UNIVERSITY OF TURKU **ABSTRACT**

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Abstract

The number of business interested in Cloud Computing is increasing, but many organisations are hesitant to use cloud-based IT services. Many difficulties are related to security and compliance. Community Cloud is a strategy for dealing with these issues, decreasing security and compliance issues, and achieving additional benefits like cost reduction and faster time to market.

Community Cloud is a Cloud deployment model where the computational resources and infrastructure are exclusive to two or more organisations. Community Cloud has proven to be beneficial in some instances; however, research about the benefits and benefit drivers of Community Cloud is inadequate.

The study aims to develop a model to evaluate the benefits of Community Cloud and illustrate the usage of the model by assessing the benefits of three Community Cloud cases. The obtained information from using the evaluation model can be used in the decision process of adopting a Cloud deployment model. Organisations can deploy a Community Cloud to improve their current operations and develop and extend their offerings.

Based on the nature of the topic, the paper adopted an exploratory research strategy, including a multiple case study. Expert opinions, stakeholder interviews and literature review resulted in triangulated analysis of the subject.

The contributions of the paper are twofold. First, the research shows a TOE-based benefits evaluation model for Community Cloud and second, it illustrates the use of the evaluation model reporting benefits in three Community Cloud cases.

Key words	Community Cloud, Cloud Computing, Business Benefits, TOE framework, Benefit Evaluation Model, Digital Ecosystems

UNDERSTANDING THE VALUE OF COMMUNITY CLOUD

An exploratory multiple case study

Master's Thesis
Triple International Master Degree in Management of Information Technology

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List of Abbreviations

NIST – National Institute of Standards and Technology
SaaS – Software as a Service
PaaS – Platform as a Service
IaaS – Infrastructure as a Service
TOE – Technological Organisation Environment [framework]
AES - Advanced Encryption Standard
GDPR – General Data Protection Regulation

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1 INTRODUCTION

This chapter introduces the research by providing the topic's background, presenting the research design and substantiating the scientific and business research motivation.

1.1 Background

Cloud Computing is rising fast and is even considered the fastest-growing technology in the IT world (Haris & Khan, 2018). Cloud computing focuses on providing dispersed access to scalable, virtualised hardware and software infrastructure through the internet to a wide variety of users (Goyal, 2014). It refers to the systems' software and hardware in data centres providing applications delivered as services over the internet (Goyal, 2014). The data centre software and hardware are what we call Cloud. According to the National Institute of Standards and Technology (NIST), the essential characteristics of Cloud Computing are on-demand self-service, broad network access, resource pooling, rapid elasticity, and measured service (Mell & Grance, 2011).

Cloud Computing can be classified through deployment models. There're four ways to deploy a Cloud: (1) Private Cloud: an internal infrastructure used by one organisation; 2) Public Cloud: infrastructure provisioned for open use by the general public; 3) Community Cloud: infrastructure shared by a community exclusively; 4) Hybrid Cloud: a composition of two or more of the previously mentioned models (Mell & Grance, 2011).

The third Cloud deployment model, the Community Cloud, has received comparatively little research. This paper will focus on the deployment of Community Cloud from a business perspective. In a Community Cloud, sharing of resources and infrastructure takes place, but more importantly, it focuses on building a physical network called Community Networks (Dias, 2015).

The benefits of successfully implementing Cloud Computing, in general, have been studied. It can offer significant advantages, like low entry cost for small firms, immediate access to hardware resources, lower IT barrier to innovation and scalability (Marston, Li, Bandyopadhyay, Zhang, & Ghalsasi, 2011).

However, Community Cloud is not yet extensively researched. Only 11 studies have focussed on Community Cloud cases (appendix 1). The understanding of benefits and benefit drivers of Community Cloud can be deemed limited. The lack of extensive research provides an opportunity for further investigation.

Traditionally to evaluate Cloud adoption, a Cost-Benefit-Analysis (CBA) is executed (Maresova, Sobeslav, & Krejcar, 2017). A CBA requires all benefits and cost to be assigned to monetary values. Benefits of the Community Cloud can arguably be challenging to assign to monetary values, e.g. increased ability to share information. Therefore, a new approach is required. To evaluate Community Cloud deployment post hoc, the study looks at what information is needed before adopting a (Community) Cloud and aims to align the output of the evaluation with the input for the decision framework. This paper's designed evaluation model is based on the Technology, Organisation and External Task Environment framework (TOE).

The TOE framework is a technology implementation theory that focuses on analysing technology usage, adoption, and the value-added from technological progression Gangwar et al. (2014). By basing the evaluation model on the technology implementation theory, information input for decision making will be more applicable.

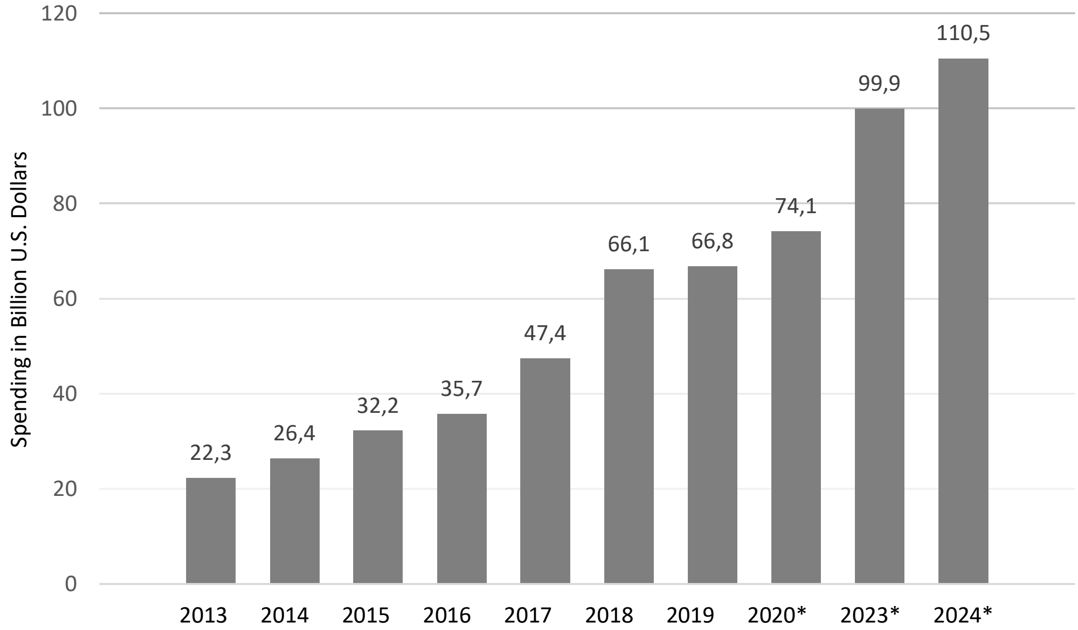
1.2 Research Motivation

To assess the research motivation, an understanding of the business relevance and scientific relevance is needed. The concept of relevance refers to how one subject is linked to another, so that it is helpful to think about the second topic when thinking about the first. In research, relevance refers to the extent to which the results can be applied to a real-life situation. The term "interrelationship" refers to the relationship between two topics. To put it differently, relevancy in science means that the analysis you're doing should be beneficial to others as well. The relevance of this research is divided into business relevance and scientific relevance.

1.2.1 Business Motivation

The cloud computing market is estimated to grow from \$40.7 billion in 2010 to \$240 billion in 2020 (Alhammadi, 2016). Cloud computing drastically changes the way businesses are operating. Community Cloud is still a relatively unknown deployment model and can create many opportunities in various sectors.

Table 1. Annual spending on cloud IT infrastructure worldwide from 2013 to 2024 (in billion U.S. dollars) (Mlitz, 2021)



This graph depicts Cloud IT technology expenditures from 2013 to 2019 and projections for 2020, 2023, and 2024. Spending on cloud IT technology is projected to hit 110.5 billion dollars by 2024. The use of public cloud computing is growing, and it is a significant driver of IT spending (Mlitz, 2021).

Therefore gaining knowledge in this area of business will be beneficial. Organisations can deploy a Community Cloud to improve their current processes, and organisations can develop and extend their offerings with a Community Cloud. For consultancy services, it creates the opportunity to address the market demand better and comes with an innovative solution.

1.2.2 Scientific Motivation

Research on how Cloud Computing is developing businesses and how organisations can expand in Cloud Computing is plentiful. However, these studies address the Public Cloud and the Private Cloud rather than Community Cloud (Odun-Ayo, Ananya, Agono, & Goddy-Worlu, 2018).

Secondly, studies on Community Cloud tend to be industry-specific or case-specific, therefore reducing their generalizability. There're a number of case-specific studies on Community Cloud (Baig, Freitag, & Navarro, 2018; Bruque-Cámara, Moyano-Fuentes, & Maqueira-Marín, 2016; Dias, 2015; Dubey, et al., 2019; Hao, et al., 2014; Hao, Park, Kang, & Min, 2018), creating a need for generalisable studies on Community Cloud.

Thirdly, technology in Cloud Computing is rapidly evolving. The first comprehensive studies on Community Cloud data back to over ten years ago (Briscoe & Marinos, 2009; Marinos & Briscoe, 2009). The value of studies on Community Cloud roughly ten years ago should be evaluated before implementing them further.

Concluding, the above-mentioned research needs form the objective and relevance of this research. This research will contribute to the scientific literature by analysing Community Cloud in multiple cases using current Cloud technology.

1.3 Research Design

Businesses require a reliable Computing system to fulfil their goals (Srinivasan, 2014). In their research, Dibbern et al. (2004) emphasise the importance of the Decision phase in IT outsourcing decisions, which shows a similar roadmap for Cloud Computing decisions. The outsourcing decisions cover the “why”, “what”, and “which” stages of outsourcing decisions. By increasing the information and knowledge used in this phase, the business will be able to make more adequate decisions.

This study is analysing the benefits obtained in three cases. The reason for focusing on benefits is that many organisations still judge projects exclusively on their performance rather than the benefits they provide. Many people feel that project benefits are impossible to measure, particularly advantages realised through product service, which typically occurs long after the project has concluded (Serra & Kunc, 2015). This research develops a benefit-evaluation model in the post hoc evaluation of Community Cloud deployment. Information gathered from the evaluation model can be efficiently utilised in Cloud adoption decision models. This study will develop an answer to the following research questions.

1. *How can Community Cloud enable (inter-) organisational benefits?*
    a. *How can Community Cloud be defined?*
    b. *How can (inter-) organisational benefits of Community Cloud be evaluated?*

Subchapter 2.2 answers the first subquestion (a) based on the literature review. Subquestion two (b) is answered in 2.3 with literature, building a case for utilising the Technology, Organisation, External Task Environment (TOE) framework (Baker, 2011) to create a benefits evaluation model. The evaluation model is used and discussed in chapter 5. Lastly, chapter 5 builds toward answering the final research question, which is answered in chapter 6 with empirical data obtained through interviews in a multi-case study.

2 LITERATURE REVIEW

The following chapter provides an overview of the literature on various aspects surrounding Community Cloud. It starts by giving an overview of the Cloud, including origin, essential characteristics, service models and deployment model. Afterwards, subchapter 2.2 discusses Community Cloud and its features. Subchapter 2.3 builds a better understanding of business benefits evaluation. Subchapter 2.4 provides an overview of the research on the business benefits of Community Cloud, categorised according to the model introduced in 2.3.

2.1 Cloud Computing

Cloud computing has gained popularity in recent years and is quickly becoming a common platform on the internet. (Al Bahad, 2020). Cloud Computing, according to Mell and Grance (2011), is a concept that allows for convenient, ubiquitous, on-demand network access to a shared pool of configurable computing resources (e.g., servers, networks, applications, storage, and services) that can be instantly supplied and released with minimum human intervention. Cloud can exist in many forms depending on the service and deployment models (Figure 1). For more information on Deployment models, see chapter 2.1.2, and for more information on service models, see chapter 2.1.3.

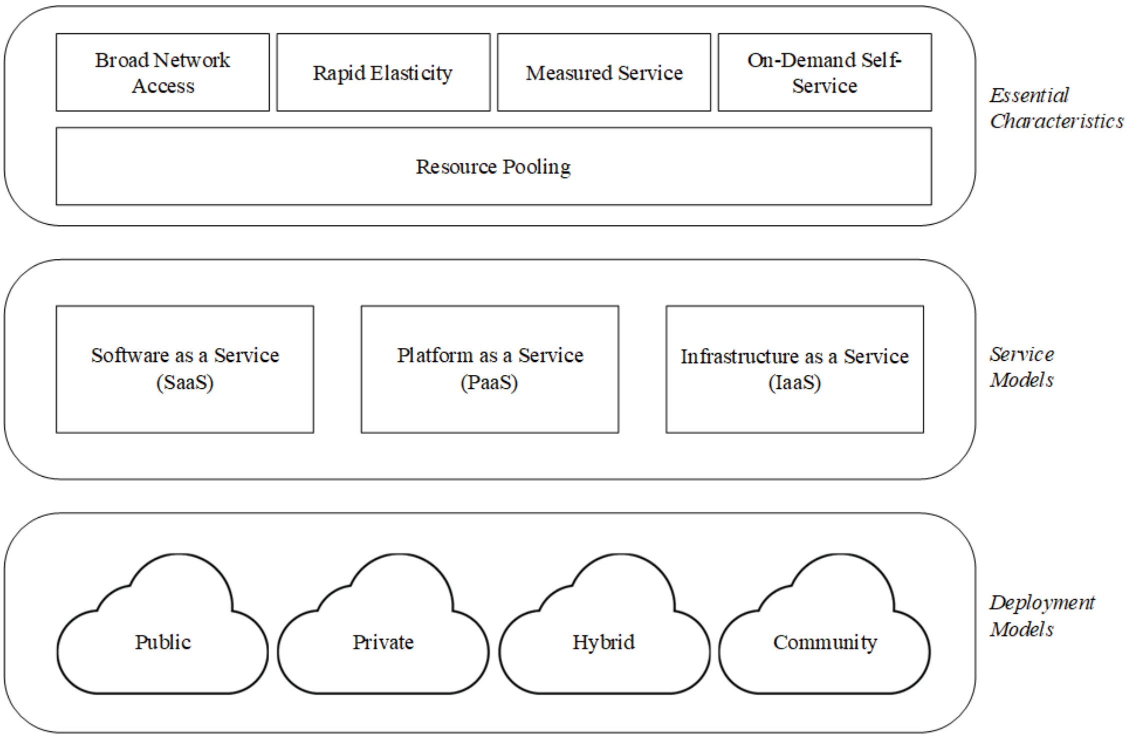


Figure 1. Overview Cloud Computing

2.1.1 Historic Review

Cloud Computing combines various technologies like Distributed Computing, Utility Computing and Grid Computing (Haris & Khan, 2018). Therefore Cloud Computing isn't a new paradigm but rather an enhancement of said technologies.

- *Distributed Computing* focuses on a group of computers working together to achieve a common goal. It's a system in which a group of computers achieved a common goal by working together (Haris & Khan, 2018). It breaks down the program into smaller segments and simultaneously solves the parts. This doesn't affect the complexity of the program, but it minimises the execution time.
- *Utility Computing* builds on Distributed Computing by providing resources and services on-demand to the end-user (Briscoe & Marinos, 2009). It can be seen as the pioneer for as-a-service computing.
- *Grid Computing* refers to a type of Distributed Computing that is no longer dependent on geographical location. It's able to provide powerful computational resources by using clusters of computers from different physical locations connected with a network. It's focused on computational power to solve large problems (Haris & Khan, 2018).

Cloud Computing emerges from these technologies, focusing on tackling computing power and providing on-demand services (Marinos & Briscoe, 2009; Haris & Khan, 2018). Next to the computing technologies, the roots of Cloud Computing (Figure 2) also lie in changes and improvements of other aspects, i.e. hardware improvements, like virtualisation and multi-core chips, appearing internet technologies such as Service-oriented Architecture (SOA), web 2.0, web services, and changes in system management, such as data centre automation and autonomic computing (Haris & Khan, 2018).

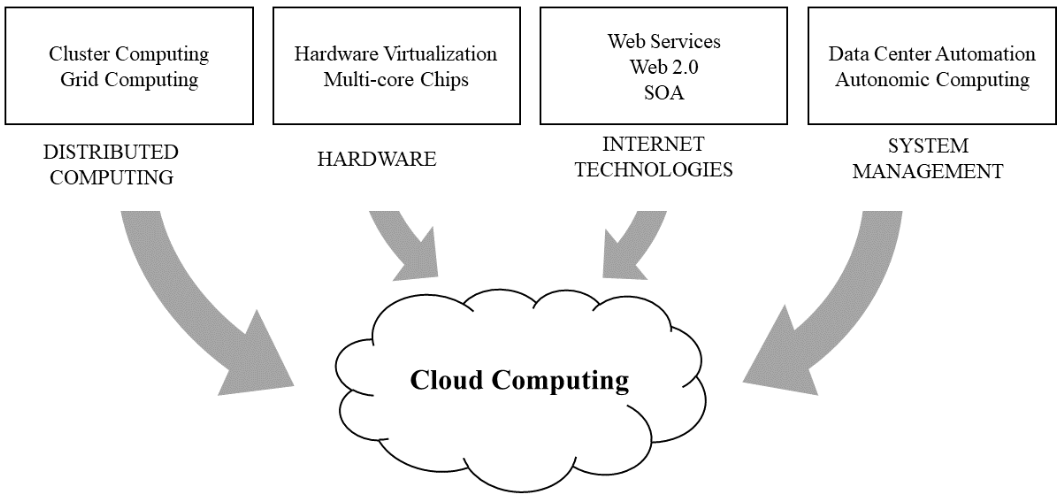


Figure 2. Roots of Cloud Computing (Haris & Khan, 2018)

2.1.2 Cloud Deployment Models

Cloud Computing technologies are classified in several ways. One of these organises the Cloud according to four deployment models (Mell & Grance, 2011):

1) Private Cloud: refers to an internal infrastructure used by one organisation;
2) Public Cloud: is an infrastructure that is made available to the general public;
3) Community Cloud: meaning an infrastructure shared by a community exclusively;
4) Hybrid Cloud: a composition of two or more of the previously mentioned models.

Table 2. Overview Cloud Deployment Models *non-exhaustive

	Private	Public	Community	Hybrid
Elements	Operates within an organisation's internal data centre (Goyal, 2014)	Pay-per-use cloud infrastructure accessible to the public and owned by cloud service organisation (Goyal, 2014)	The infrastructure and computational resources are exclusive to two or more organisations (Goyal, 2014)	Implementation of two or more of the previous clouds (Mell & Grance, 2011)
Benefits*	Increased Data Security (Goyal, 2014) (Alhammadi, 2016), Greater Control, In-house Resource Utilization	Data Availability and Continuous Uptime, Technical Expertise, On-Demand Scalability, Easy and Inexpensive Setup, No Wasted Resources	Flexibility, Efficiency, Less internal management, Cost reduction (Giovanoli & Gatziu Grivas, 2013)	Combines the advantages of cost-effectiveness and high scalability of a Public Cloud with the security advantages of Private Clouds (Alhammadi, 2016)
Challenges*	Higher cost (Goyal, 2014; Alhammadi, 2016)	Security & Privacy issues, More prone to Malicious Attacks (Goyal, 2014; Haris & Khan, 2018)	Data Accessibility (Goyal, 2014), Data Storage (Tavbulatova, Zhigalov, Kuznetsova, & Patrusova, 2020)	Security Issues, Portability and Interoperability (Goyal, 2014) (Alhammadi, 2016)

*Non-exhaustive

2.1.3 Cloud Service Models

Community Cloud Computing can be used in assosiation with other Cloud Computing service models (Bruque-Cámara, Moyano-Fuentes, & Maqueira-Marín, 2016). The Cloud service models are mentioned below, and table 3 provides an overview of the Cloud service model features.

1) Software as a Service (SaaS): the consumer can use an application from the provider through a Cloud infrastructure, i.e. Google Apps, Salesforce, Dropbox;
2) Platform as a Service (PaaS): the consumer can deploy their created or acquired applications onto the cloud infrastructure by using programming languages, libraries, services and tools created by the provider, i.e. OpenShift, AWS Elastic Beanstalk;
3) Infrastructure as a Service (IaaS): the customer is provisioned with processing, storage, networks and other fundamental computing resources, i.e. AWS EC2, Rackspace, Google Compute Engine.

Table 3. Summary of differences between Cloud service models adopted from (Alhammadi, 2016)

	SaaS	PaaS	IaaS
Control of Resources	No control, data ownership	Data and application control	Full resource control (excl. physical)
Responsibility for Security	Limited user security choices	Limited cloud consumer security	User responsibility for system security
Cost	No upfront cost, low cost, No internal IT staff	No upfront cost, operational costs incl. developers	Some upfront cost (purchasing VMs), operation costs incl. paying IT staff and developers
Level of IT Skills	A minimal level is required	Good IT skills required, because it's oriented towards developers	High-level IT skills required (managing OS, VM, networks)

2.1.4 Stakeholders

The National of Standards and Technology (NIST) identified five major actors in cloud computing (Hogan, Liu, Sokol, & Tong, 2011). These actors, as developed in 2011, are still used in Cloud Computing literature, and Odun-Ayo et al. (2018) describe the actors in their cloud computing analysis as such:

1) Cloud Consumer: A person or organisation that establishes and maintains a business relationship with cloud service providers and needs their services;
2) Cloud Provider: A organisation or person that provides Cloud computing services to individuals or organisations, i.e. AWS, Azure, Google, IBM;
3) Cloud Auditor: An organisation in charge of performing independent cloud computing evaluations and assessing the efficacy and security of the systems, i.e. someone with a Certificate of Cloud Security Knowledge (CCSK) or Certified Cloud Security Professional (CCSP);
4) Cloud Broker: An mediator between cloud users and cloud providers who are a third-party organisation or person. They help negotiate contract terms and conditions for the purchasing of cloud services, i.e. AWS Service Broker, IBM Multicloud Management Services, Cloudmore;
5) Cloud Carrier: An intermediary individual, organisation, or entity that connects cloud providers and cloud consumers and transports their services, i.e. network access devices, such as laptops, mobile phones, computers, mobile Internet devices (MIDs).

2.2 Community Cloud

The number of businesses interested in Cloud Computing is increasing, but many institutions hesitate to employ IT services in a cloud approach (Giovanoli & Gatziu Grivas, 2013). Many issues concern compliance areas and security (Giovanoli & Gatziu Grivas, 2013). Community Cloud is a way to face these challenges, decrease security and compliance issues, and achieve additional benefits like cost reduction and faster time to market.

Community Cloud is a form of volunteered resources sharing networks (Dias, 2015) and can be perceived as a Private Cloud shared by a community. Community Cloud can generate collaborative and trusting cross-firm relationships and enable information accessibility (Bruque-Cámara, Moyano-Fuentes, & Maqueira-Marín, 2016).

Community Clouds are typically shared by and tailored to a specific vertical industry (Giovanoli & Gatziu Grivas, 2013). These vertical industries include but are not limited to government, healthcare, or finance. Dias (2015) determined that the main focus of Community Cloud is on the censorship removal and free economy, putting the end-user back in control of the data and providing them with the freedom to share data without a company's censorship or interest.

This subchapter will provide a further explanation of the Community Cloud Concept. It starts with the definition and criteria used in this research, followed by various governance models available in Community Cloud. Afterwards, the subchapter will introduce the aspects concerning Community Cloud, including ecosystem and laws and regulations.

2.2.1 Definition & Context

The National Institute of Standards and Technology (NIST) is one of the best-know standardisation organisations (Moravcik, Segec, & Kontsek, 2018), trying to standardise essential functions of Cloud Computing. They offer the following definition of Community Cloud:

"The [Community] cloud infrastructure is provisioned for exclusive use by a specific community of consumers from organisations that have shared concerns (e.g., mission, security requirements, policy, and compliance considerations). It may be owned, managed, and operated by one or more of the organisations in the Community, a third party, or some combination of them, and it may exist on or off premises." (Mell & Grance, 2011, p. 3)

The *Cloud Infrastructure* is a term used to describe components needed for cloud computing. These components can include applications, virtual machines, operating systems, etc. Exclusive use of the infrastructure refers to usage solely by the community members. It can be addressed by carefully designed contracts, such as asking the third party (e.g. Amazon) to “separate” infrastructure for the community use. Against this, the Community is willing to pay a higher price. It can be challenging to define what constitutes a Community Cloud. Subchapter 2.2.3 discusses the infrastructure of Community Cloud in previously conducted studies.

The *Community* is a social unit where members put in the collaborative effort (Hao, et al., 2014). The Community can be governed as common-pool resources (CPR), meaning with ground rules, contractual agreements, regulations, etc. (Baig, Freitag, & Navarro, 2018). More on organisation and governance in subchapter 2.3.4.

According to Giovanoli & Gatziu Grivas (2013), an essential aspect of Community Cloud is that it addresses shared compliance requirements (*shared concerns)* for the specific groups and offers appropriate solutions to their concerns. Individuals may or may not have a direct interest in an issue that someone is trying to address, but they nevertheless share resources for the common good, according to Dias (2015). It’s a vital dispute because this could be one of the decisive factors when choosing between adopting Community Cloud or a standard SaaS solution. It’s a common conception that actors involved in Community Cloud have shared interests and/or concerns (Bruque-Cámara, Moyano-Fuentes, & Maqueira-Marín, 2016; Dias, 2015; Dubey, et al., 2019; Giovanoli & Gatziu Grivas, 2013).

An example of a Community cloud is the collaborative operation between Mt. Sinai Hospital of Toronto and the Canadian Government (Srinivasan, 2014). They made available a fetal ultrasound application to 14 area hospitals, highlighting the benefits of a community cloud. Digital Healthcare generates vast amounts of petabytes (PB) of data annually. The internal storage of such large volumes of data becomes cost-prohibitive. Hospitals can not only save money on storage by using a Community Cloud, but they can also share data with other hospitals (Srinivasan, 2014).

Table 4. Community Cloud Overview

	(Marinos & Briscoe, 2009)	(Goyal, 2014)	(Giovanoli & Gatziu Grivas, 2013)	(Bruque-Cámara, Moyano-Fuentes, & Maqueira-Marín, 2016)
Definition	C3 combines distributed control from Digital Ecosystems, distributed resource provision from Grid Computing and sustainability from Green Computing while making greater use of self-management advances from Autonomic Computing	C3's infrastructure and computational resources are exclusive to two or more organisations with common regulatory considerations, security and privacy	Union of Private Clouds, tailored to a vertical industry, such as healthcare, government, or finance, offering various services, incl., platform, infrastructure or software.	Community Cloud computing is an infrastructure that enables third parties to provide platforms and applications for the development of new services involving several different stakeholders and a unique environment in which fixed costs turn into variable costs through a pay-per-use arrangement
Stakeholders	Consumer, producer, coordinator (role of vendor is removed)	Consumer, producer, and most importantly, coordinator	Users and providers	Community of users from organisations that have shared concerns & optionally a third party
Benefits	Resource optimisation, promotion of open standards & innovation	Low set up cost, outsourced management to a provider, leveraging of information through tools	Satisfy organisation requirements, flexible solutions, matching market needs, data restriction, less management, cost reduction, more efficient	Increase businesses' business value and provide firms with capabilities
Challenges	Distributed computing issues, reaching critical mass to ensure Quality of Services (QoS) & security constraints	Fixed amount of bandwidth and data storage and higher costs than Public Cloud	Organisational Structures and management models, Communication, Ease of Use	Security concerns, the suspicion that comes with disclosing personal information to third parties, service availability and quality, and the potential difficulties that come with switching suppliers and adhering to legal data protection requirements

2.2.2 Governance Models

This subchapter will highlight three governance models for organising a Community Cloud as found in previous literature. The first model is the Federated Community Cloud (Figure 3). The Federated Community Cloud enables its users to share their resources effectively. The Federated Community Cloud model has the benefit of sharing idle computing resources of the organisations (Srinivasan, 2014). The Federated Community Cloud is a peer-to-peer system. Storage and content sharing are two types of peer-to-peer systems (Giovanoli & Gatziu Grivas, 2013). They're popular because they can distribute content without legal control (Giovanoli & Gatziu Grivas, 2013). There're a few benefits to using a peer-to-peer sharing system, like bandwidth usage optimisation, file partitioned transfer enabling from multiple users, integrity by using hashes (Giovanoli & Gatziu Grivas, 2013). However, the main challenges with the federated model are the liability issues concerning processing, e.g. a service interruption in the middle of processing (Srinivasan, 2014; Giovanoli & Gatziu Grivas, 2013), and difficulty to provide cost transparency (Giovanoli & Gatziu Grivas, 2013).

An example of a Federated Community Cloud, as researched by Dias (2015), is the browserCloudjs. The browserCloudjs project attempted to create a Federated Community Cloud, allowing its users to share resources successfully, giving developers an efficient and reliable way to process and store data for their applications. The browserCloudjs allowed for efficient resource discovery, job distribution through available peers, and removal of the need for centralised indexes or points of control, etc. (Dias, 2015).

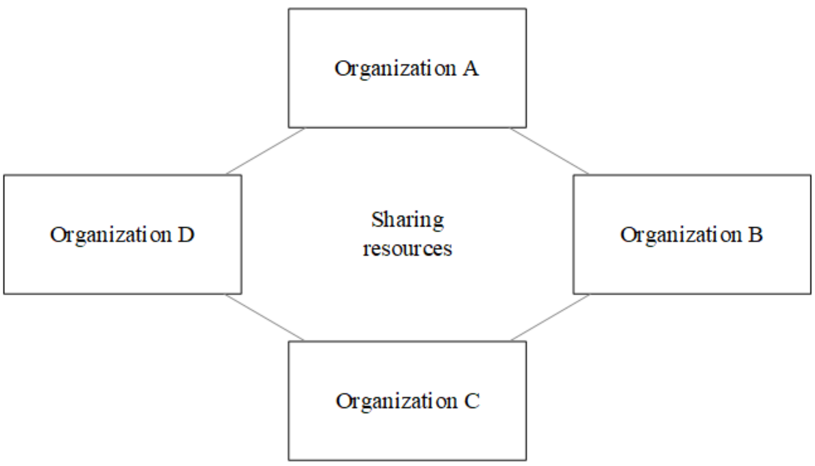


Figure 3. Federated Community Cloud adopted from (Srinivasan, 2014)

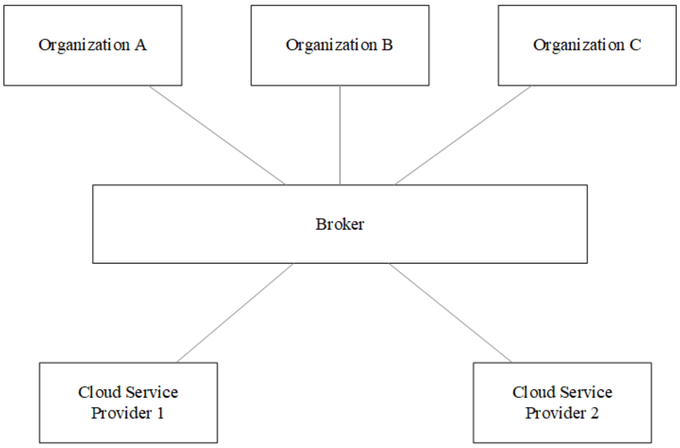


Figure 4. Brokered Community Cloud adopted from (Srinivasan, 2014)

The second organisational model is the Brokered Community Cloud model (Figure 4). A trusted third party acts as a broker between the organisations and the cloud service provider in this model. The brokered Cloud is better at handling liability issues in the Community Cloud. The broker has multiple responsibilities, i.e., arranging contract settlements with the providers, providing trust for the system's usage to members, resolving disputes and providing the necessary data for the members for meeting their compliance obligations (Srinivasan, 2014).

The third Community Cloud model is the Centralised Community Cloud model, as introduced by Giovanoli & Gatziu Grivas (2013). There is just one IaaS provider and broker in the centralised architecture. The leading party in the concept is an IaaS provider responsible for creating the cloud's infrastructure platform, which includes services such as storage, networking, computational power, virtualisation, and so forth.

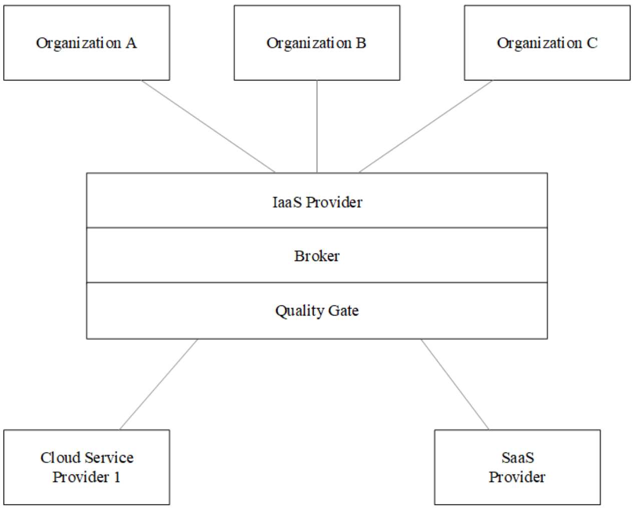


Figure 5. Centralised Community Cloud (Giovanoli & Gatziu Grivas, 2013)

2.2.2.1 *Stakeholders in Community Cloud*

In the previous chapter, the stakeholders within a Cloud have been defined as Cloud Consumer, Cloud Provider, Cloud Auditor, Cloud Broker and Cloud Carrier (Hogan, Liu, Sokol, & Tong, 2011). Hogan et al. (2011) defined these categories on the roles of the stakeholders, whereas Baig et al. (2018) have defined the stakeholders based on their interest in the project. The stakeholders are divided into three main groups. Stakeholders with 1) *Public Interest,* i.e. Public Administrations 2) *For-profit,* such as customers and professionals and 3) *Non-profit,* including Volunteers and Governance Bodies (Figure 6).

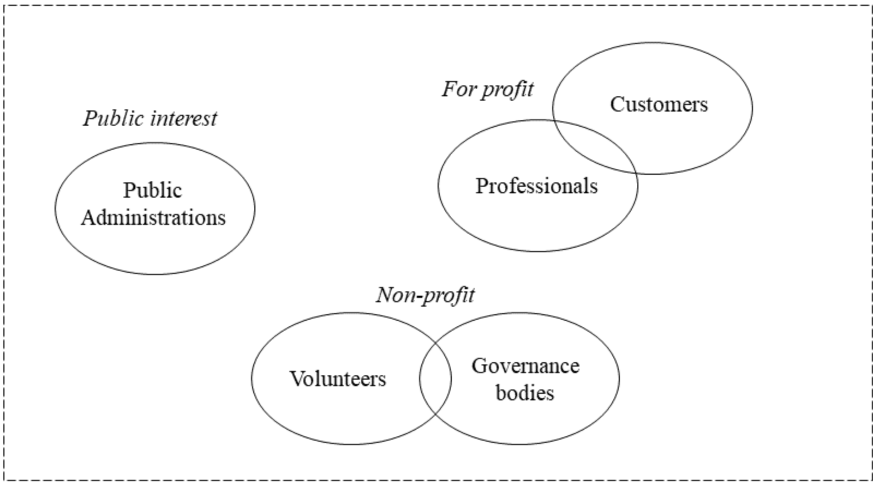


Figure 6. Identified Stakeholders in Network Infrastructure of Common Pool Resources (Baig, Freitag, & Navarro, 2018)

2.2.3 *Infrastructure*

Cloud Infrastructure consists of hardware and software that enables the five essential characteristics of Cloud Computing, broad network access, on-demand self-service, rapid elasticity, resource pooling and measured service (Mell & Grance, 2011). The infrastructure can include development tools, hosted applications/apps, operating systems, database management, business analytics, servers and storage, networking firewalls/security and a data centre physical plant/building. Various Community Cloud cases can have different features in the Cloud's infrastructure.

Baig, Freitag and Navorro (2018) have researched three models of Community Cloud: vertical integration, infrastructure commons and platform commons. The models create a differentiation between the organisation of business models at the end-user service level (Figure 7). The models have in common that the physical infrastructure and active network infrastructure can be owned and managed by the Community, the market of a single organisation.

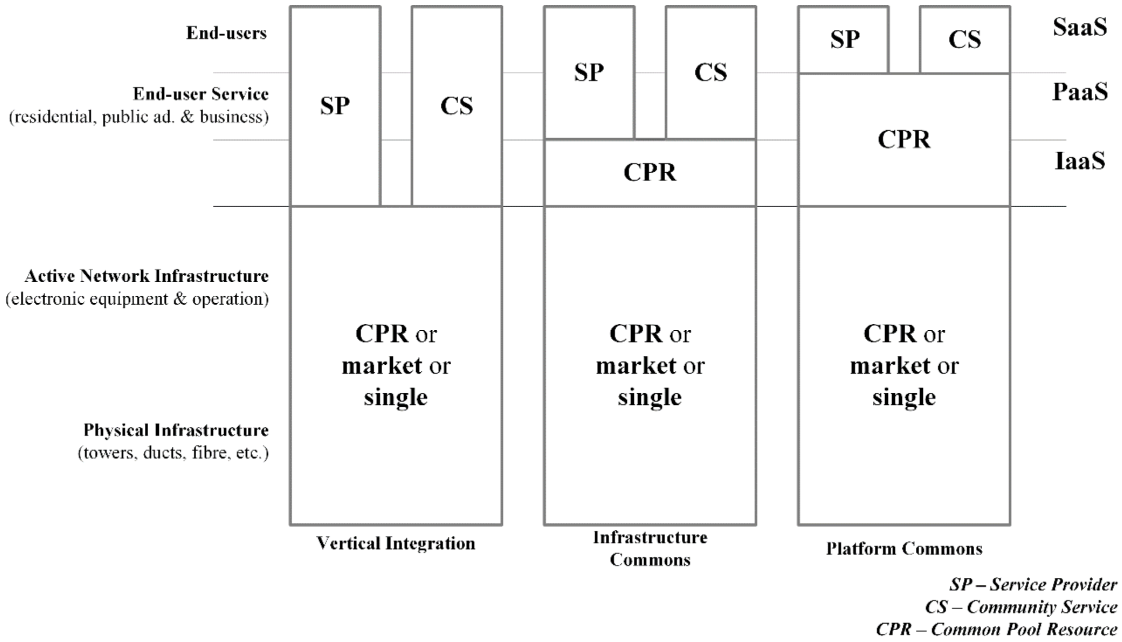


Figure 7. Business Models layering Community Cloud Service Provision (Baig, Freitag, & Navarro, 2018)

2.2.4 Commons & Legal Implications

A digital ecosystem is a system in which a group of active individuals interacts with an environment in which they engage in shared activities (Sabry & Krause, 2012). Within the digital ecosystems, commons exist. Natural or artificial resources that are administered cooperatively are known as commons. Community Cloud infrastructure is managed as commons. Managing commons refers to managing information flow within the infrastructure.

Information sharing within an ecosystem is an essential characteristic of Community Cloud that can form significant challenges for organisations. Hourani & Abdallah (2018) state significant legal and security challenges within Cloud Computing, e.g. handling disputes and government and political relations. On May 25th, 2018, the EU General Data Protection Regulation (GDPR) went into effect throughout the EU. Businesses that employ Cloud Computing were confronted with complex challenges, called Cloud Forensic Issues (Duncan, 2018). There are several techniques to reduce this problem, and it’s essential to keep that in mind. The challenges for Community Cloud have not yet been researched. However, because resource sharing is such a crucial aspect of Community Cloud, security measurements should be set up to comply with the legislation for all stakeholders.

2.3 Business Value

The research focuses on the business benefits and value generated by the adoption of Community Cloud. Therefore it's essential to address what business benefits and business value are and what their purpose is. This chapter discusses frameworks for business benefits and business value from a post hoc strategic perspective. Additionally, it introduces the TOE framework, which is used for technological decision making. The information gained from the understanding of the benefits generated by Community Cloud can be used to improve the application of the TOE framework for future IT decisions of organisations (Figure 8).

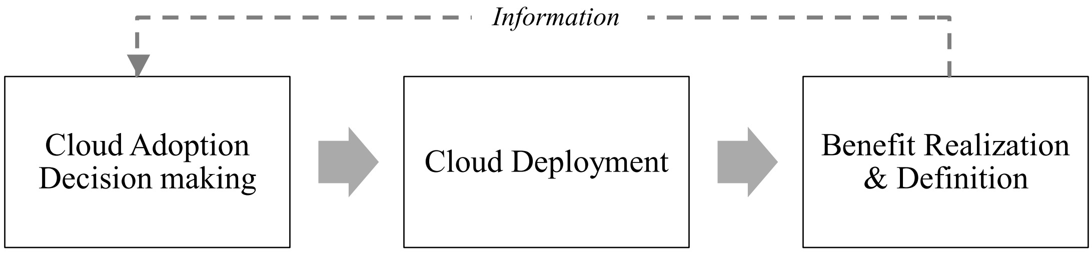


Figure 8. Information flow in Cloud Adoption Decision making

According to Serra & Kunc (2015), *benefits* are seen as improvements that aim for positive organisational objectives. The achievement of benefits creates value for businesses, allowing the business strategy to be executed successfully (Serra & Kunc, 2015). In business strategy, the organisation wants to move from the current situation towards the desired situation (Figure 9). The gap between the current and desired situations is referred to as the business value. The business value is made up of smaller benefits realised by one or more projects.

Defining business benefits helps break down business value and will allow organisations to evaluate their work more profoundly. Zwikael & Smyrk (2012) state the importance of defining business benefits because hereto forth organisations have been evaluating their projects based solely on efficiency and monetary value, and they indicate that defining business benefits will allow a more comprehensive view of the project's value.

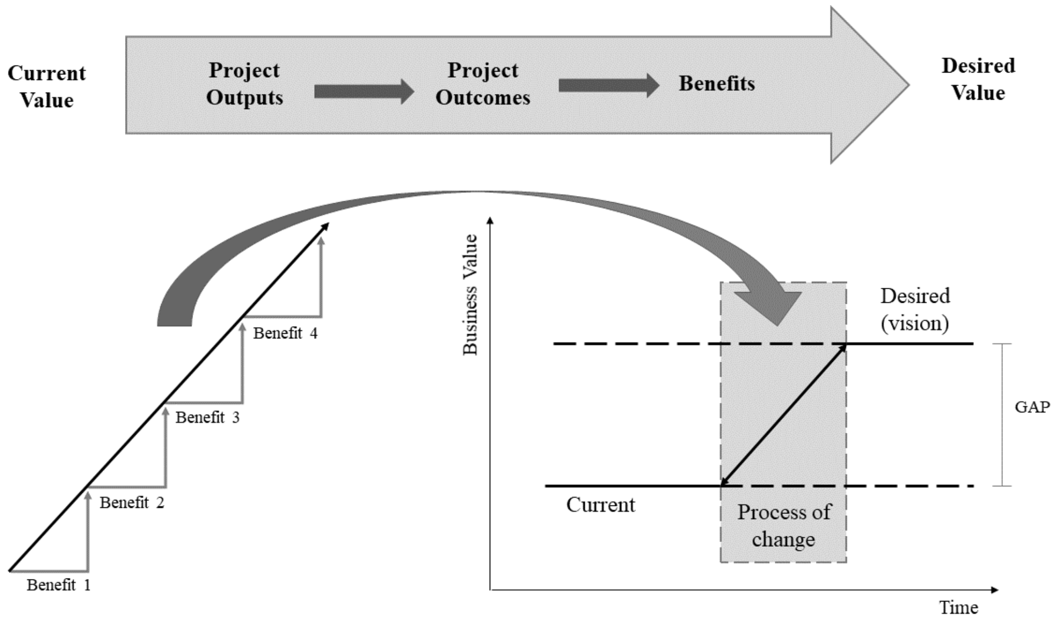


Figure 9. Business Value from Benefits (Serra & Kunc, 2015)

2.3.1 TOE framework

Traditionally to evaluate Cloud adoption, a Cost-Benefit-Analysis (CBA) is executed (Maresova, Sobeslav, & Krejcar, 2017). A CBA requires all benefits and cost to be assigned to monetary values. Benefits of the Community Cloud can be arguably challenging to assign to monetary values, e.g. the increased ability to share information. Therefore a new approach is required. To evaluate Community Cloud deployment post hoc, the study looks at what information is required before adopting a (Community) Cloud and aims to align the output of the evaluation with the input for the decision framework. Therefore, the designed evaluation model is based on the Technology, Organisation and External Task Environment framework (TOE).

DePietro et al. (1990) initially developed the TOE framework, which described the innovation process from innovations development by entrepreneurs and engineers through the implementation and adoption of those innovations by users within the environment of an organisation. The TOE framework is still used repeatedly and profoundly. The TOE framework has an advantage over other technology implementation theories in terms of analysing technology adoption, usage, and the added-value from technological progression, according to Gangwar et al. (2014), since it integrates these three components: technology, organisation, and external task environment.

The TOE framework (Figure 10) is an organisation-level theory, explaining three elements of an organisation's context: the technological context, the organisational context and the environmental context (Baker, 2011). The technological context includes all technologies that are relevant to the organisations (Baker, 2011). Technologies may consist of both hardware and processes. The organisational context includes characteristics and resources of the organisations, such as linking structures between personnel, intra-organisational processes, organisation/community size and the number of slack resources (Baker, 2011). The environmental context includes the macroeconomic context, the size and structure of the industry, the industry regulations and the organisation's competitors (DePietro, Wiarda, & Fleischer, 1990).

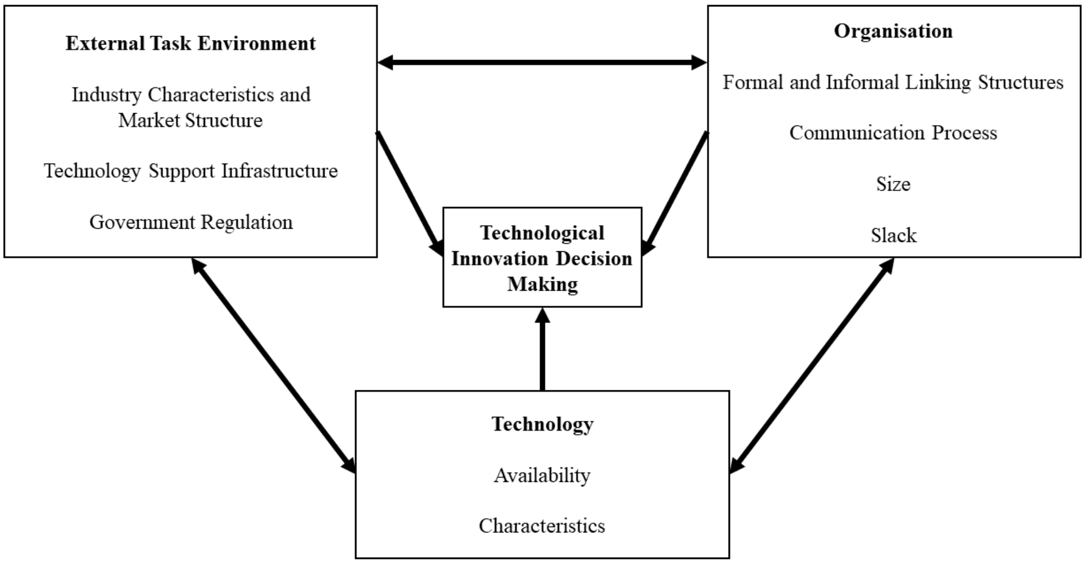


Figure 10. TOE Framework (Baker, 2011)

This evaluation model is loosely based on the TOE framework with the main goal to create a more structured and holistic overview of the business benefits of Community Cloud. It's loosely based for two reasons. First, because the intended purpose of the TOE framework is to assist in Innovation Decision making, and the purpose of the paper is to elaborate on the benefits generated by Community Cloud, e.g. a post hoc analysis, which means that solely the categories as provided by the framework are adopted in the analysis and structuration of the benefits.

Secondly, because the TOE framework originally takes the point of view of a single firm (DePietro, Wiarda, & Fleischer, 1990). However, this research focuses additionally on the inter-organisation value of Community Cloud; therefore, the scope is broadened.

The method used for finding benefits generated by the deployment of Community Cloud for each of the three categories is as follows: 1) papers selected where Community Cloud was analysed, 2) benefits and corresponding drivers identified, 3) gathered information placed in the best-fitting category. Therefore, it's a non-exhaustive list, and some benefits might turn out to be case-specific rather generalisable for all Community Cloud deployments.

2.4 Literature Based Benefits Evaluation of Community Cloud

2.4.1 Community Cloud Technological Aspect

This section describes the research related to the benefits in the technical environment of Community Cloud. As mentioned before, the technological context covers all technologies relevant to the firm, including those already in use and those not currently in use but available in the marketplace (Baker, 2011).

From previous literature, technological benefits generated by Community Cloud deployment can be found. However, it can be a challenge to allocate such benefits specifically to Community Cloud. That is, technological benefits found in Community Cloud cases can also be devoted to the adoption of Cloud technologies in general.

This subchapter considers a non-exhaustive sum of technological benefits found in Community Cloud cases. An important remark is that the benefits found in previous literature can be case-specific and are not yet proven to be general benefits for Community Cloud.

The first benefit driver and benefit is that *Virtual Machines increase the ability to offload tasks*, increasing efficiency and speed. In the research of Dubey et al. (2019) on a multi-organisation Community Cloud case, it's stated that a Virtual Machine (VM) allocation algorithm is used. A Virtual Machine is the virtualisation of a computer system. The allocation algorithm allocates the available virtual machines according to each organisation's use efficiently and fairly to execute the submitted applications.

Additionally, Hao et al. (2018), who created a collaborative computing architecture for a multi-community cloud ecosystem incorporating cloudlets, have found similar results. A cloudlet (also known as an edge cloud) is a secure cluster of computers linked to the Internet that provides resources to mobile devices nearby. A cloudlet can run a VM capable of supplying resources to end-user devices. In their model, tasks can be offloaded to clouds and cloudlets. Task offloading increases efficiency and speed; however, they note that task offloading increases energy consumption.

The second benefit driver and benefit is that *Increased Computing Resources lead to Vertical Scaling*. Sangavarapu et al. (2014) researched a case of Community Cloud deployment in the Indian Banking environment. In this case, they implemented vertical scaling. Vertical scaling refers to building up resources, i.e. installing more memory on a single computer. During the pre Community Cloud phase of the Indian banking case, most less critical applications were hosted on a single server. Moving the applications to the Community Cloud allows VM allocation. However, Sangavarapu et al. (2014) state that VM allocation will only be effective if that single server could manage increased computing resources at runtime on the same VM rather than creating a new one.

Because of the Community Cloud, there's an increased amount of computing resources on the same VM. Vertical scaling is needed to support the increased computing power. Therefore, it can be said that Community Cloud forces vertical scaling and, in turn, allows increased computing resources.

The third benefit driver and benefit is that *Data Encryption leads to increased Security*. Sangavarapu et al. (2014) researched a case of Community Cloud deployment in the Indian Banking environment. They stated that data security in Community Cloud is increased by data encryption. The data at rest is encrypted and kept in a storage environment, preventing cloud administrators from accessing or altering data.

The controversy with this benefit is that it can be seen as a means to solve the risk created by the data sharing among parties in a Community Cloud. Therefore it can also be categorised as risk mitigation rather than Community Cloud benefit.

The fourth benefit driver and benefit is that *hosting solutions on the internet increases scalability.* Another finding from Sangavarapu et al. (2014) in the Indian Bank Community Cloud case is that operating in a private network creates bandwidth constraints. Therefore, they found that hosting an e-learning solution on the internet-based environment of the Cloud allows for its features to be scaled on usage demand.

However, this benefit can also be displayed as a benefit obtained from the Public Cloud, rather than specifically from Community Cloud.

The fifth benefit driver and benefit is that a *brokered cloud increases the ability to provide flexible solutions*. Giovanoli & Gatziu Grivas (2013) have elaborated on a specific organisational form of Community Cloud, namely the brokered Cloud (Figure 4). They see the brokered Cloud be part of a global marketplace, where customers and service providers come together to find suitable matches. The cloud broker is knowledgeable about the services that each customer uses and the services available on the market (Giovanoli & Gatziu Grivas, 2013). If a consumer requests new services, such as a different quantity of service or additional software, the brokering service immediately fulfils the request and orders the service from the service market. According to Giovanoli & Gatziu Grivas (2013), a service market's mission is to make IT offerings straightforward, clear, and comparable. Therefore, the outcomes of such a marketplace should be shorter procurement periods, higher customer satisfaction, and lower prices.

The sixth and last benefit driver and benefit is that *sharing hardware leads to cost savings*. In some cases of Community Cloud, the owned infrastructure and software licenses can be eliminated, resulting in cost reduction (Giovanoli & Gatziu Grivas, 2013). Additionally, Giovanoli & Gatziu Grivas (2013) state that the Community Cloud is more efficient and less expensive than existing systems and requires less cost than building an own data centre or private cloud.

2.4.2 Community Cloud Organisational aspect

This section describes the previous literature related to the benefits in the organisational environment (O) of Community Cloud. The organisational context includes characteristics and resources of the organisations, including linking structures between personnel, intra-organisational processes, organisation/community size and the number of slack resources.

The first benefit driver and benefit is that *management outsourcing increases expertise and lower operating cost*. With minimal management feedback or service provider involvement, networks, servers, storage, software, and services can be quickly deployed in general Cloud Computing (Goyal, 2014). According to Goyal (2014), the Community Cloud's management may be outsourced to a cloud provider. The benefit is that the supplier will operate as a neutral third party governed by a contract, with no preference for any of the customers involved beyond what is contractually required. The outsourcing of management can lead to increased expertise and lower operating cost and therefore cost savings.

The second benefit driver and benefit is that *sharing risk reduces individual risk.* Risk in various Community Cloud management models can differ. For example, in a federated Community Cloud, the risks a higher than in a brokered Community Cloud, where the Cloud broker is to be held accountable for the Cloud risk (Giovanoli & Gatziu Grivas, 2013). Nevertheless, the risks in Community Cloud are shared among the Community participants, therefore reducing the risk of an individual party.

The third benefit driver and benefit is that *vendor management reduces the changes of vendor lock-in.* Vendor lock-in in economics is a phenomenon where the customer is dependent on the vendor, which can form many issues, i.e. when the customer wants to move to a competitor. Giovanoli & Gatziu Grivas (2013) have described a management model in Community Cloud where there's no vendor lock-in issue, namely the federated (Figure 3) or centralised (Figure 5) models. It's important to remember that removing vendor lock-in problems can be viewed as a Community Cloud advantage or a way to address an issue that arises from deploying a Community Cloud.

Giovanoli & Gatziu Grivas (2013) state the importance of communication between the various stakeholders. It is essential even before planning a community cloud. Customers must recognise the benefits and disadvantages of cloud computing in such a closed environment. However, providers must also be aware of the unique needs of the Community. It can be assumed since communication is deemed so crucial, good communication will be beneficial to Community Cloud operations.

2.4.3 Community Cloud Environmental Task Environment aspect

The third category of the TOE framework covers the External Task Environment (E). This category includes the size and structure of the industry, the organisation's competitors, the macroeconomic context and the industry regulations (DePietro, Wiarda, & Fleischer, 1990).

The first benefit driver and benefit is that *Community Cloud increases the ability to match market fluctuations.* The cloud computing market is estimated to grow from $40.7 billion in 2010 to $240 billion in 2020 (Alhammadi, 2016). The evolving market results in market fluctuations and changes in demand. Giovanoli & Gatziu Grivas (2013) have found that certain forms of Community Cloud - that is, when there's a cloud broker involved – can match market fluctuations.

The second benefit driver and benefit is that *sharing resources enables inter-organisational learning.* Collaboration between parties within a Community can lead to community-wide e-learning (Sangavarapu, Mishra, Williams, & Gangadharan, 2014). Return monitoring and just-in-time production and delivery are examples of tools used to optimise the information collected in the Community Cloud to support consumers and the supply chain (Goyal, 2014).

The third and last benefit driver and benefit is that *having restrictions on data sharing increases control on data.* Some companies can be hesitant to share resources with competitors (Giovanoli & Gatziu Grivas, 2013), and security is an important consideration when adopting any form of the Cloud. In the Community Cloud, data restricted under privacy regulations can remain in the Community network (Giovanoli & Gatziu Grivas, 2013), which positively increases the control over data.

2.4.4 Literature-based Community Cloud Benefits

The following figure summarises the finding from the literature as discussed in the previous subchapter.

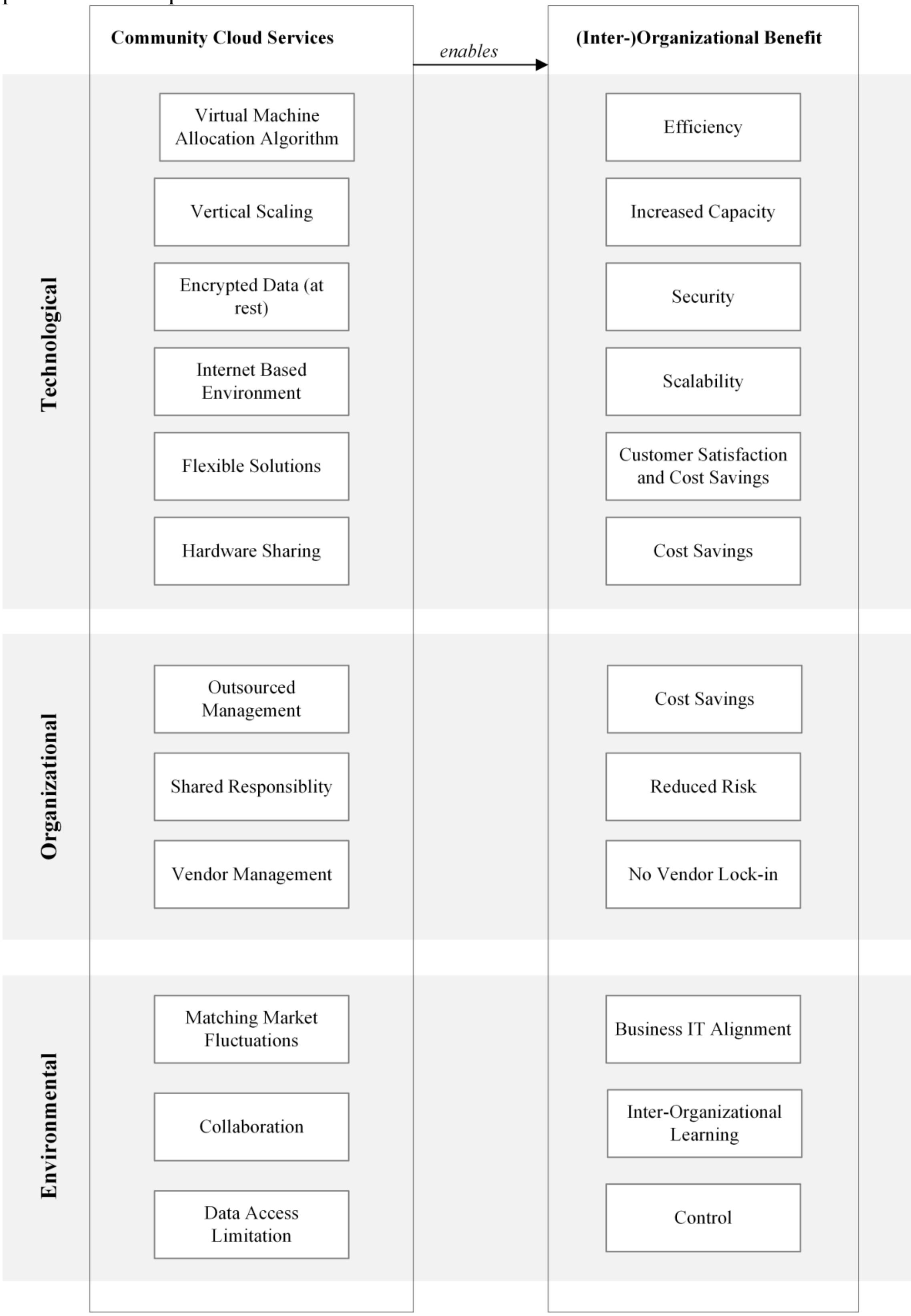


Figure 11. Community Cloud Benefits Conceptual Model based on Literature

3 METHODOLOGY

The following chapter describes the empirical part of this master thesis. It elaborates on the research strategy and research design applied to study the relationship between Community Cloud and business benefits. Subchapter 3.2 discusses the data collection methods followed by 3.3, concerning the data analysis of the study. Lastly, subchapter 3.4 elaborated on the quality measures of the research.

3.1 Research Strategy

The correct selection of a research method is a critical choice for successful scientific research. It is primarily concerned with matching research objectives with the characteristics of available research methodologies (Basias & Pollalis, 2018). Qualitative research examines phenomena, and it can be selected for a multitude of reasons, e.g. an interpretation is required, the topic concerns a relatively new research area, answers are required for questions starting with "what", "how", "when" and "where", or when there's uncertainty about the conceptions under consideration (Basias & Pollalis, 2018).

The qualitative research approach is the most adaptable of many experimental techniques since it encompasses a wide range of commonly used methods and frameworks. This research approach, ranging from case studies to in-depth interviews, requires careful planning and development, but it lacks a standard framework. The most widely used techniques are sociological analysis, interviews, and surveys (Smith, 2015).

Based on the nature of Community Cloud research, this research has adopted a qualitative research approach and the positivism paradigm. The positivism paradigm is a methodological philosophy in quantitative research that applies natural sciences to uncover the study of social science (Pham, 2018). The input of the research process in positivist qualitative research usually consists of a variety of data, especially unstructured data (Su, 2018).

3.1.1 Multiple Case Study with Semi-Structured Interviews

Case study represents an essential genre of social science research, and it can be categorised into three types: exploratory, descriptive and explanatory. It can also be categorised into single or multiple cases. Since the benefits generated by Community Cloud are not yet researched extensively, an exploratory approach is adopted. Additionally, a multiple-case study is executed. The cases can be used as literal replications by predicting identical outcomes, or they can be used as theoretical replications by predicting opposite outcomes (Su, 2018). The cases will be further elaborated upon later in this chapter.

The data from the case studies is gathered through semi-structured interviews. The questions in semi-structured interviews are pre-determined and formatted using the interview guide (Mason, 2004). The interviewer has an interview guide (Appendix 2) to ask the informant during the interviews. The informant is free to respond, leaving room for further exploration of the topic, which could be beneficial in exploratory research.

3.2 Data Collection

A thorough literature review was conducted prior to the interviews, from which a Community Cloud definition was developed. Consultation with Cloud experts and utilisation of Deloitte's network has lead to case selection. Criteria for the cases included that at least some form of Community Cloud had to be identified. They had to exist in different industries. Preferably, each case should cover informants with different backgrounds to provide a holistic view of the Community Clouds. Table 5 shows an overview of the interviewed informants. A literature review was conducted during and after the case selection, from which a semi-structured interview guide was developed (Appendix 2).

This research uses triangulation as a validation strategy. The word "triangulation" is used in social science to describe the study of a research topic from (at least) two different perspectives (Steinke, 2004). It combines data drawn from various sources, at different times, from different people or different places. Data triangulation occurs in this research by combining data obtained from literature, interviews from three cases and consultations with cloud experts.

Before the interviews, the (potential) informants were sent an overview of the research by email. The interview guides were not disclosed to prohibit biased answers. The interviews were conducted online. To minimise the risk of audio malfunction, the interview questions were displayed on the screen. At the beginning of each interview, the purpose, duration and privacy of the interview were discussed. All interviews were audio-recorded, transcribed and anonymised. The audio files were removed no later than two months after the interview. All informants freely consented to the terms, and the transcripts of the interviews were shared with the informants.

Table 5. Overview Interview participants

Case	Function	Expertise Level *			Date (d.m.y)	Duration (h:m:s)
		Technological	*Organisational*	*Environment*		
A	Manager Consulting	5	3	4	04.05.21	01:26:13
A	Data and Implementation lead	4	4	3	04.05.21	01:00:33
A	Consultant	5	4	3	18.05.21	01:17:57
B	CFO	2	3	3	04.05.21	01:18:25
B	Information Manager	2	5	3	05.05.21	00:51:25
B	Technological developer	5	4	4	19.05.21	01:15:17
C	CEO Information Management Partner	5	3	4	10.05.21	00:53:55

* Individuals personal estimation

3.3 Data Analysis

Braun and Clarke (2006) propose a six-step method for analysing collected data to ensure consistency and transparency in qualitative data analysis: 1) familiarisation with collected data, 2) assigning preliminary codes to data to define information, 3) searching for trends or themes in codes through various interviews, 4) updating themes, 5) identifying and naming themes, and 6) completing the final report. These measures were followed during the coding section of this thesis's analysis of primary data from interviews.

The interviews were audio-recorded, and an automated transcript was produced with Microsoft Word Live. The Transcripts were checked and corrected manually using intelligent verbatim transcription techniques; afterwards, the clean transcripts were read through various times (step 1). Preliminary codes were assigned to all written interviews based on the findings from the literature review (step 2). Prior decisions can have a profound influence on the analysis of the gathered data, e.g. the definition of a 'theme' in the research context (Braun & Clarke, 2006). To minimise the risk of biased analysis, all potentially important statements in the written interviews were given a code, regardless of their fit with the prior literature research. After the initial coding, themes and patterns were found (step 3), and the initial themes were reviewed (step 4). Finally, the newly discovered themes were merged with the original themes to form final connections and patterns (step 5). The final results are elaborated upon in chapter 5 (step 6). Table 8 in chapter 4 displays the codes from the interviews after being combined with the literature, as shown in chapter 2.

Triangulation took place alongside the coding process by researching the Community Cloud offerings in the market, professional reports and whitepapers, and the expertise of diverse consulting experts, with either a technical focus, business focus or a combination.

3.4 Research Quality

The research's processes must meet specific quality requirements to ensure the research's credibility. The procedure of ensuring the reliability of qualitative research is more complex than that of quantitative research because it does not use statistical or quantitative methods. Quantitative studies are used to describe phenomena, while qualitative studies are used to create information about concepts and phenomena. To access the research quality in qualitative research, Steinke (2004) has generated a list of quality criteria. This chapter will shortly address the quality criteria in table 6 and how they are met.

Table 6. Quality Criteria adopted from (Steinke, 2004)

Confirmability	In a qualitative study, conformability refers to how objective the research is, mainly while gathering and interpreting data (Lichtman, 2014). It aids in ensuring that the findings stay objective and that they are confirmed and collaborated upon by others. In this study, triangulation was used as a mean to ensure confirmability.
Dependability	The dependability was achieved by ensuring that the research process is reported in detail, allowing the same research to be replicated. As a result, demonstrating a simple research design is critical. Methods used in the study must show their efficacy and must provide detailed explanations of how the research is organised, how data is collected, and an overall assessment of the effectiveness of the tactics used (Shenton, 2004).
Credibility	In a qualitative analysis, the credibility or validity of research relates to the accuracy of the findings obtained and the methods used. Credibility was achieved by adopting a research method that works in line with the dataset.
Transferability	Transferability, according to Lichtman (2014), illustrates that the results are useful and may be used to a wider population. Transferability was achieved by providing enough contextual information.

4 CASE DESCRIPTION

The following subchapter describes the cases researched in the study. The descriptions include an introduction to each case, the infrastructure, a short overview of the Community, and a diagram displaying the stakeholders involved in the Community Cloud. In the diagram, the Community covers the inner circle. The stakeholders with some form of connection with the Community's Cloud, yet not in the Community, are part of the ecosystem, which is the outer circle.

The Community Cloud definition is used to determine which stakeholders make up the Community, e.g. "*The [Community] cloud infrastructure is provisioned for exclusive use by a specific community (...)".*

- *Case Description Financial Guidance Service*

Typically, the pension funding industry actors are restricted in some areas, e.g. funds are prohibited from providing financial advice. From this restriction, a unique approach flourished. One of the largest pension providers of The Netherlands (P1) initiated a financial service company. The financial service subsidiary of the pension provider (P2) is the initiator of the platform, where instead of giving individual financial advice, they provide a service for employers to provide financial guidance towards their employees. With this platform, the employees of said employers can test their financial fitness. This service is the basis for the first case, "Financial Guidance Service". The service assists employees in being more financially fit with an e-learning approach. According to the pension fund, it's beneficial for employers to have financially fit employees because they will feel better, have fewer headaches, and ultimately be better employees.

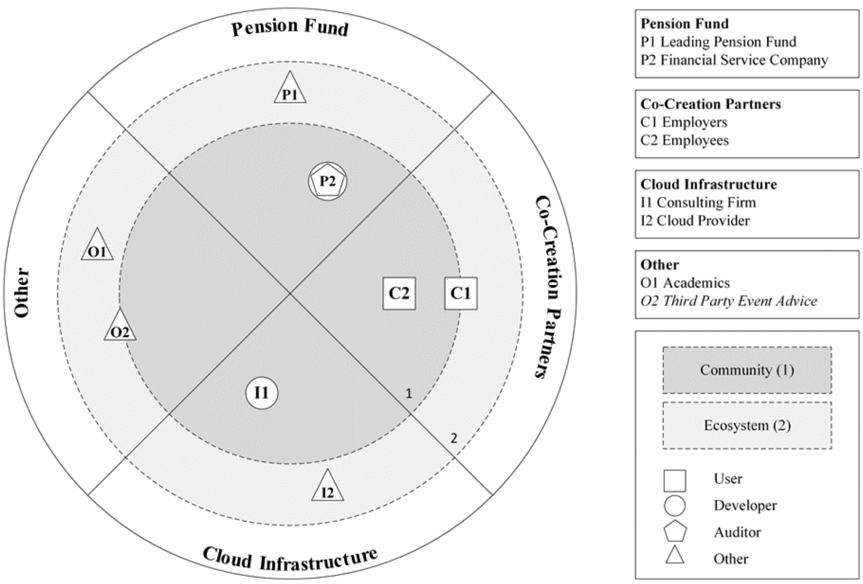


Figure 12. Financial Service Case Stakeholder Overview

Figure 12 displays the stakeholders in the Community and Ecosystem. The infrastructure in the case shows similarities with a Platform-as-a-Service solution, where the financial guidance service provider launches an application onto the cloud infrastructure, making them both the developer and auditor. The platform is for the exclusive use of the financial service subsidiary. The application launched on the platform is co-created by many partners (C1), including but not limited to municipalities, government agencies, educational institutions and energy companies. These co-creation partners have input on what the application should include but will not develop the application. Their employees (C2) are the stakeholders who will be using the application. They can use the application exclusively, yet they have little input in the design and content. Therefore, they're categorised as users partly in the community network. The financial guidance service subsidiary also works with a technical consulting company, assisting in developing the Cloud and its services. The Cloud Provider (I2), Microsoft Azure Cloud, provides the Cloud infrastructure, i.e. datacentres, storage and servers. They have no further role in developing the solution and are therefore characterised as "other". The financial guidance service subsidiary partnered with academics (O1) to develop their application. They aren't part of the Community but influence the solution and are therefore part of the ecosystem. Lastly, the financial guidance service subsidiary plans to partner with a third party event advice organisation to develop its offerings in the future. Depending on what this collaboration will look like, they can be part of the Community or the Ecosystem.

- *Case Description Agricultural Platform*

In 1973 a group of potato growers in The Netherlands came together and joined their efforts in a cooperative. In almost 50 years, the collaboration has led to the improvement of innovation and created one of the industry's leading parties. Today, roughly 1500 growers have joined the cooperative. Their mission is to contribute to food security for a growing world population. The Community Cloud technology, in this case, takes place in the form of a low-code platform. A low-code platform allows flexibility in the development of portals and additions to the ERP system. The project has developed five focus areas: 1) insight into stock, 2) optimal allocation, 3) digital information exchange in the chain, 4) data-driven guidance, 5) future proof ICT. What distinguishes this case is that community cooperative has existed for many years; therefore, the benefits gained by cooperation already existed. The benefits generated from the community cloud technology can be differentiated.

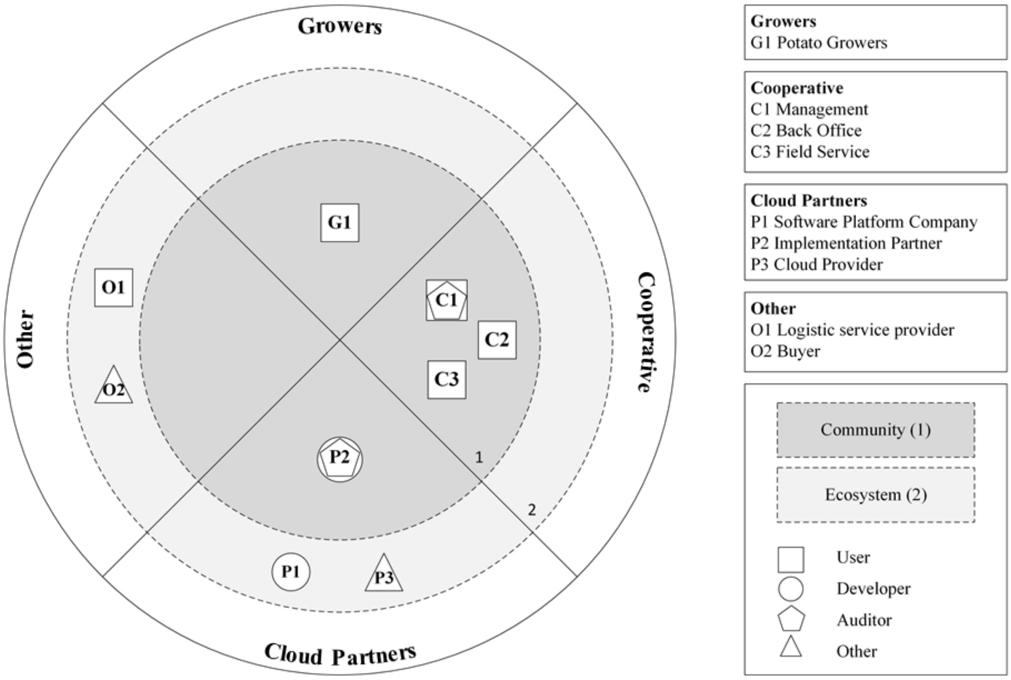


Figure 13. Agriculture Case Stakeholder Overview

Figure 13 shows the stakeholders in the Community and the ecosystem. The potato growers (G1) share their harvest data, and together with the stakeholders in the cooperative, they exclusively use the platform. The cooperative's management team (C1) are users of the platform and partly audit the platform's services. The back office employees (C2) and field service employees (C3) improve their working methods by using the platform to obtain information in the supply chain. The cooperative partners with various Cloud partners. First, a low-code software platform company (P1) provides tools to build, test, deploy, and iterate applications. In Figure 13, P1 is characterised as a "developer" but primarily offers so-called "building blocks" for developing the applications on the platform. Second, there's an implementation partner (P2) involved. The implementation partner is both developer of applications and the auditor of the platform and processes in general. Because of the significant role of the implementation partner within the project, they are considered part of the Community. Thirdly, there's the Cloud infrastructure provider (P3), Microsoft Azure. Finally, two parties utilise the Cloud for applications and data sharing but are not considered Community members. The logistic service provider (O1) transports the potatoes, and the buyers (O2) buy the potatoes. These parties are in contact with the cooperative's back office and indirectly use the platform's mechanisms.

➢ *Case Description Transparent Municipalities*

The municipality's cooperation, in this case, is a collection of towns and cities in The Netherlands. They work together in a joint regime, which carries out shared responsibilities for the municipalities in the economy, development, culture, and social support. The cooperation creates regional policy and implements it regionally, keeping their independence and power to make local decisions. The cooperation created a platform that can be categorised as an open database. In this database, anyone can read the information concerning meetings, conferences, regulation etc.

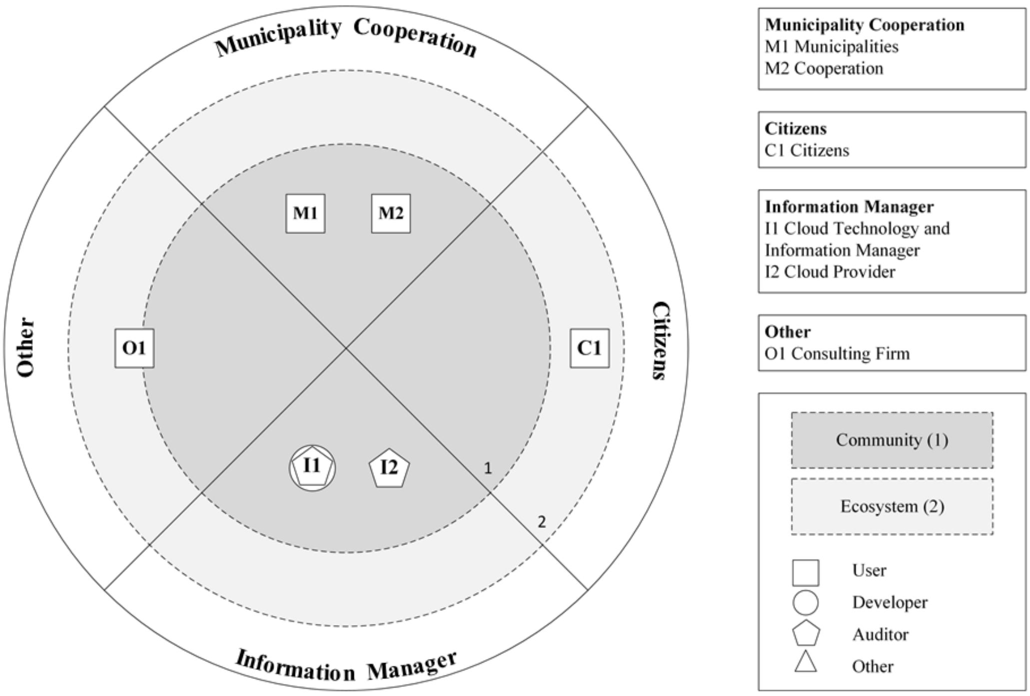


Figure 14. Transparent Municipalities Case Stakeholder Overview

Figure 14 depicts the stakeholders in the case. The first two stakeholders in the Community are the municipalities (M1) and their cooperation (M2). They have exclusive access to the platform and can upload their data. Citizens (C1) can read the data yet have no other relation to the infrastructure and are therefore characterised as stakeholders in the ecosystem. A Cloud Technology and Information Manager (I1) is both developer and auditor of the infrastructure. They develop the online platform with an open-source container-orchestration system and upload information weekly. The organisation works together with Digital Ocean, a cloud infrastructure provider (I2). Lastly, often consulting firms (O1) or other research-focused organisations are included in the service, e.g., conducting research or questionnaires.

5 RESULTS & ANALYSIS

This chapter describes the results from the interviews in the multiple case study. First, the chapter summarises the results of the three cases in 5.1 and discusses the significant similarities and noteworthy differences between the cases, as showcased in table 7. Subchapter 5.2 displays an overview of the constructs, e.g. drivers and benefits, found in the interviews and their occurrence in each case (Table 8). Subchapter 5.3 till 5.5 further elaborates upon said drivers and benefits for the technical, organisational and external task environment. Each construct is presented and shortly discussed. The chapter summarises all drivers and benefits in a model (Figure 29), where the new drivers and benefits are highlighted. The constructs are discussed in the discussion, chapter 6.

5.1 Case Result Comparison

The three cases used in this research show similarities and differences (Table 7). This subchapter starts by providing a summary of the main focus of each case. Later it shows table 7 with an overview of the similarities and differences. For a more elaborate explanation of the purpose and scope of the cases, please refer to chapter 4.

The first similarity found is the similarity in the cloud environment. All three cases are hosted on a Public Cloud Environment, which is crucial to keep in mind in further analysis. According to the definition, Community Cloud can exist in various forms, and this research covers one aspect of this. Community Cloud benefits that can be obtained with an on-premise cloud structure are not part of the results but should be considered.

Secondly, all three cases show one leading party as the driving force in the development and management of the Community Cloud, e.g. in the Financial Guidance Service Case, it's a pension funding organisation, in Agriculture case, it's the cooperative and in the municipalities case that is an organisational body.

The third similarity is that – regardless of their operational purpose - the three cases often mentioned the sharing of data in the operational process as on the main focusses. Data sharing can be seen as the driver for many benefits, i.e. more insights, efficiency, satisfaction, etc. Lastly, all three cases mention that one of the primary purposes of implementing a Community Cloud is to establish a future proof ICT.

The significant differences between the cases include purpose, main benefits and perspectives. The cases can be interpreted to be serving a variety of purposes, e.g. the Financial Guidance Service Case is using Community Cloud to offer a new service. In contrast, the Agriculture Case is using the Community Cloud to improve the current processes in the supply chain, and the Municipalities case uses Community Cloud to share and obtain information. The different purposes result in varieties in deployment and, therefore, other benefits, or at least a different perspective on benefits. The main benefits of the Community Cloud in Case are focused on scalability and flexibility. For the Agriculture Case, that's insight in stock, optimal allocation and information exchange. For the Municipalities Case, the main benefits are centred around information exchange and transparency.

Table 7. Case Similarity & Differences Overview

Similarities	Differences
Based on the Public Cloud environment	Purpose
One leading party	Main benefits
Focussed on data sharing	Perspective of Outsourcing
Focus on becoming future proof	

5.2 Drivers and Benefits Occurrence

This subchapter discusses the drivers and benefits as mentioned in the cases (Table 8). The themes have been extracted from the TOE framework. Significant statements from the transcribed interview were coded and formed into categories. The categories were matched with the corresponding themes. Table 8 indicates if the constructs were mentioned in one or more of the interviews for each case. The constructs are elaborated upon in Subchapter 5.3 Technological context, 5.4 Organisational contexts and 5.5 External Task Environment. The next chapter, chapter 6, discusses the drivers and benefits, comparing them and analysing them with literature.

Table 8. Coding Table

Themes	**Category**	**Mentioned** Financial Guidance Service	Agriculture	Municipalities
Technological	VM & Task Allocation	x	x	x
	Vertical Scaling		x	
	Accessibility		x	x
	Data Encryption	x	x	x
	Independence for Scalability	*x*	x	x
	Data Processing	x		x
	Continuous Integration		x	x
Organisational	Management Outsourcing Structures	x	x	x
	Insights & Satisfaction		x	x
	Data-Driven Communication	x	x	x
Environmental	Matching Market Fluctuation	x	x	
	Interorganisational Learning		x	x
	Restricted Data Sharing	x	x	x

5.3 Technological aspect

This section describes the results related to the technical environment of Community Cloud. It builds on the constructs developed in subchapter 2.3. It's worth noting that the cloud environments of the three cases used in this study are all focused on an off-premise, public setting, meaning that the technical benefits are limited to this form of Cloud and might differ from a Community Cloud deployed on an on-premise environment.

- *Increased Scaling through Virtual Machine & Task Allocation*

A virtual machine (VM) is a software environment that mimics the operation of a computer system. It enables a computer to be used as a stand-in for an actual device. The existence of virtual machines in the Community Cloud results in the ability to process more tasks at a faster pace e.g. increased velocity. The increased velocity in return results in increased scalability (Figure 15).

"*There is also scalability. Then, for example, a lot of people are on the platform at the same time. Then, with a few presses of a button, you actually want the IT infrastructure to scale automatically. That it automatically creates new instances of the same software*."– CEO Information Management Partner, Municipalities case.

Figure 15. Virtual Machine Allocation increases Scalability

- *Increased Capacity through Vertical Scaling*

Vertical scalability refers to the ability to add resources to existing hardware or software to improve performance. In all cases, an increase in computing power compared to their previous situation was mentioned, e.g. in the Municipalities case, three computers can now handle more information than before. Vertical Scaling allows an increased capacity (Figure 16), i.e. increased operational power.

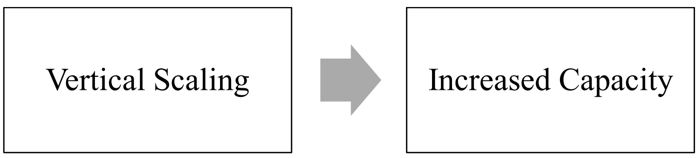


Figure 16. Vertical Scaling increases Capacity

- *Increased Accessibility through Mobile Devices*

One benefit in technical availability includes the removal of the need for physical presence. The increased accessibility of the systems on mobile devices results in the removal of location boundaries. On the one hand, this means an increase in participation rates, and on the other, cost-saving in, i.e. transport and location rental.

"*Before (...) physically going to a place to talk about the subject. (...) And now they can just pick up their smartphone or laptop at any time. (...) That is much more accessible.*" – CEO Information Management Partner, Municipalities case.

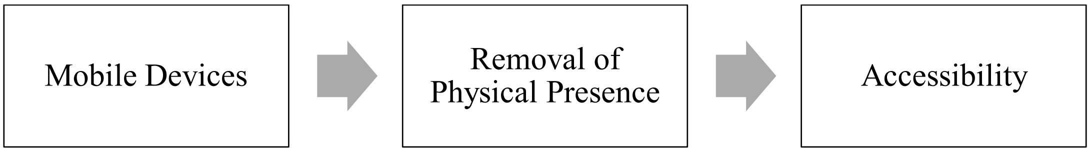


Figure 17. Mobile Devices increases Accessibility

- *Increased Security through Data Encryption*

In all three cases, Multifactor Authentication (MFA) for users to enter the Cloud environment was mentioned, which is intended to increase security. Multifactor authentication (MFA) adds an extra layer of security to the sign-in process. Users must provide additional identity authentication, such as scanning a fingerprint or entering a code provided by phone when accessing accounts or applications.

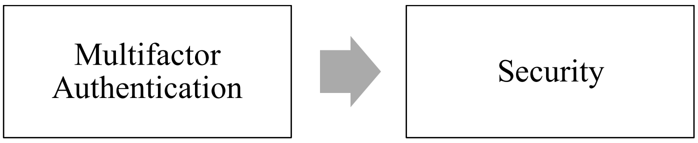


Figure 18. MFA increases Security

- *Increased Scalability through Independent Solutions*

The creation of solutions independently increases agility and the ability to launch or go live fast. Therefore, according to informant one - manager consulting of the Financial Guidance Service case – there's faster development, one of the most essential scalability factors (Figure 19). Additionally, the CEO of the Information Management Partner in the Municipalities case mentioned that faster development leads to more output and, therefore, lower cost.

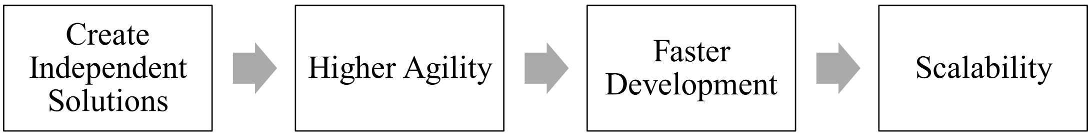


Figure 19. Independent Solutions increase Agility and Scalability

- *Process Improvements through Algorithms*

The platform allows for a higher volume of data. By applying algorithms, the data can be better analysed, and insights can be gathered. Insights in the process will provide the opportunity for improved processes business-wise and customer wise (Figure 20). The CFO of the Cooperative in the Agriculture case mentioned how the algorithm makes a difference in their Community Cloud: *"In fact, we take the information from the portals. And by means of an algorithm, we make an allocation of that hump of our customers, and we feed that back through the platform."*

Additionally, this informant mentioned how steering on a minimal viable product (MVP) allows for steering based on insights and coherence. An MVP is a version of a product that has only enough capabilities for early consumers to use and provide feedback for potential product advancement.

Figure 20. Algorithm Usage increases Process Improvements

- *Decreased Dependency through Continuous integration*

Continuous Integration, Continuous Deployment (CICD) refers to closing the gap between development and operations activities and teams through enforcing automation in the construction, testing, and implementation of software. With continuous integration, it's easier to adjust solutions, resulting in less dependency on one party (Figure 21) and potentially a lower chance of vendor lock-in.

"Firstly, it becomes much easier to make changes. Secondly, it makes it easier to scale; for example, if you have several customers who want something different, you would otherwise have to select each time manually (...) And it also ensures that you have less of a lock-in." – CEO Information Management Partner Municipalities case.

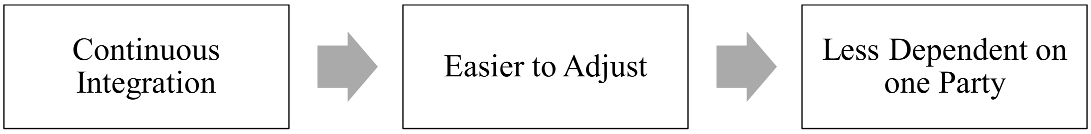


Figure 21. CI/CD reduces Dependency

5.4 Organisational aspect

This section describes the results related to the technical environment of Community Cloud. It builds on the constructs developed in subchapter 2.3.

- *Increased Efficiency through Management Outsourcing*

There's a consensus that by outsourcing, parties make use of vendor's scale benefits and expertise and, therefore, increases individual efficiency (Figure 22).

However, the perspectives of the informants on outsourcing were contradictory. On the one hand, the Financial Guidance Service case informants were making a case for outsourcing. They mentioned benefits such as "*increased flexibility, more significant impact power, increased expertise, increased efficiency and speed"*. Additionally, they noted,*" 'the vendor' has good control of their warehouses. (...) If you look at security at the hardware level, you have an advantage there if you use the public Cloud."*. On the other hand, the informant of Municipalities case revealed that quite often, governmental instances are entrapped in a counterproductive arrangement, e.g. *"Governments have been working with all kinds of software companies for years, and they also get screwed quite often. There are those big parties who charge a lot of consultancy hours. Or just really drive up costs until the software is not very interoperable, and that's actually a bit of a fear from which they [governments] are coming. So that is why they are moving very much in the direction of open-source (...)."*

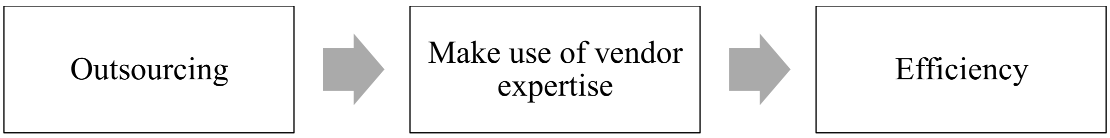


Figure 22. Outsourcing increases Efficiency

- *Operational Excellence through Operational Structures*

The implementation of operational structures increases operational excellence (Figure 23). The Agriculture case explicitly drew this conclusion. Structures, i.e. formats to fill in and specific order of steps, increase automatisation and the amount of data the system can analyse. The quality of the output is better, and the quantity increases, thus increasing operational excellence.

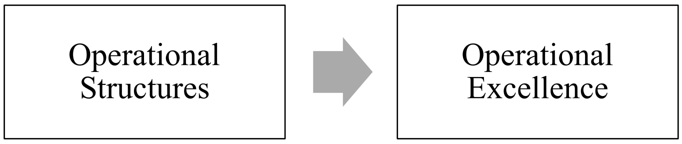


Figure 23. Structures increase Operational Excellence

➢ *Increased Satisfaction through Variable Definition*

The Community Cloud allows for a more precise description of supply chain variables. Good sales are the product of better and quicker stock insights and matching them to consumer demand. Better net profits result in a higher purchase price for the seller. As a result, the sellers will be satisfied (Figure 24). This example orients itself at supply chains that include the trade of goods.

Figure 24. Insights increase Satisfaction

➢ *Improved Decisions through Data-driven Communication*

In the Agriculture case, improved communication in the supply chain is often mentioned as one of the main focuses of the Community Cloud. The availability of information leads to data-driven communication, which results in improved decision making. The influence of data-driven communication is also highlighted in the other cases. The advice in the Financial Guidance Service case is based on data obtained through the solution. In the Municipalities case, the main focus is sharing information and communicating based on it. Therefore, Community Cloud allows data-driven communication, which leads to improved decisions.

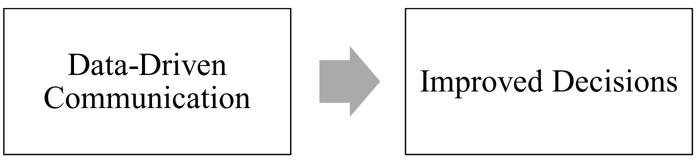


Figure 25. Data-Driven Communication improves Decision Making

5.5 Environmental aspect

This section describes the results related to the External Task Environment of Community Cloud. It builds on the constructs developed in subchapter 2.3.

- *Improved Ability to Match Market Fluctuation through Variable Definition*

It's crucial to decide what market fluctuations refer to in each case to determine the factor that drives the ability to match market fluctuations. In the Financial Guidance Service case, matching market fluctuations was referred to as providing a service to the employers and indirectly their employees. In the Agriculture case, matching the market fluctuations focuses more on provisioning for actors in the supply chain, such as responding quickly to buyer demands and providing information and services to potato producers. In the Municipalities case, the market fluctuations refer to citizen and municipalities demands for transparent information. That being said, the Community Cloud allows for a better definition of variables in the market and in the processes, which allows for better decision making and, therefore, a better ability to match market fluctuations.
"(…) And they are grown in many different places. The better we can match supply with demand, the better it is for the cooperative in the end." – CFO Agriculture case

Figure 26. Defining Variables increase the ability to Match Market Fluctuations

- *Inter organisational Learning through Information Sharing*

Information sharing to achieve inter-organisational learning was mentioned in the Agriculture case. Information sharing takes place at multiple levels, e.g. to optimize product flow in the supply chain. However, information sharing to obtain inter-organisational learning occurred top-down. Members of the cooperative share information on the platform about aspects concerning their work, e.g. changes in the market, regulations, etc. Additionally, inter-organisational learning occurred when data from the growers was collected, internally compared, and progress and comparison reports were shared.

"Now, we can post things like that and create a forum on a subject. 'How do you deal with pesticides or plant protection products?' Then you have a very lively discussion there on a sort of quasi-social network." – CFO Agriculture case

Figure 27. Information Sharing enables (Inter-) Organisational Learning

- *Increased Ability to Comply with Legislation through Partnerships*

In all three cases, the impact of governmental regulation was mentioned. Additionally, it was said that information sharing is enabled by Community Cloud, yet it brings difficulties to comply with privacy legislation. Therefore, additional measures were required. In the Agriculture case, putting agreements on paper concerning the partnerships and information sharing results restricts data sharing and makes it possible to comply with legislation.

"The need for sharing the information is quite simple. If you can put it on paper and agree with each other in the form of the cooperation agreement that you have, that is, the cultivation agreement that ultimately leads to the whole process that follows it." – Information Manager Agriculture Case

Figure 28. Partnerships increase the ability to comply with regulations

5.6 Benefits of Community Cloud

This section presents a summary displaying the benefits of Community Cloud (Figure 29). The model shows the constructs that answer the research question: "How can Community Cloud enable (inter-) organisational benefit?" The constructs obtained from the empirical research are outlined and addressed in the discussion in 5.7.

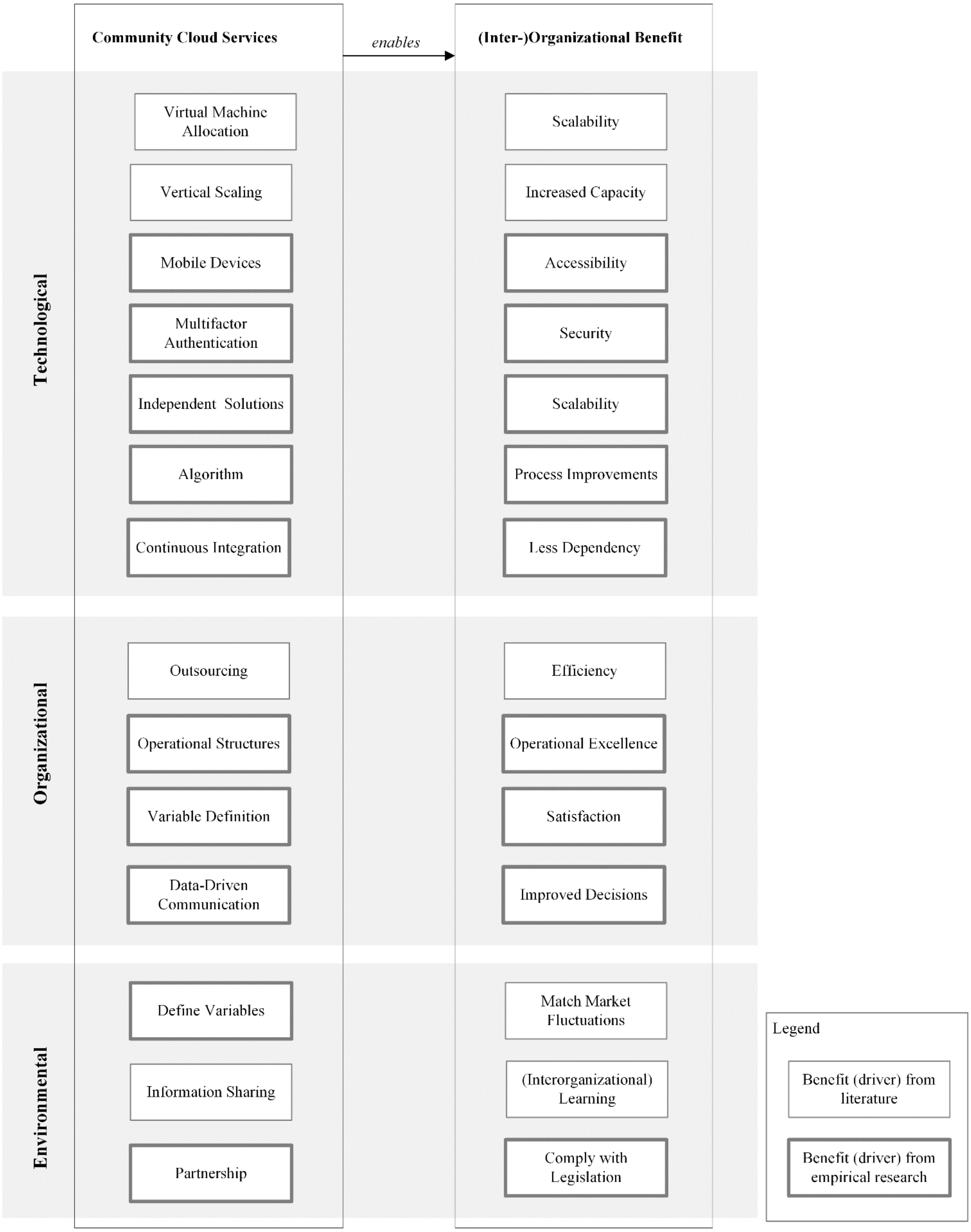


Figure 29. Community Cloud Benefits Model after Case study

5.7 Discussion

This subchapter shortly discusses the study's general findings as well as some patterns found in the cases. It starts in 5.7.1 by discussing the results from the interviews, comparing them to literature. Secondly, it discusses the role of the TOE framework in 5.7.2.

5.7.1 Drivers and Benefits Discussion

The constructs from the "Community Cloud Benefits conceptual model after literature" (Figure 11) shows differences with the "Community Cloud Benefits model after the case study" (Figure 29).

- *Technology Context*

For the first two benefits and benefit drivers of the Technology context, the findings from the interviews are somewhat similar to what can be found in the literature. The benefits gained with virtual machine allocation align with what was found in the literature (Dubey, et al., 2019), e.g. increased speed and scalability. The existence of virtual machines and their ability to operate on various hardware devices was mentioned in all three cases. The same may be said about Vertical Scaling. Vertical Scaling in the Community Cloud results in increased capacity and allows the solutions to execute more task in a shorter time. Sangavarapu et al. (2014) discussed how the increased capacity leads to the ability to handle data of a higher volume at a higher velocity. In all three cases, the increased capacity was mentioned and was observed to be of great importance for the future of the solution, e.g. increased capacity allows for the project's innovation.

A new significant benefit found for the availability of technology in the Community Cloud, as seen in the cases, is that the use of mobile devices increases accessibility. Accessing the solutions through mobile devices was mentioned in the Agriculture case and the Municipalities case. The benefits gained from mobile devices is often categorised as a benefit from Cloud Computing in general (Goyal, 2014). In the cases, the informants mentioned how mobile accessibility removes physical constraints and therefore also has a significant impact on cost savings.

Additionally, four new benefits have been found through the interviews compared to the literature study. First the security; all three cases mentioned that they work with multi-factor authentication to access their solution. Multi-factor authentication increases the security of the solution. However, there's no consensus about the effectiveness of the MFA when a third party arranges it. According to an informant of the Agriculture case, cloud vendors "*say they can do it, but practice shows that it doesn't work at all. So, as a* *business, you will have to make your own rules and provide for multi-factor authentication to be applied.”*. In contrast, informants of the Financial Guidance Service case mention that cloud vendors have well-developed security standards that can be utilised for their solution. A significant finding from the interviews is that the informants who scored themselves higher on technological expertise have less faith in the delivered security of Cloud Vendors.

Another new benefit refers to scalability. According to literature, an internet-based environment allows for scaling features on-demand and therefore increases scalability. One of the Financial Guidance Service case informants elaborated on this topic and stated a different driver for said scalability, namely creating independent solutions. The primary influence of the independent creation of solutions is that it increases agility and the ability to launch or go live fast, which increases development speed. The speed of development is one of the significant factors of scalability (Stampfl, Prügl, & Osterloh, 2013).

The following new benefit refers to using an algorithm to gain insights into the processes and make decisions accordingly. The algorithm construct is included in the Technology Characteristics because of its technical nature. Still, it can also be considered an organisational benefit because it allows for better decision making, referring to the organisation.

The last new benefit (driver) is “Continuous Integration”. The term continuous integration or continuous integration/continuous development (CI/CD) is mentioned by the informant of the Municipalities case but referred to in other words by other informants, e.g. “constant development” or “repeated improvement”. The informant of the Municipalities case made a significant statement about the effect of CI/CD. They stated that implementing CI/CD practices makes it easier to adjust solutions. Keeping your solution up to date with current demands results in less reliability of an outsourcing partner and, therefore, a lower chance of vendor lock-in.

Two drivers were found in the literature on these concepts of the Technology context but were not significantly mentioned by the informants. First, the impact the broker has on “Flexible Solutions” to increase customer satisfaction. One informant in the Financial Guidance Service case stated that when an organisation is working together with a Cloud Vendor, they can utilise the vendor’s economies of scale. However, this benefit is incorporated in one of the Organisation context benefits. The second is the benefit obtained from “Sharing Hardware”, which can be misleading. There was no sharing of hardware in the cases, and therefore, there were no benefits obtained from it. It does not rule out the possibility of occurring in another Community Cloud case.

An overall significant finding for the Technological context is that most constructs of the Community Cloud are based on the fact that the Cloud infrastructure in the cases is deployed in a Public Cloud environment. Therefore, the benefits obtained in the technological context show significant similarities with benefits obtained from Public Cloud as described in Alhammadi (2016), rather than specifically Community Cloud.

➢ *Organisational Context*

In the Organisational Context of the Community Cloud, one construct that was found in literature was confirmed by the informants. According to informants of all three cases, the "Outsourcing" of cloud management allows for utilising the Cloud vendor's expertise, results in increased control and efficiency, which in turn lead to cost savings. However, as stated before, there's no consensus on whether or not the benefits outweigh the potential risks. The risks, in this case, are being entrapped in deductive arrangements. A vast amount of research has gone into determining whether or not to outsource (Pankowska, 2019). In the case of Community Cloud, there's no single solution. The benefits and drawbacks of outsourcing depend on the industry, characteristics, targets, etc. From this case study, it can be concluded that the public sector, e.g. municipalities, are more prone to deductive arrangements, making outsourcing a less ideal option. This consideration, however, might vary depending on the situation.

