:

1) Can you identify yourself with the following statement?
   a) "My work requires me to allocate time to both mature services as well as emerging new services"

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2) What is your view on working in this "Bimodal" way of working?

Gartner on the Bimodal approach:

"Bimodal is the practice of managing two separate but coherent styles of work: one focused on predictability; the other on exploration. Mode 1 is optimized for areas that are more predictable and well-understood. It focuses on exploiting what is known, while renovating the legacy environment into a state that is fit for a digital world. Mode 2 is exploratory, experimenting to solve new problems and optimized for areas of uncertainty.

These initiatives often begin with a hypothesis that is tested and adapted during a process involving short iterations, potentially adopting a minimum viable product (MVP) approach. Both modes are essential to create substantial value and drive significant organizational change, and neither is static. Marrying a more predictable evolution of products and technologies (Mode 1) with the new and innovative (Mode 2) is the essence of an enterprise bimodal capability. Both play an essential role in the digital transformation."

Comments:
