MASTER

Cloud computing in the Dutch healthcare

a study into the cloud computing adoption behaviors of Dutch health tech startups

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Award date:
2017

Eindhoven, March 2017

Cloud Computing in the Dutch Healthcare

A study into the cloud computing adoption behaviors of Dutch health tech startups

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In partial fulfillment of the requirements for the degree of

Master of Science

In Innovation Management

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Series Master Thesis Innovation Management

Subject headings: technology adoption, cloud computing, technology-organization-environment framework, TOE framework, Diffusion of innovation, Software-as-a-Service (SaaS), Platform-as-a-Service (PaaS), Infrastructure-as-a-Service (IaaS), startups, healthcare.

Management Summary

Large technology suppliers are investing billions of dollars in building infrastructures, services, tools and applications to facilitate cloud computing (CC) usage for consumers, organizations, and businesses to exploit and benefit from CC services (Scott, 2016). One of the companies facilitating CC services is Philips, a Dutch multinational, who intends to improve the Dutch healthcare market with their new cloud based platform called the HealthSuite Digital Platform (HSDP). Cloud computing (CC) is defined as "*… a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction*" (Mell & Grance, 2011, p. 2). A platform is defined as a product, service, or technology developed by one or more firms that can serve as a foundation upon which a larger number of organizations can build complementary innovations, and potentially generate network effects (Gawer & Cusumano, 2014). A complementary product is one where its sales increase the demand for another product (Brandenburger & Nalebuff., 1997). In addition, network effects are phenomena that describe the relationship between the value of a product and its installed base (Katz & Shapiro, 1985).

The intentions of Philips with HSDP are to generate a connected ecosystem of devices, apps and digital tools that work seamlessly together and enable health information exchange, personalized health and continuous care. One of the mechanisms that Philips could use to develop these ecosystems and generate network effects, which increase the potential value of HSDP, is by attracting health tech startups to HSDP and encourage them to develop on top of it. Exploratory interviews with Philips personnel showed that health tech startups, i.e. technology startups developing digital health innovations, could be valuable because they are responsible for most of the external digital health innovations. Digital health is defined as value propositions that exploit novel IT and web-based technologies that aim to aid or to improve human health and healthcare (Krijgsman et al., 2015). Technology startups are referred to as new ventures based on technology eight years old or younger (Li & Atuahene-Gima, 2001). Although some initiatives are currently set in motion by Philips to stimulate the adoption of their cloud based platform services among external health tech startups, these initiatives are limited and in their early stages. Concurrently**,** the diffusion levels of CC services within the Dutch healthcare market are low (Krijgsman et al., 2015). In addition, this market is characterized as one with a high degree of regulatory control and instable CC policies, high cost of failure, and adoption, privacy and security concerns. These unique market conditions are expected to influence CC adoption behaviors in a different way than other industry contexts. Although studies are conducted towards the CC adoption behavior of startups, these studies are often conducted in different industries, e.g. manufacturing, services, and high tech, or with different type of organizations, e.g. hospitals (Oliveira et al., 2014). It is therefore expected that current adoption models do not explain the adoption behavior of health tech startups adequately from an organizational perspective. In addition, many CC adoption studies do not exploit frameworks grounded in theory for their research while other studies take a narrow focus e.g. Table E.1 and do not take a needed holistic approach that uses multiple theoretical perspectives (Oliveira et al., 2011). Finally, many CC adoption studies do not take the different modalities of CC into account, e.g. different pricing mechanisms, deployment forms, and service models. See Section 2.1 for more information about these modalities. These modalities make CC adoption quite different than previous enterprise IT adoption and the influence of these modalities will be addressed in this study (Hsu et al., 2014).

Research Purpose

Thus, this study intends to support Philips in its efforts of stimulating the adoption of HSDP among health tech startups in the Dutch healthcare market. This is done by researching the CC adoption behavior of these startups to increase the understanding of their willingness to and ability to adopt CC

technologies such as that of HSDP. This is achieved by using and integrating IT adoption models grounded in theory. This study therefore aims to answer the following main research question:
"*How can the cloud computing adoption behavior of health tech startups in the Dutch healthcare market be explained?"*

Methodology

To answer the research question and understand what adoption behaviors are occurring and why they are occurring, a qualitative and descriptive research was designed (van Aken et al., 2012). This research aimed to answer the research question by using three data collection methods: primarily semi-structured interviews, complemented with both a desk research and a survey. Accordingly, interviews were conducted with twelve health tech startups and eleven HSDP or startup experts within Philips. This data was analyzed using the template approach. The survey was only filled in by the startups.

Theoretical model

This study took a holistic approach to identify the CC adoption determinants by using and integrating firm-level IT adoption frameworks grounded in theory. Accordingly, this study integrated the Diffusion of Innovation (DOI) theory and the Technology-Organization-Environment (TOE) framework (Rogers, 1995; Tornatzky and Fleisher 1990). This study extended this model with the perceived platform openness construct as defined by Benlian et al. (2015). This construct is included because empirical evidence shows that this construct plays a vital role in the selection criteria of developers (and thus potentially of startups) in their selection of development platforms, e.g. Apple's iOS and Google's Android. The resulting conceptual model, shown in Figure 1, allowed this study to research the influence of the technology, the organization, the environment contexts, and the perceived openness on the CC adoption behavior of health tech startups. Subsequently, this study empirically validated, modified and complemented the proposed relationships in the integrative research model derived from literature.

Conclusions

The results indicate that each of the contexts and the perceived openness construct complement each other by providing a holistic perspective on CC adoption behavior. A summary of the results can be found in the following tables: Table 9 shows the results of the technology context, Table 6 shows the results of the organization context, Table 8 shows the results of the environment context, and Table 11 and Table 12 show the results of the perceived openness construct.

In addition, this study finds important differences in CC adoption behavior between IT&S (IT and service oriented) and CD (clinical device) startups. This research therefore proposes a conceptual CC adoption model to explain the adoption behaviors of health tech startups, see Figure 8. Table 13 shows an overview of the propositions of this study. The following elaborates on the main findings starting with the current CC usage of the respondents, shown in Table 5, and the organization context. It then continues with the technology context, the environment context and the perceived CC openness.

Table 5 shows that all the respondents exploit CC technologies with a strong preference for public cloud services and IaaS or SaaS service layers. The organization context proposes that affordability is one of the main drivers of this behavior, see Figure 8 or Table 13 for the entire set of variables and their proposed relationships. Table 5 also shows that the preference of service layers and pricing schemes differ between startups with distinctive value propositions. Startups with an IT and service oriented value proposition, i.e. IT&S startups, were found to increasingly adopt more SaaS and IaaS or PaaS with a preference for both a pay-per-use and a monthly fee as payment models. In contrast, startups with a (clinical) device oriented value proposition, CD startups, were found to increasingly adopt more SaaS services with a preference for a monthly fee as a payment model. The organization context proposes that IT&S startups adopt lower CC services relatively early because technology readiness, i.e. adequate technology infrastructure and human resources for CC usage and management, plays only a minor role

for them in contrast to CD startups. It is therefore proposed that CD startups adopt lower CC services in later growth stages once they reach technology readiness.

In terms of the technology context, it is proposed that the rate of CC adoption depends to a large extent on the degree of perceived relative advantage, e.g. Table 10, and the degree of perceived complexity. Furthermore, startups working with trade partners or with sensitive data were found to be more risk averse than other startups. This risk adversity in combination with a lack of competitive pressure is proposed facilitate uncertainty reduction behaviors. This reduction of uncertainty is proposed to occur to a large extent via the identified variables in the technology context (e.g. trialability and degree of observable benefits), in the environment context (e.g. regulatory and trade partner support of CC services, the level of CC usage in their informal networks, and characteristics of the technology supplier such as its trustworthiness, reputation, and competence), and in the perceived openness construct (e.g. degree of transparency and accessibility of the CC platform).

Theoretical Implications

The first main contribution of this research is the integration of two theoretical frameworks (the DOI theory and the TOE framework) to develop the research model (Rogers, 1995; Tornatzky and Fleischer, 1990). The second main contribution of this study to the literature is being, to my knowledge, the first to explore the perceived openness construct within a CC adoption study from a startup's perspective. Therefore, this study contributes to the literature on IT governance with a comprehensive and rich conceptualization of CC openness from a startup-centric perspective. The construct of Perceived CC Openness illuminates a relationship between a set of governance choices of CC suppliers with startups' CC openness perceptions and subsequent on their attitudes and adoption behaviors. The third main contribution of this study is by proposing distinctive preferences of CC configurations, i.e. selection of the service model, the pricing scheme, and the deployment mode, between startup groups based on a certain set of variables. This suggests that future CC adoption studies could incorporate the modalities of the cloud in their research model to, first, reduce the ambiguity of what is being adopted when referring to CC adoption, and, second, to increase the understanding of the drivers of adoption decisions. Lastly, while the DOI and TOE frameworks have been used intensively in IT studies and have consistent empirical support, specific measures within the contexts of the TOE framework vary across different studies or settings. Therefore, the fourth main contribution of this research to the IT adoption literature is by proposing variables that confirm or reject variables found in other CC adoption studies, e.g. technology readiness, innovativeness, competitive pressure, trade partner support, and regulatory support. In addition, this study added a set of new variables that were not previously identified in other CC adoption studies, e.g. value proposition, Firm stage, and informal networks. These findings can be found in Table 13.

Managerial Implications

The findings of this study help CC suppliers sharpen their business strategy of creating superior customer value and achieving superior performance by offering strategic insights, such as selecting target customers and designing promotion strategies (Slater et al., 2007). The degree to which these activities will successfully stimulate adoption among health tech startups is expected to depend mainly on the fit of the services with the needs of the startups, the degree to which adoption uncertainties and complexities are reduced, and the degree to which services are affordable. Therefore, this study provides insights to managers on how these vital aspects can be addressed. Table 14 for example shows the most important considerations for targeting health tech startups in general, and IT&S and CD startups. Also, this study suggests that startups should be included relative early during the service development to prevent alienation between their needs and the developed services, but also to start content creation early on. Lastly, a tool is developed based on the findings to increase their practical use as explained in Section 5.3. Screenshots of this tool can be found in Appendix K (not for publication).

Preface

After a substantial amount of time and hard work, I am finally able to finalize the final requirement to graduate from the Innovation Management Master's program at the Eindhoven University of Eindhoven. I started this Master program about three years ago while working as a full-time software engineer, one year after I finished my Bachelor's study in Electrical and Electronic Engineering. This pursuit of a Master's degree, which was initially outside of my expertise and comfort zone but strongly within my interests, has truly been one of the most challenging and rewarding experiences of my life. Words cannot describe how much I have gained from completing this study and thesis. On one side, I learned substantially from literature and I improved my academic skills tremendously. On the other side, I learned a great deal about myself. This learning came mainly from activities such as making decisions on my own, which was not always a standalone task in the past. Nevertheless, I would never have been able to complete this work without the people who helped me and who I want to thank for their support.

First of all, I want to thank Myriam and Isabelle, my first and second supervisor from the university. Myriam, I want to thank you for your support and the freedom that you gave me throughout this period. Especially your guidance during the final period of the thesis were of great help. This support was greatly needed as this gave me the required confidence to stay on track and finish the thesis on time. Isabelle, I want to thank you for your constructive feedback that helped me to bring more focus and clarity in the message of my thesis.

Second, I want to thank Philips Design for providing me the opportunity to conduct a Master thesis research under their provision. I want to thank Geert in special for the opportunity and for the freedom I was given to design and conduct the research. Although I spent a lot of time on finalizing this thesis, your patience, support, and confidence in me gave me the confidence to finalize the work. Furthermore, I want to thank Jeroen for introducing me to Geert and enabling this entire process. In addition, I want to thank all of the interview respondents within Philips and outside of Philips. This thesis could not have been finalized without their support and willingness to participate in the research.

Finally, I want to thank a few people who supported me during this time. A lot of gratitude goes towards my girlfriend Annina. Your support has been invaluable during the entire process and I cannot thank you enough for standing there for me during the difficult times. Furthermore, I want to thank my friends for their support and confidence in me. I want to thank the following persons: Bob, Nick, Kasper, Tom, Wouter, and Evan. Furthermore, I want to thank my parents, sisters and other close friends who supported me throughout the entire process.

Melkon Youssif

Eindhoven, March 2017

Table of Contents

Appendix K is not available to the public. These documents are therefore presented separately to readers with the right authorization.

List of Figures

List of Tables

Appendix K is not available to the public. These documents are therefore presented separately to readers with the right authorization.

1. Introduction

This thesis presents the results of the master thesis graduation research conducted at the multinational Royal Philips N.V. This study is conducted at the Philips Design department in Eindhoven as a part of the Master thesis for the degree of Master of Science in Innovation Management in the department of IE&IS at the Eindhoven University of Technology. Philips Design is the global function for the Philips company that works intensively with Philips businesses to ensure that innovations are meaningful, people-focused, and locally relevant. This introduction provides the context of the master thesis, the research questions, and an overview of the document setup.

1.1 Practical background

Philips (2016) is a global leader in healthcare who is active in countries such as the Netherlands and the United Sates. The mission of Philips is to leverage their world-class innovations, capabilities, their clinical and consumer insights, long-standing customer relationships with healthcare providers, and their integrated solutions portfolio to create greater value while lowering the cost of care. Both Philips and the Dutch government argue that the Dutch healthcare market is in need of a transformation that embraces digital health to reduce the cost of healthcare (Philips, 2016; Schippers, 2014). Digital health is defined as value propositions that exploit novel information technologies (IT) and web-based technologies that aim to aid or to improve human health and healthcare (Krijgsman et al., 2015). According to Schippers (2014), a vast majority of industries have embraced (digital) innovations at a fast pace while the Dutch healthcare has not. This is in line with Philips who argues that the next essential step forward for the (Dutch) healthcare market is to a large extent the adoption of cloud computing (CC) technologies. A prominent definition of CC is that of the National Institute of Standards and Technology (NIST), which defines it as, "… *a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction*" (Mell & Grance, 2011, p. 2). In other words, CC enables users to rent information technology (IT) infrastructure, platform, and software services via the internet, eliminating the need to deploy and maintain the underlying IT structure themselves (Hsu et al., 2014). CC emerged in 2007 and is predicted to represent the next generation application architecture (Lin & Chen, 2012). Large technology suppliers are investing billions of dollars in building infrastructures, services, tools and applications to facilitate CC usage for consumers, organizations, and businesses to exploit and benefit from CC services (Scott, 2016; The Wall Street Journal, 2016). It is estimated that by 2020 the cloud market will reach $195 billion dollars (IDC, 2016).

1.2 Establishing the Research Subject

Philips is currently developing an open cloud based platform, called the HealthSuite Digital Platform (HSDP) and contemplating about introducing it into the Dutch healthcare market. A platform is defined as a product, service, or technology developed by one or more firms that can serve as a foundation upon which a larger number of organizations can build complementary innovations, and potentially generate network effects (Gawer & Cusumano, 2014). A complementary product is one where sales of one of the products increase the demand for the other product (Brandenburger & Nalebuff., 1997). Network effects are phenomena that describe the relationship between the value of a product and its installed base (Katz & Shapiro, 1985). Network effects can be "direct", which occur when the value of a product to any user depends on the network's size, where a platform with a larger size is more appealing than a smaller size. Network effects can also be referred to as "indirect", which occur in environments where different "sides" of stakeholders are present and when the value of the platform increases for one side of users as the other side of users' increases, e.g. the increasing number of consumers on Facebook make it more attractive for advertisers to advertise on it.

The intentions of Philips with HSDP are to generate a connected ecosystem of devices, apps and digital tools that work seamlessly together and enable health information exchange, personalized health and continuous care (Koninklijke Philips N.V., 2016). HSDP will thus be developed with services, capabilities and tools that allow Philips and its strategic partners, e.g. large HCOs, to create the next generation of health innovations. Innovation refers to the creation of novel and useful products, processes, or services and the implementation thereof (Brentani, 2001). A substantial part of the launch efforts of Philips are currently focused on establishing and maintaining partnerships with hospitals and other health related organizations to understand their needs, to provide integrated solutions, and to engage in multi-year cooperation. These initiatives are aimed at driving improvements in terms of patient outcomes, quality of care delivery, and cost productivity. However, Philips intends to make their platform accessible for external firms by publicly sharing Application Programming Interfaces (APIs). By using APIs, Philips could extend the reach of HSDP and encourage external firms, e.g. who are not a strategic partner, to leverage the platform's healthcare-optimized cloud services. These external firms could then incorporate the services of HSDP within their own (complementary) digital health innovations and potentially generate positive network effects for the platform. Such a construction was argued by Philips personnel to be beneficial for both Philips and external firms.

Exploratory interviews with Philips personnel showed that health tech startups, i.e. technology startups developing digital health innovations, are responsible for most of the external digital health innovations. Technology startups are referred to as technology based ventures who are eight years or younger (Li & Atuahene-Gima, 2001). Therefore, it was argued that by attracting these startups to HSDP, Philips could offer a more differentiated, broader and innovative solutions to its customers without having to own or control the innovation. See Appendix A for a further overview and elaboration of the benefits that startups could offer to Philips. In addition, startups were argued to benefit by gaining access to a highly advanced technological foundation from a respected player in the healthcare market, which allows startups to focus more on product development (rather than on developing such an infrastructure themselves), reduce their cost and time-to-market. However, exploratory interviews indicated that healthcare organizations and startups are distinctive markets, which require different approaches and different strategies. Although some initiatives are currently set in motion to stimulate the adoption of HSDP among external health tech startups, these initiatives are limited and in their early stages. Therefore, to support Philips in its efforts of stimulating the adoption and diffusion of their cloud based health platform among health tech startups in the Dutch healthcare market, this study intends to find out the CC adoption behaviors of health tech startups in this market. The findings of this study intend to sharpen the business strategy of creating superior customer value and achieving superior performance by offering strategic insights, such as the selection of target customers and designing promotion strategies (Slater et al., 2007).

1.3 Cloud Computing Adoption as a Prerequisite

The novel and unique characteristics of CC have changed the ways in which companies adopt IT (Christensen, 1997). Previously, expensive and advanced IT innovations were usually adopted first by wealthy firms since they were the only ones who could afford them. With the presence of CC however startups, can now benefit of access to affordable and advanced IT resources by the elimination of the high up-front cost of buying IT resources themselves. However, products that enter new markets are characterized by their high levels of product and market uncertainty (Utterback, 1994). Accordingly, despite the benefits of CC, there are still substantial concerns about its usage. The literature shows concerns about is usage such as security, confidentiality, performance instability, latency, and network bottlenecks (Sultan, 2011). Such concerns slow the adoption of CC down in markets such as healthcare. This market is characterized as conservative, diverse, complex and unique, and includes challenges such as HCO's protecting members' health records and the need to comply with regulatory policies. For startups or SMEs to innovate in the Dutch healthcare sector means potentially accessing a vast, diverse

and complex ecosystem with stakeholders that can consist of consumers, care providers (such as hospitals), health insurance companies, or the government and other entities (Zorg voor innoveren, 2014). This results in challenges such as having to engage with difficult to access care practitioners or having to comprehend sufficient patient and regulatory knowledge (Schippers & van Rijen, 2016). This trade-off between exploiting the benefits of the cloud and dealing with the challenges of the market raises the question about the degree to which health tech startups are able to or willing to adopt HSDP services or CC services in the healthcare market, which has not yet embraced CC technologies fully.

1.4 Initial Theory background

Currently, the diffusion levels of CC services within the Dutch healthcare markets are low (Krijgsman et al., 2015). Although studies are conducted towards the CC adoption behavior of startups, these studies are often conducted in different contexts, e.g. manufacturing, services, and high tech (Hsu et al., 2014; Alshamaila et al., 2012). Because of the challenging and risk averse context of the healthcare market, it is expected that this unique context will influence startups' CC adoption. This influence is expected to result in different behaviors than found by other studies. Although CC adoption studies within the healthcare context are conducted, the sample of these studies consists mainly of hospitals (Lian et al., 2014; Oliveira et al., 2014). In addition, many CC adoption studies do not exploit frameworks grounded in theory for their research. Other studies take a narrow focus and fail to provide a holistic explanation, e.g. Table E.1. Finally, many CC adoption studies do not take the different modalities of CC into account, unlike Hsu et al. (2014). CC services in fact consist of a larger range of options than traditional IT. These options include a set of pricing mechanisms, e.g. pay-per-use or a monthly fee, a set of deployment forms, e.g. public or private, and a set of service models, e.g. infrastructure, platform or software services. This allows firms to adopt CC partially or completely, or distribute cost in different ways via different pricing mechanisms. This is different than previous enterprise IT adoption. Therefore, this study intends to advance the enterprise IT adoption literature by researching the influence of these different modalities. This is expected to lead to a better understanding of the variables that influence companies' preferred pricing mechanism, deployment model, and service model.

1.5 Research Purpose and Research Questions

This study researches the CC adoption behavior of health tech startups to increase the understanding of their willingness to and ability to adopt CC technologies by using IT adoption models grounded in theory. This study aims to answer the following main research question:

"How can the cloud computing adoption behavior of health tech startups in the Dutch healthcare market be explained?"

To answer the main research question, three sub questions are defined. The first question will only be answered with theory while the other two questions will be answered with theory and empirical research.

Sub questions

1. What is the definition of cloud computing and what are its characteristics?
2. Which technology adoption models help explain the cloud computing adoption behavior of health tech startups?
3. Which determinants affect the cloud computing adoption behavior of health tech startups?

This document is organized as follows. The second chapter presents the theoretical background of this study and derives an initial conceptual CC adoption model from the existing literature. The third chapter describes the used research methodology for the empirical research. The fourth chapter presents the analysis of the collected data and the results. The fifth chapter discusses the implications of the results for research and practice, points out this study's limitations, provides promising areas for future research, and it presents a solution design. Lastly, the sixth chapter answers the main research question and provides an overall conclusion.

2. Theoretical Background

This chapter provides the theoretical background for this thesis. This chapter aims to provide answers to the literature review and the sub questions stated in the previous chapter. Therefore, this chapter first defines CC and its characteristics. Second it discusses technology adoption models that help explain CC adoption behavior of startups. Third, it discusses determinants of CC adoption behavior from earlier studies.

2.1 Cloud Computing Definition and its Characteristics

This section addresses the first sub question regarding the definition of CC and its essential characteristics. Although it seems that CC is identical to adopting any enterprise IT, cloud technologies differ in certain aspects including pricing and deployment strategies. According to the NIST, the CC model consists of five essential characteristics, three service models, and four deployment forms. The characteristics of CC include on-demand self-service, broad network access, resource pooling, rapid elasticity and measured service. On-demand self-service means the unilateral provisioning of resources without human interaction with the provider. Broad network access denotes that the services are distributed over a network. Resource pooling means the aggregation of resources such as storage, processing, memory to serve heterogeneous group of customers. Rapid elasticity means that resources scale up and down dynamically adapting to the demand. Finally, measured service refers to the automatic control and optimization of resources through pay-per-use metering capabilities appropriate to the type of service, e.g. storage, processing, bandwidth, and active user accounts. This metering capability can additionally provide transparency for both the provider and the consumer of the utilized service (Brender & Markov, 2013).

The three service models, which are also built on top of each other in the following order, are Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). The IaaS model stands for resources including processing, storage, networks, and other essentials, on which a user can deploy operating systems and applications, e.g. Amazon's Elastic Compute Cloud (EC2). The PaaS model is developed on top of IaaS and provides an operating platform. This platform enables users to exploit cloud applications or to create these with programming tools and libraries of the provider, examples include the Google App Engine, Microsoft Azure, Amazon Web Services (AWS) and Force.com (of Salesforce.com) (Sultan N. , 2011). Finally, the SaaS model is developed on top of IaaS and PaaS and offers a set of applications including word processing, spreadsheets, customer relationship management (CRM), HR management, and enterprise resource planning (ERP) systems running on cloud infrastructure(s). In addition, these service models are built to distribute the set of controls and responsibilities different per service layer. Lower service layers' shift distributes these aspects to the user whereas higher service layers distribute these aspects to the technology supplier. For example, users exploiting an IaaS architecture have more control and responsibilities over their resources such as the configuration and maintenance of the operating systems, storage, and deployed applications in contrast to SaaS users (Brender & Markov, 2013). Appendix C Table C.2 provides a visual example of how separation of responsibilities differs per service model.

The four deployment forms are: private clouds, public clouds, community clouds, and hybrid clouds. Although all of them grant (external) actors access to an infrastructure and computation resources through the internet, the following discusses their distinctions. The private cloud represents a set of services that organizations can take advantage of where the computing environment is exclusive for a single organization. This form benefits organizations by allowing them greater control over the infrastructure and computational resources (in comparison to public clouds). This form of cloud is often preferred by organizations focusing on privacy and data security. The drawback of this form is the complex implementation that makes it expensive and/or time consuming. In contrast, public clouds

represent a set of services available for the general public, i.e. these computing environments are not designed for one organization only as the private clouds. This form enables organizations to adopt CC fast and easy in a time and cost efficient way. However, drawbacks include concerns about data security, data loss, but also legal and ethical concerns are present (Chang et al., 2013). Community clouds provide cloud infrastructure exclusively to multiple firms sharing the same mission, security concerns, and compliance requirements. This deployment form is more cost efficient than private clouds and has reduced risk compared to public clouds. The drawback of this form is that it can take a long time to establish a working community for sharing and mutual learning. The final type is the hybrid cloud, which comprises of a combination of the cloud deployment forms. In this case, the deployment forms, e.g. public and private, remain separate but share common standards that enables data and application portability. This configuration enables organizations to reduce costs, whilst maintaining privacy and data security. The drawback of this form is the complex integration of different architectures (Chang et al., 2013; Brender & Markov, 2013). Figure C.1 in Appendix C Illustrates a reference model of the cloud architecture.

In summary, the major aim of CC is to reduce the cost of accessing and exploiting IT services while increasing processing throughput, reliability, availability, and flexibility and decreasing processing time. However, CC is a comprehensive construct that can refer to multiple layers and configurations. Each of these configurations have their own benefits and drawbacks. The following section discusses the IT adoption models that guided the empirical research to understand how health tech startups make their CC adoption decisions and which configurations they prefer.

2.2 IT Adoption Theories

This section addresses the first sub question regarding the IT adoption theories within organizations. Researchers have conducted substantial amount of studies on the adoption and diffusion of innovation. This has led to a rich but also diverse body of theoretical and empirical work. As such, different theories are developed over the years whose explanatory power are validated empirically by many studies. These theories are shown in Table D.1 in Appendix D, where a further distinction is made between the type of adopting unit, i.e. individual or an organization.

Since this thesis focuses on health tech startups, the main attention is on theories relevant to organizations. These theories are mainly used to analyze the adoption of actors such as companies, business units, agencies or departments (Jeyaraj et al., 2006). The search for useful organizational adoption studies resulted in theories such as that of the Diffusion of Innovation (Rogers, 1995), Technology Acceptance Model (Davis, 1989), the Technology Acceptance Model II (Venkatesh et al., 2003), Diffusion/Implementation Model (Kwon and Zmud, 1987), the Tri-Core Model (Swanson, 1994), and the Technology-Organization-Environment (TOE) Framework (Tornatzky and Fleisher, 1990). These organizational adoption theories are also shown in Table D.1. To make an appropriate decision about which adoption model(s) to use, a further analysis was conducted. Previous studies on CC adoption were analyzed to identify which adoption theories are widely used. The result of this analysis is shown in Table E.1. The results indicated that the most used theories are a combination of the TOE. Surprisingly, the results showed that a substantial amount of studies use no theoretical foundation for analyzing CC adoption. Furthermore, Oliveira et al. (2014) and Yang and Tate (2012) note that a substantial amount of studies conducted on CC adoption are skewed toward technological issues. They argue the need for more studies taking a holistic approach to empirically validate the effect of the innovation characteristics and the underlying technology, organization, and environments context. Therefore, the results suggest that the TOE framework in combination with the DOI framework are well-suited to serve as the theoretical basis for the empirical research. Because of this direction, the remainder of this chapter discusses the selected frameworks in more detail to provide theoretical answers to the sub questions and guide the empirical study for empirical answers to the sub questions.

2.3 The TOE and DOI Frameworks

CC adoption studies of organizations exploit often adoption theories such as the DOI and the TOE frameworks (Rogers, 1995; Tornatzky & Fleischer, 1990). The TOE framework is a generic firm-level theory of technology diffusion that can be used to analyze innovation adoption processes from multiple contexts: the technological context, the organizational context, and the environmental context. The technological context describes the internal and external technologies related to the organization. These technologies can be both already in use by the focal firm or not. The organization context refers to the resources and characteristics of the firm (e.g. scope, size, and managerial structure). Finally, the environmental context explains the surroundings in which a firm conducts its business, e.g. its industry, competitors, and the regulatory environment. This results in the model shown in Figure D.1 in Appendix D.

DOI is an adoption model that explains how, why, and at what rate new ideas and technologies spread through cultures, operating at the individual and firm level (Rogers, 1995). This framework exploits five attributes to explain the adoption of innovation within an organization. These attributes comprise of: relative advantage, the degree to which an innovation is an improvement in relationship with an alternative one, compatibility, the extent to which the solution is compatible with the organizational policy, structure, value, and most importantly products and services, complexity, describes the degree of difficulty in using an innovation, trialability, indicates how easy it is to experiment with the innovation. Rogers (1995) argues that the diffusion of innovations is a social process, even more than a technical matter, which spreads through various channels within the social system. Based on DOI theory at firm level, the attributes that influence the adoption of innovation within firms are the individual (e.g. openness towards change), internal firm structure (e.g. centralization, complexity, formalization, interconnected, organizational slack, and the number of employees), and external characteristics (system openness) of the firm. This results in the model shown in Figure D.2 in Appendix D.

In line with the work of Oliveira et al. (2014), this study combines both adoption models, which are empirically validated on a consistent basis. This approach fulfills the call of different studies to combine theoretical perspectives to obtain higher understanding of IT adoption of new technologies (Fichman, 2004; Lyytinen & Damsgaard, 2011; Oliveira & Martins, 2011; Wu et al., 2013). As Chau and Tam (1997) argue, a good method to capture the decision-making of organizations related to the adoption of technological innovations is to design the context of a study in a comprehensive way and to use tailored variables to the specificity of the innovation. The similarity between both models allows these frameworks to be combined and direct the empirical study to help answer the research question. In terms of similarity, the technology context of the TOE framework includes implicitly the same idea as that of the DOI framework. Also, the DOI's internal and external firm characteristics include the same measures as TOE's firm context. However, differences are also present such as the presence of individual characteristics (e.g. top management support) in the DOI framework but not in the TOE framework. In addition, the DOI does not take the environmental context into account. The TOE framework thus complements the DOI framework by including the technology, organization, and environment contexts into one holistic framework, resulting in a mutually complementary framework (Oliveira & Martins, 2011; Oliveira et al., 2014). To identify the constructs of the integrative research model and guide the empirical research, an elaborate literature search was conducted within scholarly databases, e.g. Google Scholar. The identified variables were then grouped and evaluated to determine the most representative variables in the published literature on CC adoption. The following section introduces these variables and presents the integrative research model.

2.4 Determinants of CC Adoption within Startups

This section first elaborates the definition of a startup and then it addresses the second and final sub question regarding the determinants affecting the CC adoption of health tech startups.

The life cycle of a company can be characterized by their movement through alternative growth stages characterized by their relationship with dominant problems (Kazanjian, 1988). According to Kazanjian (1988), a company can be one of the following four stages: the conception and development stage, the commercialization stage, the growth stage, or the stability stage. In their early stage or their first growth stages, a company is called a startup and is busy setting the business up, e.g. primarily by developing the value proposition. There are also no sales yet, but they have already set up their management, prepared a business plan and have conducted market studies. They move to the early stage or commercialization once the production, and the preparations for a market launch start, where external funding often enables this transition. In some cases, revenue is generated, but they are not making any profits yet to scale substantially and become stable (Wilson & Silva, 2013).

To identify the variables that could explain the adoption behavior of startups, the identification of empirically validated variables included also studies with samples of other type of organizations. The results show a total of 27 variables influencing organizational CC adoption. The variables supported by empirical findings are listed in Table E.2 in Appendix E. This table shows the sources of the variables and how often their relationship with CC adoption was supported. Furthermore, this study includes an essential construct from the platform literature into its integrative CC adoption framework. This construct is the *Perceived Platform Openness* (PPO) as described by Benlian et al. (2015). This construct is included because empirical evidence shows that this construct plays a vital role in the selection criteria of developers (and thus potentially of startups) in their selection of a development platform such as Apple's iOS and Google's Android. Because of the similarities between the business models of platforms and cloud platforms, e.g. both allow external parties to access a technological infrastructure to create and to innovate, this study expects to find the same importance of this construct in the current context. However, because of the different contexts, e.g. their study examined individuals while this one examines organizations, this study expects to find a set of different and a set of similar variables that explain the drivers of this construct. The proposed relationship between PPO and CC adoption will be discussed after the variables identified from earlier CC adoption studies are discussed.

2.4.1 Research Model and Propositions

The integrative research model is shown in Figure 1. The following discusses the propositions starting with the technology context.

Propositions of the Technology Context

Innovations characterized with a strong *relative advantage* have a clear, unambiguous benefit that promises to create strategic effectiveness such as optimize sales, gain operational effectiveness, which results in an innovation to perform better in terms of adoption (Low et al., 2011; Hsu et al., 2014). Therefore, if the benefits of CC exceed alternative and current practices and processes, the benefits are expected to positively influence its adoption (Rogers, 1995). *Complexity* makes it more challenging to integrate a technology into one's business operations, thereby reducing the probability of its adoption (Lin & Chen, 2012). This can take more time to understand and implement the new system, which can function as a barrier to implementation. Furthermore, complex systems can require organizations to have a certain degree of expertise to manage this complexity, which may not be present in the firm (Lian et all, 2014; Gangwar 2015a; 2015b). It is therefore expected that complexity has a negative effect on adoption (Rogers, 1995). *Compatibility* is in alternative studies found to be a strong driver of adoption alternative studies. This is because incompatible technologies can require one to apply major adjustments in process that can require and involve considerable learning (Lin & Chen, 2012; Alshamaila et al., 2013). Therefore, it is expected that when a technology is viewed as compatible with for example one's current systems, organizations are more likely to consider to adopt the novel (Rogers, 1995). *Trialability* is less often used in IT studies, as the first three variables, but its importance is still

found in alternative IT adoption studies (Alshamaila et al., 2013). For example, Ramdani (2009) argues that in the case of trial opportunities, one can assess the performance of a technology and prepare themselves properly before commiting to fully implementing an innovation. Therefore, it is expected that trialability will positivel influence adoption. *Observability* is as trialability as less often used variable in IT studies. However, Lin and Chen (2012) provide empirical evidence that its inclusion is still vital. Moreover, this aspect becomes increasingly important as an offering becomes more service oriented (Zeithaml & Bitner, 1996). See Appendix B for more information about products and services. Lin and Chen (2012) argue that new technologies such as CC, require to demonstrate the true value of cloud usage and its benefits (e.g. increase in revenue or reduced costs). This demonstration can aid organizations to determine the commercial value of CC and can reduce the uncertainty around the cost of adoption. Therefore, the technology propositions consist of,

P1. *There is a positive relationship between relative advantage and CC adoption.*
P2. *There is a negative relationship between complexity and CC adoption.*
P3. *There is a positive relationship between compatibility and CC adoption.*
P4. *There is a positive relationship between trialability and CC adoption.*
P5. *There is a positive relationship between observability and CC adoption.*

Propositions of the Organization Context

Organizational readiness is the extent to which managers believe and evaluate their oganization to have the required awareness, resources, commitment, and governance to adopt CC services (Iacovou et al., 1995; Tan et al., 2007). This construct can be divided into *technology readiness*, e.g. *infrastructure* and *human resources* for CC usage and management, and *financial readiness*, e.g. financial resources for CC implementation and maintance cost. The infrastructure refers to the network technologies and enterprise systems that the startup uses which can be replaced or complemented by CC services. In this regard, Oliveira et al. (2014) find that firms with at established technology infrastructure are more likely to adopt CC services. Human resources are the personnel within the startup who have the knowledge and skill to implement CC services, e.g. IT specialists. In this regard, Oliveira et al. (2014) find that startups with specialized human resources are better positioned to adopt CC services. The findings of Hsu et al. (2014) complement these findings by finding that current cloud adopters are more likely to have strong IT capabilities rather than weak (Hsu et al., 2014). These findings suggest the importance of having specialized human resources with the appropriate knowledge and skill to implement the CC services (Gangwar et al., 2015). In terms of financial readiness, several studies such as Lian et al. (2014) find that CC services can require one to have sufficient financial resources. These financial resources are not always present among startups and this can prevent them from investing in such services. Because of the low financial resources of startups, this study expects that startups with access to more financial resources will have a positive effect on CC adoption. Therefore, this study expects that startups with an established technology infrastructure, specialized human resources, and financial support, increase the likelihood of CC adoption (Abdollahzadegan et al., 2013; Lian et al., 2014, Oliveira & Martins, 2010). This readiness is however expected to be related with the *willingness of top management* to comprehend the benefits of CC (Low et al., 2011; Oliveira et al., 2014). This willingness increases the probability of top management to invest financially for adoption but also to provide the necessary technological competencies (or provide *education and training opportunities* for it) (Alshamaila et al., 2013; Gangwar et al., 2015; Ostlund, 1974).

Furthermore, because the CEO in small organizations is often the owner-manager, the cognitive style of such a person is expected to play a key role in how organizations handle new products. This style is explained with their *degree of innovativeness*. This variable describes how open one is to new products and the degree to which one desires to be the first to adopt a new product (Marcati et al., 2008; Alshamaila et al., 2013). Therefore, highly receiptable organizations for new technological innovations are expected to adopt more new products than those who do not (Rogers, 1995; Marcati et al., 2008). In

addition, a positive relationship is expected between *prior technology experience* and CC adoption. This is because of the positive relationship between a user's prior knowledge and their understanding of a new context or situation. Therefore, *prior technology experience* with comparable IT innovations is expected to facilitate cloud adoption (Alshamaila et al., 2013). Additionally, *firm size* is found to influence the decision of adopting cloud services. However, empirical evidence shows mixed findings in this area. For example, some researchers argue that startups are more likely to adopt cloud services due to their innovativeness and agility (Alshamaila et al, 2013). In contrast, other studies argue that larger technically advanced firms are more likely to adopt cloud services because they possess more resources, skills, experience and ability to survive failures than smaller firms (Low et al., 2012). Because of support for both size of organizations, this study expects that startups will adopt CC services independent from their size.

Finally, the degree of *business process complexity* is expected to influence CC adoption positively where organizations with a higher degree of complex processes are expected to leverage CC opportunities faster. Business process complexity is here defined as the extent to which an organization's business process are difficult to analyze, understand or explain. As such, CC can benefit these complex organizations by being scalable, available on-demand, adaptable to meet their (changing) needs, thereby being potentially very useful for supporting complex business processes (Wu et al., 2013). Thus, the organizational context consists of the following propositions

P6. *There is a positive relationship between organizational readiness and CC adoption.*
P7. *There is a positive relationship between top management support and CC adoption.*
P8. *There is a positive relationship between the degree of training and education offered and CC adoption.*
P9. *There is a positive relationship between the degree of innovativeness and CC adoption.*
P10. *There is a positive relationship between prior technology experience and CC adoption.*
P11. *Firm size does not influence CC adoption.*
P12. *There is a positive relationship between the degree of business process complexity and CC adoption.*

Propositions of the Environment Context

Organizations can be seen as *trading partners* of each other when they conduct economic interactions with each other. These interactions configure one of the parties as a buyer of and the other as a seller of value. The findings in the literature suggest that these types of relationships can influence the adoption of new technologies. For example, Katz and Shapiro (1986) illustrate that technologies that are advocated by trading partners are more likely to be adopted. This makes sense for CC as the value of it can increase when many trade partner use it and accept it. As such, Wang et al. (2010) argue how requests from strong partners (in terms of impact they can make on one's sales or profits) can be a critical decision-making factor of certain technologies. This relationship is also suggested by different studies such as Low et al. (2011) and Hsu et al. (2014). In addition, the market in which startup operates can be characterized by its *degree of competitiveness*. In this regard, the high-tech industry can be characterized of a highly competitive market with rapid changes where firms face constant pressure. Accordingly, competitive pressure occurs as market competition increases and firms feel increasingly the need to innovate to obtain competitive advantage and/or to survive. As empirical studies suggest, increasing competitive pressure on organizations is expected to result in a positive influence on CC adoption. In line with the previous reasoning, the industry in which a startup is active in can have substantial influence on one's technology adoption (Alshamaila et al., 2013). For example, certain *industry sectors* are found to leverage CC technologies more frequently than in others. This suggests that the *industry sector* could potentially be helpful in explaining CC adoption.

Furthermore, alternative studies suggest the importance of the *supplier's trustworthiness and reputation*. For example, Gupta et al. (2013) argue that CC adoption depends on how CC providers build trust, faith,

confidence and reliability of their cloud services to stimulate usage. This is in line with Repschlaeger et al. (2013) who find that the *reputation* of the CC supplier is a key characteristic that characterizes over 85% of the startups in their sample. In this study, trust is defined as the expectation of organizations that the CC provider will perform as expected and treat them fairly and reasonably (Garrison et al., 2012). Trust can furthermore be categorized into *competence and openness* dimensions. The former refers to the trust in the competence of the CC provider whereas the latter form refers to the degree to which the partner is willing to share information and is honest in conducting business (Ibrahim & Ribbers, 2009). This study therefore expects that the supplier *trustworthiness*, in both dimensions, and *reputation* has a positive influence on CC adoption. Another environmental variable is *regulatory support*. This support refers to the support provided by a government authority to promote the adoption of IT innovations by organizations (Zhu et al., 2006b). The impact of existing laws and regulations is expected to influence the adoption of novel technologies within the healthcare substantially. Accordingly, this influence can be positive or negative for CC. For example, Oliveira et al. (2014) argue that legislators can promote CC adoption by requiring businesses to comply with CC specific standards and protocols. Although Low et al. (2012) and Oliveira et al. (2014) found no significant relationship of regulatory support, different studies such as Lian et al. (2014), Bose & Luo (2011), Kuan (2001), Zhu & Kraemer (2005) and Zhu et al. (2006b), find proof for the existence of a positive relationship. Therefore, this study expects that regulatory support will have a positive effect on CC adoption.

Finally, *market scope* is expected to have a positive relationship on CC adoption. This variable is defined as the horizontal extent of a company's operations (Zhu et al., 2003). Accordingly, a firm can extend its scope by operating not only on the local level, but also on the national or international level. Alshamaila et al. (2013) find empirical support and argue that expanding one's target market can increase costs such as search costs (e.g. searching for new consumers, trading partners, and distributors). These costs are expected to stimulate CC adoption because it could decrease such costs and make organizations less dependent of their location. Therefore, the propositions of the environmental context are

P13a. *There is a positive relationship between trading partner support and CC adoption.*
P13b. *There is a positive relationship between supplier support and CC adoption.*
P14. *There is a positive relationship between competitive pressure and CC adoption.*
P15a. *There is a positive relationship between the supplier trustworthiness & reputation and CC adoption.*
P15b. *There is a positive relationship between the trust in the competence of the supplier and CC adoption.*
P15c. *There is a positive relationship between the trust in the openness of the supplier and CC adoption.*
P16. *There is a positive relationship between the industry and CC adoption.*
P17. *There is a positive relationship between regulatory support and CC adoption.*
P18. *There is a positive relationship between market scope and CC adoption.*

As discussed earlier, this study incorporates the perspective of Benlian et al. (2015) to study *perceived openness*, which is found empirically to stimulate the adoption of individual developers. Their perspective is used since their empirically validated construct offers the most comprehensive and useful breakdown of the openness construct from a third-party perspective.

Propositions based on Perceived CC Openness

Openness refers to the degree to which external parties can access, understand, and modify one's CC services (West, 2003). *Openness* of a platform lies on a continuum of being closed to open for external parties (Gawer (2014; West, 2003). According to Gawer (2014), opening means at least making interfaces available to external firms for access to the technical side of the platform. According to Benlian et al. (2015), third party developers require to leverage both a development environment by developing applications but also a distribution channel. This distribution channel can be a part of the platform's market place, which enables users to make profit with their innovations. To clarify the distinction between the two, the technical platform includes the facets of CC services related to the

technical development of third-party applications. The distribution channel of the CC services refers to all facets related to promoting, selling, and distributing complements. The study of Benlian et al. (2015) addresses both of these aspects based on two distinct but complementary dimensions: *transparency* and *accessibility*. *Transparency*, captures the potential that complementors' can comprehend of what is happening and why it is happening. *Accessibility*, involves aspects that involve of how developing and commercializing applications of third-party developers is constrained or supported on the platform. This means that both the technical platform and the distribution channel have a transparency and an accessibility dimension. Accordingly, this study expects that scoring high on these dimensions results in a higher perceived openness, which in turn is expected to stimulate adoption positively. However, because of the sample differences, differences are expected in the drivers of the construct. This study therefore also explores the set of variables related to the transparency and accessibility dimensions. This new construct is defined as Perceived CC Openness (PCCO), because of the lack of such a construct in CC literature. Further information about perceived platform openness can be found in Appendix F PCCO thus extends the openness trust proposition (P15C) and will be included in the final model as follows:

P19. *There is a positive relationship between transparency of the technical platform and CC adoption.*
P20. *There is a positive relationship between accessibility to the technical platform and CC adoption.*
P21. *There is a positive relationship between the transparency of the distribution channel and CC adoption.*
P22: *There is a positive relationship between the accessibility to the distribution channel and CC adoption.*

As mentioned earlier, CC technologies offer novel usage opportunities than regular (enterprise) IT. As such, organizations can adopt cloud at different levels of commitment by selecting different modalities (pricing, service levels, and deployment). Therefore, to enhance the (enterprise) IT adoption literature, this study follows the work of Hsu et al. (2014) and explores this multi-modal approach to adoption. Accordingly, the following propositions are designed to examine whether the variables used to explain adoption, could also explain the modalities of adoption (pricing, service model, and deployment model) offered by cloud suppliers.

P23. The TOE factors are related with the preference for pricing mechanism
P24. The TOE factors are related with the preference for a service model
P25. The TOE factors are related with the preference for a deployment model

The research model is shown in
Figure 1: Integrative Research Model and the variables with their corresponding definition are shown in Table 1.

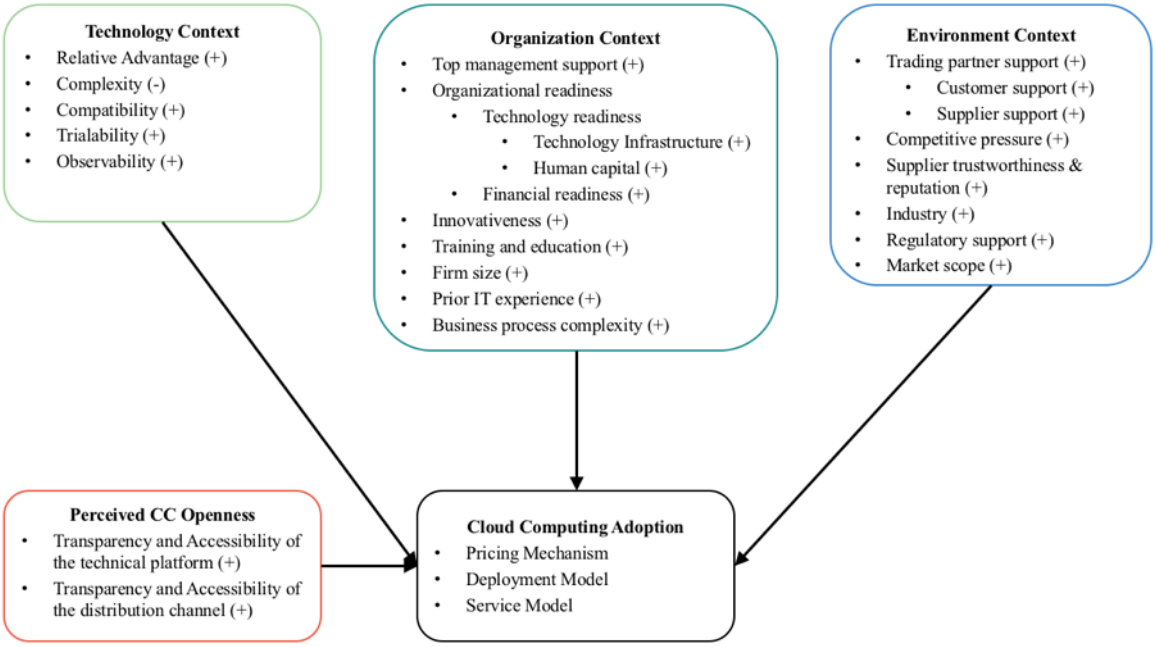

Figure 1: Integrative Research Model

This chapter has thus far shown the research model and the propositions that will be validated empirically. Therefore, the following chapter discusses the methodology of the empirical research.

Table 1: The Independent Variables and their Definitions

Variable	Description/Construct
Technology Context	
Relative advantage	• "The degree to which an innovation is perceived as being better than the idea it supersedes" (Rogers, 2003, p. 15)
Compatibility	• "The degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters" (Rogers, 2003, p. 15)
Complexity	• "The degree to which an innovation is perceived as relatively difficult to understand and use" (Rogers, 2003, p. 15)
Trialability	• "The degree to which an innovation may be experimented with on a limited basis" (Rogers, 2003, p. 16)
Observability	• "The extent to which the results of using an innovation are visible to others" (Rogers, 2003, p. 16)
Organization Context	
Top management support	• The degree of support provided by the higher management in adopting the technological innovations for business use is referred as top management support (Abdollahzadegan et al., 2013)
Organizational readiness	• The extent to which managers believe and evaluate their oganization to have the required awareness, resources, commitment, and governance to adopt an IT (Iacovou et al., 1995; Tan et al., 2007)
Technology readiness	• The extent to which the infrastructure and human resources are ready for CC usage and management (Tan et al., 2007)
Financial readiness	• The extent to which financial resources are available for for CC implementation and maintance (Iacovou et al., 1995)
Innovativeness	• The extent to which a client adopts innovations earlier than other members of the same social context (Rogers, 1995)
Training and education	• The degree to which a company instructs its employees in using a tool in terms of quality and quantity (Schillewaert et al., 2005)
Firm size	• The number of employees in the entire organization (Tan et al., 2007)
Prior technology experience	• The extent of a user's experience with previous similar technologies (Heide & Weiss, 1995)
Business process complexity	• The extent to which an organization's business processes are difficult to analyze, understand or explain (Wu et al., 2013)
Environmental Context	
Trading partner support	• The degree to which trading partners, e.g. suppliers, customers, governmental units, and financial institutions support or require the use of CC (Iacovou et al., 1995)
Supplier support	• The supplier activities aimed to support the adoption process and increase the adoption of a specific technology (Repschlaeger et al., 2013)
Competitive pressure	• The degree of pressure felt by the firm from competitors within the industry (Oliveira & Martins, 2010)
Supplier trustworthiness & reputation	• The expectation of an organization that the CC provider will perform as expected and treat them fairly and reasonably (Garrison et al., 2012)
Industry	• The sector to which the business belongs (Yap, 1990; Goode and Stevens, 2000)
Regulatory support	• The degree of support provided by a government authority to promote the adoption of IT innovations by organizations (Zhu et al., 2006b)
Market scope	• The horizontal extent of a company's operations (Zhu et al., 2003)
Perceived CC Openness	
Transparency	• The potential that complementors' can comprehend of what is happening and why it is happening (Benlian et al., 2015)
Accessibility	• The aspects that involve of how developing and commercializing applications of third-party developers is constrained or supported on the platform (Benlian et al., 2015)
Technical Platform	• The facets of CC services related to the technical development of third-party applications (Benlian et al., 2015)
Distribution Channel	• The facets of CC services related to promoting, selling, and distributing complements (Benlian et al., 2015)

3. Research Methodology

This chapter explains the research methodology which was designed to answer the research question. This research aimed to explain the CC adoption behavior of health tech startups in the Dutch healthcare market. This was done by empirically validating and modifying the relationships of the integrative research model, presented in Figure 1. The main focus of interest, i.e. unit of analysis, are in this study the health tech startups active in the Dutch healthcare market (van Aken et al., 2012). Furthermore, to answer the research question adequately, it was required to understand what is occurring and why it is occurring. Therefore, this research combined a qualitative research design with a partially descriptive research design. A major part of the empirical study relied on qualitative data collected by conducting semi-structured interviews. A small part of this study was descriptive and used a survey to derive initial insights about the influence of variables found in the literature. This survey was also used to increase the reliability of the results by complementing the qualitative data with descriptive data (Harris & Brown, 2010).

3.1 Literature search strategy

First, a systematic review of the existing literature was conducted to answer the first sub question and to aid the empirical part of the study. This literature review was then synthesized to derive a theoretical framework, see Figure 1. The literature search strategy for the review started with a systematic and iterative search process leveraging two complementary search strategies: the keyword strategy and the snowballing strategy (van Aken, Berends, & Van der Bij, 2012)

The keyword strategy was used to identify articles that could help to answer the research question. The literature search involved peer-reviewed published journal articles concerning relevant topics. Main relevant keywords for the search were 'technology startups', 'cloud computing, 'cloud computing adoption', 'diffusion of innovation', 'technology adoption', 'technology adoption models', and 'TOE framework'. To obtain a broad and diverse set of literature, multiple search engines were used including: 'Focus TU/e', 'Web of Science', and 'Google Scholar'. The keywords were used and combined to find relevant articles. The most relevant literature for this study were identified by including only articles with the used key word(s) in the title and/or abstracts that were further analyzed. Although the search started with only one or a couple of key words, additional keywords were added when the number hits was too high. In addition, a substantial amount of literature was found by analyzing the sources of a relevant article, i.e. using the snowball strategy. In addition, a search for platform related articles was conducted to gain insights on strategies for launching innovation foundations. This latter search combined with the snowballing strategy resulted in valuable articles such as the identification of perceived platform openness construct defined by Benlian et al. (2015). In addition, this snowball strategy resulted in the identification of peer reviewed articles published in low quality journals, e.g. with no impact factor or lower than 1, or to a book. These sources were only added if they were cited by an article published in an excellent journal, e.g. impact factor higher than 1,5 and an ABS 2010 ranking of (3) or (4), and if they were highly relevant to answer the research question. In the case of a book, it was important to identify the author(s) as a published contributor in high quality journals.

Following van Aken et al. (2012), the research design is described along the data collection, data analysis, and the data reliability and validity.

3.2 Data Collection and Sample

This study aimed to answer the research question by using three data collection methods: primarily semi-structured interviews, complemented with a desk research and a survey. Desk research was mainly conducted to compose a comprehensive and holistic conceptual model of CC adoption with a set of propositions and to analyze the respondent's website to allow for a better preparation for the semi-structured interviews. The survey was used to increase the reliability of the results and obtain an initial

measurement of the influence of the variables identified from the literature. This influence was measured with a survey using 5 point Likert scaled questions (Clason & Dormody, 1994). The use of semi-structured interviews as a primary data collection method was favored because of three reasons (Gray, 2004). First, interviews allow one to gain insights about a person's knowledge, values, preferences and attitudes. Second, they allow one to identify variables and their relationships. Furthermore, semi-structured interviews allow one to use a list with specific questions while leaving sufficient room for additional questions.

Furthermore, this study conducted semi-structured interviews with twelve health tech startups and eleven HSDP or startup experts within Philips. Both startups and Philips employees were interviewed to generate more reliable outcomes by including multiple perspectives (Gray, 2004). The survey was only filled in by the startups. A combination of criterion and convenience sampling were used for finding health tech startup in this study (Gray, 2004). The used criterion for the selection of startups was that they had to have their headquarters in the Netherlands, meet the definition of a health tech startup (stated earlier in this document), and be in their conception and development or initial commercialization stage (Kazanjian, 1988). Startups in Noord-Brabant were approached first and preferred because of the strong interest of Philips in this region. However, this area expanded to Noord-Holland and Utrecht because the criteria to stop was not reached. The main aim was to stop collecting data once saturation was achieved or if twelve startups were collected (van Aken et al., 2012). This latter criterion was found to be sufficient to remain within the available time and to still be able to interview all of the startups who responded positive to the interview request. In addition, Philips personnel were interviewed to identify their experiences and opinions about the CC adoption behavior of startups and how Philips could best proceed to stimulate the adoption of HSDP among the startups. Their insights were used to complement the interviews with the startups and to provide more information for the solution design. The snowball sampling method was used for identifying the appropriate Philips personnel for the research subject (Gray, 2004). Table 2 illustrates an overview of the Philips respondents that participated in this research. Appendix G illustrates the interview questions that guided the meetings with the startups and the Philips personnel, and Appendix H illustrates the survey questions that were used. The approximate average duration of these interviews was one hour. The survey was occasionally also filled in during this time, but it was in general sent afterwards via mail due to time constraints.

This study used two sources to find startups: 1) via startupdelta.org, a public-private partnership initiated by the Netherlands Ministry of Economic Affairs to take the Dutch startup ecosystem to the next level, and 2) zorginnovaties.nl, an open platform and community of startups in the health and well-being sectors (StartupDelta, 2015; ZorgInnovatie, 2015). The following process was used to find respondents: 1) find healthcare startups via either platform, 2) contact them via phone and otherwise via mail using the acquisition process and content described in Appendix I, 3) arrange skype call or face-to-face meeting with key staff, e.g. the CTO, involved in the technology adoption decision-making process, and 4) send a mail with an explanatory PowerPoint presentation about the study one day prior to the meeting.

Table 2: Interviewees at Philips

Name	Function
Brian Rosnov	R&D Project Manager
CK Andrade	Director Product Manager
Edgar van Zoelen	Head of HealthSuite Labs
Rogier Veugen	Digital Program Director
Rich Wilmot	Sr. Director Corporate Venturing
Ad Dijkhof	Platform Manager HSDP Device Cloud
Jan Smets	Account & Portfolio Manager
John Hegge	Business Development Manager
Michele Taurielo	Business Development Manager, HSDP Device Cloud
David Ariel	Engineering Senior Manager, HSDP R&D
Maarten Nielen	Sr. Project Manager

Startupdelta provides an overview of 119 startups active in the health market. Their characteristics include the following: only a few received between 10 and 50 million dollars in funding, they are based in the Netherlands, they are in the seed (92) or early growth stage (27), they are in the business-to-business (81) or business –to-consumer (23) market. Figure 2 illustrates their locations and the amount of startups in a certain province in the Netherlands. ZorgInnovatie.nl on the other hand lists 397 ventures based in the Netherlands in different stages, such as concept phase, development phase, test phase or scaling. Table 3 illustrates an overview of the startups respondents that participated in this research. Appendix K (not for publication) shows their company descriptions.

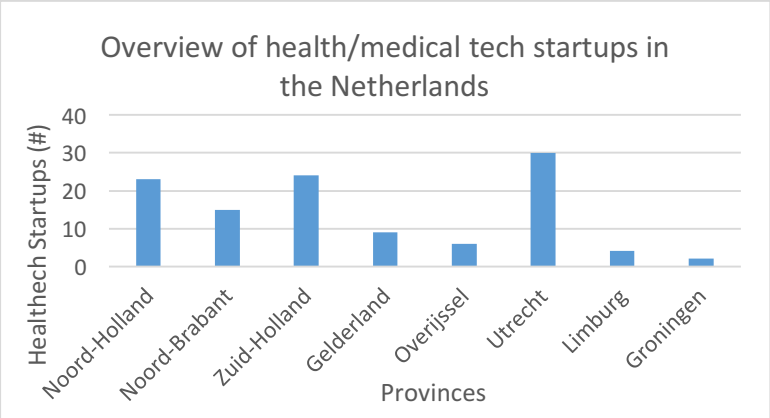

Figure 2: Health/medical startups in the Netherlands. Adapted from: startupdelta.org (2016)

Table 3: Health Tech Startups in the Sample

#	Alias	Clinical	B2B/B2C	Delivery Method	Employees	IT Budget (x100.000 €)	Function
1	ST1		B2B	Connected Device	3 – 5	1 – 5	Innovation Manager
2	ST2		B2C	SaaS	6 – 10	5 – 10	COO
3	ST3		B2B	Offline	3 – 5	< 1	CEO
4	ST4		B2C	Connected Device	3 – 5	1 – 5	CEO
5	ST5	Yes	B2B	Offline	3 – 5	< 1	VP Clinical Application
6	ST6		B2B	SaaS	3 – 5	< 1	Co-founder
7	ST7	Yes	B2B	Offline	3 – 5	< 1	CTO
8	ST8		B2B	SaaS	6 – 10	1 – 5	CEO
9	ST9		B2B/B2C	SaaS	3 – 5	< 1	Founder
10	ST10	Yes	B2B	Offline	6 – 10	< 1	CEO
11	ST11	Yes	B2B	SaaS	1 – 2	1 – 5	Medical Director
12	ST12		B2B	PaaS	11 – 50	> 10	CTO

3.3 Data Analysis

The conducted interviews were all transcribed to text and analyzed using the template approach (van Aken et al., 2012). The systematic analysis of the qualitative data is performed through coding transcribed interviews. Coding is defined as attaching a concept to a phenomenon, i.e. applying a concept to specific transcribed data (van Aken et al., 2012). The template approach was chosen as the method for data analysis since new insights were sought about an already identified phenomenon, i.e. CC adoption behavior. Accordingly, this approach allows one to use existing codes from literature and apply it to the transcribed data. The used codes for this study are shown in Appendix J. The data transcription was performed using the QDA Miner software, which is a qualitative text analysis software. The process used in this research for data analysis consisted of collecting data, reducing data, displaying data, and drawing conclusions/verification (Gray, 2004; Miles & Huberman, 1994). Data reduction refers to reducing the sheer volume of data to make it more coherent and manageable (Gray, 2004). Displaying data refers to the design of a visual format that presents information systematically so that valid conclusion can be taken from it (Gray, 2004).

3.4 Reliability and Validity

3.4.1 Ensuring Reliability

Reliability refers to the degree to which the same results can be obtained independent from the characteristics of a study and thus whether they can be replicated in alternative studies (van Aken et al., 2012). The literature notes four factors that could harm reliability: the researcher, the instrument, the respondents and the situation. A set of actions are taken into consideration to reduce errors and biases. In terms of the researcher, aspects such as one's experience influence the degree of reliability in a study. Although this specific aspect could not be addressed directly, this study attempted increase the reliability by standardizing procedures as much as possible and design explicit procedures for data collection, analysis and interpretation, e.g. by using the template approach. Furthermore, to reduce the dependency with the researcher, digital tools were used for qualitative data analysis, e.g. QDA Miner, and for data collection and analysis from a survey, e.g. Google Forms. These survey questions however were not subject to any statistical validation. Therefore, they were merely used to reinforce an argument rather than to serve as the sole basis of an argument.

In terms of the instrument, reliability was attempted to increase with the use of multiple research instruments, i.e. triangulation, so that they complement each other. These sources included for example interviews, surveys, documents, and archives. In terms of the respondents, two measures were exploited to increase reliability. First, this study aimed to include respondents who are involved in the problem to be represented among the respondents. This criterion was more useful for the respondents within Philips though, because the respondents from the health tech startups were pre-selected by the organization self and only one person was available for this task. Second, all the identified respondents were at least interviewed to increase the number of respondents and not miss out on, potentially, vital information.

3.4.2 Ensuring Validity

Validity can be described in three ways: construct validity, internal validity and external validity (van Aken, 2012). Construct validity refers to the degree to which a measuring instrument measures what it aims to measure. This study attempted to increase its construct validity in three ways. First, the coding list and the interview questions are to a large extent based on already-defined concepts and questions derived from articles published in peer-reviewed journals. Appendix G lists the interview questions, which was inspired by the studies of Alshamaila et al. (2013) and Benlian et al. (2015). Second, both experts from the university and from Philips were asked to evaluate the measuring instruments. Their input was subsequently used to improve the instrument. Third, the triangulation of research instruments, e.g. interviews, documents, archives, and surveys, and the triangulation of multiple perspectives were used, e.g. health tech startups and experienced Philips personnel. This helped to cover all aspects of a concept in the case where this was not possible with only one instrument.

Furthermore, internal validity refers to the degree to which the conclusions between phenomena are justified and complete. This study attempted to increase its internal validity in two ways. First, the research subject is studied from multiple perspectives to facilitate the discovery of all causes of CC adoption behavior. Second, the analysis was attempted to be conducted as systematic as possible (as discussed earlier). However, because of the qualitative nature of this study, internal validity will be limited to a certain degree. Finally, external validity captures the degree to which the research results can be generalized (van Aken, 2012). The degree of external validity of this study is expected to be moderate at most, because of the qualitative nature of this study. In addition, the unique and specific context of the current study, which is the Dutch healthcare market makes it less generalizable. However, it is expected that within the same context and with similar type of health tech startups, findings are to a certain extent to be generalizable. The following chapter shows the analysis of this study.

4. Data Analysis

This chapter presents the analysis of the collected data, both from interviews and surveys, from twelve Dutch health tech startups to answer the research question of this project. The data collected from Philips personnel was used for complementary and triangulation purposes. As such, the aim of this chapter is to validate or modify the integrative research model, presented earlier, that explains the cloud adoption behavior of Dutch health tech startups. This chapter is organized as follows. The following section describes the current CC behavior of the startups in the sample. The next section starts with the findings based on the organization, environment, and environment contexts and the Perceived CC Openness from the integrative research model. Finally, the CC adoption model is presented with an overview of the propositions and their results. Selected quotes are used to illustrate the results, indicated with the abbreviation (Q#). The group to which the startup is assigned to is also added at the end of the quote to highlight the perspectives of the different groups.

4.1 CC Adoption Behavior in the Sample

This section analyzes the CC adoption behaviors of the startups in the sample. This analysis is conducted by first grouping the startups into two groups based on their delivery method, i.e. used mechanism through which their value proposition is delivered. This grouping is based on two reasons. First, three Philips respondents argued these differences between startups groups. Second, the data corroborates this grouping by showing alternative behaviors between groups. These differences and similarities will be highlighted throughout this chapter. The first group consists of four startups developing offline (medical) products (CD startups), which leverage mostly the SaaS layer of CC. In contrast, the second group consists of eight startups who are either developing (non-clinical) connected devices or (medical graded) IT services, which leverage mostly a combination of the SaaS layer and either the IaaS or the PaaS layer (IT&S startups). Table 4 lists the groups and their population.

Table 4: The Two Startup Groups in the Sample

CD Startups (delivery method)	IT&S Startups (delivery method)
ST3 (offline product)	ST1 (connected device)
ST5 (offline medical device)	ST2 (SaaS)
ST7 (offline medical device)	ST4 (connected device)
ST10 (offline medical device)	ST6 (SaaS)
	ST8 (SaaS)
	ST9 (SaaS)
	ST11 (medical graded SaaS)
	ST12 (PaaS/SaaS)

Interestingly, group 1 viewed themselves to be less aware of CC potential for their business, whereas group two viewed themselves to be more aware of this potential, reflected in the survey with an average of 3,3 and 4,9 respectively. This difference was also noticeable in their business model, where the first group had not yet included CC into their core product in contrast to the second group. The CD startups excluded CC from their business model for several reasons including perceiving no added value from embedding cloud capabilities into the value proposition and the need to save cost and focus on their current business model. This CC exclusion from the business model was also reflected in the usage of cloud layers, where the CD startups leveraged more frequently SaaS in comparison to the other layers whereas the second group leveraged more frequently the lower layers of CC (a difference that will be explained later in the chapter).

In terms of implementation models, both groups were found to have a strong preference for public clouds and only a small portion had a preference for hybrid or private. Although private clouds are more expensive than public clouds, they were still preferred by two startups because of the higher security and privacy levels. However, these startups would opt for a public cloud if the appropriate security and privacy mechanisms are applied sufficiently. These higher privacy and security levels explains also why

three startups would opt for a hybrid cloud allowing them to leverage both public and private cloud and to store data on the cloud depending on the sensitivity of the data.

In terms of payment methods, the preferred payment method differed between the groups. The descriptive statistics shows that CD startups mostly favor a fee model whereas IT&S startups favor both with a slightly higher preference for the pay-per-use model. These differences could be explained by the different expected usage patterns of both groups and the more complex price calculations for pay-per-use pricing schemes. CD startups have a more predictable CC usage pattern and so it is likely that they prefer to opt for a simple and consistent way of paying rather than having to deal with complex price calculations when they opt for a pay-per-use pricing scheme. In contrast, IT&S startups have a lower predictable usage pattern and so it is likely that they mostly prefer the pay-per-use pricing scheme because of its flexible usage. This flexibility turns otherwise fixed costs into variable costs, which is essential for them because of their lack of financial resources. Table 5 lists the main descriptive CC adoption statistics, i.e. the CC usage and preferences of the startups in the sample.

Table 5: Descriptive Statistics of Startups and their CC Usage and Preference

Service Layer Usage			
	IaaS (Frequency)	PaaS (Frequency)	SaaS (Frequency)
CD Startups	1	0	4
IT&S Startups	6	4	8
Total	7	4	12
Implementation Model Usage			
	Public Cloud (Frequency	Hybrid Cloud (Frequency)	Private Cloud (Frequency)
CD Startups	2	1	1
IT&S Startups	5	2	1
Total	7	3	2
Payment Model Preference			
	Pay-per-use (Frequency)	Fee (Frequency)	License(Frequency)
CD startups	1	3	0
IT&S Startups	5	4	1
Total	6	7	1

Note: startups could select more than one option for their service layer usage and their preferred payment model

This section grouped the respondents based on their delivery method and presented descriptive statistics of their CC behaviors. The following sections start first with similar findings between groups and end with differences between groups. The following section analyzes the internal organizational context of the startups in the sample. These contextual sections are set up as follows. They first provide a general overview of the findings and then they provide the analysis of the collected data.

4.2 Organization Context

This section analyzes the collected data to identify the internal organizational influences on the CC adoption behaviors of health tech startups in the sample. This analysis found a relationship between CC adoption and *organizational readiness* (*technology readiness* as in *technology infrastructure* and *human capital*, and *financial readiness*) (P6), *top management support* (P7), *prior IT experience* (P10), *firm stage* (new), and the *value proposition* (new). In contrast, support was not found for *training and education* (P8), *innovativeness* (P9), *firm size* (P11), and *business process complexity* (P12). Table 6 provides an overview of these findings with a short description.

The survey results give a first indication of the results. The organization context average survey scores are shown in Figure 3. This figure shows that top management support and technology infrastructure

score relatively high on average (minimum of 4,1) whereas the size of the firm, innovativeness, and the competitive pressure score relatively low (maximum of 3,5) The following parts elaborates further on the findings.

Table 6: Overview of the Internal Organization Influences on CC adoption of Startups

Variable (analyzed in section)	Finding
No support found for	-
Firm size (4.2.1)	
Innovativeness (4.2.2)	
Training and education	
Business process complexity	
Support found for	
Organizational readiness	• CD startups are more likely to start with SaaS services and use lower CC services as their technology infrastructure matures. In contrast IT&S startups are more likely to use any of the CC service layers early in the operation of their business. Their selection depends on other variables, e.g. human capital.
Technology Readiness	
Technology infrastructure (4.2.1)	
Human capital (4.2.3)	• Specialized human resources are required for PaaS and IaaS and are often more accessible for IT&S startups than for CD startups
Financial Readiness (4.2.3)	• Technology adoption is constrained by limited financial resources, which is why most of the startups prefer public cloud
Prior technology experience (4.2.4)	• Prior experience is proposed to guide the selection process in the early stages
Top Management Support (4.2.5)	• Top management support is proposed to be required and especially for both essential and financial requiring decisions
Firm Stage (**new**) (4.2.1)	• Startups are expected to use increasingly more CC services as they move through growth stages.
Value proposition (**new**) (4.2.1)	• The value proposition is proposed to influence whether CC services are used for product or service development (IT&S) or more for complying with requirements, regulations or gaining operatonal efficience (CD)

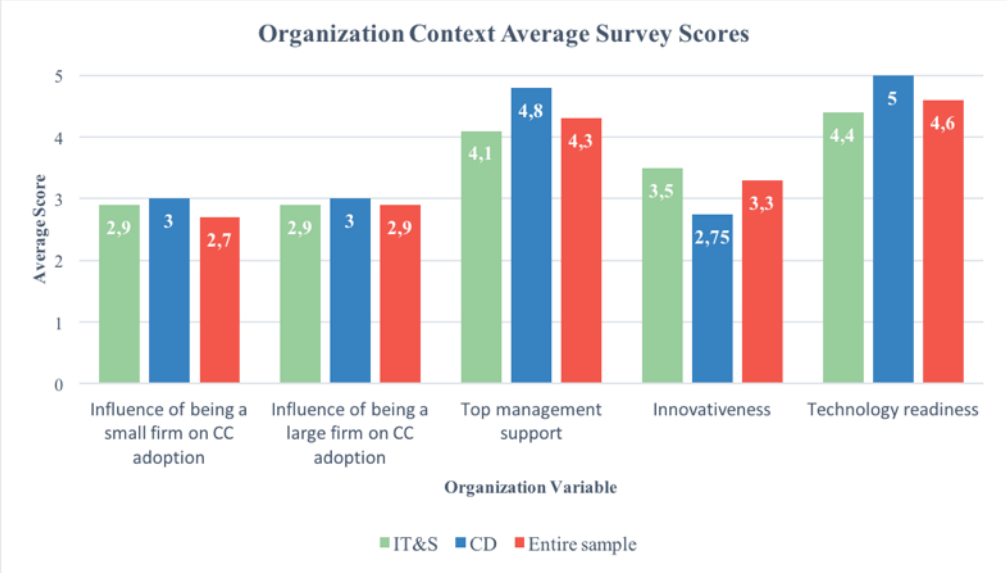

Figure 3: Organization Context Average Survey Scores

4.2.1 Firm Stage, Value Proposition and Technology Infrastructure

This section proposes the relationship between CC adoption with the *firm stage*, the *value proposition*, and the maturity of the *technology infrastructure*. The first finding is the proposed relationship between CC adoption with *firm stage* rather than with *firm size*. Startups are by their nature small in size, which was also evident in the current sample as shown in Table 7. Although the respondents were consent on an increasing usage of CC services as their organization grows, the data suggests that CC adoption among the respondents was not found to rely on the size of the organization. That is, smaller organizations, e.g. ST4 and ST6, were just as likely to be CC adopters as larger sized organizations, e.g. ST8 and ST12. The first argument for this are the low average survey scores of questions 20 and 21, i.e.

2,9 and 2,7 respectively. See the first two variables in Figure 3 for their results. The data shows both reasons for small organizations to adopt CC technologies as for large organizations. The following quotes indicate how larger organizations could be using more CC technologies. It argues that the presence of more people equals the level of CC usage.

(Q1) I believe that the amount of employees does influence CC adoption, because communication challenges will increase as this amount increases. Thus, you will start to search for tools to solve these challenges – ST7 (CD)

(Q2) I believe that both employees and cloud usage increase simultaneously. I think that these two figures are equal to each other, because you will work with more people and thus require more systems. – ST8 (IT&S)

The following quotes indicate how smaller firms could be using more CC technologies. These quotes argue that startups are in general to a large extent agile because of their lack of legacy systems. They are therefore able to leverage high advanced technologies and introduce cloud systems relatively fast and easy within the organization.

(Q3) I believe that novel technologies such as CC are adopted often by young and small firms. This is because they will adopt it easier and they are often more intrinsic motivated in new innovations than older firms. Although larger firms have more money, they tend to be more conservative. This is because they need to justify their decision, which involves multiple layers within the firm. So, there could be more money for more expensive products, but the decision-making is so much slower that you will need that money to be able to pay everyone consistently at the end of the month. ST3 (CD)

(Q4) The advantage of a small firm is that we can introduce new systems very fast. We do not experience challenges because of legacy systems. So, I believe that that is an advantage for us. The disadvantage is that we do not have a dedicated professional team for these kind of activities like a large company. – ST5 (IT&S)

(Q5) I think all startups use cloud infrastructures. I have never met one single startup that has like a physical server somewhere. Not one. For us it is pretty cheap. We just get a service from AWS. I don't need to deal with anything from before, because we have no legacy. – ST9 (IT&S)

Table 7: Firm Size of the Respondents in the Sample

Interval of Employees	< 3	3 – 5	6 – 10	> 50
Frequency	1	6	4	1

The data thus suggests that *size* plays only a minor role in explaining CC adoption. However, the data suggests that the *stage* of a startup could be more useful in explaining their CC adoption behaviors better. This influence was found to be related with the *value proposition* and the *technology infrastructure* The following example from Philips personnel explains the different stages, which is somewhat similar as that described earlier by Kazanjian (1988), of a startup and it continues with an elaboration of the proposed relationships.

Three people from Philips, an R&D Project manager, a Sr. Director of Corporate Venturing, and a Sr. Manager of Engineering and HSDP R&D, argued that startups in the early stage have to decide how to build their business and infrastructure. This means that startups have to decide whether to raise more capital and build an infrastructure, partner with companies who have already built this infrastructure, or search for platform solutions that could serve as outsourced infrastructure. This platform selection is made early in their life cycle where the concerns about which tool to use are relatively low. Once these startups are settled into a platform, they will start to search for ways to scale and will increasingly focus on other strategic objectives, e.g. their customer acquisition process, their value proposition, and revenue generation opportunities, rather than migrating off a platform.

The analysis of the conducted interviews with startups shows that this predicted behavior holds true with a large portion of IT&S startups and to a lesser extent with CD startups. A difference, also noted by an

R&D Project Manager. The data shows that all of the startups invest most of their resources in conception and new product/service development, i.e. their *value proposition* or the core of the venture, and to a lesser extent in supportive functions, e.g. human resources, finance and accounting, or sales and marketing (Laudon & Laudon, 2008). The *value proposition* is a key aspect in one's business model and it defines the value that the firm creates for its stakeholders, i.e. customers and partners (Osterwalder, 2004). This value proposition addresses the product/service mix and indicates the firm's role in its production or service delivery (Morris et al., 2005). Accordingly, depending on one's value proposition concerns and effort weight differently. These startup concerns include for example such as how to bring a certain idea to market (as a product/service), does the idea already exist, which platform to use, and the cost of conducting business. The importance and usage of CC service decisions can thus depend on the type of usage sought and whether it is part of their value proposition or whether it is used to support the firm's operations. The drivers of cloud usage are in the former case more driven with product or service development, whereas in the latter case it is more driven with complying with requirements, regulations or gaining operatonal efficiency. In both cases though, startups are required to adopt new and more CC services as they progress through the *growth stages* and address new issuess.

However, the data suggests that IT&S and CD startups have a different sequence of adopting lower cloud services layers (e.g. IaaS or PaaS) during their *growth stages*. IT&S startups showed to comply with the behaviors suggested by the Philips personnel, i.e. they select an infrastructure early on and most probably scale on it, but CD startups showed their intentions to scale on a CC infrastructure only in later stages. That is, CD startups in their early stages did not want to select a CC infrastructure to scale on (like IT&S startups), but rather wanted to develop and scale their business with a product or service without CC services into their value proposition. In a later stage, they could select a CC platform to integrate this into their value proposition and scale their business similar to IT&S startups. This suggests a potential relationship between the adoption of lower layers of CC and the readiness of the *technology infrastructure* of CD startups. The data also suggests that IT&S startups are more likely to adopt relative early lower service layer CC technologies. The reasoning for this is that IT&S startups are expected to use these lower CC services early to develop their value proposition in contrast to CD startups.

Note that the earlier quotes also showed how different stages can require the adoption of new systems, e.g. Q1 and Q2. Nonetheless, the following quotes provide further evidence for the suggested relationships between CC adoption and a firm's stage (e.g. Q8, Q9, Q10, and Q11), technology infrastructure readiness (Q9, Q10, Q11 and Q12), and the value proposition (Q6, Q7, Q8, Q9, Q10, Q11 and Q12). The quotes supporting these suggested relationships are the following.

(Q6) I think that depending on whether you choose to develop and distribute an application via the Apple app store for example or you'll decide to design a device that can connect with someone's iphone to measure the blood pressure. I think that the questions for those kind of people differ substantially more than how one selects a platform. So the question really is, how does someone want to earn his money? ST1 (IT&S)

(Q7) There are two kind of end users for such platforms. An end user like me and someone who likes to code and write programs for such platforms. However, I am not going to write applications myself as a startup. I do not know how to do it, I do not have the expertise about it, I do not have the time for it, and I do not have the money for it. So, we are definitely not interested in a PaaS, because for us CC is a necessary evil. However, if someone already wrote an application that we can use, then we might download it and use it. So, we use it because we need it or because it is useful. It helps us with our daily work, but it is not our core business. So, we prefer easy to use applications that work. ST3 (CD)

(Q8) Basically, it is the same with every startup. They are all very focused on their product or service and all the aspects around it are secondary. Nonetheless, both finance and sales are important aspects. So it is important that a startup starts selling after a while and does not get stuck in the concept and

development phase. Once the product is developed, aspects such as human resources and manufacturing become increasingly important. This is because you need to hire personnel and you'll need aspects such as contracts, and you'll need to give attention to the requiring manufacturing process if you have a physical product.. – ST4 (IT&S)

(Q9) Our entire time is dedicated to the development of the product. Everything else is required to be be both as efficient and easy as possible so that they require as little as time as possible. Therefore,, we are all assigned with both our own core tasks and sub tasks. CC is for example currently not a core task and so little attention goes into that direction. However, CC can become a primary task when it becomes an integral part of our product in the future. In any case though, we tend to decide the importance of tasks based on our strategic direction. So, how do we see our value proposition grow and which affordable mechanisms do we need and can we use to make this happen? ST5 (CD)

(Q10) Our business model does not exploit CC services currently. We are in the hardware business. I mean, we have not yet worked with software what so ever till now. This will occur perhaps in the future, but it has not happened yet. We have talked about a software component, but we have not yet decided. It is really a matter of added value. We do not see added value in adding it to our business model. However, software based startups will likely include this very early in their business model - ST7 (CD)

(Q11) Everything is done in steps. So, first we are going to develop the hardware. After that, we are going to develop the software to gain access to the monitor via the cloud. So the cloud is planned for later. So, we are not busy with it in our current developments. It is now being developed for in a hospital as a closed system. Focus is very important for a startup, because as a startup you have to bring your product as soon as possible to the market. So you have to make decisions and you only have limited resources. So, CC is a nice to have, but not a must have for our customers. Therefore, at the moment incorporating CC capabilities into our product has a low priority to us. As a startup I want to focus all of my time on a couple of things such as visiting hospitals and on product development. The software therefore needs to work fast and easy. ST10 (CD)

(Q12) Our primair process is in fact the development of the application and that is what we do day and night – ST12 (IT&S)

4.2.2 Innovativeness

In terms of innovativeness, the data shows that only a small set of startups follow the hype of a new technology and like to develop and co-create on novel technologies such as IBM Watson. Most of the startups therefore preferred to reduce uncertainty and adopt technologies that hold a strong customer demand, relative advantage, suficient documentation and guaranteed service continuity. Additional drivers of CC adoption are that it should reinforce the business model, the value proposition, or generate efficiency gains. These were far better reasons for them to adopt CC rather than to show their innovativeness. The following quotes provide evidence where most of the respondents were open to new technologies but were not driven to adoption because of it. However, as Q16 shows, there were also startups present who were driven to adoption for their brand image or for their customers. This was however contingent on the environment context. For example ST8 (Q16) was less restricted in its adoption decisions because it does not work with sensitive data. ST2 (Q14) and ST5 (Q17) however work with sensitive data and they argued that they cannot adopt the latest (IT) technologies so easily because of it. The influence of the environmental context is discussed further in Section 4.3.

(Q13) I think that a certain amount of startups like to create solutions using the latest infrastructures because they believe that they posses a certain application that they can easily develop further on the new infrastructure. In this way, they believe that they can benefit from the hype surrounding this novel system. However, I think that most of the startups reside on the other side and they will say what we have is so novel and innovative that we are actually hurting because of the platform's newness. This newness causes a lot of uncertainty around the platform and so they would rather select a platform that contains enough documentation. ST11 (IT&S)

(Q14) The newness of the technology is not really important to me as long as it adheres to the requirements that we have set. It is not about the technology, it is about the performance. And so, if the old technology works better than the new technology, then we will simply use the old technology. ST2 (IT&S)

(Q15) Being the first does not play a role for me. I do not need to be the first, it is about the end user. However, if the new product is good and adds a lot of value for the company and for the users, than it is important to use it. ST6 (IT&S)

(Q16) I think that we are a quite innovative company and that is also what we want to illuminate to others. We select our CC services based on this aim and we aim to remain open to new technologies. I think that that is the right thing to do for our customers, because we need to know the developments in the market and the available solutions to their problems.However, I do think that once we start to work with sensitive data such as patient data, that we need to change our approach in this regard. ST8 (IT&S)

(Q17) The regulations are very important to us, because we need to cope with a substantial amount of privacy aspects. So, we need to comply with a substantial amount of privacy rules. This makes the usage of CC very challenging because a lot of these companies are located in the United States. And the rules are less strict over there than here in Europe in terms of privacy. So, that makes the adoption challenging. You need to be careful when dealing with patient records so that they are stored in a safe and secure environment. ST5 (CD)

4.2.3 Human Capital and Financial Readiness

The following finding relates to the proposed relationship between CC adoption and organizational readiness, i.e. both technology readiness, and financial readiness. This study found in the data that in general, startups exploit CC services substantially because of its low perceived barriers in terms of cost, time, and complexity. These low barriers were argued to be sought by startups because of their resource constraints, e.g. lack of human capital and financial resources. This lack of resources constrained them in taking advantage of expensive and advanced cloud systems. In addition, it made them prefer the public cloud more than the private cloud. These constraints were found to depend on the technological readiness, i.e. the accessibility of human capital and the readiness of the technology infrastructure (for CD startups), and the accessibility of financial resources. Note however that technology infrastructure was analyzed already and will not be analyzed here again. In terms of human capital, the data shows that lower level CC solutions such as PaaS and IaaS require human capital with specialized technological competence in comparison to SaaS. This requirement was found to be stronger for the actual usage of the service rather than for understanding the service (on a high level). For example, Q21 shows that the founder understands the IaaS services but is not capable of operating it. SaaS services were found to be easier to use and understand, and so they required less specialized human resources (which is also why every startup was using them). The following quotes provides proof for this suggested relationship. Q18 and Q19 show that it is important for startups to have access to people with technical know-how. Q19 further shows that is not always evident that startup founders possess technical skills nor is it always easy for startups and founders to have access to (software) developers (like large companies). Q20 shows that the lack of specialized human resources in-house can direct a startup or the founders to access human resources outside the company. The sample provides an example of both. ST11 for example outsourced its product development and its IT maintenance because of their lack of specialized human resources for these operations (see Q21) whereas ST12 is an example with available in-house human resources. ST12 had around 21 developers who develop and comprehend all of their CC systems. The data shows that all of the IT&S startups were exploiting lower level service layers and had access to these specialized human resources. In contrast, CD startups were found to access mostly the top service layer and had no ongoing relationship with lower level CC developers, e.g. Q7 and Q9, except for ST5 (CD startup). ST5 argued that although they are able to write and deploy applications on a PaaS, they currently do not intend to do this because it does not fit well with their competencies. As such, the high

usage of lower level CC service layers by startups who have access to specialized human resources in IT and the high usage of high level CC services of all startups suggests that startups with access to these specialized resources are more likely to exploit lower layers of CC than organizations who do not have access to these resources. The following quotes provide evidence for the suggested relationship.

(Q18) CC services are actually easy to use. We use a couple of them. And they are on average very simple to use. You do need to be competent with IT however, but it is in general very easy to adopt a cloud service. ST1 (IT&S)

(Q19) We were lucky that we had technical knowledge inhouse. We originially worked in the telecom industry. So we know how it works and we know how to work with a server etcetera. However, if you lack these skills and you know that you require technology, then you will require such a cloud platform. And that is why I always say that the people with the good ideas on the business side need technical support to get their ideas further developed. I had this idea for a startup for a long time, but I'm not a techie. I was lucky that an old co-worker liked the idea and wanted to build the startup together. However, if you do not know such a person and you do not know any software developers, because they are dificult to find, then.. That is where things get tough, because you need a technical person who can predict whether you are developing the right solution for the current use case. So that is very important. ST4 (IT&S)

(Q20) I think that technical startups do not face challenges in using CC. This is because you would expect that an IT startup would have substantial knowledge inhouse to understand technical aspects and is able to bring things further. Things can become quite challenging if you are in for example a more service oriented sector such as a physiotherapist and you start a company that is not technical and you want to do something technical. In that case, you might require to hire an external company to develop it for you, which will cost you defintely something. So, having the technical knowledge inhouse is quite important. ST5 (CD)

(Q21) What we did was simple. We searched for a great IT company who could develop, maintain and host the application. ST11 (IT&S)

(Q22) Most of the CC services are well documented, for example AWS has documentation which is very technical for engineers but they also have very simple explanations of what EC2 is and what S3 is, what Dynamo DB is. And very similar to say what is a non-relational database, what is different between dynamo db and redhat, and how they work. At least for myself as a decision maker, I can make sense of it. I can google a bit, read a bit and tell them okay guys I found this, does this make sense to you? Okay. Then we just make a decision to go further or not. ST9

Another related finding is the potential relationship between the adoption of CC services and access to financial resources. For example, startups indicated that they have to be selective in their service usage because of limited money unlike large companies who have access to large funds. In fact, all of the respondents argued the importance of using affordable services because of their financial constraints. Because of this constraint, startups highlighed their strong preferrence of services with low startup costs and the possibility to increase usage (and thus cost) over time (as the business grows). The following quotes show how the financial resources constrained or stimulated the adoption of certain CC services and how their adoption decisions are influenced by this aspect.

(Q23) Platforms like Salesforce or the infrastructure of Amazon are interesting technologies for startups like us. We have also examined such solutions in the past. However, these solutions require financial resources that depending on the stage of your startup allows you to be able to pay for it or not. So, although these platform services are interesting, they are to a small extent interesting for a startup. This is because their services are too expensive. There are for example a lot of services of Salesforce that we simply replicate and solve in Excel. ST1 (IT&S)

(Q24) The cost of using services is very important to us as startups because we do not have a lot of money and money is scarce. That is why for example Salesforce is doing really bad with startups. Startups cannot pay for Salesforce. Salesforce is maybe great for big companies like Philips.However, we use AWS since day one and we've never paid an invoice to AWS for three years. So it is still free for us. ST9 (IT&S)

(Q25) The cost of using Google Apps is fine and it is scalable. So, you pay per user, which fits our need. This is because you want to keep your expenses as low as possible as a startup. This is why you try to do everything as cheap as possible. ST10 (IT&S)

(Q26) We only use CC services that are not expensive, so we do not use services that cost hundreds of euros per month. For example, we do not use Salesforce, because we do not have the money for expensive CC solutions. I understand that large companies use it, but we do not have the required money to use it. ST11

4.2.4 Prior Technology Experience

Furthermore, the interviews with the startups show that in the early stages, CC adoption can be influenced by the earlier technology experience of the founders and the startup. Accordingly, experience was found to facilitate the founders' ability to appreciate and value CC technologies, but also to process and assimilate its content better. Just as the three Philips personnel argued, startups in their early stage have a high willingness to start and lack essential resources such as time and money. Therefore, startups want to leverage platforms that they trust and find easy to use. The following quotes show how the technology experience of the respondents influence their CC adoption.

(Q27) The design of our software depended also on our experience. Our software architect who designed it in this way already had a substantial amount of experience in these kinds of environments. And that is why we chose to do it like this. ST1 (IT&S)

(Q28) I think that I was always intrinsically interested in online solutions and I was always playing with online solutions. I have always found it interesting to see what occurs online and what people build. I am now truly happy since I have been able to turn my hobby into my work. ST8 (IT&S)

(Q29) I do not think that we used an entire selection process for our systems. The selection of our systems was mainly based on what we know and what we do. Our CTO for example received his PhD in Industrial Design and he uses the same systems now as he did during his study. ST10 (IT&S)

(Q30) I can imagine that if you have experience negative situations with CC that you are nervous about using it. However, we have never had negative experience with CC and so we intend to keep on using it. ST11 (IT&S)

(Q31) A part of our decisions was based on experience and our willingness to start. In other words, we have a startup with quite a large amount of skillful technical people. So we came together to talk and think about what we wanted to achieve on a technical level and we decided pretty fast. ST12

4.2.5 Top Management Support

Finally, the top management, who are often the founders within startups, were found to influence the CC adoption decisions. Exceptions to this support requirement were also present though. These exceptions were found to apply mostly for decisions that do not influence the business model, the business operations, nor cost money, e.g. selection of a mail client or an operating system of a laptop. In contrast, decisions that do influence these aspects were often found to require top management support. The following quotes provide evidence for this suggested relationship.

(Q32) We decide which systems is used by our employees. In small organizations, especially if you look at one to ten employees, the founder is simply the boss. It could be that the decision is delegated to someone else, but the system is definitely not selected if the boss does not want it. ST3 (CD)

(Q33) We make our decisions with our developer. So we have a weekly meeting and then we evaluate the progress. This evaluation could show that we need to switch systems if things are not going well. ST4 (IT&S)

(Q34) Yes, our employees require permission before they are allowed to use other systems. ST6 (IT&S)

(Q35) The decisions here sometimes require top management support and sometimes they do not. We discuss everything before we decide though. For example, we allowed people to select their own computer, but we told them that we only support Windows. In contrast, the email address was decided from the top and so everybody was required to choose Google. However they were free to choose their own preferred mail client. So we try to enable everyone to work together and have access to the same document. So, I would not be very happy if someone would want to work with an entire different office package. ST5 (CD)

(Q36) There have been cases where the developers use systems that they want because they have a license for it on their computer. However, I am in general the person who decides which systems we will use. Especially if such a system costs money. We are still a small company, so things are very simple. We will go into the direction that I want. However, this will likely change as we grow. In general though, I want to select systems that I understand. However, if the developers need to use systems that I do not understand then they have to explain it to me. The adoption decision will then be made by me or my father. ST10 (CD)

This section has thus far analyzed the organization context of health tech startups. The following section analyzes the environment context.

4.3 Environment Context

This section analyzes the collected data to identify the external organizational influences on the CC adoption behaviors of health tech startups in the sample. This analysis found a relationship between CC adoption and trading partner support (both for customers and technology suppliers) (P13a; P13b), supplier characteristics (trustworthiness and reputation (P15a), trust in the competence and openness of the supplier (P15b; P15c) producer activities (new), support (efforts)(P13b), and install base (new)), regulatory support (P17), market scope (P18), informal networks (new), and penetration pricing strategy (new). In contrast, there was support was found for the proposed relationships between CC adoption and industry (P16) and competitive pressure (P17). Table 8 provides an overview of these findings. Figure 4 and Figure 5 illustrate the average results of the surveys. These results give a first indication of the environment influences on the CC adoption behavior of the respondents. The survey results suggest that regulatory support, the support services and the IP regulations of the supplier, the size of the install base, and the price influences adoption behavior of both startup groups equally. In contrast, a developer's community and the ability to leverage innovation are suggested to be more important for IT&S startups than for CD startups whereas the size of the install base seems to play a more important for CD startups than for IT&S startups. In addition, pressure from trading partners and competitive pressure are suggested not to play an essential role on the adoption behavior of both startups. Note that the qualitative data shows that support from trade partners for CC technologies does play a role. The following elaborates further on the findings.

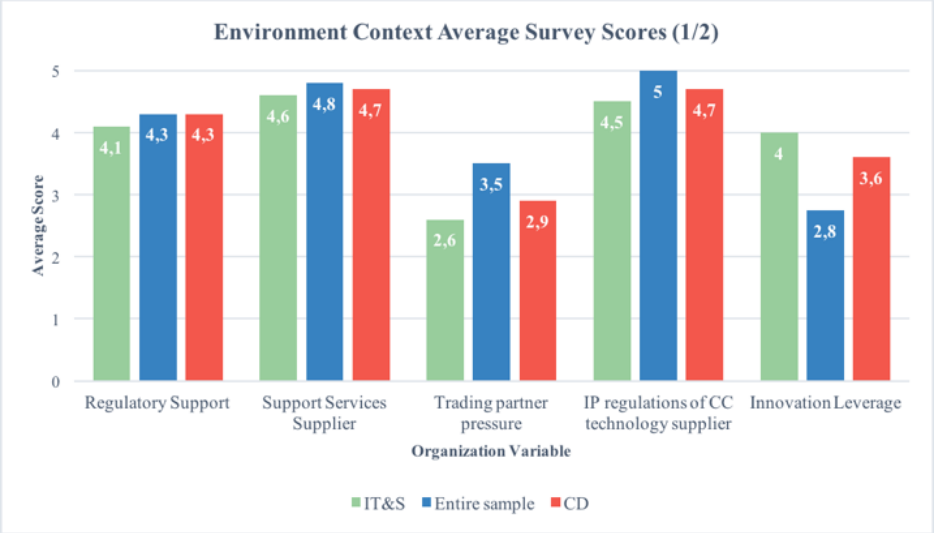

Figure 4: Environment Context Average Survey Scores (1/2)

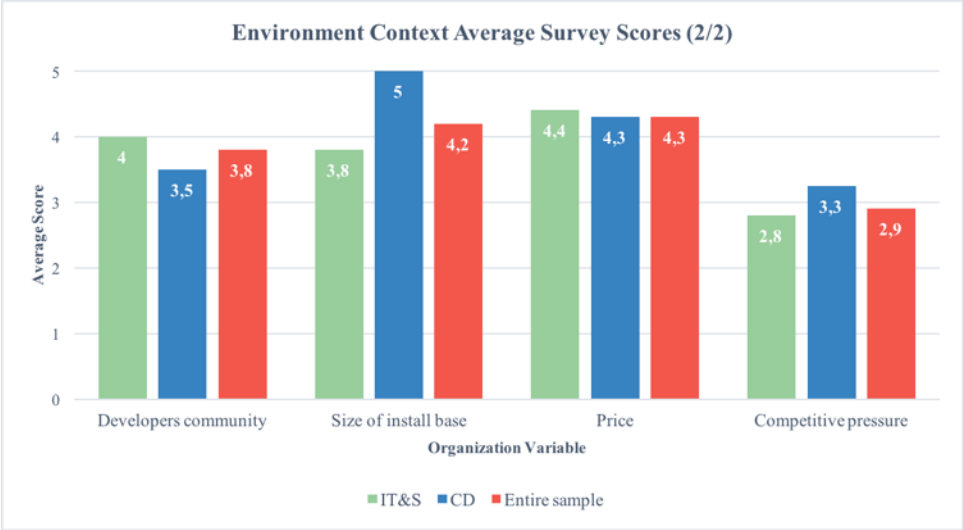

Figure 5: Environment Context Average Survey Scores (2/2)

Table 8: Overview of the Environmental Influences on Cloud Computing adoption Behavior of Startups

Variable (analyzed in section)	**Finding**
No support found Industry Competitive pressure	-
Support Found Trading partner (Customers) and Regulations (4.3.1)	• Startups leveraging the cloud and targeting HCOs or processing sensitive data face higher degree of technical and regulatory challenges than startups who do not exhibit these characteristics • Target group influences CC decisions but safety and privacy measures taken by health tech startups are mostly driven by law • The changing regulations about CC technologies could influence CD startups negatively that they delay the inclusion of CC technologies into their business model • IT&S startups working with sensitive data and targeting business customers often require certifications to ensure confidence into their services and reduce adoption resistance while IT&S startups working with sensitive data and targeting consumers expect less adoption resistance by complying with regulations • IT&S startups who did not work with sensitive data were influenced by their customer demands and only to a small extent influenced by regulations.

Market scope (4.3.2)	• The degree of regulatory differences between countries are expected to influence the decision of entering a country where larger differences affect this decision negatively. • IT&S startups aiming to increase the size of their target market rapidly will adopt CC earlier than CD startups who do not necessary intend to scale their software business as their hardware business
Trading partner (Supplier) (4.3.3) Characteristics Trustworthiness and reputation, Producer activities **(new)**, Support (efforts), and Install base **(new)**	• A technology supplier with a strong and positive reputation promotes CC adoption by ensuring trust in the competence and willingness of the supplier to ensure a safe and secure environment. This trust level was found to be influenced by brand familiarity, size of the supplier and the level of trust in the openness of the supplier. • The producing activities of the technology supplier benefit the overall impression of the CC platform to startups. However, these producing activities create tensions when the product portfolio of the user and the supplier overlap. • The install base of a supplier can influence the CC adoption behavior in the following ways. A large install base of *relevant* end users was found to influence both startup groups positive. In contrast, a large install base of developers was found to only influence IT&S startups positively, while CD startups were more interested in the amount of available solutions on the CC platform. Accordingly, IT&S startups were found to be more interested in a developer's community that provides them with opportunities to contribute, develop or exchange content, or improve developed solutions.
Informal networks **(new)** (4.3.4)	• Health tech startups were found to be interested in and actively attempting to gain access to potentially valuable online and offline informal networks (e.g. accelerators or incubators) that subsequently influenced their CC adoption behavior. • Although both online and offline networks influence health tech startups to a certain degree, the influence of offline communities were more noticeable • IT&S startups were found to imitate the software portfolio of other IT&S startups more often than CD startups
Penetration pricing strategy **(new)** (4.3.5)	• CC technology suppliers who price their services competitively are expected to benefit from higher adoption rates than those who use other pricing schemes, e.g. skimming pricing.

4.3.1 Trading Partner Support (Customers) and Regulations

The data suggests that startup's cloud adoption behavior are influenced by their trading partners such as their customers, i.e. the target audience to whom the firm sells and makes profits from. These customers can be for example consumers, businesses or both. Startups targeting consumers noted that they encounter adoption barriers from their users as the result of excessive choice, lack of standards to enable interoperability, and ambiguous information about security, privacy, liability policies and procedures. Startups targeting businesses noted that they encountered adoption barriers from their users as the result of lack of cloud knowledge or awareness, the lack of compatible systems and lack of clear regulations within the markets. This latter group faced additional adoption challenges when they leveraged the cloud and targeted for example HCOs or dealt with sensitive information, e.g. accessing, storing, processing, and transferring patient data. These startups were required to comply with higher degree of technical and regulatory requirements than startups who did not work with HCOs nor with sensitive data. For example, in some cases, startups were inhibited to transfer data or store data outside the HCO's venue. In cases, though, where cloud was allowed, startups were required to certify their systems with the NEN 7510. This certification is about information security in care. Moreover, in cases where the application will be used as a medical tool, e.g. for diagnostic or therapeutic purposes, startups need to be certified to comply with regulations and assure their customers.

In general, certifying one's processes requires valuable time and resources to setup, but these mechanisms do generate the much-needed trust in cloud systems from important customers. These regulations and type of customers however were found to influence the startups differently. First, all of the CD startups targeted HCO's and were required to medically grade their applications except for ST3. Two out of the remaining three CD startups (ST5 and ST10) were evaluating the possibility of incorporating CC services into their value proposition while one had not yet evaluated this possibility

because of their current stage (ST7). Both of these startups indicated the positive direction of regulations and HCO's and the positive effect it has on them. However, ST5 indicated the negative influence of the changing regulations on its CC adoption decisions (see Q17 and Q37). This suggests that the changing regulations and the demands of business customers can positively influence the CC adoption behaviors of CD startups if they are supportive and stable. The following quote shows an example of the influence of an instable regulatory policy on CD startups.

(Q37) *It would be great if we could use CC services for certain operations. However, we looked at these services in 2011/2012 when we had to think about it. Our conclusion back then was that it is a moving target, because the regulations were changing so much. ST5 (CD)*

Second, the data shows that IT&S startups targeting businesses and working with sensitive information (ST1, ST6, ST11, and ST12) were influenced by regulations and to a certain extent by their customers' demands. Some of them were found to be concerned with complying with the NEN 7510 norm to convince the adopting unit of their secure environments, e.g. ST6 and ST12. The data shows that especially business customers with sensitive data can be very hesitant about sharing their data via the cloud, which reduces the amount of CC service usage by startups. However, these challenges were not found among startups working with sensitive information in the consumer domain. For example, Q41 shows that ST2, does not experience serious adoption concerns nor does this startup seem concerned about the regulations. This suggests that startups working with sensitive information and target business customers are mainly influenced by regulations and customer demands. The following quotes provides examples of these relationships.

(Q38) What influences us are the demands of the customer and the regulations. Customers are quite sensitive depending on the sensitivity of the data. These organizations are very conservative when it comes to the cloud. Those operations that we conduct is already a big step for the majority of our users. There are still users though who want a service contract where we have to visit them once or twice per year to update the systems since they do not want to allow any external access. ST1 (IT&S)

(Q39) Regulations are very important. There are for example grants for cloud solutions in the telecare and image guided care that advances the development of cloud solutions. However, these developments often fail in the market as they do not get adopted or used. ST6 (IT&S)

(Q40) We are affected to a large extent by regulations and our customers. For example, our customers demand the 7510 certification to ensure them about our compliance with safety standards. Furthermore, our business can close when for example a new law states that online treatments are not allowed. Or imagine when the insurance companies stop funding our projects via our customers. That will really be the end of our operations. ST12 (IT&S)

(Q41) I do not see so many challenges. You just need to comply with the regulations. For example, you need to make sure that you store medical data in the Netherlands, which is something that is not so difficult. ST2 (IT&S)

Finally, IT&S startups targeting businesses or consumers who were not working with sensitive information (e.g. ST4, ST8 and ST9) were more influenced by their customer demands and only to a small extent by regulations. These startups showed to be less influenced by regulations because they were not working with sensitive data or in areas where strong regulations apply (e.g. ST9). In contrast, the interest and demands of their users in CC services influenced their exploitation of CC services. In most cases, though, this interaction was more a technology push than a market pull. This means that the startups in question were engaging the market with their solutions rather than reacting on certain demands from the market (Peters et al., 2012)

4.3.2 Market Scope

In terms of market scope, the data shows that, especially, IT&S startups believe that serving a large audience requires the use of cloud services, as Q42 shows. The market scope was however found to be influenced by the regulations of other countries. For example, according to the Dutch and German law sensitive patient data cannot be stored outside the country, which means that the data center containing the data needs be located in the country of operation. This aspect seemed to be more important among startups dealing with sensitive information because they need to comply with the laws of the country in which they operate. As such, the data shows that variety of the regulations influences the market scope of startups by favoring countries who require less operational changes than others. The following quote shows an example of this concern and how one could be influenced to change its scope because of it.

(Q42) We have now received a European grant to launch the service in 5 European countries. An important aspect of this launch is the jurisdiction. We have for example the CE certification, which is a label from the European community. So, we are classified as a medical device and we can go to France, Germany and Spain. Although I am not that concerned about Spain, I am more concerned about Germany because of their rules in terms of privacy about medical affairs that can sometimes overrule European regulations. The advantage of the cloud is that the data is easy transferrable, but I want to highlight how Germany can argue that the data needs to be in Germany while the rest of Europe argues that it does not care. So, you need to select a German server when Germany is viewed as an important country where you want to do business. ST11 (IT&S)

(Q43) I cannot imagine a startup who wants to grow and operate worldwide to not use cloud services. You really need the scalability benefits of the cloud. ST2 (IT&S)

4.3.3 Trading Partner (Technology Suppliers)

The data shows that there is a potential relationship between the characteristics of a trading partner such as a technology supplier and the CC adoption of health tech startups. These characteristics were found to be their reputation, trustworthiness, their producer activities on the platform (new), and the support efforts (new), and install base (new). The following quotes show how the reputation and trustworthiness of the technology suppliers can influence the CC adoption behavior of health tech startups. The data suggests in terms of trustworthiness that suppliers are selected if they trust their competence and willingness to ensure a safe and secure environment. These trust levels were found to be influenced by brand familiarity, size of the supplier and the trust in the openness of the supplier. Although trust was sometimes facilitated by proxies such as the size of the install base (to reduce search costs), data suggests that openness plays a key role in building trust. Openness is further elaborated in Section 4.5. Furthermore, the data suggests that the reputation of a supplier can also influence the decision of health tech startups to adopt CC services. This reputation was found to be based on one's products and services in a market, on one's capabilities in solving problems, on one's history of stability in strategy and services and the extent of one's engagements with startups and innovation. The following quotes provide support for the suggested relationships.

(Q44) Trusting our partners is very important to us. I think we can take Google as an example if we look at the trustworthiness of partners. We selected for Example Google because I trust them. So I trust in their capabilities to provide me a safe environment to store my documents and exchange emails with others. Of course, you will hear sometimes about data breaches, but I am confident in Google's efforts in trying to prevent such events from happening. ST10 (CD)

(Q45) Storing data on the cloud can mean that you can lose your data. However, I am not afraid to lose my data when I store it on Amazon or to ever go offline. That is also why we joined Amazon. They have a reputation of never going offline, but a new player such as Philips still needs to prove its capabilities in this area. ST11 (IT&S)

(Q46) I believe that Philips can be more successful as a cloud provider if they can ensure trust about their partners in the value chain. For example, I do not think that they stand a chance if they collaborate with Google and that they are unsure about what happens to your data. Trust is key in such systems. So I would rather work with Philips than with Google, because I live in the Netherlands, I know Philips, it is their brand experience. ST4 (IT&S)

(Q47) Making services level agreements is important to ensure that the service stays available for a certain amount of time and that the cost stays the same. It cannot be that the prices increase once you become a customer there. Or imagine that Philips goes bankrupt or someone else takes over and changes their strategic focus every four years. This can mean that even though everything seems great now, everything can change in four years. And that is fine for Philips businesses, but this is very concerning for organizations who are very dependent on their services. ST5 (CD)

(Q48) Well we were first customers of ABN Amro, but then we switched to the Knap Bank. The reason for this was that Knap was engaging a lot with entrepreneurs and innovations. That was a good reason for me to switch from banks. ST8

(Q49) I think that companies like Amazon and Philips can leverage their brand image, because they are very respected players in their fields. However, it is very important for such large companies to be startup friendly. I think that companies who can become more startup friendly can attract much more startups than those who do not. ST9 (IT&S)

(Q50) We could benefit from working with Philips by gaining popularity by association. That is something where Philips could play a role in. I think that everyone in the world knows Philips as a reliable and trustworthy supplier of healthcare related products. So the associations with Philips products are positive and not from the United States, so we know what to expect. However, suppliers who started in the cloud such as Google, Microsoft rise immediately privacy and regulatory concerns. I think that a managing director who has been the managing the ICT for 30 years of a HCO organization would get worried if I would tell him that we work with Microsoft Azure. However, these concerns would be less if I tell him that we work with Philips. So these kind of things do really influence our decision-making. ST12

Furthermore, a technology supplier can act both as a producer and a consumer on its own platform, e.g. Amazon provides IaaS services via Amazon Web Services to external parties but it also exploits the same services to serve as the foundation that powers its web-based retail store Amazon.com. As such, the data shows that most of the health tech startups favor these operations as long as the technology supplier remains open about its (future) operations. Three startups were found to be neutral and a large portion of the sample welcomed the producing activities since it can show the multiple income streams of the supplier making it less dependent on either one streams. Additionally, it can show the performance and capabilities of a technology via use cases, its commitment and its trust in the technology by using it as the foundation for its products, which strengthens the belief in the continuity of the technology. Also, these activities can draw attention from customers, which then can generate a demand that startups can address. The startups who were less in favor, e.g. ST2 and ST11, argued that the overlap in product portfolio influenced their decision negatively by creating tensions.

(Q51) I do not really care whether Philips develops products on HSDP. I am neutral on this matter, but they should remain open and transparent to keep tensions low. ST10

(Q52) I would not join the platform of Philips because they are active in the same market as us. ST2

In contrast,

Furthermore, the following was found in terms of the install base. The install base here can refer to the amount of end users, i.e. the users consuming the available services (such as the people downloading application from the Apple App store), developers who enrich the ecosystem with new complements (such as the app developers on the Apple App Store), or both. The data suggests that both startup groups

prefer services that are used by a lot of end users. This effect seemed to be stronger when the end users were related to their own market so that they could also target them as noted by ST11 (Q56). In terms of a developer's community, the data shows that CD startups are more interested in the amount of available solutions on the platform than the size of the community, e.g. Q7. In addition, IT&S startups were found to be more interested in a developer's community that provides them with opportunities to contribute, develop or exchange content, or improve developed solutions. The following quotes give examples of the findings presented above.

(Q53) The install base of Philips is quite large and interesting, but not for us. This is because they are not active in the same market as us and so the advantage of their install base of Philips for us is less. ST1

(Q54) I think that Philips can benefit from their install base in general. However, in our case, I do not see how that would benefit us directly. For other digital health startups, it could be attractive, but not for us. ST9 (IT&S)

(Q55) I prefer openness in the sense that there is a forum where implementation issues are discussed for example. So the entire communication around the innovation of a platform, whether that is being discussed or not. For example, the templates which are built for Wordpress by developers contain a lot of bugs. We as developers are therefore required to see how we can fix these issues as soon as possible. That is why it is important to have a good functioning developer's community. ST8 (IT&S).

(Q56) An incentive to use the platform could be that Philips has superior hardware, which is used substantially by medical institutions. However, it would be even better if patients were using this hardware because we operate mainly on the patient side. Anyways, it would be great if it would be relatively easy to connect their software with their hardware. ST11 (IT&S)

Furthermore, a CC supplier can choose to offer support services to support a startup in using or adopting a certain technology. This offering can also be offered by others, e.g. via a developer's community where users can help each other. Startups were found to favor these support services as these could help them to make sense of the technology and reduce barriers by easing the adoption process and saving time. The data suggests that startups care about support in the following four categories. First is the technical aspect of the service, e.g. configuration of the services and solving technical issues such as ensuring interoperability between systems, second is the relational aspects of being a user, e.g. the type of relationship that exists between the startup and the supplier, the transparency of the platform and the notification practices in case of future changes, third is the regulatory aspect, e.g. solutions or support measures to obtain regulation compliance, and fourth is the financial aspect, e.g. opportunities to funding and the cost of adoption and usage.

4.3.4 The Influence of Informal Networks

A new finding was the influence of online and offline informal networks on CC adoption behavior of health tech startups. These networks were found to act as influencers as they allow a group of people with similar interests to interact and innovate while being linked together, e.g. via startup programs, communities, or digitally via alternative tools and platforms (examples include Skype or Facebook). Examples from the data show that startups participate in programs such as accelerators, incubators, challenges, hackathons or join co-location facilities (Cohen & Hochberg, 2014). An accelerator is here defined as a program with a fixed time frame that includes mentorship and educational components and ends in general in a public pith event or demo-day. An incubator is similar to an accelerator but this program attempts to support a startup by offering it a more continuous environment to build a successful venture. A challenge is similar to an accelerator, but its timespan is generally shorter and there are money prizes to win at the end. A hackathon is defined as an intense multiday event devoted to rapid prototype building to develop an application that meets the challenge posed by the organizers and sponsors (Almirall et al., 2014). A co-location facility is an environment where startups can rent spaces that offer

benefits such as working in a community based environment, e.g. Wonderlab (2016) or the High Tech Campus (2017). In terms of offline networks, the data shows that within the sample, two startups work in a standalone office, whereas the rest of the startups were part of an accelerator (four startups) or were working in a co-location space (six startups). In addition, one startup, e.g. ST11, had participated in multiple challenges and one startup, e.g. ST9, had participated in a hackathon. This distribution suggests the idea that health tech startups are interested in and actively attempt to gain access to these potentially valuable networks.

A further analysis of the interviews shows that startups want to join such startup programs or communities e.g. developer communities, accelerators, or incubators, for a variety of reasons including to learn, to build, to exchange, and to save or earn money. The way that startups save money by participating such programs is that certain technology suppliers provide large amounts of discounts to startups in selected programs. These discounts differ and include in accelerators such as Rockstart discounts up to a value of € 564,000, ranging from AWS with a value of € 95,000,-, Microsoft Bizspark with a value of € 56.000,-, to IBM with a value of € 108.000,- (Rockstart, 2016). Technology suppliers thus use these startup programs as a mechanism to filter startups, which reduces their search costs for valuable users, i.e. startups can become valuable users once they scale substantially on one's platform as argued by the Sr. Director of Philips Design and ST9 (who participates in an accelerator program at Rockstart). In contrast, online networks were also suggested to facilitate trialing of a (new) technology, e.g. search engine results, buzz from technology websites, blogs, user reviews, social networks, and recommendations from friends and relatives. Although both environments indicated a certain degree of influence on startups, the influence of offline communities was more noticeable from the data.

During startup programs, e.g. accelerators, startups get influenced in different ways such as by rules of participation (where usage of certain technologies can be required), by (other) experienced members or through educational or mentorship organized by the host of the program. Furthermore, these environments allow startups to share and learn from each other, which usually results in startups leveraging each other's processes, applications, procedures, tricks, and hacks. Although the data indicates that CD startups imitate other's software also frequently, it is assumed that this occurs less frequent than with IT&S startups since they are more into hardware development, which is more challenging to imitate. The following quotes illustrate the evidence for the suggested influences.
(Q57) We first searched for locations to work and we also evaluated incubators. Finally, we chose for the accelerator on the High Tech Campus contained more relevant companies for us. ST10 (CD)

(Q58) I would definitely talk to people who use certain services to hear their experiences. So, my personal and private connections are in that sense very important for me to help me create an image about the quality of a service. ST10 (CD)

(Q59) I often trial services when someone I know tells me that I should trial a certain service. I will then simply trial the service and decide for myself at the end whether I want to use it or not. ST3 (CD)

(Q60) We use what we find actually. There is a startup in our accelerator who is developing a finance and accounting service, so we are using that. In addition, we also simply google when we need a tool like for communication. This leads often to lists with tools. Then you will see for example that Slack is very useful and you then will try out one or two. ST7 (CD)

(Q61) Entrepreneurs discuss a lot with each other about the tools they use. So, we ask each other do you know any useful tool for this issue? So we tend to exchange a lot of tools with each other. ST8 (IT&S)

(Q62) Yeah well, this (Rockstart) has the smallest group I have ever worked at. Before, I worked in one accelerator in Chili and there was like every single day like close to a hundred people there and so you would get massive word of mouth about other tools. That is when we started using Streak, that is when we started using Slack, Trello, all these things. I mean it is not like there is one path for me, I have founder friends from all over the world, and I'm like hey guys who is using something for invoicing, and someone says I'm using honeybird, so I'm like okay. You google it and then you start using it. ST9 (IT&S)

(Q63) I'm sitting here with a set of other startups, so it is always filled with startups. And when we lunch together, I say hey I need a CRM tool, and the guys from another startup says for example we are using Streak and then you go on Streak to check the tool out. We startups copy a lot of things that our next door neighbor is doing. And what happens hopefully in co-working spaces is that you get to overhear things or you even see the screen. So, you are walking past someone and then you see someone is in Trello and perhaps that guy is really good and is making 20.000 dollars per month in revenue, you then could say to yourself perhaps I should try that too. There is a lot of that going on in the world of startups, so there is a lot of copying going on in the startup world. Copycatting each other's processes, applications, operations, procedures, tricks, hacks. ST9 (IT&S)

(Q64) We are participants of a European grant program. This program allows them to enforce rules stating which tools are allowed for development to achieve your deliverables. This provides them of course the opportunity to create best practices and these best practices can subsequently be used for marketing purposes. However, a startup benefits also from such activities because you will receive a lot of stimulation to work towards a solution. This solution will definitely be obtained because of the financing and the technical guidance from experts. Such events are great because they assign you with a mentor who knows a lot about ICT. These mentors are of great help and enable you to continue your project even after such an event. ST11 (IT&S)

4.3.5 Penetration Pricing

Finally, the data suggests that the pricing strategy of CC services influences the CC behavior of health tech startups. The pricing strategy can be for example skimming, e.g. setting the price high to "skim" profits from less price-sensitive innovators and early adopters and then decreasing prices gradually to reach broader markets, or penetration pricing, e.g. setting the price low to "penetrate" the market and obtain a large market share within a short time (Lee & O'Connor, 2003). The limited financial resources direct startups to affordable services, e.g. Q23, Q24, Q25 and Q26. As such, the adoption of CC adoption is suggested to be positively influenced by penetration pricing strategies rather than skimming pricing strategies.

This section has thus far analyzed the organization context of health tech startups. The following section analyzes the environment context.

4.4 Technology Context

This section analyzes the collected data to identify the technology influences on the CC adoption behaviors of health tech startups in the sample. This analysis suggests a relationship between CC adoption and relative advantage (P1), complexity (P2), compatibility (P3), trialability (P4), and observability (P5). Table 9 lists an overview of these findings with a short description. Figure 6 provides an initial indication of their importance as it provides an overview of the average survey scores for each startup group and for the entire sample. This figure shows that for the entire sample the average score for each technology variable is at least a 4 thereby indicating a strong preference for their presence. It also shows for the entire sample in terms of average scores that relative advantage is viewed as the most important aspect with observability as second, complexity and trialability as third, and compatibility as last. The following provides an elaboration on these findings and the potential differences between groups.

Table 9: Overview of the Technology Context Influences on Cloud Computing Adoption Behavior of Startups

Variable (analyzed in section)	Finding
Relative advantage (4.4.1)	• The adoption CC technologies by health tech startups can be positively influenced by the relative advantage(s) of CC. These advantages include: cost structure, trust, security, scalability, short time-to-market, integrated solutions, loss of IT governance and IT maintenance, community presence, co-creation opportunities, and operational efficiency
Complexity (4.4.2)	• Complexity is perceived as a cost driver and is ideally avoided. However, complexity to a certain degree be tolerated in the presence of a justifiable relative advantage
Compatibility (4.4.3)	• Compatibility becomes increasingly important as a startup passes through the growth stages • Compatibility is viewed as a subset of complexity where incompatible systems make adoption (more) complex
Trialability (4.4.4)	• Trialability is often a prerequisite for adoption. However, trialability alone is not enough for advanced or expensive systems, because trialing of such systems is equivalent to adopting and introducing the system into the organization. • Advanced or expensive systems could benefit from offering their services in separate components that allows users to increase their usage in accordance with their needs and usage.
Observability (4.4.5)	• Observability was found to be an important mechanism to signal the relative advantage of services. Efforts to increase the observability of CC services should include addressing benefits for a range of departments, e.g. sales and marketing, within an organization and not only for the technical department.

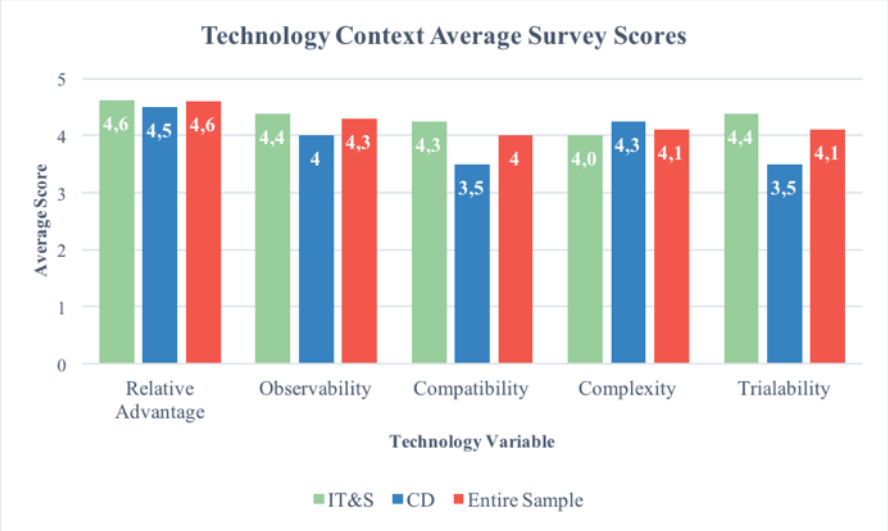

Figure 6: Technology Context Average Survey Scores

4.4.1 Relative Advantage

The data suggests that relative advantage can be an essential aspect influencing CC adoption. The data shows that health tech startups will not adopt a technology if it cannot not provide a benefit over another or current used solution. As such, the respondents indicated that they first want to comprehend the benefit of a solution before they introduce a system into their organization. This benefit was then weighted against the cost of adoption in terms of money and effort. The following quote provides an example of the suggested importance of relative advantage.

(Q65) What I would like to know is the benefit which I am gaining if I would introduce this technology in to my organization. What can I do now that I could not do previously? And I also want to know the cost of this benefit both in monthly billings and in terms of required effort. So we conduct a cost-benefit analysis and these have to be in proportion of each other. ST5

The data illustrates a set of benefits of CC that facilitate adoption. The entire set of reasons with their frequency counts sorted from highest counts to lowest count are shown in Table 10. The reasons that were mentioned at least four times were found to be: cost structure, trust, security, scalability, short time-to-market, integrated solutions, loss of IT governance and IT maintenance, community presence,

co-creation opportunities, and cost efficiency. The following elaborates more on these variables, because based on the frequency count and data analysis, it is expected that they are more important than the other variables.

The first variable, cost structure was as expected found to be very important and mentioned frequently during the interviews. Because this variable has been mentioned multiple times earlier, this variable will not be elaborated further here. A closely related facilitator of CC is the fifth variable scalability, which was mentioned seven times and mainly by IT&S startups, e.g. Q25. Scalability was defined earlier, it offers the advantage of scaling resources down, to reduce cost, and to scale up resources, to keep up with the high demand. Because of the inconsistent growth of IT&S startups in their CC usage, this aspect was found to be more relevant for this group than for CD startups. In addition, the eleventh variable, efficiency, was more important for CD startups and highlights their preference for CC services that save them time and make their operations more efficient.

Table 10: An Overview of the Potential Relative Advantages of Cloud Computing

#	Variable	Frequency (#)	Percentage (%)	Important for both startup groups (B)/CD startups (CD)/IT&S startups (IT&S)
1	Cost structure	12	100%	B
2	Trust	8	67%	B
3	Security	8	67%	B
4	Global Access, Collaboration, and Sharing	8	67%	B
5	Scalability	7	58%	IT&S
6	Short time-to-market	7	58%	CD
7	Integrated Solutions	7	58%	CD
8	Loss of IT Governance and IT Maintenance	7	58%	B
9	Community Presence	6	50%	IT&S
10	Co-creation Opportunities	5	42%	IT&S
11	Efficiency	4	33%	CD
12	Convincing interface	3	25%	-
13	Availability	3	25%	-
14	Leveraging existing innovation	3	25%	-
15	Larger distribution range	2	17%	-
16	Appropriating Innovation	2	17%	-
17	Fast access	2	17%	-
18	Reliability	2	17%	-

The second variable trust was found to be mentioned eight times and this variable was consistently mentioned between both groups. This variable was also mentioned earlier to be important when selecting a supplier. Nevertheless, the data suggests that health tech startups trust the cloud in general and are not so much afraid of using it. Note that this does not mean that the startups do not conduct their due diligence before using cloud services. This is for example more important for startups dealing with sensitive data and are required to comply with regulations.

The third variable related to trust is security. This variable was found to be mentioned eight times and this variable was found to be mentioned consistently between both groups. The qualitative data shows that health tech startups value a safe and secure environment for their (sensitive) data. This need originates often from within the startup, but is sometimes reinforced through the environment, e.g. customer demands or regulations (see for more about this influence the section about external influences). In general, startups want CC service providers to apply the right amount of security and management of privacy/permissions, this means also not too much since a highly controlled and closed environment could impede the speed of the technology. Interestingly, the data shows that several startups store their data on multiple clouds (with different data on different clouds), whereas others store a part of their data offline or on a private server. Most of the startups however mainly use public clouds

as long as they can trust and believe that the security measures by the supplier are sufficient for their use case. The following quote illustrates this.

(Q66) We share quite a lot via the cloud. But for us it is important that security measures are taken and that our IP is safe with them. So, ideally you do not want to be scared for data leakages. ST7

The fourth variable Global Access, Collaboration and Sharing is expected to be another facilitator of CC adoption, which seems to be important for both startup groups. Accordingly, the respondents were found to prefer to be mobile. That is, they want to be able to work from any place and in certain occasions work with and share data with others, e.g. employees and partners, on a global scale to create and exchange value. The following quote illustrates this preference.

(Q67) We do not store anything on our local computers, because we believe that everyone should be able to access their work and be able to work from anywhere. ST8 (IT&S)

The sixth variable, short time-to-market, and the seventh variable, integrated solutions, were both found to be mentioned seven times and were found to be more important for CD startups. Startups want to use CC services that enable them reach the market in a shorter time. Services that can thus provide them a short time-to-market have an advantage since one of the greatest challenges that startups experience are lack of time and money, e.g. Q11. Another advantage is obtained when CC services can be connected with each other, which results in a synergy. Google for example offers a range of services that can be connected with each other, e.g. their email and calendar services can be connected with each other so that they exchange data with each other. However, the data suggests that IT&S startups find this aspect less vital than CD startups as long as it was not too complicated to connect services together manually.

(Q68) We use Google apps where our applications such as email are synchronized with each other. That makes it convenient to use Google Docs and Google Drive. ST8 (IT&S)

(Q69) The advantage is that you do not need to develop everything yourself, so a shorter time-to-market. At least, when the technology is good. ST4 (IT&S)

(Q70) Salesforce can actually be very useful for startups. I mean if you have a great product that allows you with one or few clicks to create tenders, to create an overview of your customers and their details, to send emails to a group where the receivers also have an online portal to request for more information or to ask question, and to send all your invoices. These are operations that currently require manual labor. This is what a CC platform like Salesforce can do, which is appealing because you do not want to use a range of services but only one. ST1 (IT&S)

Furthermore, variable eight, loss of IT governance and IT maintenance, was found to be mentioned seven times and it was found to be important for both groups. CC enables a startup to outsource their IT management and governance of the underlying IT infrastructure. In general, startups exploit CC because they do not want to hire a professional IT staff nor do they want the challenge of maintaining the servers over time, e.g. for security reasons, or when demand increases exponentially. However, this loss of IT maintenance and governance meant that they have to select carefully about the appropriate environment for their data, especially sensitive data. The following quote gives an example of the influence of this variable.

(Q71) We had to decide whether we wanted to maintain the entire system ourselves. The greatest advantage of the cloud is that we can delegate this task. We do not need to keep anything at the office. So we are also not afraid of burglars or that we lose something. They make backups of everything. ST6 (IT&S)

In addition, variable nine, the presence of a community, and variable ten, co-creation opportunities, were found to be mentioned six and five times respectively. These variables were found to be more relevant for IT&S startups though. The IT&S startups argued during the interviews that an active community can be a decisive factor for selecting a cloud platform. Moreover, these startups were found to prefer the ability of co-creating value with this community, e.g. Q55.

4.4.2 Complexity

The data shows that in terms of complexity, health tech startups do not find CC technologies difficult nor complex to use. However, this does not mean that they prefer complex systems. The data shows that startups view complexity as a cost driver to setup and to introduce it in the firm. As such, complex systems without a relative advantage are often avoided. The following quote provides an example of this.

(Q72) I translate complexity to cost, because that provides information about how much time you require to understand the system. In general, you do not want complexity because that will cost you a lot of time. So the level of complexity is very important. ST5 (CD)

4.4.3 Compatibility

The respondents indicated that in their early stages, systems that are compatible with their experiences, values and their relative advantage are preferred but are not required. However, startups indicated to increasingly evaluate new systems based on the degree of compatibility and the ease of integration with their systems Therefore, compatibility with their systems and organization's policy are expected to become increasingly important as the startup grows. Compatibility was found to be relevant because incompatible solutions were perceived to require a longer time-to-market and increase complexity which in turn is perceived as higher costs. In addition, compatibility was also viewed in the sense of being able to leverage different kind of innovations and connecting them to each other in an easy and a fast way. These unbundled solutions that can become integrated solutions offer benefits such as low-cost entry fee's but it reduces also (the feeling of) lock-in effects, because services from multiple vendors can be used. These lock-in effects are ideally avoided by startups since they do not want to create unnecessary dependencies that could turn out negative for them in the future, e.g. if the technology supplier decides to shut down an important service.

4.4.4 Trialability

The data shows that at least nine of the respondents, view trialability as a prerequisite to even consider a system. Trialability is viewed as important because it allows them to evaluate the risk and cost of adoption. A trial can, in general, allow a startup to experience the required IT maintenance work and the configuration processes. However, several startups argued that complex or large systems are more difficult to trial and that such systems often resemble a full roll out within the organization locking users in. Such a roll out was argued to be an expensive and time intensive process, which is preferably avoided or prevented when the system is not suitable or not good. Therefore, they argued that other aspects of the technology context such as observability were required to be very good for complex systems to reduce the risk of adopting the wrong (expensive) system.

4.4.5 Observability

The data shows that observability could be an important factor in influencing the CC adoption behavior of health tech startups. The data shows that observability is an important mechanism through which startups could perceive the relative advantage(s) of a technology. As such, it was found helpful to predict one's expectations, e.g. the degree of complexity. From this perspective, technologies with a high relative advantage expected to also score high on observability. Therefore, one could assume that there are no relative advantages when the observability is low. In addition, the data shows that to increase the impact of observability two important aspects need to be considered. The first dimension is to take different functional backgrounds into account. Accordingly, use cases should show a broader set of

benefits than only those designed for the technical department. Quote 72 provides an example of such a suggestion. Another important aspect here is to consider the different set of benefits and required mechanism per cloud service layer and to adjust the message accordingly.

(Q73) Different functional areas within a firm have different requirements. For example, I would examine the degree to which the technology complies with regulations or with hospital policies and whether they allow us to transfer data to the cloud, whereas the IT department will examine the integration difficulty, the degree to which it can be customized, its maintenance requirements, and the training requirements for employees to use the system , whereas the sales and marketing department will examine the potential rise in sales, and the service supplier will evaluate whether the need to travel for repairs or maintenance reduce because of the system. ST5 (CD)

The aforementioned discussion illustrates how the technology context of CC influences the decision-making of startups. According to the interviews and literature, the perceived openness of a technology supplier also plays an important role. The following section therefore discusses this aspect.

4.5 Perceived Cloud Computing Openness

This section analyzes the collected data to identify the perceived CC openness influence on the CC adoption of health tech startups in the sample. This analysis suggests a relationship between the transparency and accessibility of the technology platform on the CC adoption behavior of health tech startups. The analysis however does not offer support for a relationship between the transparency and accessibility of the distribution channel on the CC adoption behavior of health tech startups. These analysis results are supported with the collected qualitative data, but less on the survey data. The reason for this is that the survey indicates that both the platform and its distribution channel are important drivers of CC adoption, since the average scores are not less than 4. However, the analysis of the qualitative data shows that the influence of the distribution channel is less than what the survey conveys. The survey results are shown in Figure 7. The following provides an elaboration on these findings and the potential differences between groups.

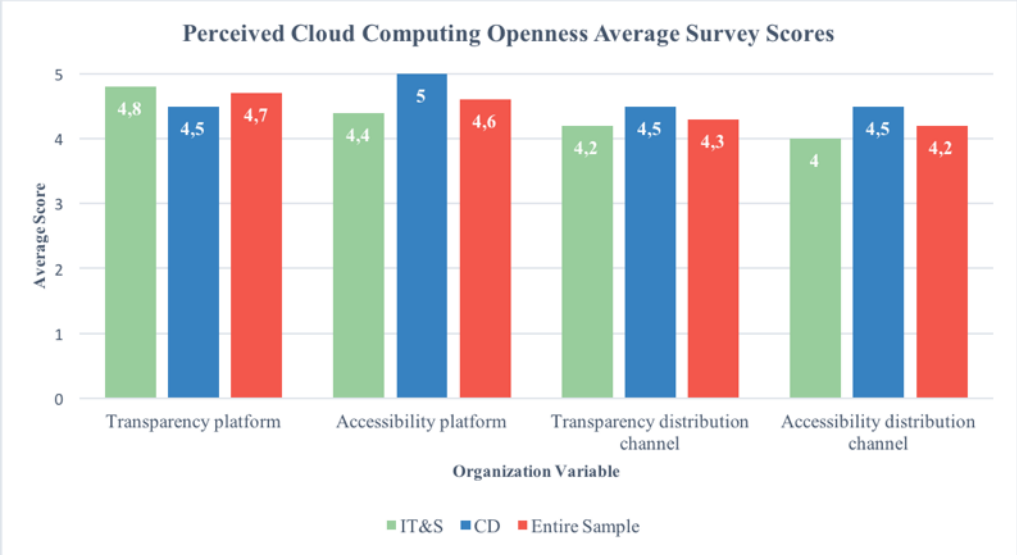

Figure 7: Perceived Cloud Computing Openness Average Survey Scores

4.5.1 Transparency and Accessibility of the Technology Platform

The data shows that the respondents view transparency and accessibility as important constructs for their CC adoption decisions (P19; P20). During the interviews though, the respondents indicated their associations with transparency and accessibility. This resulted in a list of variables presented in Table 11. This table shows how many of the respondents, in counts and percentage of the entire sample, related

a certain variable to platform openness. Based on a further analysis of this result and the data, this study finds the variables mentioned more than once important enough to include them into the Openness construct. This is partially motivated by the fact that several of these variables were also identified by Benlian et al. (2015). Table 11 lists these variables based on their designated category, i.e. transparency or accessibility. The remainder of this section elaborates these variables. The data shows that the most important aspect for health tech startups relates to openness about privacy and data aspects.

Table 11: An Overview of the Variables Related to Cloud Computing Platform Transparency and Accessibility

#	Transparency (T)/Accessibility (A)	Variable	Frequency (#)	Percentage (%)	Important for both startup groups (B)/CD startups (CD)/IT&S startups (IT&S)
1	T	Privacy and Data	7	58%	B
2	T	Continuity of Services	5	42%	B
3	T	Roadmap Openness	5	42%	B
4	A/T	Pricing (barriers)	5	42%	B
5	T	Security	4	33%	B
6	T	Developer's community	4	33%	IT&S
7	T	Complexity	4	33%	B
8	A	Interoperability	3	25%	B
9	T	Used by other developers and consumers	3	25%	IT&S
10	T	Functional scope	3	25%	IT&S
11	T	Technical performance	3	25%	IT&S
12	T	Trustworthy	2	17%	B
13	T	Notification practices	2	17%	B
14	A	Customizability	2	17%	IT&S
15	T	Degree of openness about the underlying code	2	17%	IT&S
16	A	Accessible data	2	17%	B
17	A	Helps create standards	1	8%	
18	A	Degree of dependency	1	8%	

The data shows that the respondents want to know where their data is stored, what kind of operations the supplier conducts on their data or is allowed to, the distribution of rights on their data, and the distribution of access to their data. For example, one of the startups noted how the location of the supplier's servers are essential since servers located in the United States are allowed to be accessed by the government.

(Q74) We evaluated the cloud solutions of Google and Amazon, but there are great privacy and data related issues. Besides from the fact that the servers are located in the United States and the issues surrounding that, they will not tell you what they exactly do with your data even though it is big data. You know that Google has software to relate big data back to personal data. So we are bit concerned about that. That is why we initially developed our own solution, because there was no supplier who could do that. ST12 (IT&S)

A related variable to these variables is openness in security measures, which is the fifth variable in the table. In terms of security, all of the respondents indicated the importance of knowing how secure their data and solutions are with their selected technology supplier, e.g. Q66.

Furthermore, the second variable, continuity of services, and the third variable, roadmap openness, were found to be mentioned four times each and were important for the entire sample. The respondents noted how they could be dependent on certain services while technology suppliers could think about shutting these services down without notification, e.g. variable 13 from the table. This continuity refers also to the degree of guarantees that the supplier can make about the consequences for their data once the company is bought or shut down for example. Accordingly, the respondents indicated their preference for openness about the roadmap and/or vision that shows the direction of the company, which also helps

to evaluate the company fit. This company fit refers to the degree to which a startup feels that the direction of a technology supplier will benefit their relationship.

In addition, five respondents related pricing aspects to openness. The respondents argued that they want to understand the pricing mechanisms and cost structure before they adopt a technology to prevent sudden price changes or unexpected and unaffordable prices. Furthermore, the sixth variable, a developer's community, was found to be related to openness as it was mentioned four times. This aspect was again found to be of greater importance for IT&S startups than for CD startups. As such, the respondents argued that platforms that allow one to understand, modify the underlying code and to co-create value with an active community to be perceived as more open than platforms that do not disclose their code and do not allow others access to their proprietary code, e.g. variable number fourteen and fifteen. Moreover, these respondents argued that an install base of developers who can work with the platform and an install base of consumers makes the platform more accessible, e.g. variable number 9.

Also, openness about complexity, variable number seven, and interoperability, were found to be important aspects for the respondents. As such, a less complex system is viewed as more accessible. These complexity barriers related to the participation requirements, the learnability of a technology, the initial cost of required technical equipment both from a financial and an effort perspective. The same was found to be true for interoperability, which is here referred to as being able to exchange data between solutions in one's ecosystem but also outside of it. The respondents argued here that they do not want to be locked-in into one system that does not allow them to exchange data with other systems nor do they want to have difficulties in accessing their own data, e.g. variable number sixteen.

Furthermore, the openness about the functional scope, variable number ten, and the technical performance, variable number eleven, were found to be important. These variables were used as indicators to help predict one's expectations on the platform. As such, ambiguity about the scope or the performance (limits) of one's technology can result in unexpected negative events that the respondents would rather avoid. In case of such an occurrence though, ST6 indicated that they prefer a supplier who notifies them and is open about such technology failures. Finally, two respondents related a trustworthy supplier as one who is transparent. This suggests that transparency can facilitate CC adoption by increasing one's trust in the supplier.

Table 12: An Overview of Variables Categorized by Transparency and Accessibility Dimensions

Transparency Platform	Accessibility Platform

• Privacy and Data
  ○ Storage location,
  ○ Rights to the data of the host
  ○ Security and privacy mechanisms
  ○ Accessibility of data
• Continuity of services
• Roadmap Openness
• Security mechanisms and measures
• Developer's community
• Install base of developers and consumers
• Pricing
  ○ Available pricing mechanisms
  ○ Clarity about pricing
• Technical documentation
• Notification practices
	• Barriers as low as possible in technical terms and financial terms.
	  ○ Participation requirements
	  ○ Learnability of a technology
	  ○ Initial cost of required technology equipment in terms of money and effort
	• Degree of interoperability with other solutions
	  ○ Within the ecosystem
	  ○ Outside the ecosystem
	• Co-creation and customization capabilities
	• Technical scope and performance
	  ○ And capacity limitations

This section has thus far analyzed the openness aspects of the CC platform. Table 12 shows an overview of these variables categorized by transparency and accessibility dimensions. The following section advances this by analyzing the data about the distribution channel.

4.5.2 Transparency and Accessibility of the Distribution Channel

This section analyzes the collected data about the openness of a CC distribution channel in terms of transparency and accessibility. Although the data shows a range of variables which were found to be important for a distribution channel, the distribution channel itself was not found as an essential influencer on CC adoption (P21; P22). This section therefore does not present the found variables, but it presents the set of reasons explaining why the respondents were hesitant about the presence of such a distribution channel within the healthcare context.

The data shows that a distribution channel for healthcare related services concerns a small set of startups. These concerns were found to be based on the current transitioning state of the healthcare market. For example, ST12 argued that the healthcare market does not so much need a distribution channel as it needs to solve larger issues. He argued that the Dutch healthcare market is currently not ready for a health-related CC service distribution channel as it is still in its early stages of adopting cloud. Because of this transition to the cloud, a substantial amount of aspects need to be addressed before this shift is completed in the right way. These aspects include the (new) design of financial flows, clear agreements about the location of the servers (for data storage), the meaning of digital health in European and international context, and the mechanisms through which caregivers can pay for new innovations. Furthermore, ST4 highlighted that exchanging (sensitive) patient data requires strict and standardized procedures to prevent any harmful events from occurring. He argued his concerns about a case where one could be using health related services from an unverified external party who could subsequently gain access to (sensitive) patient data. These concerns suggest that Dutch health tech startups could benefit more from their innovations when the market is in a more mature state in terms its CC adoption.

Note that the data did show a set of startups who found the business model of a CC platform with a distribution channel appealing, but not necessary. These startups were mainly from the IT&S group who saw opportunities in appropriating value by exchanging their developments on such a channel. In contrast, CD startups were found to be more interested in consuming such third party developed cloud based services if their quality, i.e. safety, security, and functioning, could be guaranteed.

4.6 Summarizing the Analysis

This research studied carefully and thoroughly organization-level adoption of CC within the Dutch healthcare by health tech startups. The CC adoption behavior of these startups was analyzed in terms of their selection of CC service models, pricing mechanisms, and deployment forms. This was mainly done through the lens of the TOE and the DOI frameworks and the Perceived Platform Openness construct. This integrative approach allowed this research to study the influence of the technology, the organization, the environment contexts and the perceived openness on CC adoption behavior. The results indicate that each of these contexts and the openness construct complement each other by providing a holistic perspective on CC adoption behavior. Furthermore, this study finds important differences in CC adoption behavior between startups, e.g. IT&S and CD startups. This research therefore proposes a conceptual CC adoption model to explain the adoption behaviors of health tech startups. The proposed conceptual model is shown in Figure 8. This figure also shows the variables that are mainly relevant for one of the startup groups. Table 13 shows an overview of the propositions and their results. The following elaborates on the main findings starting with the current CC usage of the respondents, shown in Table 5, and the organization context. It then continues with the technology context, the environment context and the perceived CC openness.

Table 5 shows that all the respondents exploit CC technologies with a strong preference for public cloud services and IaaS or SaaS service layers. The organization context proposes that affordability is one of the main drivers of this behavior. The table also shows that the preference of service layers and pricing schemes differ between startups with distinctive value propositions. Startups with an IT and service

oriented value proposition, i.e. IT&S startups, were found to increasingly adopt more SaaS and IaaS or PaaS services with a preference for both a pay-per-use and a monthly fee as payment models. In contrast, startups with a (clinical) device oriented value proposition, CD startups, were found to increasingly adopt more SaaS services with a preference for a monthly fee as a payment model. The organization context proposes that IT&S startups adopt lower CC services relatively early because technology readiness plays only a minor role for them in contrast to CD startups. It is therefore proposed that CD startups adopt lower CC services in later growth stages once they reach technology readiness.

In terms of the technology context, it is proposed that the rate of CC adoption depends to a large extent on the degree of perceived relative advantage, e.g. Table 10, and the degree of complexity. Furthermore, startups working with trade partners or with sensitive data were found to be more risk averse than other startups. This risk adversity in combination with a lack of competitive pressure is proposed facilitate uncertainty reduction behaviors. This reduction of uncertainty is proposed to occur to a large extent via the identified variables in the technology context (e.g. trialability and observability), the environment context (e.g. regulatory support, trade partner support, characteristics of the CC supplier, and informal networks), and in the perceived openness construct (e.g. transparency and accessibility of the CC platform).

These findings have theoretical and managerial implications, which are discussed in the following chapter.

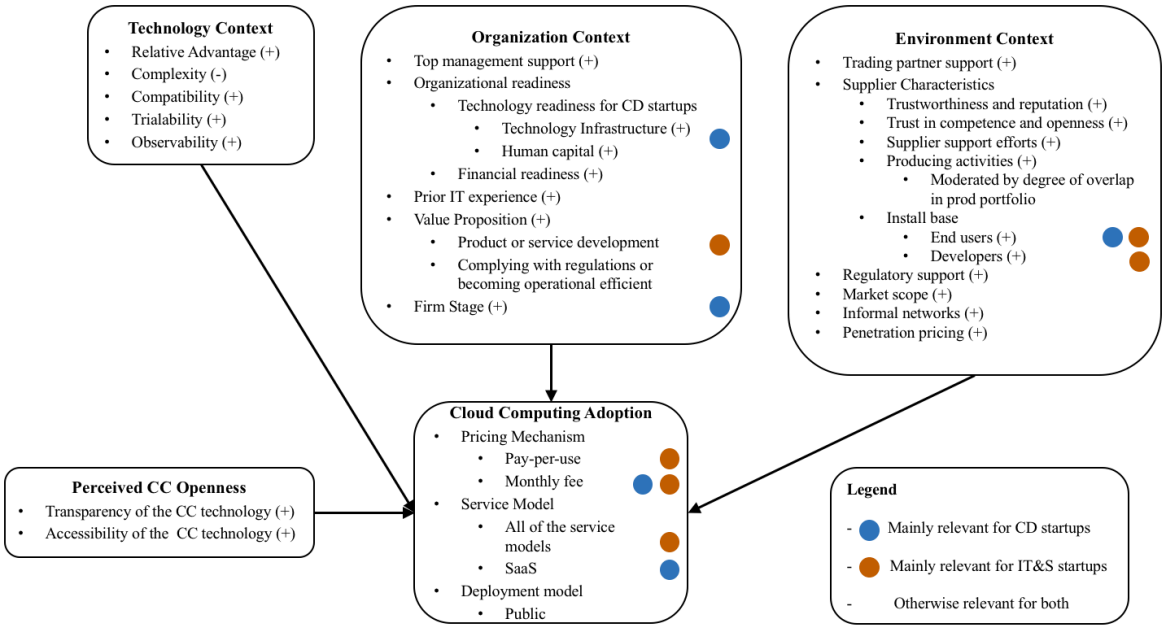

Figure 8: The Proposed Integrative Model Explaining the Cloud Computing Adoption Behavior of Health Tech Startups

Table 13: Overview of the Findings

Proposition	Support	Note/Difference between startup groups
Technology Context		
P1. Relative advantage	Supported	
P2. Complexity.	Supported	
P3. Compatibility	Supported	
P4. Trialability	Supported	
P5. Observability	Supported	
Organization Context		
P6. Organizational readiness	Supported	• Technology readiness only essential for CD startups; Financial readiness essential for both
P7. Top management support	Supported	
P8. Training and education offered	Not supported	
P9. Innovativeness	Not supported	
P10. Prior technology experience	Supported	
P11. Firm size	Not supported	
P12. Business process complexity	Not supported	
Firm stage (**new**)	Supported	• Startups are expected to use increasingly more CC services as they move through growth stages
Value Proposition (**new**)	Supported	• The value proposition is proposed to influence whether CC services are used for product or service development (IT&S) or more often for complying with requirements, regulations or gaining operatonal efficience (CD)
Environment Context		
P13a. Trading partner support	Supported	
P13b. Supplier support (efforts)	Supported	
P14. Competitive pressure	Not supported	
Supplier Characteristics		
P15a. Supplier trustworthiness & reputation	Supported	
P15b. Trust in the competence of the supplier	Supported	
P15c. Trust in the openness of the supplier	Supported	
Producer activities (**new**)	Supported	
Install base (**new**)	Supported	• *Relevant* end users influence both group of startups, amount of developers influence IT&S startups, and amount of solutions influence both type of startups
P16. Industry	Not supported	
P17. Regulatory support	Supported	
P18. Market scope	Supported	
Informal networks (**new**)	Supported	• Health tech startups were found to be interested in and actively attempt to gain access to potentially valuable online and offline informal networks that subsequently influence their CC adoption behavior.
Penetrating pricing strategy (**new**)	Supported	• CC technology suppliers who price their services competitively are expected to benefit from higher adoption rates than those who use alternative pricing schemes, e.g. skimming pricing
Perceived CC Openness		
P19. Transparency of CC technology	Supported	
P20. Accessibility of CC technology	Supported	
P21. Transparency of the distribution channel	Not supported	
P22: Accessibility of the distribution channel	Not supported	
TOE and CC modalities		
P23. Pricing mechanism	Supported	• IT&S startups prefer pay-per-use pricing whereas CD startups prefer monthly fee
P24. Service model	Supported	• CD and IT&S startups adopt SaaS whereas IT&S startups are more likely to adopt either PaaS or IaaS
P25. Deployment model	Supported	Public

5. Discussion

This chapter discusses the theoretical and managerial implications, the limitations of the study, and it proposes suggestions for further research.

5.1 Theoretical Implications

This research makes essential contributions to the stream of research on the adoption of new technologies and CC. Studies such as that of Oliveira and Martins (2011) and Wu et al. (2013) have called for more holistic approaches that use multiple theoretical perspectives to comprehend the IT adoption phenomenon involving new technologies. Therefore, the first main contribution of this research is the integration of two theoretical frameworks (the DOI theory and the TOE framework) to develop the research model (Rogers, 1995; Tornatzky and Fleischer, 1990). This research model captures the adoption behavior of the organization based on the technology, the organization, and the environment contexts. This approach is different from other studies on CC that take a narrower focus by including only one adoption theory or use no supportive theory, e.g. studies in Table E.1. This study finds that the generic TOE framework with the DOI framework are well-suited to help explain the adoption behavior of health tech startups. However, this study takes the model a step further by extending it with the perceived openness of the CC platform and its associated marketplace (Benlian et al., 2015). Therefore, the second main contribution of this study to the literature is being, to my knowledge, the first to explore the perceived openness construct within a CC adoption study from a startup's perspective. Therefore, this study contributes to the literature on IT governance with a comprehensive and rich conceptualization of CC openness from a startup-centric perspective (in contrast to the sample of individual developers in the study of Benlian et al., 2015). Comprehending the dimensions of startup's Perceived CC Openness advances the understanding of startups' motivations to (consistently) exploit the offered services, and thus provides a theoretical lens to CC governance. That is, the construct of Perceived CC Openness illuminates a relationship between a set of governance choices of CC suppliers with startups' CC openness perceptions and subsequent on their attitudes and adoption behaviors. This is an essential result since the success of such platforms depend to a large extent on the degree to which external expertise and ingenuity can be harnessed (Gawer & Cusumano, 2008; Weill & Woerner, 2015).

Furthermore, an important differentiation of CC is that it offers a larger set of adoption strategies than many previous enterprise solutions. Studies such as that of Oliveira et al. (2014) view the adoption decision of the cloud as a binary decision, i.e. an organization adopts CC services or not. Their approach however neglects the different levels of commitment one can have to CC by adopting different modalities, i.e. selection of the service model, the pricing scheme, and the deployment model. This study therefore contributes to the literature by proposing distinctive preferences of CC configurations between startup groups based on a certain set of variables. This approach is in line with Hsu et al. (2014). Although both approaches result in valuable insights, it seems that the latter approach (and of this current study) allow for a better understanding of why CC is adopted by distinguishing their different modalities. This study therefore contributes to the literature by illustrating that richer descriptions can be identified by including the different cloud modalities in CC adoption studies, e.g. Hsu et al. (2014). For example, because adopting a SaaS is different than adopting an IaaS, it is expected that there are different (and similar) drivers and inhibitors for adoption. This approach allowed for example the identification of different preferences of relative advantages of CC based on the value proposition of a startup, i.e. an IT and service oriented value proposition or a (clinical) device value proposition, and the preference of different CC modalities, e.g. Table 5 or Table 10. This suggests that future CC adoption studies could incorporate the modalities of the cloud in their research model to, first, reduce the ambiguity of what is

being adopted when referring to CC adoption, and, second, to increase the understanding of the drivers of adoption decisions.
Lastly, while the DOI and TOE frameworks have been used intensively in IT studies and have consistent empirical support, specific measures within the contexts of the TOE framework vary across different studies or settings. Therefore, the fourth main contribution of this research to the IT adoption literature is by proposing variables that confirm or reject variables found in other CC adoption studies, e.g. technology readiness (technology infrastructure and human capital), innovativeness, competitive pressure, trade partner support, and regulatory support. In addition, this study added a set of new variables that were not previously identified in other CC adoption studies, e.g. value proposition, Firm stage, and informal networks. These findings can be found in Table 13. The following discusses the main variables in relationship to the existing literature. It starts first with the confirmed and rejected propositions and ends with the new set of variables.

5.1.1 Confirmed and Rejected Propositions

The first proposition that this study does not find evidence for is the relationship between *innovativeness* and CC adoption. This finding contradicts with studies such as that of Alshamaila et al. (2013). This study finds that most of the respondents perceive the level of newness as irrelevant for their decision to adopt CC technologies unless it is very new. Services with a high degree of newness were argued to harm their business due to their high degrees of uncertainties and were not preferred. Hsu et al. (2014) argue that current adopters of CC within the healthcare market could be viewed as the early adopters (Rogers, 1995). Rogers (1995) argues that early adopters are adventurous, dare to attempt new things, and lead the crowd. Moreover, early adopters are expected to embrace the latest technologies. However, the results of this study suggest that only a minor set of health tech startups share these characteristics and that a major set of startups are in fact risk averse. Therefore, one could argue that health tech startups perhaps should not be viewed as early adopters of CC but rather as the early majority, which contradicts the claim of Hsu et al. (2014). The early majority adopts an innovation after a varying degree of time that takes longer than the early adopters, who have above average social status, have contact with early adopters and hold seldom positions of opinion leaders (Rogers, 1995).

The second proposition that this study does not find evidence for is the relationship between competitive pressure CC adoption. This finding contradicts with studies conducted in markets where the technology is more mature, e.g. the manufacturing industry, or in competitive environments, e.g. in the high-tech industry (Low et al., 2012; Zhu et al, 2006a; 2006b). The reason for the minor role of competitive pressure might be related to the current low diffusion levels of CC in the healthcare market or the relative high adoption resistance of the market to new innovations (Hsu et al., 2014). This suggests that competitive pressure could become a driver in the future if the market can become more open to adopting new innovations. It is also expected that higher diffusion levels of CC in the market could generate competitive pressure by facilitating the development of innovations and reducing entry barriers (Utterback, 1994). With the current low CC diffusion levels, though, this study proposes the positive influence of trade partner support on CC adoption due to positive network effects (Hsu et al., 2014; Shapiro & Varian, 1999). This study proposes that regulatory support is also a facilitator of CC in the current stage of the market (especially for startups working with trading partners or with sensitive data) (Zhu et al., 2006a). However, the influence of this variable is only to a small extent researched in other CC adoption studies. This variable is proposed to facilitate adoption especially in markets characterized by instable regulations or lack of good regulations for the use of CC technologies. Accordingly, a lack of adequate regulations in terms of security and privacy protection of (patient) data is proposed to slow the diffusion of CC technologies within the Dutch healthcare market down. This negative effect is proposed to occur also on a larger scale as the lack of a Europe wide and worldwide standards discourages startups to scale to countries with substantial different regulations (Oliveira et al., 2014).

5.1.2 New Propositions

This study proposes that the CC adoption behavior could be related to the value proposition of startups. This variable is found to help explain the selected service layer and the preferred pricing mechanism. However, previous CC adoption studies have not yet examined this variable. The value proposition helped this study to distinguish startups with an IT and service oriented value proposition (IT&S) and startups with a clinical device oriented proposition (CD). Subsequently, IT&S startups were found to be more likely to be firms with (access to) strong IT capabilities, i.e. human capital and more likely to exploit all of the service layers with a preference for a pay-per-use pricing mechanism. In contrast, CD startups were found to be more likely to be firms with less (access to) strong IT capabilities and more likely to exploit the top service layer with a preference for a monthly fee pricing mechanism. The relationship between human capital and lower level service layer adoption, i.e. PaaS or IaaS, however contradicts with Hsu et al. (2014). Their study only finds a relationship between human capital and the adoption of IaaS services. This difference could be due to the different sample characteristics. Their sample consisted of Top 500 Companies in Taiwan who exploited CC only to a minor extent, i.e. 30% of their sample used SaaS, 5% used PaaS, and 13% used IaaS, in comparison to the high usage of CC in the current sample. Furthermore, this study finds that technology readiness only plays a role for CD startups in adopting lower CC service layers. This contradicts with the findings of Low et al. (2011) who find technological readiness to be irrelevant for companies in the technology sector. It could be that this study found this relationship because it analyzed the adoption behavior in terms of the different service layers in contrast to their study. A reason for why this only would apply to lower service layers is that CD startups could be required to make substantial changes to their business processes or to their product before adopting lower service layers in contrast to IT&S startups. This requirement could cause an adoption barrier that does not justify the adoption of these lower service layers. Therefore this study proposes that CD organizations who posses both a (more) mature technology infrastructure and (access to) strong IT capabilities to be better suited for adopting lower cloud service layers.

Furthermore, this study proposes that the firm's growth stage facilitates CC adoption. This variable is argued to explain their adoption better than firm size. This suggestion is based on the observation that startups remain low on employees, for example because they hire freelancers, while progressing through their growth stages. Thus, this variable could be used to identify the set of problems that a startup attempts to address with CC in certain stages and relate these to their CC adoption behavior (Kazanjian, 1988). For example, the data in this study suggests that CD startups could be delaying their use of CC technologies or could be using different services and service layers depending on the stage they are in. It is therefore proposed that firm stage allows one to better understand the CC adoption behavior of startups by linking their required services and the services that they adopt during and between growth stages. Lastly, this study proposes that informal networks have a positive influence on CC adoption by not only creating positive word-of-mouth effects but also by reducing uncertainties (Cheung, Lee, & Rabjohn, 2008). The influence of informal networks on startups is found to be significant in alternative studies such as Almeida et al. (2003) but is not yet examined in CC studies. Their study finds that startups learn substantially form informal networks through informal geographically mediated networks. However, this study found that startups can also be influenced independent of their location via online networks (where geolocation matters less). Although the influence of strong offline networks was more noticeable, this study proposes that both online and offline informal networks influence startups' CC adoption behavior. It is therefore suggested that researching this variable more in depth extends the comprehension of the underlying drivers of CC adoption.

5.2 Managerial Implications and Solution Design

The findings of this study have managerial implications for CC technology suppliers wanting to diffuse their innovations among health tech startups, but also other essential stakeholders such as the Dutch

government. These implications could be of great value as they provide strategic insights, such as the selection of target customers and designing promotion strategies.

First, based on the technology context, this study suggests managers to focus on promoting and validating the relative advantage of CC within the healthcare market. This could for example be achieved by developing your own solutions on the CC platform first. The benefits that could then be highlighted include the cost structure, the high degree of security, the shorter time-to-market, loss of IT governance and IT maintenance, or becoming operationally efficiency. This targeting procedure should however be tailored to the user group's context to effectively highlight the potential benefits for their business on, at least, technical and business dimensions. This could help facilitate the required support from top management and other departments within the startup. In addition, trial opportunities should be available to reduce adoption barriers and increase familiarity with the technology. The marketing activities should aim to reduce ambiguities about the CC services and increase the ability of startups to predict the gain in benefits, and to trade it off with their associated risk, cost of adoption and expected technical complexities. Moreover, CC suppliers should strive to build a strong reputation for themselves as a trustworthy and competent technology supplier who establishes and maintains relationships based on openness and offers an excellent active customer support. In terms of openness, this means to be at least transparent about privacy and data policies, the product's and the company's roadmap and the continuity of services, security mechanisms that are in place, pricing mechanisms, and technical documentation. It also means to remain accessible by consistently working on reducing financial and technical barriers and ensuring a high degree of compatibility between systems within and outside the ecosystem. To obtain better adoption results with IT&S startups, CC suppliers should disclose the technical scope and the performance capabilities of their services, and ensure an active and growing developer's community with opportunities to co-create and customize applications. In terms of support, CC suppliers should actively approach startups and show that they value them in a genuine way and offer excellent customer support on at least technical, regulatory and (potentially) financial dimensions. In the case of a low set of, users, viable solutions and business models, it is suggested to first focus on IT&S startups so that the reach and range of solutions of the cloud platform increase. These startups can then generate successful stories, where their positive experiences could result in positive network effects on other firms later on. Once a sufficient install base of solutions is obtained, positive networks can be exploited to draw CD startups in. In terms of pricing mechanisms, this study suggests to provide a pay-per-use pricing mechanism (for IT&S startups) and a monthly fee pricing structure (for CD startups).

Furthermore, this study suggests to factor in the organization characteristics of the startups and their associated usage behaviors. In this regard, IaaS and PaaS vendors should target startups with strong IT capabilities with enough financial resources whereas SaaS providers could target both type of startups who have access to enough financial resources. Furthermore, it is suggested to target CD startups with lower service layers in their later stages so that their technology infrastructure and human resources are ready for the offering. In cases where a CC platform is too advanced or expensive for startups, one should think of unbundling services (to make it more affordable per component) or to target startups in in their later stage once they obtain the required human and financial capital. Furthermore, this study suggests to apply a penetration pricing strategy during launch to increase the install base as fast as possible and to leverage network effects and capture profits once a startup scales on the platform or once the install base of users achieves a critical mass on the platform (Lee & O'Connor, 2003). However, it is suggested to be transparent to (potential) users about any planned price changes to reduce the negative effects of increase in prices.

Also, this study suggests to exploit positive network effects by diffusing CC technologies among important large stakeholders within the healthcare sector such as HCO's, who can influence the CC

adoption behavior of health tech startups. These trade partners could be opinion leaders in their field and they could function as ambassadors of one's CC services. Their (positive) opinions could therefore be used to attract (more) health tech startups. Although such an indirect approach can have benefits such as generating large amount of revenues, it is important to include startups early in the development process of the cloud services. This early inclusion helps to start content creation early on, and prevent alienation between their needs and the developed services. This investment in content creation can be a successful strategy in markets characterized by network effects and can be more important than investing in the performance of the product itself (Anderson Jr. et al, 2013). This inclusion should be conducted selectively though because of the high variety in regulations in different markets and the associated costs of addressing them. Therefore, startups that can function as lead users or segments that show a high fit with the company's strategy, capabilities and resources should be targeted first (Brentani, 2001). Furthermore, once trade partners are on board and uncertainties within the market around the usage of CC are reduced, CC suppliers should attempt to make it easy for different sides to find each other and exchange value through the platform, e.g. by introducing of a marketplace for services. Another indirect way that CC suppliers could influence health tech startups is by collaborating with (or by designing and leading) startup programs, e.g. accelerators or incubators, specialized in digital health because of their strong abilities to influence their participants. These programs can then function as screening mechanisms of potentially good startups who get introduced to your CC services.

Furthermore, the results show that the Dutch government can play an important role in the diffusion of CC services within the healthcare market. The data shows that concerns and instability surrounding privacy and security regulations have a negative influence on CC adoption. However, by installing strong or better privacy legislations and security protection mechanism could promote CC usage by large HCO's. This provides also an opportunity for CC suppliers and other important stakeholders such as insurance companies to work with governments to establish such regulations and standards that advance the CC adoption levels within the healthcare market.

Lastly, an Excel tool is developed based on the findings to increase their practical use. The following section therefore elaborates on this tool.

5.3 Solution Design

This section proposes a solution design based on the results of this research. As the start of this thesis indicated, Philips is interested in the opportunity of attracting health tech startups to HSDP. However, currently most of the efforts go into large health or technology related companies. Therefore, to aid them in the process of addressing smaller organizations such as health tech startups, a tool is developed, which is an interactive and easy to use Excel application called the "HSDP Startup Focusing Tool". This tool is developed to increase the practical use of the research results. The tool is developed to ask a small set of twelve questions from multiple perspectives to understand the areas which need more attention from the HSDP management. Based on the given answers, users receive a set of suggestions to address health tech startups. These answers are indicative answers though, and should not be treated as the only way or the best way. Instead, this tool should be used a source of inspiration or to spark discussion of how to address health tech startups. Screenshots of this tool can be found in Appendix L Figure K.1, Figure K.2, and Figure K.3.

This tool is based on the empirical results such as the adoption model shown in Figure 8. As this study shows, it is essential to view organizational cloud computing adoption decisions from multiple perspectives. The decision of which perspectives to include for the tool was decided base on the analysis of the results. These results were first combined in a table to show the most important findings for the entire sample, CD startups and IT&S startups categorized on the technology, organization, environment contexts and perceived openness. This overview is shown in Table 14. A further analysis of this table

identified important areas that require attention from the HSDP management. This resulted into four perspectives: the technology context, the environment context, the perceived openness, and the install base. Note that this is not an exhaustive list and other aspects not mentioned in the tool, but mentioned in this study should also receive attention. However, addressing the areas mentioned in the tool should help in building a strong foundation to address health tech startups. In addition, the tool does not highlight the differences between IT&S and CD startups as much as the rest of this study does. The idea here was to aim for simplicity and to design so that it could also be useful for people who have not read this thesis. The remainder of this chapter highlights the focus areas of the tool. It also elaborates further on the questions based on the insights that were derived from the interviews with Philips personnel.

The Important Focus Areas

The technology perspective in the tool emphasizes the perceived benefits and the complexity levels, but also the self-service channel of Philips. A self-service channel uses automated processes for users to get to the information or services they need by themselves (Kolsky, 2002). A self-service channel is thus about automation. This channel was mentioned frequently during the interviews and is therefore viewed as an important mechanism to address startups in an economically viable and scalable way. The reason for this is that individual startups have an inconsistent growth rate and are not expected to generate a lot of revenue for Philips unless they become successful. The likelihood of becoming successful is however very small. In contrast, a large amount of startups could generate more revenue as their total usage will be higher than an individual startup. A self-service channel could thus aid in this target of addressing a large set of users by keeping the cost per (new) user low.

The environment perspective emphasizes the reputation and trustworthiness of the Philips brand, the level of customer support, and the diffusion levels of cloud computing in the Dutch healthcare market. The first aspects were already identified in this study as important and to a degree manageable by Philips. The last aspect here suggests taking the adoption levels of cloud computing in the Dutch healthcare market into account in one's strategy. The reason for this is that it is expected that health tech startups behave differently when the cloud computing usage in the market increases. This different behavior could have implications for the proper adoption stimulation strategy and could require a different strategy. The suggestions to this aspect are therefore expected to only be valid to a certain extent when the cloud computing usage in the healthcare market is low.

The perceived openness perspective emphasizes the transparency levels, accessibility levels, and the affordability levels of the services. These three have been repeatedly identified in this thesis as important to reduce the risk and uncertainties of a service. Finally, the install base perspective highlights the importance of strategic assets such as end users, developers, or solutions. Indeed, the install base can be used to gain a competitive advantage (Shankar & Bayus, 2003). This study finds that these assets can have positive network effects on startups and should receive the proper attention to maximize their effect on adoption.

5.4 Limitations and future research

This study is unfortunately not without limitations, hence the following suggestions for future research. The first limitation includes the sample population, which consisted only of health tech startups who leverage CC. Further research could include health tech startups who do not use CC to determine the differences between cloud adopters and non-adopters (if this is possible).

The second limitation of this study includes the research setting. The geographical scope is limited to the Netherlands and it would be interesting to see whether similar results can be obtained in other countries and continents. Moreover, the scope of this study consisted only of startups active in a fraction of the markets available in the Dutch healthcare. Further research could be performed on health tech

startups from other healthcare markets to examine whether the same behaviors can be found. Another limitation of this study is that the sample includes only one person per startup. Having more participants from the same firm could have led to better representation within one organization, hence a better identification of the variables. Future studies could consider collecting data from different stakeholders within the firm, e.g. employees from different departments such as product development or sales and marketing. In addition, interesting insights could probably also be found by collecting data from other important stakeholders within the healthcare market, e.g. healthcare organizations, insurance companies, regulatory bodies or consumers. Furthermore, although the respondents within Philips were selected with great care, the selection of respondents could be biased because only people who had a relationship with HSDP or startups were selected. Also, not all the respondents were familiar with Dutch health tech startups even though they work in similar regions.

Furthermore, this study shows only the current state of the Dutch healthcare market and the perspectives of the startups about CC with some predictions about the future. However, it would be interesting to conduct a replication of the study in later stage of the market or to identify changes in variables during the growth stages of firms. Finally, this study made an attempt to understand the relationship between adoption options (pricing, deployment forms, and service models) and the antecedent factors of the TOE framework, but more research of this kind is needed in contrast to the binary approach that currently prevails within CC adoption studies.

Table 14: Overview of Managerial Implications per Startup Group and per Perspectives

	Entire Sample	CD Startups	IT&S Startups
Technology	• Observable relative advantages on technical and business dimensions. For example: cost structure, trust, security, integrated solutions, loss of IT governance and IT maintenance, and cost efficiency. • Be compatible with their experiences and IT systems • Reduce complexity levels of adoption and usage • Offer trial opportunities	• Highlight the shorter time-to-market with your services • Highlight the set of easy to use solutions that can work together	• Highlight the opportunities of the platform to scale, customize and co-create by accessing an active and growing community
Organization	• Articulate a set of mutually enhancing business models for different value propositions • Reduce the cost of adoption or target later stage startups (which are financially ready to adopt)	• Reduce the requirement of strong IT capabilities for adoption • Highlight the SaaS services and offer the option of paying a fixed amount per month • Highlight how the services allow them to comply with regulations or to gain operational efficiency • Communicate the ease of incorporating the services into the product once technology readiness is obtained • Optional: make it possible to find entities with strong IT capabilities	• Highlight the set of available service models and the opportunity to pay-per-usage • Highlight the ease of developing new products or services with the platform • Optional: make it possible to offer strong IT capabilities to others

Environment	• Diffuse cloud computing among important stakeholders in the healthcare market and use them as opinion leaders for your product
	• Work with startup program's and communities to screen for valuable startups and offer them discounts
	• Work (and keep working) on firm's trustworthiness. Gradually build up one's reputation as an open and neutral industry broker
	  • Keep investing in the platform's core capabilities and show these with own created content
	  • Sow the install base of end users for indications of success
	  • Offer strong customer support in the areas of technical, regulatory or financial issues
		• Highlight how others have used your set of solutions and the benefits of integrating more solutions with each other
		• Once regulations stabilize and increasingly more trade partners support the cloud, increasingly start to highlight the benefits of incorporating cloud computing into the value proposition
			• Highlight the install base of developers and the developer's community
			• Highlight the degree of security and safety levels of your services
			• Indicate the ease of scaling to countries to which your services comply with the regulations

Openness	• Have clear privacy and data policies • Guarantee and communicate continuity of services • Design and share the roadmap of the product and the company • Provide clear about prices and pricing mechanisms • Reduce technical and financial barriers • Provide technical documentation • Notify users on time about (planned) changes	• Indicate the high level of interoperability between solutions within the ecosystem and outside of it • In the case of a distribution channel, highlight the benefits of consuming services from it and do not restrict them to consume services only from your distribution channel	• Highlight the developer's community, the level of customizability, the technical scope and performance, • In the case of a distribution channel, highlight the benefits of consuming from and producing on it but provide easy distribution not just on your own platform but also on others

6. Conclusion

Philips is currently developing a cloud based health platform, which it intends to launch in the Dutch healthcare market. This launch decision is partially driven by the transitioning of the Dutch healthcare market to cloud based solutions. This creates opportunities for both Philips and its partners (who are often large HCOs) to create the next generation of health innovations on the new cloud platform. However, exploratory interviews indicate that a substantial amount of health-related innovations could occur outside of HCOs. A valuable part could originate from health tech startups who will exploit CC technologies to develop digital health innovations. This creates an opportunity for Philips to attract such startups to their cloud platform and encourage them to innovate on top of it and increase the platform's potential value. However, CC technologies are a new phenomenon that bring both benefits and challenges to users. Benefits include easy and affordable access to highly advanced IT infrastructures via the internet. Challenges include privacy and data concerns, which have a negative effect on the adoption of CC in the healthcare market. Because of the high degree of regulatory control and instable CC policies, high cost of failure, and adoption, privacy and security concerns, it is expected that health tech startups have similar but also different CC adoption behaviors than startups studied in other industry contexts such as high-tech, finance, or in logistics. To understand their adoption behaviors and aid Philips in their aim of stimulating cloud platform among health tech startups, this study sought answers to the research question: "*How can the cloud computing adoption behavior of health tech startups in the Dutch healthcare market be explained?"*

This study finds that CC adoption behavior of health tech startups in the Dutch healthcare market can be explained with a conceptual model that integrates the DOI framework, the TOE framework and the Perceived Platform Openness construct. The conceptual model shows the influences of the technology, the organization, the environment contexts, and the perceived openness on CC adoption. This model is illustrated in Figure 8. This study proposes that each of the contexts and the perceived openness complement each other. As such, they each explain a part of the CC adoption behavior of health tech startups. In addition, this study finds important differences in CC adoption behavior between IT&S (IT and service oriented) and CD (clinical device) startups. In short, the adoption behavior can be explained by the degree to which startups can afford the services, and perceive strong benefits with low uncertainties by adopting the services. The following summarizes the identified adoption behavior according to the contexts and the perceived openness, and how these are related with each other.

The organization context proposes that top management support is often required for adopting CC services. In this regard, positive experiences with cloud services can be a positive contributor to CC adoption decisions. Furthermore, this study proposes that startups with an IT and service oriented value proposition are more likely to have (access to) strong IT capabilities and adopt relatively early SaaS, and PaaS or IaaS with a preference for pay-per-use pricing in contrast to startups with a (clinical) device oriented value proposition. This latter group of startups is found to mainly adopt SaaS services with a monthly fee pricing in its early stages until its technology infrastructure reaches an adequate maturity level and they acquire (access to) strong IT capabilities. In the early stages of a startup though, financial resources are low and this requires them to focus intensively on their value proposition. These limited resources constrained the respondents from adopting expensive and advanced systems, but not from cheaper and less advanced alternatives. As such, financial constrains functioned as a driver of public cloud adoption (a cheaper alternative to private clouds). This constrain in their CC selection, becomes less of a challenge in later stages though, as financial resources become increasingly available. These organizational characteristics are related to the technology context in the following way.

The main reason why startups adopt cloud services is because it offers them a benefit or it reinforces their business model. Therefore, the adoption of CC services was mainly driven by the degree to which certain benefits were sought and perceivable on at least technical and business dimensions. Because of the financial constraints and focus on the value proposition though, CD startups deprioritize CC services and often omit CC capabilities into their value proposition. Their drivers for adopting CC services were mainly to save time, gain operational efficiency, and to shorten their time-to-market. Accordingly, this group preferred CC providers with a set of compatible and ready to use solutions. In contrast, IT&S startups viewed CC services as a necessity and so they adopted CC services for the same reasons but to a large extent also for product or service development. This group was therefore more driven to CC providers that enabled them to customize services, access a developer's community to co-create, and to scale their business on it. In overall, the sought benefits of CC were affordable cost structures, trusted environments with high security levels, and the omission of IT governance and IT maintenance. However, the perceivable advantages of the technology context were not always enough to stimulate adoption because of the influence of the environment. The following section illustrates therefore how the aforementioned contexts are related to the environment context and perceived openness.

The environment context proposes that startups working with sensitive information or with trading partners, face adoption challenges which has a negative effect on their CC adoption. These challenges include the need to comply with regulations or the need to comply with technologies and standards supported by trading partners. Such trading partners, e.g. a hospital, however, do not always support CC nor every service. As such, new CC solutions with strong perceivable advantages have a higher probability of being neglected by health tech startups if they fail to address uncertainties, e.g. degree of complexity to comply with regulations or obtain trading partner support. This environment context thus influences startups by reducing the importance of adopting the latest technologies, which are surrounded with higher degrees of uncertainty. This results in a higher demand from health tech startups for CC technologies with low uncertainties, or in the case of CD startups, a delay of incorporating CC capabilities in the value proposition. Accordingly, startups preferred trustworthy suppliers who possess a good reputation, are technically competent and have a large install base of users. In addition, strong support services for technological, financial, or regulatory issues were also found to have positive effects on uncertainty reduction. These CC technology suppliers can reduce uncertainties (further) by addressing aspects from the technology context, the environment context and by improving their openness levels. From the technology context, trial versions could be offered or systems with higher compatibility levels could be developed. From the environment context, uncertainties or adoption barriers could be reduced by establishing CC support from important and large trade partners, e.g. hospitals, within the healthcare market. To reduce adoption concerns further, CC suppliers can produce exemplary solutions and business models on their own platform. Developing on one's own platform raises the necessity substantially though of obtaining higher levels of being perceived as open. Although startups currently view producing behaviors as positive, this can change in the future as tensions rise due to market developments. Therefore, to reduce uncertainty and increase trust in the supplier, openness can be improved by addressing the transparency and the accessibility dimensions shown in Table 12. Another environmental influence were the informal networks in which health tech startups are active in. It is proposed that startups within such networks will often use a more similar set of technologies as they share their technology portfolio with each other than those who are not in such networks.

Lastly, the results show that the Dutch government plays an important role in the diffusion of CC services within the healthcare market. Concerns and instability surrounding privacy and security regulations have a negative influence on CC adoption. For example, startups argued that because of the lack of adequate regulations and agreements that the market is not ready for a health-related CC service distribution channel. As such, the government can improve CC usage by designing stronger or better

privacy legislations and security protection mechanism to promote CC usage among large HCO's. This could then have positive network effects on health tech startups by reducing uncertainties of using CC. This provides also an opportunity for CC suppliers and other important stakeholders such as hospitals or insurance companies to work with governments to establish such regulations and standards that advance the CC adoption within the healthcare market.

In conclusion, this study explored the cloud computing adoption behavior of health tech startups based on their context. It finds that health tech startups are intensive users of cloud services and are able to exploit cloud services such as that of HSDP. The adoption levels however are expected to depend mainly on the fit with the needs of the startups, the degree to which adoption uncertainties and complexities are reduced, and the affordability of the services. Furthermore, this study argues the importance of IT adoption models that capture multiple perspectives. These models are found to be highly relevant and useful for the explanation of adoption and diffusion of CC. Therefore, it is suggested that these adoption models deserve more attention from scholars and practitioners to understand the adoption behaviors of a sample.

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Appendix A. How Startups Can Create Value for Philips

The semi-structured interviews with Philips personnel show the following ways how Philips could benefit from health tech startups using HSDP.

HSDP could for example function as a mechanism to share IP and knowledge in a controlled matter and extend R&D capabilities into startup communities that allows Philips to fill strategic gaps and de-risk their core business. This allows startups to serve the long-tail or adjacent opportunities in the strategy, thereby illustrating opportunities or creating creativity spillovers to internal businesses. Moreover, these small opportunities could become a new valuable market or a threat eventually, and augmenting this group in a controlled way allows Philips to augment the market and learn about the occurrences in the market and act on this information accordingly. In addition, startups could function as valuable data sources or technology sources that increase the understanding of a person's context and could play a part in identifying the pathway of a certain disease. Also, their innovations could increase the depth of the Philips product portfolio. This could allow Philips to leverage the HSDP ecosystem to differentiate its core offerings from competitors allowing them to draw in more (diverse) users. Interestingly, early stage ventures were noted to be responsible for the majority of digital health innovations, so attracting these ventures to HSDP could allow Philips to offer the broadest and most innovative solutions to its customers without having to own or control the innovation. For example, a startup could develop a complementary image analysis solution related to a Philips MR that incentivizes a Philips partner to purchase a Philips MR over a competitors' MR. Furthermore, in terms of designing an effective platform and community, startups are perceived as a good benchmark. This means that by being able to address this target group, they could apply the same mechanisms in other areas. Table A.1 lists how startup could create for Philips.

Table A.1: The Value of Health Tech Startups on HSDP

Stakeholder	Value Proposition
Platform owner	• Extend R&D capabilities externally • Serve long tail or adjacent opportunities • Create spillovers to internal businesses • Function as data or technology sources • Fill strategic gaps and de-risk core business • Learn about market developments • Increase product portfolio • Offer the broadest and most innovative solutions to customers without having to own or control the innovation, i.e. offers valuable insights into potential ventures and need less M&A • Serve as a benchmark for other type of users • Opening channels to new markets

Appendix B. Characteristics of Services

A vast research field focusses on the marketing of services. Zeithaml and Bitner (1996) argue that services can be typified by their intangibility, level of heterogeneity, production and consumption, and perishability. First, a service can be seen as an intangible offering because it is difficult to touch, hold, smell or illustrate it. Without these possibilities, it is quite difficult to communicate their benefits.

Second, the heterogeneous needs of users require a service to be adaptable to address different needs. However, rather than communicating all of the features at once, a modularized marketing message could be used. This approach allows for an improved communication process and offers cost advantages.

Third, in terms of simultaneous production and consumption, cloud services have a manufacturing component, as they must be developed, and they also have a service component in which data transfer and continuous updates are needed (Zeithaml & Bitner, 1996; p. 20).

Finally, in terms of perishability, services cannot be kept in stock, transferred to other parties, or be returned to the vendor. The customers pay per usage and the services end with the cancellation of their subscription. Because users cannot control the "supply chain", most of these responsibilities rely with the provider to ensure that for example database services are able to process the peak of what is demanded (Zeithaml & Bitner, 1996). See Figure B.1 in this Appendix for an illustration of these differences in characteristics.