Three new significant benefits were found in the Organisational context. The first one is that the implementation of "Operational Structures" result in operational excellence. Working with Community Cloud enforces the use of operational structures, e.g. information has to be uploaded according to specific standards, which allows for better and faster processing of data. However, an informant of the Agriculture case touched upon two drawbacks of the arisen structures, decreased flexibility and the loss of personal contact, which is essential because *"(...) growers need the personal contact and that this is disappearing, which is something you should definitely take into account as an organisation."*. The decreased flexibility comes to light when there's a need for a last-minute change of plans, i.e. in the Agriculture case when an additional load of potatoes need to be transported. However, it can be argued that, in the future, flexibility will be less critical due to improved operational excellence.

The second new construct found is also in the Organisational context. The definition of variables leads to higher stakeholders' satisfaction. According to one of the informants in the Agriculture case, an example of variable definition is track-and-trace. The construct was only mentioned in the Agriculture case, which could be because of the nature of the case. The Agriculture case is focused on a supply chain in comparison to the other cases. Stock insights are therefore irrelevant. However, the benefit stream can be generalised into a version of Community Cloud, where the main focus is information sharing. In this scenario, a better characterisation of the process variables leads to a greater understanding of the business process. As a result, the capacity to support Cloud users will improve, and users will be more satisfied.

The third additional construct of the Organisational Context, Communication-based on data, results in better decisions. In all cases, the importance of data-driven communication was mentioned, even though the scope of the communication differed, e.g. the focus in the Agriculture case lies on supply chain communication, and the focus of the Municipalities case lies on transparency. Overall can be said that the Community Cloud allows data-driven decision making resulting in better decisions.

Another finding from the cases related to the Organisational context is that the importance of stakeholder involvement is mentioned in all cases. Stakeholder involvement leads to better adaptivity, which increases the satisfaction of the members involved. It’s not characterised as a benefit of Community Cloud, but it is essential to keep in mind when deploying a Community Cloud. A Consultant of the Financial Guidance Service case mentioned the following; *“But the fact that it says “community” worries me a bit because you actually have more teams, more organisations, maybe even have teams outside your organisation, collaborating on that community cloud - you have the chance of proliferation which might make it more expensive.”*

When identifying the advantages of Community Cloud in the context of an organization, it's critical to distinguish between the benefits gained through community collaboration in general and the advantages gained from the specific Community Cloud solution. The Agriculture case is a solid illustration of a situation where collaboration already existed, and the Community Cloud solution's benefits could be explicitly highlighted.

- *External Task Environment*

In the External Task Environment, one benefit and benefit driver, as found in literature, were confirmed; the ability to match market fluctuation. Community Cloud allows for a better definition of variables. These variables include data used to define what is needed from the market. The market can be perceived as internal partners, e.g. cloud users, and external partners, e.g. consumer outside the Community.

The benefit and benefit driver of information sharing was slightly adjusted after obtaining empirical data. From the literate, sharing resources was discussed as a means to get inter-organisational learning. The empirical data found that a limited form of resource sharing was occurring, e.g. in the form of information and data sharing. Additionally, information sharing with the inter-organisational learning objective was often a top-down activity.

The last benefit and benefit driver of the External Task Environment concerns creating collaboration on paper to share data and comply with regulations. This benefit can be seen as controversial. That is because information sharing in Community Cloud brings additional challenges to comply with regulations; therefore, creating these partnerships to overcome them can be seen as necessary tasks rather than benefits of Community Cloud.

5.7.2 TOE-based evaluation model

Traditionally to evaluate Cloud adoption, a Cost-Benefit-Analysis (CBA) is executed (Maresova, Sobeslav, & Krejcar, 2017). A CBA requires all benefits and cost to be assigned to monetary values. The study stated before that the benefits of the Community Cloud could be arguably challenging to assign to monetary values. Therefore, the proposed evaluation model was based on the TOE framework.

The results from the empirical research demonstrate this. Some benefits can be assigned to monetary value, e.g. improved operational excellence, process improvements and cost savings. However, the empirical research showed benefits that are valuable to an organisation yet are not directly linked to monetary value, e.g. scalability, less dependency and inter-organisational learning.

Community Cloud should not be perceived as a stand-alone technology, but rather an implementation of Cloud, with significant impact on a wide range of stakeholders. Therefore, the added value of a TOE based benefits evaluation framework is that it provides room for a more detailed overview of benefits.

When comparing the empirical results with the traditional TOE model, it can be seen that benefits are found for all the factors in the Technological and External Task Environment, e.g. *Availability*, *Characteristics*, *Industry Characteristics and Market Structure*, *Technology Support Infrastructure* and *Government Regulations*. For reference, see figure 10. For the Organisational context, benefits are found *for Formal and Informal Linking Structures* and *Communication Process*. The last two factors, *Size* and *Slack*, there're no benefits nor benefit drivers found. *Slack* and *Size* are two of the most commonly mentioned characteristics that affect innovation (Baker, 2011). However, for both factors, there isn't a consensus about its impact on innovation. Therefore, the lack of benefits found for these factors is deemed insignificant.

6 CONCLUSION

This chapter concludes the study that has been done on the benefits of Community Cloud. The chapter is structured as follows. Subchapter 6.1 discusses what has been researched and answers the main research question. Additionally, it states some noteworthy finding from the study. Subchapter 6.2 discusses the limitations of the research, and subchapter 6.3 discusses the implications of the study. Lastly, subchapter 6.4 provides a research agenda for future research on Community Cloud.

6.1 Summary of Research

In this study, the benefits of Community Cloud have been defined. The research started with an overview of Cloud Deployment, including the origin. Secondly, it elaborated on the Community Cloud definition based on literature. Afterwards, the need for an improved benefit evaluation model was indicated, and a TOE-based benefits evaluation model was introduced. The use of the benefits evaluation model was illustrated in a multi-case study evaluating the benefits of three Community Cloud cases. The case studies and model provide the base for the answer to the research question.

RQ1 *How can Community Cloud enable (inter-) organisational benefit?*

Community Cloud can enable (inter-) organisational benefit in three focus areas. First, in the Technology context, the Community Cloud uses VM allocation, MFA and algorithms, resulting in scalability, security and efficiency through process improvements. Additionally, Community Cloud allows Vertical Scaling, removing physical constraints, independent solutions and continuous integration. These drivers result in increased capacity, increased accessibility and less dependency.

For the Organisational context, the Community Cloud outsources, resulting in efficiency. In the Community Cloud operational structure, improving operational excellence and enforces variable definition and data-driven communication, resulting in increased satisfaction and improved decisions.

For the External Task Environment, the Community Cloud enforces variable definition and information sharing, resulting in an increased ability to match market fluctuations and (inter-)organizational learning.

The additional overall findings are that the technological benefits of the Community Cloud in this research are similar to benefits from a Public Cloud. Therefore, the technological benefits of the Community Cloud presumably depend on the infrastructure implementation choices, e.g. technological benefits of a Community Cloud in a private environment might differ from a public environment.

Secondly, the most significant benefits were found in the organizational context. The Community Cloud can be seen as an application of Cloud rather than a stand-alone technology because of its influence on collaboration within an organisation. Additionally, the cases researched in this study identified one leading party, and the importance and the role of the leading party were emphasised.

Lastly, the cases showed that the Community Cloud allowed for significant cost saving, e.g. through efficiency and operational excellence. One of the main drivers for the organisations in this study to deploy a Community Cloud was to have future proof ICT.

6.2 Limitations

The study's limitations are aspects of its design or methodology that impact or influenced your research's interpretation. The limitations include methodology limitations and researcher limitations.

The first methodology limitation of this study is the lack of prior research studies on the topic. The literature study looked at 22 papers, of which only 11 were focused on Community Cloud explicitly. Case studies were executed to cover the limitation of the lack of prior knowledge,. Case studies offer a holistic view of processes involved in facilitating a multi-perspective analysis that leads to a holistic understanding of a cultural system of action, providing insights (Basias & Pollalis, 2018).

A second methodology limitation is the sample variation. The study includes three cases with various purposes. However, in all three cases, the infrastructure is deployed off-premise in a Public Cloud environment. Having another case with an on-premise or Private Cloud-based infrastructure would strengthen the claims made. Additionally, the Financial Guidance Service case and the Agriculture case include informant from various backgrounds, i.e. financial and technical backgrounds. However, in the Municipalities case, only one informant provided information concerning the case, forming a limitation. The limitation could have been solved by interviewing multiple stakeholders in the case, yet there was a lack of availability of the stakeholders in the given period of time.

Thirdly, the measures used to collect the data cause limitations for the study. Conducting interviews has limitations, e.g. generalisability. The fundamental criterion for interview sample size is that when interviewers share the same themes, issues, and subjects, adequate sample size has been attained (Boyce & Neale, 2006). The rule has been applied for the interviews; however, it's essential to keep in mind that the results could have been different if other informants were interviewed.

The last methodology limitation includes the influence of selecting the TOE framework for the analysis. The use of the TOE framework has been justified in the methodology chapter. However, one should keep in mind that using a framework in research can lead to a pre-set direction and overlook outliers. The limitation has been minimized by coding the interview transcripts and assigning them to themes in the framework afterwards, e.g. inductive coding.

Researcher limitations of the study include a combination of access and longitudinal effects. The given timeframe has proven difficulty in gaining access to various cases and potential informants. A longer timeframe could have resulted in a significantly larger amount of resources, increasing the generalisability of the research. A research agenda has been provided in 6.3.1 for further research to overcome the limitations.

Lastly, researcher bias can form a limitation. A categorical weakness of case study research is the difficulty in simplifying findings and assessing relationships (Eisenhardt, 1989). Adapting the inductive coding approach has lead to a minimization of the limitation of adopting the TOE framework; however, it increased the limitation of researcher bias.

6.3 Implications

This study has two main contributions: the development of the TOE based benefits evaluation model for Community Cloud and illustrating the use of the framework reporting of benefits in three Community Cloud cases.

The main academic contribution of the study is the development of the TOE based benefit evaluation model for Community Cloud. The need for the evaluation model has been discussed in chapter x. In future research, the created evaluation model can be adapted to analyse the benefits of other Community Clouds, and it could be argued to be adopted in additional Cloud benefits analyses.

The evaluate the business benefits of a masters thesis, the following aspects are discussed, according to a framework from Jakubik (2018). First, “what has been developed?”. This study has developed a TOE based benefits evaluation model for Community Cloud. Second, “who has/have immediate business benefit?’. The immediate business benefit is for organizations that have deployed a Community Cloud and are looking for a way to evaluate the fit to their business. Third, the “future business benefits” refer to the plans for using the outcomes of the master’s thesis in the future. The future business benefits of the study are twofold, e.g. 1) business benefits for organisations in the process of deciding *if* or *which* Cloud deployment model for deploying and 2) business benefits for consulting organisations providing information for said companies. The evaluation model improves the understanding of the Community Cloud benefits and could enhance the process of selecting a Cloud deployment model. The fourth and last theme refers to with whom the findings of the master's thesis have been shared. The results of this study have been shared widely within the supervising organisation.

6.3.1 Research Agenda

The amount of research on Community Cloud can be categorised as limited. This study has provided a better understanding of the benefits of Community Cloud, and further research will increase the knowledge on Community Cloud. This subchapter provides a research agenda and research strategy to indicate how the scientific gap can be closed.

For organisations that have recently deployed a Community Cloud, it would be interesting to research the maturity of their Community Cloud. A quantitative approach covering multiple cases of Community Cloud with various infrastructures could provide significant results.

For organisations deciding between Cloud deployment models, the following research question should be answered: what aspects does an organisation or community need to make the Community Cloud deployment interesting? Qualitative research could be executed further to understand the motives behind the Community Cloud adoption.

Lastly, future research should focus on the traditional versus modern view on Community Cloud. This research has shortly addressed the conventional view on Community Cloud-based on theories developed by Briscoe & Marino (2009). However, ever-evolving technology results in various understandings of what a Community Cloud entails. A quantitative futures study could compare and further address the modern view of Community Cloud, e.g. where its infrastructure is deployed in a Public Cloud environment.

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APPENDICES

Appendix 1 – Literature Overview Community Cloud

Community Cloud	(Baig, Freitag, & Navarro, 2018) (Briscoe & Marinos, 2009) (Dias, 2015) (Dubey, et al., 2019) (Giovanoli & Gatziu Grivas, 2013) (Hao, et al., 2014) (Hao, Park, Kang, & Min, 2018) (Henn & Lohwasser, 2020) (Marinos & Briscoe, 2009) (Mohan, Reddy, & Gangadharan, 2017) (Sangavarapu, Mishra, Williams, & Gangadharan, 2014)
Cloud Computing	(Goyal, 2014) (Haris & Khan, 2018) (Hourani & Abdallah, 2018) (Marston, Li, Bandyopadhyay, Zhang, & Ghalsasi, 2011) (Moravcik, Segec, & Kontsek, 2018) (Odun-Ayo, Ananya, Agono, & Goddy-Worlu, 2018) (Sabry & Krause, 2012) (Srinivasan, 2014) (Tavbulatova, Zhigalov, Kuznetsova, & Patrusova, 2020) (Trigueros-Preciado, Pérez-González, & Solana-González, 2013)

Appendix 2 – Interview Guide

Semi-structured interview guide

Introduction

- Express gratitude for your cooperation
- Request permission to record
    - o State anonymity of individuals and organization
- Explain the aim of the thesis
- State goal, structure and duration of the interview

Role of informant

- How would you describe your role in the organization?
- What has been your role in setting up the digital environment of the organization?
- In what way are you using Cloud in the organization on a daily basis?
- How would you describe the form of Cloud deployed in the organization?
    - o *Provide Community Cloud definition*
- How would you describe the relations between the parties in the project?

Technological

- How/in what way are you aware of the technological aspects of this particular Cloud?
    - o On a scale of 1-5 (novice-expert), where would you place yourself?
- What is your experience with other forms of Cloud?
- How would you describe the usage of resources, both hardware and software?
- What benefits do you perceive from using this usage?
- How do you perceive the role of Community Cloud in this usage?
- In what way do you think the current solution is scalable?
- How do you perceive the role of Community Cloud in this scalability?
- In what way does Community Cloud contribute to cost savings?

- **Organization**
- How/in what way are you aware of business strategy and evaluation?
    - o On a scale of 1-5 (novice-expert), where would you place yourself?
- How aware are you of costs concerning technology in the organization?
- How would you describe [case] community?
- How would you describe the relationship between organizations in the community?
- How would you describe the role of the service provider?
- How would you describe the task division on a daily basis?

- How would you describe vendor management?
- To what extent do you consider the responsibilities shared among stakeholders?
- In what way do you perceive benefits on an organizational level?

Environmental

- How/in what way are you aware of external factors influencing business decision? Such as market fluctuations and government regulations?
    - On a scale of 1-5 (novice-expert), where would you place yourself?
- How would you describe the impact of the cloud when it comes to flexibility to meet the market demands?
- How would you describe how legislation impacts digital technology decisions?
- How would you describe the way sensitive data is handled?

What was starting situation?

- In what way do you think the benefits could have been achieved with another form of the cloud?
- How do you see future developments?

Recap & Wrap up