The Simplicity of Adopting Technologies
A case study of cloud computing

NERMIN CIRGIC

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Enkelheten av att införa teknologier

*En fallstudie om molntjänster*

NERMIN CIRGIC

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by

Nermin Cirgic

Master of Science Thesis INDEK 2015:75
KTH Industrial Engineering and Management
Industrial Management
SE-100 44 STOCKHOLM
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KTH Industriell teknik och management
Industriell ekonomi och organisation
SE-100 44 STOCKHOLM
Abstract
This thesis addresses the issue of adopting cloud computing in two aspects. The first being the procedure of choosing a commonality that constitutes the base of comparing the most appropriate cloud platform from identified parameters. The second being to find constraints of adopting cloud computing related to the commonality.

This commonality was identified in form of a process that portrayed characteristics which made it suitable for identifying parameters and comparing two cloud platforms (Azure and AWS). The comparison of platforms based on the parameters; lock-in, standardization and data security led to conclusive remarks that discouraged any further effort on comparing cloud platforms. Lack of standards and lock-in that cannot be avoided are traits of the unfitting environment the cloud platforms constitute.

Furthermore, it was concluded that the adoption constraints are first priority when it comes to adopting cloud computing. Instead of choosing the cloud platform with least amount of constraints, it is recommended to firstly focus on the adoption constraints.

Key words: cloud computing, cloud service provider, lock-in, standards, adoption of technology, parameter
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Nermin Cirgic

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<td>2015-06-16</td>
<td>Niklas Arvidsson</td>
<td>Cali Nuur</td>
</tr>
<tr>
<td>Uppdragsgivare</td>
<td>Scania</td>
<td>Kontaktperson</td>
</tr>
<tr>
<td></td>
<td>Jan Måehans</td>
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**Sammanfattning**

Avhandlingen tar upp frågan om att införa molntjänster i två aspekter. Den första är proceduren att välja en gemensam nämnare som utgör basen för jämförelse av den lämpligaste molnplattformen. Den andra är att hitta begränsningar relaterat till införandet av molntjänster i samband med den gemensamma nämnaren.

Denna gemensamma nämnare identifierades i form av en process inom en IT-avdelning som skildrar egenskaper vilket gjorde den lämplig för att hitta parametrar och jämföra två molnplattformar (Azure och AWS). Jämförelsen av plattformar baserades på parametrarna; lock-in, standardisering och datasäkerhet. Brist på standarder och lock-in som inte kan undvikas är egenskaper av den opassande miljön som molnplattformarna utgör.

Dessutom drogs slutsatsen att de nämnda begränsningar är av första prioritet när det gäller att införa molntjänster. Istället för att välja en molnplattform med minsta möjliga begränsningar, är rekommendationen att först fokusera på begränsningarna.

**Nyckelord:** molntjänster, molntjänstleverantör, lock-in, standarder, införing av teknologier, parameter
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Stockholm, May 2015

Nermin Cirgic
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1 Introduction

The aim of the introductory part of the thesis is to introduce the readers with the background related to the subject and to gain an understanding on the reason for conducting a study of this kind. Through the problem formulation and research question, the mentioned aim should be fulfilled with a delimitation to set the scope of this study.

1.1 Background

The goal and ambition of delivering value through technology has led to many questions being asked both in the research community and in practice. The questions are often related to exploring and analyzing emerging technological trends and solutions that might contribute to the mentioned goal and ambition. Issues related to adoption of technologies, organizational effects of adopting technologies and economic factors related to the mentioned adoption are examples of such questions being asked in the research community.

An example of such an emerging technology is cloud computing. NIST is an institution responsible for developing standards and guidelines that has defined cloud computing as “a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released...” (NIST, 2011). Cloud computing is a phenomenon that is widely being researched and spoken about. There are numerous of publications and similar research papers that vary in technological depth. Cloud computing is undoubtedly a major trend that is changing the way IT is being delivered and utilized. The time has however come to the stage when the mentioned technology is on the borderline of being classified as a trend. It has been known for over 20 years in the form that is present today but it could arguably be claimed that it is not until recent 10 years that the competition within cloud computing has reached attractable levels among the IT-giants’ offerings. Nevertheless, the implementation of cloud computing is still at early stages. The implementations are an ongoing process that grows in complexity with the size of the organization.
The technology is also mentioned as a paradigm in IT that offers greater flexibility at lower costs. Organizations are offered greater flexibility of technology infrastructure while reducing costs of owning the systems (Cegielski, et. al., 2012). This technology is also related to scalability, adaptability, and elasticity in the way that it is being provisioned to multiple users. It brings an abstractable level to technology in sense that it separates the end users from the location of resources and other technical infrastructural issues (Sleit, et. al., 2013).