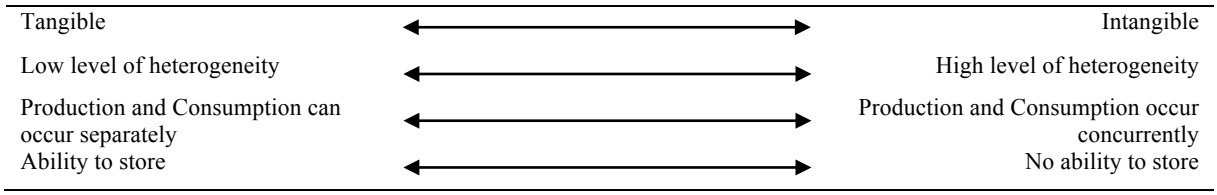


Figure B.1: Product/Service Characteristics. Adapted from: Zeithaml and Bitner (1996)

Appendix C. Cloud Computing Definition and Characteristics

Table C.1: Cloud Computing Definition, characteristics, service models, and deployment forms. Adapted from: Mell and Grance (2011)

Concept	Description
CC	A model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction
Essential characteristics of CC	• On-demand self-service, • Broad network access, • Resource pooling, • Rapid elasticity and • Measured service
Service Models	• Software as a Service (SaaS), i.e. delivers applications as a service to end users such as Microsoft office 365 • Platform as a Service (PaaS), i.e. enables users to design, develop, and deploy cloud applications such as Microsoft Azure • Infrastructure as a Service (IaaS), i.e. offers mostly hardware resources such as Amazon's Elastic Compute Cloud (EC2)
Deployment forms	• Private clouds, i.e. emphasizes privacy and security elements, but is complex to setup • Public clouds, i.e. emphasizes mass adoption, fast and easy configuration in a time and cost efficient way, but less secure than a private cloud • Community clouds, i.e. facilitates collaboration between a set of firms in a more cost efficient way than a prive cloud, and reduced risks than a public cloud • Hybrid clouds, i.e. combination of the other deployment forms simultanously in a separate matter to foster privacy and data security while reducing cost but increasing complexity

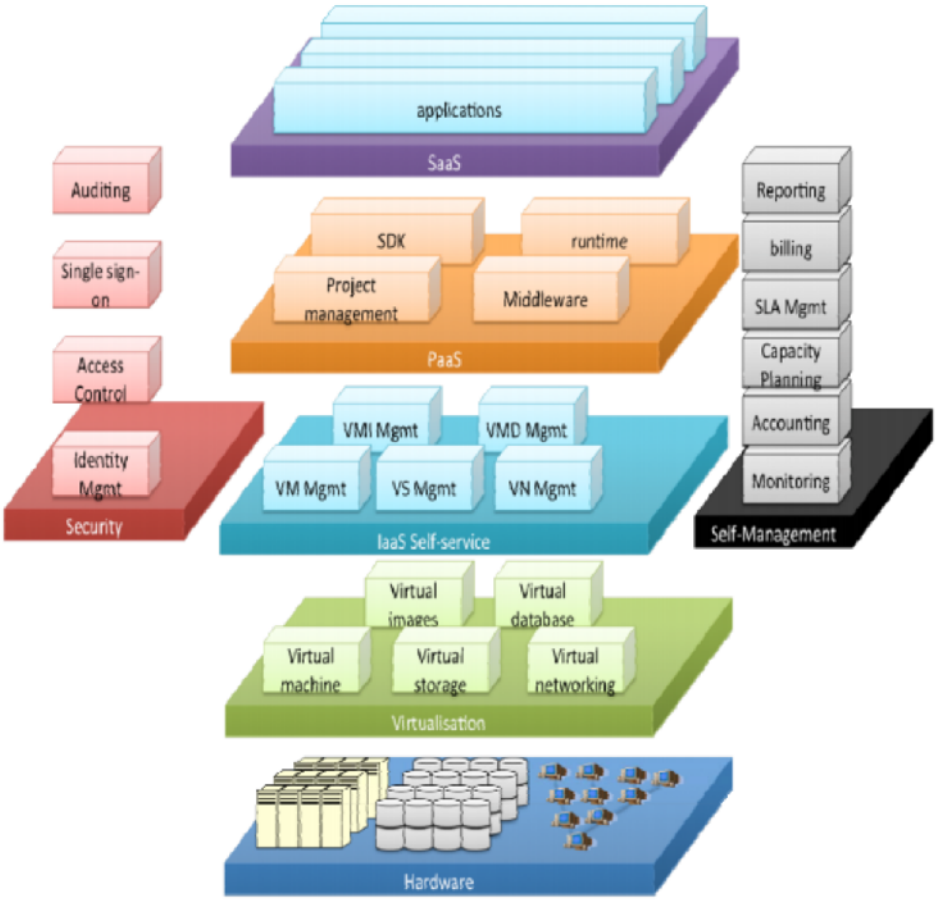


Figure C.1: A Reference Model for Cloud Computing Services. Adapted from: Chang et al. (2013)

Table C.2: Cloud Computing and the Separation of Responsibilities. Adapted from: Chou (2010)

On-Premises	CC Service Models		
	Infrastructure (as a Service)	**Platform (as a Service)**	**Software (as a service)**
Applications	Applications	Applications	Applications
Data	Data	Data	Data
Runtime	Runtime	Runtime	Runtime
Middleware	Middleware	Middleware	Middleware
O/S	O/S	O/S	O/S
Virtualization	Virtualization	Virtualization	Virtualization
Servers	Servers	Servers	Servers
Storage	Storage	Storage	Storage
Networking	Networking	Networking	Networking

Note: A green cell represents a responsibility of the provider whereas a blue cell represents a responsibility of the adopting unit (or end user)

Appendix D. Adoption Models

Table D.1: Theories of Adoption Models. Adapted from: Jeyaraj et al. (2006) and Schmitt et al. (2007)

Theory	Main author(s)	Used for explaining adoption among	
		Individuals	Organizations
Diffusion of Innovation	Rogers (1995)	X	X
Perceived Characteristics of Innovation	Moore and Benbasat (1991)	X	
Social Cognitive Theory	Bandurra (1986)	X	
Technology Acceptance Model	Davis (1989)	X	X
Technology Acceptance Model II	Venkatesh et al. (2003)	X	X
Theory of Planned Behaviour	Ajzen (1991)	X	
Theory of Reasoned Action	Fishbein and Ajzen (1975)	X	
Unified Theory of Acceptance and Use of Technology	Venkatesh et al. (2003)	X	
Diffusion/Implementation Model	Kwon and Zmud (1987)		X
Tri-Core Model	Swanson (1994)		X
Technology-Organization-Environment (TOE) Framework	Tornatzky and Fleischer (1990)		X

Note: The theories set in bold font are identified as potentially useful for this thesis.

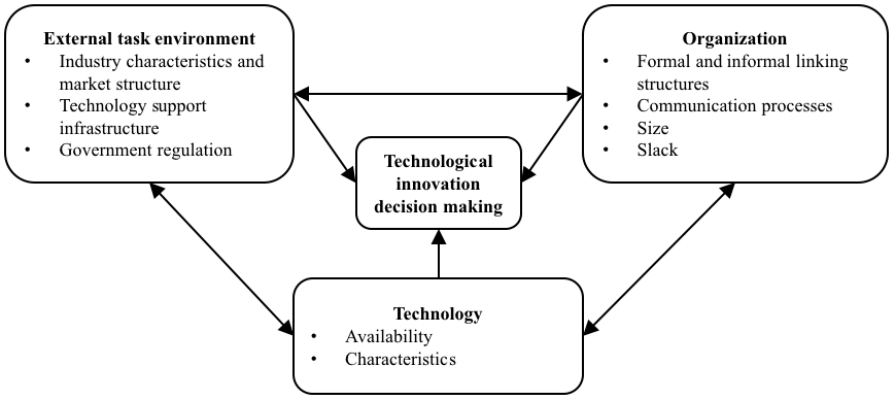


Figure D.1: Technology, Organization, and Environment Framework. Adapted from: Tornatzky and Fleischer (199)

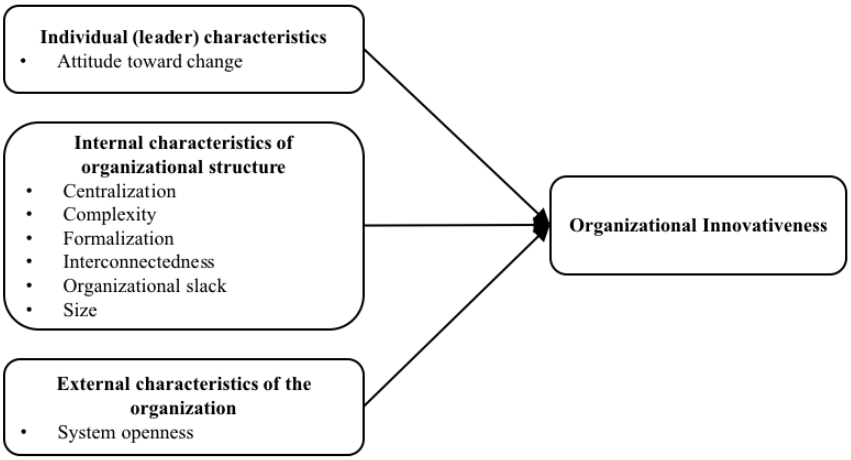


Figure D.2: Diffusion of Innovation Model. Adapted from Rogers (1995)

Appendix E. Cloud Computing Adoption Studies

Table E.1: Previous Studies on Cloud Computing Adoption. Adapted from: Hsu et al. (2014)

No.	Article	Theory	Sample/methodology	Main Results
1	Buyya et al. (2009)	No specific theory is used.	• Overview of CC	Definition, characteristics, resource management strategy, platforms, pricing and adoption of CC.
2	Lin and Chen (2012)	DOI	• Interview of 19 Taiwanese IT professionals	While the benefits of CC such as its computational power and ability to help companies save costs are often mentioned in the literature, the primary concerns that IT managers and software engineers have are compatibility of the cloud with companies' policy, IS development environment, and business needs.
3	Chang, Walters, and Wills (2013)	CCBF model	• Case study	CCBF is proposed to help organizations achieve good Cloud design, deployment, migration and services.
4	Wang and He (2014)	No specific theory is used	• Case study of a small e-learning service provider and its four clients in Taiwan	The service strategies of small cloud service providers are individually differentiated in order to survive in the competitive CC market.
5	Sultan (2011)	No specific theory is used	• Case study of a British SME	CC is likely to be an attractive option for many SMEs, particularly in the current global economic crisis, due to its flexible cost structure and scalability.
6	Brender and Markov (2013)	No specific theory is used	• Case study of Swiss companies	The adoption of cloud services depend on the company's size with larger and more technologically advanced companies being better prepared for the cloud.
7	Alshamaila, Papagiannidis, and Li (2013)	TOE and DOI	• Semi-structured interviews in 15 different SMEs and service providers in England. • Using Rogers' adopter categorization	The main factors that were identified as playing a significant role in SME adoption of cloud services were: relative advantage, uncertainty, geo restriction, compatibility, trialability, size, top management support, prior experience, innovativeness, industry, market scope, supplier efforts and external computing support.
8	Etro (2009)	Macroeconomic theory and DSGE model	• Macroeconomic data	The European Union with the creation of a few hundred thousand new SMEs and a significant contribution to growth. Governments could enhance these benefits by subsidizing the adoption of CC solutions.
9	Lian, Yen and Wang (2014)	TOE framework and DOI and HOT-fit model	• Survey of 106 CIOs of hospitals • ANOVA	The 5 most critical factors are data security, perceived technical competence, cost, top management support, and complexity
10	Lee, Chae, and Cho (2013)	Herzberg's two-factor theory	• Survey of 24 Korea IT consultants • AHP analysis	According to the PEST analysis, social economic and political factors inhibited SaaS adoption
11	Gupta, Seetharaman, and Raj (2013)	No specific theory is used	• Survey of 211 SMEs/SMBs • PLS	Firstly, ease of use and convenience is the biggest favorable factor followed by security and privacy and then comes the cost reduction. The fourth factor is reliability. The last one is sharing and collaborating.
12	Garrison, Kim, and Wakefield (2012)	Resource-based theory	• Survey of 314 IT managers • Structural-equations model	Cloud-vendor relationships characterized by trust are critical for cloud deployment and the promise of gaining advantage in a competitive market.
13	Wu, Cegielski, Hazen, and Hall (2013)	DOI	• Survey of 289 managers or executives • Regression analysis	Business process complexity, entrepreneurial culture and the degree to which existing information systems embody compatibility and application functionality significantly affect a firm's propensity to adopt cloud-computing technologies.

14	Hsu et al. (2014)	TOE and DOI	• Survey of 200 Taiwanese firms • PLS and discriminant analysis	The study investigates not only cloud adoption intention, but also pricing mechanisms and deployment model. Perceived benefits, business concerns, and IT capability are significant determinants of CC adoption, while external pressure is not. Firms with greater IT capability tend to choose the pay-as-you-go pricing mechanism. Business concern is the most important factor influencing the choice of deployment model.

Table E.2: Identified Constructs in Organizational Cloud Computing Adoption Studies. Adapted from: Oliveira et al. (2014) and Asatiani (2015)

#	Variable	Source(s)/Context	# of Sources
		Technology Context	
1	**Relative advantage**	Low et al. (2011); Abdollahzadegan et al. (2013); Wu et al. (2013); Lin and Chen (2012); Alshamaila et al. (2013); Benlian and Hess (2011); Hsu et al. (2014); Repschlaeger (2013); Trigueros-Preciado et al. (2013); Gangwar et al. (2015a; 2015b); Garrison et al. (2012)	12
2	**Compatibility**	Abdollahzadegan et al. (2013); Wu et al. (2013); Lin and Chen (2012); Alshamaila et al. (2013); Hsu et al. (2014); Lian et al. (2014); Repschlaeger (2013); Gangwar et al. (2015a; 2015b)	9
3	**Complexity**	Abdollahzadegan et al. (2013); Lin and Chen (2012); Lian et al. (2014); Gangwar et al. (2015a; 2015b)	5
4	**Trialability**	Alshamaila et al. (2013)	1
5	**Observability**	Lin and Chen (2012)	
		Organizational Context	
6	**Top management support**	Low et al. (2011); Abdollahzadegan et al. (2013); Alshamaila et al. (2013); Lian et al. (2014); Gangwar et al. (2015a; 2015b); Garrison et al. (2012)	7
7	**Organizational readiness**	Abdollahzadegan et al. (2013); Hsu et al. (2014); Lian et al. (2014); Gangwar et al. (2015a; 2015b); Garrison et al. (2012)	6
8	**Innovativeness**	Wu et al. (2013); Alshamaila et al. (2013); Lian et al. (2014); Nkhoma (2013)	4
9	**Training and education**	Gangwar et al. (2015a); Gangwar et al. (2015b); Garrison et al. (2012)	3
10	**Firm size**	Low et al. (2011); Abdollahzadegan et al. (2013); Alshamaila et al. (2013)	3
11	**Prior technology experience**	Alshamaila et al. (2013); Garrison et al. (2012)	2
12	**Business process complexity**	Wu et al. (2013)	1
		Environmental Context	
13	**Trading partner support**	Low et al. (2011); Alshamaila et al. (2013); Hsu et al. (2014); Gangwar et al. (2015a; 2015b); Repschlaeger (2013)	6
14	**Competitive pressure**	Low et al. (2011); Abdollahzadegan et al. (2013); Lian et al. (2014); Gangwar et al. (2015a)	4
15	**Supplier trustworthiness & reputation**	Gupta et al. (2013); Repschlaeger (2013); Garrison et al. (2012)	3
16	**Industry**	Alshamaila et al. (2013)	1
17	**Regulatory support**	Lian et al. (2014)	1
18	**Market scope**	Alshamaila et al. (2013)	1

Appendix F. Digital Industry Platforms

This section provides further information about digital industry platforms and its key concepts. Additionally, it discusses how an ecosystem of external developers around these platforms are created.

The emergence of platforms is evident in a range of industries, such as the automotive, aerospace, media, telecommunications, and information technology industries. Platforms have taken a central role in innovation due to the widespread of digital technology in both innovation processes and outcomes (Yoo et al., 2012). The unique characteristics of digital technology provide an environment of open and flexible affordances that are used in creating innovations characterized by convergence and generativity (Yoo et al., 2012; Hacklin et al., 2013). Technology affordance describes the action potential of a person with a technology or information system, which increases with the rise of internet of things products (Majchrak and Markus, 2012). Generativity is here defined as the overall capacity of a product to produce unprompted alteration driven by large, varied, and uncoordinated users. This generativity can support firms to address current and changing customers' needs substantially faster (Weill & Woerner, 2015). Several studies have found the positive effects of opening up a platform for external developers to accelerate developments (Boudreau, 2010). The shift towards capturing external creativity requires firms, though, to exploit alternative methods including online communities, open innovation, and innovation challenges (Yoo et al., 2012). Indeed, exploiting external and diverse knowledge is one of the key reasons for opening a platform. However, this external knowledge must also be actively applied, which requires deliberate effort and investment. Additionally, coherence could be lost when multiple firms try to innovate concurrently (Gawer & Cusumano, 2002). Therefore, platform owners have to manage the degree of convergence and generativity to prevent chaos (Yoo et al., 2012).

Although a clear consensus on the definition of platforms is missing in the literature, this study adopts the definition of platforms (also referred to as industry-wide platforms) as defined by Gawer and Cusumano (2014). Industry-wide platforms are defined as products, services, or technologies developed by one or more firms, and which serve as foundations upon which a larger number of firms can build further complementary innovations, and potentially generate network effects (Gawer & Cusumano, 2014). This definition is selected because both authors are key influencers within the platform literature and it clearly captures the essentials of a platform.

Furthermore, Thomas et al. (2014) identify in their meta-analysis the literature stream about ecosystem platforms, which is to a great extent similar to industry-wide platforms. This stream perceives the platform as the central point of control that has a central actor, which can be the platform leader or a hub firm, who orchestrates value creation and value appropriation within a technology-based business system (Ceccagnoli et al., 2011; Cusumano & Gawer, 2002; Gawer & Cusumano, 2008). Platform owners can be viewed as an integrator or as a platform leader (Nambisan & Sawhney, 2011). An integrator is one that primarily focuses on envisioning the foundation and integrating partners' contributions to create the final product or offering, e.g. Amazon.com. In contrast, a platform leader is one that designs and develops the foundation (platform) and supports partners' complementary innovations that expand its reach and range, e.g. Amazon Web Services (AWS) (Amazon Web Services, Inc., 2016).

Furthermore, ecosystem platforms are often referred to as multi-sided markets because they serve multiple side of users with goods or services, where these distinct group of users need each other and exploit the platform to mediate their transactions (Eisenmann et al., 2006). However, not all multi-sided platforms are perceived as ecosystem platforms. This perception is only valid in cases when they

promote innovation (Gawer & Cusumano, 2014). In this regard, the digital retail store of Amazon is not viewed as an ecosystem platform, but AWS is.
The following discusses the platform ecosystem further in detail and elaborates on the essentials of a platform.

Appendix F.1 The platform Ecosystem

A collection of firms who are linked loosely together that co-evolve their capabilities and roles and align their investments to create and capture value is referred to as a business ecosystem (Moore, 1993). As an example, the smartphone ecosystems connects computing, consumer electronics, media, and the mobile telecommunications industries. This system represents a complex structure of actors who collaborate and compete to create new offerings based on a shared set of technologies, knowledge, or skills (e.g., marketing). Accordingly, a platform enables ecosystem participants to leverage each other's capabilities as well as to enhance their individual innovation and financial performance. Additionally, platforms facilitate specialization by promoting horizontal innovation as increasing efficiencies are obtained by conducting the identical innovation activities across multiple products or platforms.

An ecosystem of heterogeneous actors around the platform is formed as external parties are enabled to develop complements, i.e. their products, services, or technologies, "on top" of a platform via pre specified interfaces (Gawer, 2009; Gawer & Cusumano, 2002; Tiwana et al., 2010). The architecture of a platform facilitates this process, by functioning as a conceptual blueprint that describes how the ecosystem is divided into a relatively stable platform and a complementary set of complements that are encouraged to vary, and the design rules binding both (Tiwana et al., 2010). In essence, products are complements when the demand for one increases as more of the other is sold, e.g. demand for iPhone apps increase as more iPhones are sold. Accordingly, synergies are obtained as sub-systems complement the platform (Gawer & Henderson, 2007). This industrial community and surrounding ecosystem is a critical success factor for a platform (Thomas et al., 2014).

The increasing growth in industry platforms has enabled a wide and diverse set of firms around the world to participate in associated innovation and value creation opportunities (Boudreau and Lakhani, 2009). A large and diverse innovation network of heterogeneous members indicates the value and knowledge potential to and of its members (Fagerberg, 2006). The usefulness of this diversity, though, depends largely on whether complementors are motivated and willing to contribute significant investment and effort (Boudreau, 2010). Although opening the platform to heterogeneous groups of complementors could result in spillovers that foster innovation, it could also reduce incentives to innovate by increasing competition (Parker & Van Alstyne, 2014). Concurrently, platforms are increasingly built on top of open technology standards to increase their openness. This shift has lowered the barriers to ecosystem participation for entrepreneurs with limited resources and capabilities. These partners are dispersed over the world because it is currently easier to interact and collaborate due to advanced information technologies. As such, physical proximity is no longer a key issue for ecosystem membership (Zahra & Nambisan, 2007). Constantly attracting new developers or avoiding that existing developers churn to rival platforms are thus important goals for the platform's long-term viability and success (Benlian et al., 2015). Evidently, successful innovation within innovation ecosystems depends on the depth of a firm's network, the reach of inter-organizational relationships, and the linkages with other networks in and outside its major industry (Zahra & Nambisan, 2011). Table F.1 and Figure F.1summarize and illustrate the core concepts underlying a platform ecosystem. The following sub-sections discuss the architectural characteristics and the key concepts of platform ecosystems.

Appendix F.2 The Platform Architecture

The characteristics of a platform architecture are its: decomposition, design rules, and modularity.

Decomposition illustrates the subsystems and functionality that are part of the platform's core and which ones are outside of it, and their separability. This concept is further explored in the next section. Design rules refer to the rules that complementors have to obey to maintain interoperability with the rest of the ecosystem. This concept is further highlighted in Chapter two. Finally, Modularity indicates the degree to which the innovation architecture of a network is separated into independent or loosely coupled modules, and the degree to which the interfaces that connect those modules have been specified and standardized (Baldwin & Clark, 2000).

The following sections discuss the key constructs of platforms, starting with the well-established relationship between modularity and innovation.

Appendix F.3 Modularity and innovation

Modularity is a method for reducing complexity. This modularity is achieved by decomposing a system into independent or loosely coupled systems, which then can interact with each other only through standardized interfaces within a standardize architecture. The level of modularity refers to the degree to which the innovation architecture of a network is separated into independent or loosely coupled modules, and the degree to which the interfaces that connect those modules have been specified and standardized (Baldwin & Clark, 2000). As an example, by applying modularity to a digital product, alternative layer(s) of this offering could be made accessible (Yoo et al., 2010). This figure shows the four different layers: the device layer, e.g. the computer hardware and its operating system, the network layer, e.g. cables, transmitters, and network standards, the service layer, handling the functionalities of the application such as creating, manipulating, storing and consume content, and the final layer is the content layer, which includes data such as texts, sounds, images, and videos that are stored and shared. Subsequently, these layers allow a digital product platform to act as a new product and concurrently enable others to innovate upon using firm-controlled platform resources, such as software development kits (SDKs), and Application Programming Interfaces (APIs). This method enables developers to develop new products or services by combining different modules. These modules expand each other's capabilities, as long as both follow the same standard and communicate through prespecified interfaces. In this way, a smartphone uses its GPS module to transmit its data in line with the Google's map API to visualize the location of a user (Yoo et al., 2012).

Furthermore, a platform tends to facilitate innovation. Defining innovation broadly, it can take the form of an idea, process, product, or service that is perceived as novel by an individual or other unit of adoption (Rogers, 1995). Innovations can be categorized broadly into two types of innovations, i.e. incremental or radical. This category is mainly determined by the newness of ideas, processes, products, or services. Thus, innovations which entail small changes in technology, simple product advancements, are perceived as incremental innovations (Zhou et al., 2005). In contrast, innovations which are novel, unique, or state-of-the-art technological improvements in a product category that significantly alter the consumption patterns of a market, are perceived as radical innovations (Wind & Mahajan, 1997). Miller (2006) notes that radical innovations have the potential to create new product categories, possibly new business models, and transform an industry or market with the introduction of a fundamentally new, higher value proposition.

Platforms facilitate innovation through their modular construction in three ways (Baldwin & Clark, 2000; Nambisan & Sawhney, 2011). First, modularity helps to limit the complexity of innovation process. This process significantly reduces the amount of system interconnections needed to make for an adopting member, and thus increase the ease of use. Second, modularity significantly reduces the amount of information that designers need to comprehend to design their complements. This process enables one to specialize and devise innovative labor. Third, modularity fosters autonomous innovation

within modules while maintaining internal coherence. Internal innovation coherence reflects the alignment of the innovation tasks, components, and interactions of the members within the ecosystem. Lack of internal innovation coherence is often materialized in terms of process delays, design redundancies, technological compatibilities, higher innovation costs, and inferior performance. Modularity offers besides flexibility, also communication and coordination advantages. In terms of communication, modularity indicates to the key design stakeholders about the underlying assumptions and expectations related to the functions and roles of the alternative parts. In terms of coordination, modularity indicates to members the appropriate activities for synchronizing and interacting with the modules. This internal coherence can further be stimulated in ways such as providing workshops, guidelines, physical (or digital) meetups to test interoperability between innovation components (Nambisan & Sawhney, 2011).

Finally, modularity fosters combinatorial innovation, which increases the potential level of generativity, and thereby the innovation output of a platform ecosystem (Gawer, 2014; Nambisan & Sawhney, 2011). Innovation can be leveraged by ecosystem members by sharing or reusing technologies, processes, intellectual property, and other innovation assets. These leverageable assets include design libraries, sharable utility components and application development tool sets (Nambisan & Sawhney, 2011). The following section discusses the next key concept, which are network effects.

Appendix F.4 Network Effects

Multi-sided markets are prone to the aforementioned network effect. Network effects are phenomena that describe the relationship between the value of a product and its installed base (Katz & Shapiro, 1985). The prescription for success with a network product is maximizing the installed base rapidly to achieve market dominance, because of its positive influence of user's product adoption decision (Gawer and Cusumano, 2008; Lee & O'Connor, 2003). This dominance is, once obtained, difficult to lose due to switching costs, which can be economically but also psychological (Gourville, 2006). Additionally, the beliefs about the size of the installed base significantly affects the user's product adoption decisions. Therefore, although launching a new product often means that the order of entry and relative product advantage (intrinsic value drivers) are essential, launching a network product in contrast means that extrinsic value drivers are more important because they can override the intrinsic value drivers. Thus, a more suitable launch strategy for network products is to preannounce the launch, to target the mass, use a penetration price, and to bundle the product with other products (when possible). The aim is to obtain a critical mass in a short period that eventually leads to long-term performance such as market share, profitability, and customer loyalty (Lee & O'Conner).

Network effects originate from two sources. The first kind is referred to as the "direct", also called "same-side", network effects or demand-side economies of scale or economies of mass adoption. These effects occur when the value of a product to any user depends on the network's size, where a larger size is more appealing than a smaller size. As an example, the value of Facebook for a user increases as friends, and friends of friends adopt this platform. When possible, the accompanying technical standard reinforces this effect by making it difficult or costly for users to use multiple platforms, referred to as multihoming (Gawer and Cusumano, 2014). For example, some iPhone applications require other users to have the same smartphone.

The second form is referred to as "indirect" or "cross-side" network effects. These effects occur, in multisided markets, when the value of the platform increases for one side of users as the other side of users' increases. As an example, Facebook becomes more valuable for advertisers as the amount of users increases. This indirect network effects promotes the idea of subsidizing one or multiple sides of the platform (Eisenmann et al., 2006). However, Boudreau (2012) finds that this effect has its limits, where

too many complementors within the same software genre (e.g. spreadsheets and spreadsheets, games and games) may discourage additional complementors from entering the ecosystem (Williamson & De Meyer, 2012).

In short, a platform product's attractiveness for end-users is strongly correlated with the availability of complementary applications. However, third-party developers are only willing to produce complementary applications if a platform provides sufficient incentives to fulfil developers' needs such as value appropriation or recognition. Although desired outcomes in industry platforms are achieved mainly through pricing strategies and rules set by the platform owner, combinations of legal, technological, informational, sharing risks and other instruments are also found to be used in practice (Eisenmann et al., 2006; Boudreau & Hagiu, 2008; Gawer & Cusumano, 2002). These elements describe the governance of a platform. In addition, this construct describes the control points to influence open source code projects with regards to access to the source code, how the source code is developed, how derivatives are created, and the community structure of the project. The influence and the perceived openness about these decisions is discussed in the following section.

Table F.1: Definitions of Core Concepts Underlying Platform Ecosystems

Concept	Definition
Platform	• Products, services, or technologies developed by one or more firms, and which serve as foundations upon which a larger number of firms can build further complementary innovations and potentially generate network effects (Gawer & Cusumano, 2014)
Complement	• A product, service, or technology that connects to the platform to add functionality to the platform
Ecosystem	• The set of the platform, the complements specific to it, and the interfaces between them
Interfaces	• Specifications and design rules that define how the platform and the complements interact and exchange information
Architecture	• A conceptual blueprint that describes how the ecosystem is divided into a relatively stable platform and a complementary set of complements that are encouraged to vary, and the design rules binding on both (Tiwana et al., 2010)
Key Concepts	• Network externalities; innovation; standards; modularity; Openness (Thomas et al., 2014)
Value creation	• Flexibility; cost savings; innovation; externalities; innovation; learning; market power (Thomas et al., 2014)

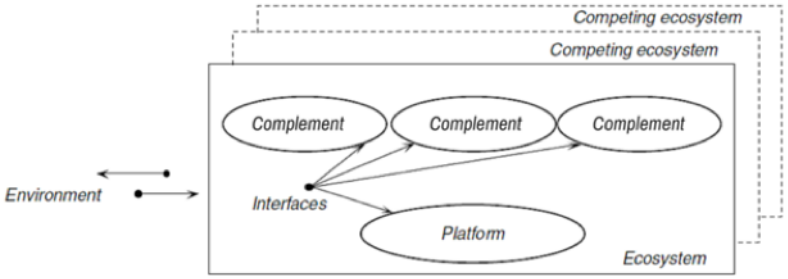


Figure F.1: Elements of Platform Centric Ecosystems. Source: Tiwana et al. (2010)

Appendix F.5 Perceived Platform Openness

The success of open source projects, e.g. Eclipse, Linux, and Mozilla is evident in long term involvement of users and developers. Additionally, a significant amount of derivate projects are present. Also, projects are consistently being developed, evolving over time, and maturing. Successful open projects are found to share certain attributes. These attributes include timely access to source, strong developer tools, process transparency, accessbility to contributing code, and accessibility to becoming a committer. Also, developers are increasingly expected to be treated equally and fair, meaning that centralized decision-making is, often, in the long run not appreciated (Laffan, 2012).

The openness of a platform can be viewed in two ways: horizontally, i.e. giving up some control by licensing the platform to additional platform providers, or vertically, i.e. broadening a platform's sponsorship, or granting third-party complementors access to the development platform and sales

market of complementary applications (Eisenmann et al., 2009; Boudreau, 2010). The remainder of this section focuses mostly on vertical platform openness to understand openness on an individual level and how it influences willingness of a developer to contribute to a software platform. Openness refers here to the degree to which external parties can access, understand, and modify one's system (West, 2003). illustrates further conceptualizons of platform openness found in the literature.

The right degree of vertical openness depends and represents a trade-off called 'diversity vs control' (Boudreau, 2010). This trade-off argues that cost and coordination issues arise as the degree of diversity increases. Therefore, Gawer (2014) and West (2003) both argue that the openness of a platform lies on a continuum of being closed to open for external parties. As noted earlier, platform owners can be an integrator or a platform leader with their own type of business model. According to Gawer (2014), opening means at least making interfaces available to external firms for access to the platform. When a company opens up its platform, it can exploit three alternative business models. An integrator uses for example the integrator business model, whereas a platform leader can choose from the product platform model or the two-sided platform model as described by Boudreau and Lakhani (2009). The integrator model was explained earlier. The Product Platform model allows external innovators to innovate on top of the platform and sell these complements to customers. Finally, the two-sided platform models allow external innovators and customers to exchange value with one another (through the platform or outside it as long as they also affiliate with the platform's owner). These business models are shown in Figure F.2. Accordingly, business models more on the left are more control oriented whereas the models on the right can provide more autonomy to external parties. For example, external innovators on product platforms have more and to hold a higher proportion of rights of control over their development, which provides them with advanced entrepreneurial autonomy in comparison to innovators on an integrator platform. External innovators on a two-sided platform could have the same freedom as the previous mentioned one, but here the platform owner could impose some degree of control over external innovators by for example using a set of alternative rules and regulations as a condition for their usage, e.g. iOS developers need to comply to certain conditions before their application is published in the App store.

In this regard, platform governance, which is defined as who makes what decisions about a platform, plays a vital role for platform owners to make strategic choices about aspects including access, ownership, and control when engaging and including external innovators. Therefore, not only a deep understanding of their individual attitudes and beliefs is crucial for an effective platform governance, but also a delicate balance of control by a platform owner and autonomy among these external innovators (Benlian et al., 2015). According to Benlian et al. (2015), this importance stems mainly on two reasons. First, because besides important factors such as potential financial performance of applications or the competitive intensity on the platform, aspects such as interoperability with other platforms and application review processes are important evaluation criteria for them. Second, the individual beliefs and attitudes of these external innovators could affect other third-party innovators' key decisions such as the selection of a platform, and important platform contribution behaviors such whether one should participate in the developer community or word-of-mouth communication with other developers and end-users.

Therefore, this study attempts to enhance the literature and work of Benlian et al. (2015) by leveraging the basis of their perceived platform openness construct and apply it to the current context of CC. In this way, the generalizability of their work can be examined. Moreover, with the conceptualization of this construct, the aim is to support Philips with their platform's long-term objectives by highlighting the variables that form complementors' perception of openness and the mechanisms on how to influence them.

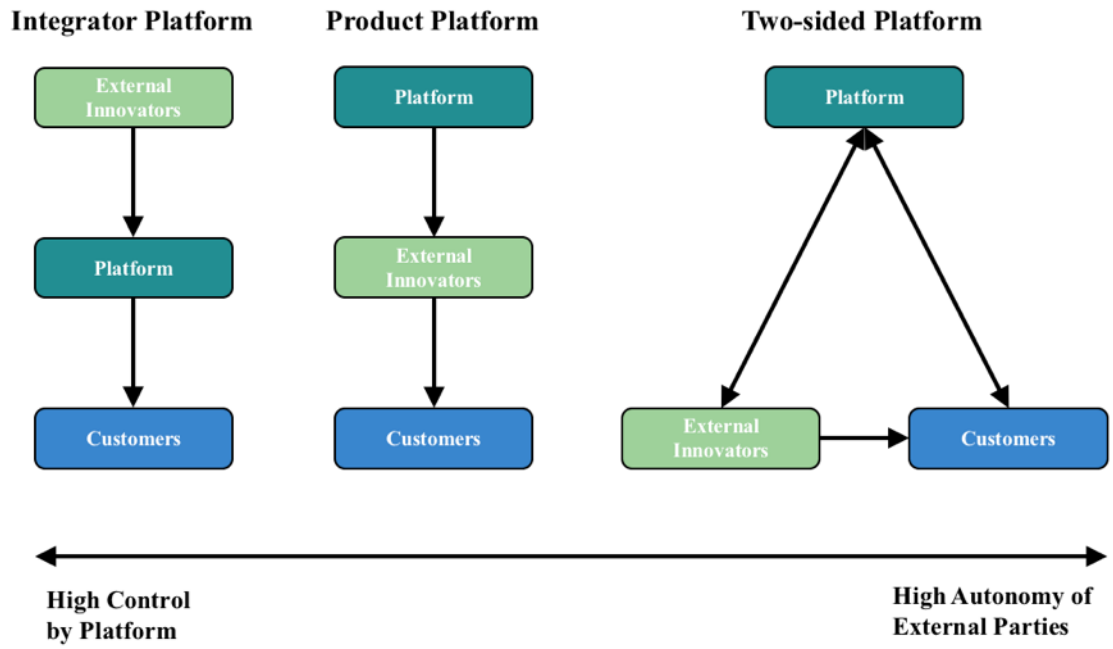


Figure F.2: Three Platform Business Models. Adapted from: Boudreau and Lakhani (2009)

Table F.2: Key Conceptualizations of Platform Openness. Adapted from: Benlian et al. (2015)

Key concepts	Conceptualization	Source
Access, development, derivatives, community	• Openness relates to the governance model created around a platform that determines the degree to which its decision-making processes are open to the community	Laffen (2012)
Granting access vs devolving control	• Openness relates to the easing of restrictions on the use, development, and commercialization of a technology	Boudreau (2010)
Access to resource vs control of resource	• Openness refers to the access, use, and control of information resources	Schlagwein et al. (2010)
Access and participation vs control and exclusion	• Openness as the degree of opportunities and invitations to users and third-party developers to participate in value creating activities	Arakji & Lang (2010)
Accessibility vs licensing	• Openness means the degree to which a software platform approaches to open characteristics which depend on accessibility and licensing as key aspects	Anvaari and Jansen (2010
Transparency and accessibility	• Openness relates to the participation architecture of developer communities	West & O'Mahony (2008)

Table F.3: Examples of Platform Perceived Performance. Adapted from: Benlian et al. (2015)

	Transparency	Accessibility
Technical Platform	• Exchange among developers • Technical documentation • Technical support by provider	• Learnability of technical standards • Availability of development tools • Technical interoperability • Functional scope Technical performance
Distribution Channel	• Communication regarding app review and marketing guidelines • Transparency of terms and conditions • Notification practices • Transparency of available market mechanisms • Opportunities of communication with end-users	• Cost of required technical equipment • Cost of selling • Restrictions in terms and conditions • Constraints through app review and marketing guidelines

Appendix G. Interview Questions

Interview "CC Adoption Interview" – for Health Tech Startups

With this interview, I want to identify the factors that stimulate and inhibit the adoption of CC by health tech startups. More specifically, I want to study the influence of the technology and its openness, the venture, and the environment on CC adoption behavior.

The expected duration for this interview is 30 minutes.

Of course, participation in the research is on a voluntary basis. Responses to the interview are anonymous and are treated confidentially. The information gained during the interview will be only used for this research, and the information will be anonymously presented within the research report.

This interview is part of a research that I'm conducting for Philips Design regarding CC adoption by startups in the health tech sector. The research is also part of the graduation project for the degree of Master of Science in Innovation Management in the department of Industrial Engineering and Innovation Sciences at Eindhoven University of Technology.

Additional information regarding this research may be obtained from Melkon Youssif (youssif.melkon@philips.com)

Thank you very much in advance for your cooperation.

(for administration purposes)
Company: _____
Name: _____
Function: _____

For startups

Firm Background

1. Can you please tell me about your firm's background?

Continue with Google Forms

Level of IS Innovations adoption & Use in the Firm

2. What IS innovations does your business need? Why?
3. What IS innovations has your business adopted?
4. What was the process of selecting these IS innovations?
5. What are the main disadvantages/benefits of running your IT operations on-premises?
6. How effective do you think your business is in exploiting new IS innovations?
7. What challenges do you think startups are confronted with in the adoption of new IS innovations? Why?

Figure G.1: Four Major Functions of a Company. Adapted from: Laudon and Laudon (2008)

Continue with Google Forms

Explorative CC usage questions

8. To what extent do you feel your firm is aware of CC?
9. Does your firm have a business model that can take advantage of CC?
10. What do you think that the main benefits are of (adopting) CC for your firm?
11. What do you think that the main challenges are of (adopting) CC for your firm?

Now I would like to ask you questions about your experience and perspective from the following three areas: technology, the organization, and the environment

Impact of TOE Factors on CC Adoption: If we classify these factors into 3 groups (Technological, Organizational and Environmental):

Technological variables can be further divided into the following characteristics

a) Relative advantage
b) Complexity
c) Compatibility
d) Trialability
e) Observability

12. How do the above mentioned technological variables influence your startup's decision to use a PaaS?
13. Which organizational factors influence your startup's decision to use a PaaS?
14. Which environmental factors influence your startup's decision to use a PaaS?

Explorative Perceived Platform Openness questions

15. What do you associate with the openness of CC platform and how does this influence your startup's decision to use it?
    (1) And which of these are important for your decision-making to adopt it?

For Philips Employees

Interview "CC Adoption Survey" – for Philips employees

With this interview, I want to understand the strategy of Philips to stimulate the adoption of HSDP. In addition, I want to understand what is needed to successfully launch a Platform as a Service in the market.

The expected duration for this interview is 1 hour.

Of course, participation in the research is on a voluntary basis. Responses to the interview are anonymous and are treated confidentially. The information gained during the interview will be only used for this research, and the information will be anonymously presented within the research report.

This interview is part of a research that I'm conducting for Philips Design regarding CC adoption by startups in the health tech sector. The research is also part of the graduation project for the degree of Master of Science in Innovation Management in the department of Industrial Engineering and Innovation Sciences at Eindhoven University of Technology.

Additional information regarding this research may be obtained from Melkon Youssif (youssif.melkon@philips.com)

Thank you very much in advance for your cooperation.

(for administration purposes)

Company: _____

Name: _____

Function: _____

1. Can you please tell me about yourself?
    a. Position
    b. Relationship with HSDP

Questions about CC

1. What are the main disadvantages/benefits of running IT operations on-premises?
2. What challenges do you think health tech startups are confronted with in the adoption of new IS innovations? Why?
3. What do you think that the main benefits are of (adopting) CC for startups?
4. What do you think that the main challenges are of (adopting) CC for startups?

Questions about HSDP and startups

5. What is the difference with promoting HSDP in comparison with other products in the past?
6. What is the value of having health tech startups using HSDP?
    a. What are the advantages and disadvantages of attracting external health tech startups to HSDP?
7. What does HSDP offer that is unique and attractive for startups?
    a. And how to address heterogeneous group of users?
        i. Hardware – Hardware/software / Software OR different phases in lifecycle
    b. And how to distinguish between clinical and non-clinical offerings?
8. How is the adoption of HSDP among health startups being stimulated?
9. How do you think that the stimulation of HSDP among health tech startups should be stimulated?
    a. Could Philips use its installed base of customers to stimulate adoption? If so, how?
    b. Which third-party firms could become complementors for your platform?
    c. With which entities could Philips collaborate with to accelerate this adoption?
        i. Do you think that partnership program's designed for other parties (e.g. system integrators/technology partners/resellers) would accelerate this adoption?
    d. Which offerings could be bundled to accelerate this adoption?
    e. Which pricing strategy helps to stimulate this adoption?
    f. Which targeting strategy is suitable for HSDP?
        i. Should there be different processes for different type of target groups?
    g. How does the openness about the platform influence the adoption rate of platforms? And how can Philips be open enough about it?
    h. How can Philips improve its image among health tech startups?

Extra questions

10. Which type of external startups is or should Philips target with HSDP?
    a. Should there be different processes for different type of users?
11. How can Philips reinforce the business models of these startups?
12. At which time in the venture's life cycle do you think is appropriate for Philips to allow connection with HSDP (pre-seed, seed, early growth)?
13. How can Philips improve its position or capabilities to address this group better?
14. Should Philips share risks with startups? If so, how?

Appendix H. Survey Questions

Dear respondent,

Thanks for your participation in this survey.

The aim of this survey is to identify the factors that could influence the decision-making of startups in the health tech sector to use cloud services. Therefore, this survey is used to research the influence of the technology, internal and external contexts of your startup and the openness about the technology on your adoption decisions.

This survey consists of 39 questions and is expected to take about 10 minutes of your time.

Introducing Questions

1. What is your name?

   _____

2. What is the name of your startup?

   _____

3. What is your function within the startup?

   _____

4. How many employees does your startup have?
   Mark only one square

☐	2 or less employees
☐	Between 3 and 5 employees
☐	Between 6 and 10 employees
☐	Between 11 and 50 employees
☐	More than 50 employees

5. What is the amount of operational years for your startup?
   Mark only one square

☐	Less than a year
☐	Between 1 and 5 years
☐	Between 5 and 10 years
☐	More than 10 years

6. In which growth stage is your startup currently in?
   Mark only one square

☐	Seed/Startup
☐	Early Growth
☐	Other: _____

7. What is the approximate amount of IT budget according to you?
Mark only one square

☐	Less than € 100.000
☐	Between € 100.000 and € 500.000
☐	Between € 500.000 and € 1.000.000
☐	More than a million euros

8. How many patents are pending for your startup?
Mark only one square

☐	None
☐	Between 1 and 3
☐	Between 4 and 6
☐	Between 7 and 9
☐	10 or more
☐	Other: _____

Continue with the interview questions before continuing with the survey questions

Current usage of cloud services

9. To which degree would you rate yourself on being aware of CC and its potential for your business?
Mark only one square

Completely not aware	1	2	3	4	5	Completely aware

10. Does your startup have a business model that exploits cloud services?
Mark only one square

☐	Yes
☐	No
☐	Other: _____

11. Does your startup use cloud services?
Mark only one square

☐	Yes
☐	No
☐	No, but we intend to
☐	Other: _____

12. Which cloud services does your startup use?
Tick all that apply

☐	Software-as-a-Service (SaaS)
☐	Platform-as-a-Service (PaaS)
☐	Infrastructure-as-a-Service (IaaS)
☐	None of the above

13. Which deployment model do you prefer?
Tick all that apply

☐	Public cloud
☐	Private cloud
☐	Hybrid cloud

	None of the above

14. Which pricing mechanism do you prefer?
Tick all that apply

	Pay-per-use
	Monthly fee
	License
	Other: _____

Influence of the technology context
Indicate to what extent you agree with the following statements.

Complete the following sentence:

When deciding to use or not to use cloud services it is important to consider the

15. Relative advantages
Mark only one square

Completely not aware	1	2	3	4	5	Completely aware

16. The level of observability about the benefits that can be obtained
Mark only one square

Completely not aware	1	2	3	4	5	Completely aware

17. The level of compatibility with other IT systems, your existing values and past experiences
Mark only one square

Completely not aware	1	2	3	4	5	Completely aware

18. The level of complexity
Mark only one square

Completely not aware	1	2	3	4	5	Completely aware

19. The level of trialability
Mark only one square

Completely not aware	1	2	3	4	5	Completely aware

Influence of the organization context
Indicate to what extent you agree with the following statements.

Complete the following sentence:

When deciding to use or not to use cloud services it is important to consider the

20. The amount of employees of the startup where it is more likely that a startup with more employees will use such services earlier
Mark only one square

Completely not aware	1	2	3	4	5	Completely aware

21. The amount of employees of the startup where it is more likely that a startup with fewer startups will use such services earlier
Mark only one square

Completely not aware	1	2	3	4	5	Completely aware

22. Top management support

Mark only one square

Completely not aware	1	2	3	4	5	Completely aware

23. The attitude of the startup to be the first exploiting the latest technologies
Mark only one square

Completely not aware	1	2	3	4	5	Completely aware

24. The compatibility with the current technology infrastructure and IT knowledge
Mark only one square

Completely not aware	1	2	3	4	5	Completely aware

Influence of the environment context
Indicate to what extent you agree with the following statements.

Complete the following sentence:

When deciding to use or not to use cloud services it is important to consider the

25. The level of pressure from competitors
Mark only one square

Completely not aware	1	2	3	4	5	Completely aware

26. The government policy and support from the government
Mark only one square

Completely not aware	1	2	3	4	5	Completely aware

27. The support services of the technology supplier
Mark only one square

Completely not aware	1	2	3	4	5	Completely aware

28. The pressure from trade partners to use the service
Mark only one square

Completely not aware	1	2	3	4	5	Completely aware

Influence of the openness about the technology
Indicate to what extent you agree with the following statements.

Complete the following sentence:

When deciding to use or not to use cloud services it is important to consider the

29. The transparency of the service
Mark only one square

Completely not aware	1	2	3	4	5	Completely aware

30. The accessibility of service
Mark only one square

Completely not aware	1	2	3	4	5	Completely aware

31. The transparency about the distribution channel of the service
Mark only one square

Completely not aware	1	2	3	4	5	Completely aware

32. The accessibility of the distribution channel of the service
Mark only one square

Completely not aware	1	2	3	4	5	Completely aware

Additional questions

Indicate to what extent you agree with the following statements.

Complete the following sentence:

When deciding to use or not to use cloud services it is important to consider the

33. The IP policy of the service provider
    Mark only one square

Completely not aware	1	2	3	4	5	Completely aware

34. The possibility to leverage the innovations of others
    Mark only one square

Completely not aware	1	2	3	4	5	Completely aware

35. The presence of a developer's community
    Mark only one square

Completely not aware	1	2	3	4	5	Completely aware

36. The amount of end users using the service
    Mark only one square

Completely not aware	1	2	3	4	5	Completely aware

37. The accessibility to the customers of the technology supplier
    Mark only one square

Completely not aware	1	2	3	4	5	Completely aware

38. The price of the service
    Mark only one square

Completely not aware	1	2	3	4	5	Completely aware

Thanks for your cooperation!

39. Please fill in your email address to receive the results of this research

    _____

Appendix I. Acquisition Letter

The process for acquiring startup respondents occurred mainly in two steps. The first step included conducting a phone call to their office using the script shown below. The second step included an email to finalize the acquisition or to initiate contact in the case where step one did not succeed using a script mail shown below. Philips personnel were mainly contacted via the internal communication system Lync (Skype for Businesses) using customized messages.

Step 1
Dear,

I found your startup on [mention source]. I am currently conducting a graduation project for the degree of Master of Science in Innovation Management at the Technical University of Eindhoven. This project is currently being conducted for Philips Design in Eindhoven.

I am currently researching the decision-making process of health tech startups in the context of CC. Therefore, I would like to know if I could conduct an interview and a survey with one or more employees from your company who are involved in these type of challenges.

This is why I am looking for companies who are already exploiting cloud services, are thinking about exploiting these services, or are not planning to exploit these services

To which category do you think that your company belongs?

That is great. I would like to come over for a conversation if you could help me set up an appointment with one or more of your co-workers who are involved in these type of challenges.

I am available on [fill in].

Could I note their mail so that I can send them a meeting request with the details? Also, I will send them additional information one day before our meeting. This information could be read prior to the meeting, but I will summarize its content also during the meeting.

Thanks for your support

With kind regards,
Melkon Youssif
Graduate Intern at Philips Design Eindhoven
Student MSc. Innovation Management
Faculty of IE&IS Eindhoven University of Technology

Step 2 (if step 1 did not succeed)
Dear,

I'm currently conducting a research as a part of my Master thesis at Philips Design in Eindhoven. This thesis is also a part of the graduation project for the degree of Master of Science in Innovation Management in the department of Industrial Engineering and Innovation Sciences at Eindhoven University of Technology.

By interviewing health tech startups, I want to identify the factors that stimulate and inhibit the adoption of CC by these type of ventures. More specifically, I want to study the influence of the technology and its openness, the venture, and the environment on CC adoption behavior. In this study, CC services can be one of the following:

- Software (SaaS), such as Dropbox, Microsoft Office 366,
- Platform (PaaS), such as Microsoft Azure, or
- Infrastructure (IaaS), such as Amazon's Elastic Compute Cloud.

Therefore, I would like to interview one or multiple people from your startup who deal with these kind of matters. I would also like to conduct the interview when your organization does not use any cloud services.

The interview is planned to take approximately one hour. Of course, participation in this study is on a voluntary basis. The collected information during the interview will only be used for this research, and the information will be anonymously presented within the research report.

My findings will be used for two purposes. First, to design a model that predicts for a part the adoption behavior of health tech startups. Second, to design a strategy for Philips that could help them to stimulate the adoption of their Platform as a Service among health tech startups. More information about their platform can be found on YouTube by searching for the Health Suite Digital Platform.

Additional information regarding this research may be obtained from me by mailing to: youssif.melkon@philips.com

Thank you very much in advance for your cooperation.

With kind regards,

Melkon Youssif
Graduate Intern at Philips Design Eindhoven
Student MSc. Innovation Management
Faculty of IE&IS Eindhoven University of Technology

Appendix J. Codebook

Table J.1: Overview of the Codebook

- Technology Context
  - Relative Advantage
  - Complexity
  - Observability
  - Trialability
  - Compatibility
- Organization Context
  - Top management Support
  - Firm Size
  - Technology Readiness
  - Innovativeness
  - Organizational Competency
  - Experience of Members
  - Business Model
  - Venture Phase
  - Strategic Objectives
  - Clinical
  - Market scope
- Environment Context
  - Competitive Pressure
  - Regulatory Support
  - Supplier Support
  - Trading partner support
  - Client Base
    - Client Lack of Knowledge
    - Client Resistance to Adoption
    - Client Needs
    - Client Choice Abundance
    - Creating Awareness
  - Informal Networks
- Perceived CC Openness
  - Transparency Platform
  - Transparency Distribution Channel
  - Accessibility Platform
  - Accessibility Distribution Channel
- Influence on CC Adoption
  - Solution Already Available
  - Agile
  - Low Learning Curve
  - Integrated Solutions
  - Leveraging Innovation
  - Availability
  - SLA
  - Liability
  - Community
  - Ease of Building UI
  - Appropriating Innovation
  - Trust
  - Fast Access
  - Offline possibilities
  - Modules
  - Size of Installed base
  - Convincing Interface
  - Analytics
  - Open-Source
  - Quality
  - Reliability
  - Customer Experience
  - Certification Mark
  - Financial Support
  - Business Support
  - Technical Support
  - Legal Support
- Drivers CC
  - Future Proof
  - Short Time-to-Market
  - Big data
  - Efficiency
  - Governance
  - Shareability
  - Security
  - Global Access all the Time
  - Scalable
  - Connectivity
  - Challenges
  - Accelerator
  - Hackathon
  - Co-Creation
- Inhibitors
  - Long Time-To-Market
  - Cost
  - Substitute Products
  - Learning Curve
  - Solution Not Available
  - Overhead
  - Privacy Sensitivity
  - Sharing Data with Others
  - Producer on Platform 2
  - Security
  - Buggy Features
  - Lock-In
  - Collaborations already in Place
  - Competitiveness of Market
  - High Speed
  - Pay-Per-Use
  - Dependency on Supplier
  - Losing Data
  - IP protection
  - Lack of Standards
  - Switching Cost
- Customer Market
  - B2B
  - B2C
  - B2Bc
- Working with Sensitive Information
  - Low Sensitivity Info
  - High Sensitivity Info
- Using IS Systems for
  - Function
    - NPD
    - Sales and Marketing
    - Manufacturing and Production
    - Other function
- CC Service Model
  - SaaS
  - PaaS
  - IaaS
- Supplier
  - Brand
  - Size
  - High Specific Knowledge
  - Producer on Platform
  - Geolocation
  - Partners
  - Growth Strategy

Appendix K. Screenshots of the Excel Tool

HSDP Startup Focusing Tool

Welcome to the HSDP Startup Focusing Tool.

Introduction
This interactive tool is designed for the management of HSDP as the result of a master thesis.

This tool can thus best be used for two applications:
1. to increase the focus on relevant areas to address health tech startups, and
2. to stimulate discussion about the required steps to address health tech startups

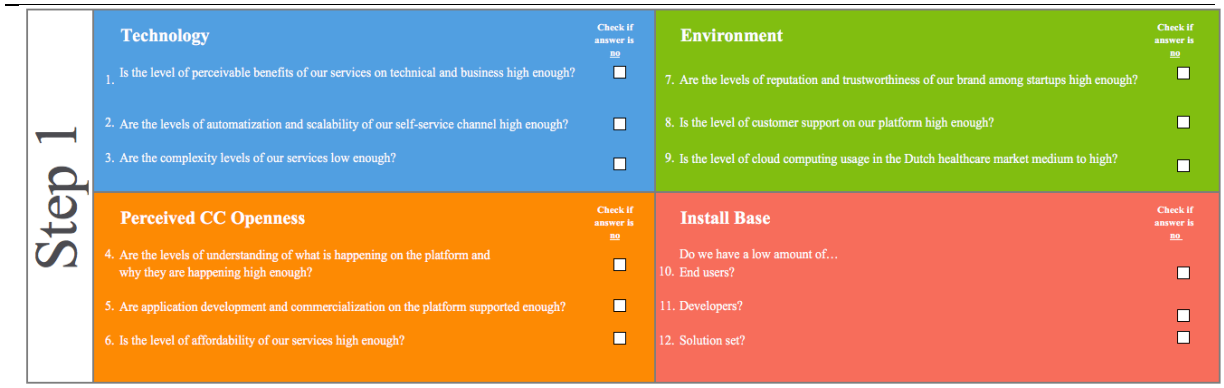
The aim of the tool is to provide indicative answers and should therefore not be treated as the only way or the best way to solve the issue.

How to use the tool
This tool can be used in multiple ways, including the following 2 ways:

Sequential
1. Answer the questions presented in Step 1 below.
2. Scroll down to Step 2 to find the highlighted recommendations in red to address the issue.
3. Discuss about the suggestions given

Higher Focus
1. Examine the four dimensions and use the questions inside them to spark discussion

Figure K.1: Screenshot of the Title and the Introduction of the Excel Tool



Step 1

Technology — Check if answer is no

1. Is the level of perceivable benefits of our services on technical and business high enough? ☐
2. Are the levels of automatization and scalability of our self-service channel high enough? ☐
3. Are the complexity levels of our services low enough? ☐

Environment — Check if answer is no

7. Are the levels of reputation and trustworthiness of our brand among startups high enough? ☐
8. Is the level of customer support on our platform high enough? ☐
9. Is the level of cloud computing usage in the Dutch healthcare market medium to high? ☐

Perceived CC Openness — Check if answer is no

4. Are the levels of understanding of what is happening on the platform and why they are happening high enough? ☐
5. Are application development and commercialization on the platform supported enough? ☐
6. Is the level of affordability of our services high enough? ☐

Install Base — Check if answer is no

Do we have a low amount of…
10. End users? ☐
11. Developers? ☐
12. Solution set? ☐

Figure K.2: Screenshot of the First Step of the Excel Tool

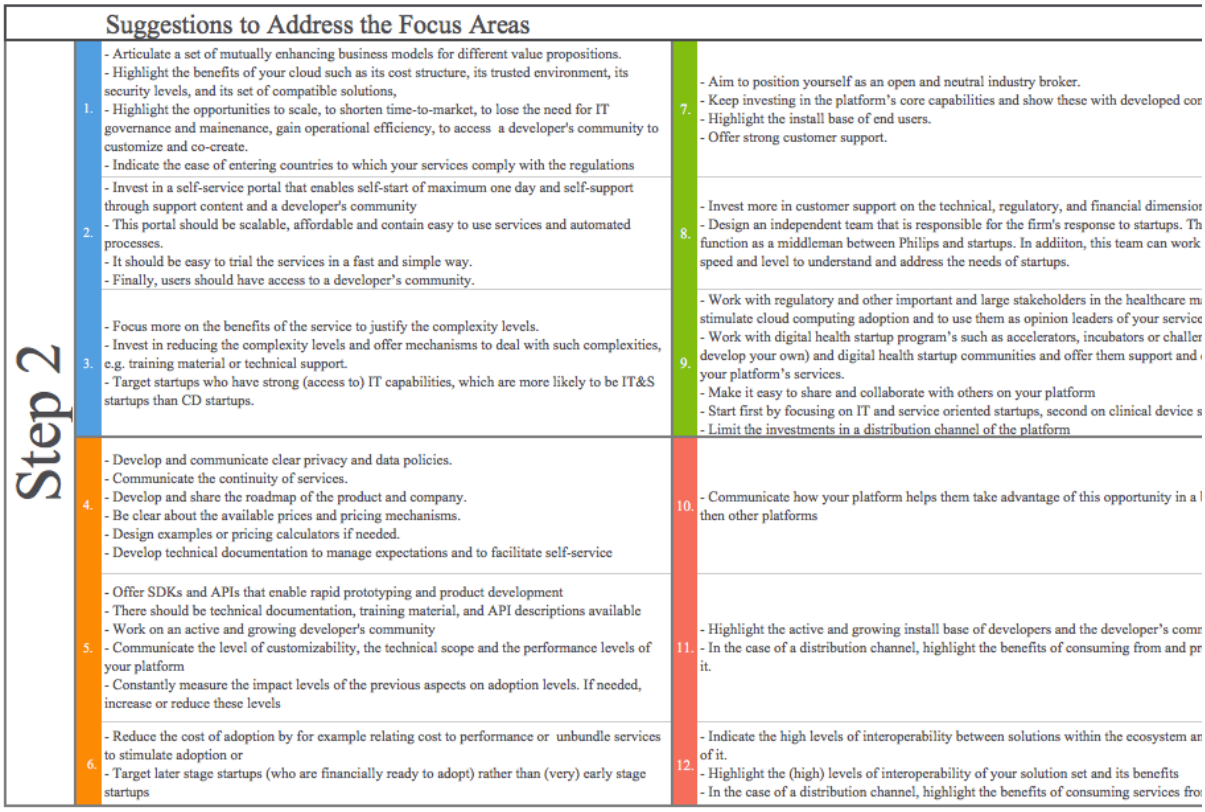


Figure K.3: Screenshot of the Step 2 of the Excel Tool