It is an industry that has been estimated to be worth $35 billion (Morgan & Conboy, 2013). The popularity of cloud computing has in recent time made many large corporations consider the option of migrating to solutions related to the mentioned technology. There are issues related to the implementation of cloud computing where the curiosity is high and where studies on different approaches are being conducted on a daily basis. Security, accountability and organizational effects are some of the factors that carry a risk that needs to be dealt with before the implementation can take place on a large scale (Paquette, 2010). The per-unit cost of computing is falling whilst computers are getting more power by the day (Lasica, 2009). On the contrary, managing the infrastructure related to computing can be classified as a complex issue that has made computing a massive expense to organizations that needs be dealt with (Roehrig, 2009). The increasing expenses have led to research such as the proposed thesis about implementations and effects of the changes that cloud computing might bring. Making technological investments does not necessarily mean that an organization is able to cope with the changes or maximize the potential of the available technology. A survey of six data centers indicated that the inefficient resource utilization are at unaccountable heights. A majority of servers were only using 10-30% (Marston et al., 2011) and PCs have less than 5% in average capacity utilization (VMWare, 2008). Motahari-Nezhad, Stephenson, and Singhal (2009) add to the subject by providing statistics that indicate 80% computational power and 65% of storage capacity that is not efficiently utilized of organizations that privately own the computational resources. This further adds to the motivation of research within the adoption of cloud computing being important and especially which platform to choose in order to maximize the utilization. One of the underlying factors behind the current state of utilization is that many cloud applications lack the functionality of similar on-premise solution. The consequences of a transition to cloud computing are related to the emergence of interactions between cloud-based
applications and applications that are unsuitable for the cloud. Managing theses type of interactions relates to technological challenges in the organization but also in roles and responsibilities. The delivery model for service changes and the organization needs to adapt to it accordingly (Marston et al., 2011).

Intel and Cisco conducted a survey which captured IT consumption and lifecycle changes (see figure 1.1). The reason for why this figure is presented is because the proposed thesis has the ambition of targeting three of the categories illustrated in the lifecycle, namely governance, deployment and procurement. Governance is one part of the lifecycle which will be examined and the process within this category will be one of the main subjects of the thesis. The process of handling technical changes within the organizations, the roles involved in the process and the problems related to these mentioned attributes will be comparing parameters. Deployment and procurement are the two other categories that will be subjects of analysis. Implementation, which is a part of deployment, will be discussed in form choosing a suitable cloud service provider (CSP) and their respective cloud platforms.

The research related to cloud computing is extensive and topics within implementation, migration and impact are examples of such studies that contribute with knowledge on a general level. There are however few studies that analyze the transition from current IT systems to cloud platforms such as Windows Azure and Amazon Web Services (Khajeh-Hosseini., et al, 2010).
There are many publications on the technical implications and suitability of different platforms, including Windows Azure and what type of applications that are suitable for the move (Speyer, 2011). The economic factors and drivers of a transition are also a common topic that has been researched and where all the conclusions point to obvious benefits of that cloud computing would bring to an organization (Forrester, 2013). Research related to the implementation of innovation has led to conclusions about how organizations need to prepare for the future in form of changing the view of IT resources and organizational culture (Sultan, van de Bunt-Kokhuis, 2012). There is a lack of research related to the implications of cloud computing from an organizational perspective (Khajeh-Hosseini, et al, 2010). Morgan & Conboy (2013) argue that there is a lack of an empirical body of knowledge about cloud adoption. Hence, an even larger gap in evaluating cloud platforms from the perspective of adoption technologies. The motivation and justification of the proposed thesis can be further strengthened by Qian & Palvia (2013), who have managed to draw conclusions on the impact that cloud computing will have on organizational IT strategy. The same authors argue that there is a gap in the literature related to organizational IT strategy. The proposed thesis will indirectly affect organizational IT through a process perspective, where there is an even bigger gap in literature.

### 1.2 Problem Formulation

The adoption of technologies is a continuously researched area with models and theories that contribute to the mentioned area from different perspectives. The reason why it is being researched is because there is a complexity within adoption of technology that requires the continuous attention in form of research. Large enterprises are often in mature levels when it comes to the discussion and implementations of cloud computing. The complexity in the implementation within large enterprises lies in choosing a platform and a cloud service provider.

To summarize, there are a number of questions that need to be answered in regards to the implementation of cloud computing in organizations; for instance, what are the challenges and opportunities in choosing a cloud computing platform? How do firms compare the pros and cons of available platforms? What are some of the organizational constraints?

Indeed, there are many questions that needs pondering on cloud computing. For the purpose of this thesis the following problem is formulated:
• *How can the adoption of a technology be compared within a large corporation?*

### 1.2 Research Questions and Objectives

The area of adopting technologies has many mentioned complexities related to it and it is therefore of major importance to narrow the scope of the study to investigate something reasonable for the time scope of the thesis. The narrowing will result in an aim to find a commonality of adopting cloud computing within a large corporation. The meaning of commonality in the context, is to find common ground in an IT department within a large corporation. Except for targeting the complexity of choosing such a commonality, the narrowing is further targeted at analyzing the commonality in order to evaluate the most appropriate technology. The point of mentioning the term *commonality* is due to its significance in form of representing a perspective within the corporation from which the parameters can be located and a comparison can be done.

Considering that the proposed thesis is based on the adoption of technologies in a large corporation, there are several degrees of abstraction related to how extensive the work will be. The following sections is therefore based on narrowing the research by addressing the following research questions:

- On what commonality can a cloud computing platform be chosen?
- What are the underlying parameters for adopting a new technology?
- What are the constraints that halt the adoption of cloud computing?

These questions lead to the objectives which are formulated as:

- Firstly, to identify a commonality to find suitable parameters for comparing cloud platforms.
- Secondly to find possible constraints that slow down the process of adopting cloud computing.
- Thirdly, to derive conclusions on which of the proposed cloud platforms is best suited based on the results of the two previous objectives.
1.3 Delimitation

Cloud computing is widely studied phenomenon which implies huge investments in time, money and manpower. This wide knowledge area needs to be limited in order to make a realistic contribution. The proposed thesis is limited due to constraints related to time, complexity and manpower. Since the methodology is related to finding parameters within a commonality, the limitations are within the scope of the commonality of an IT department within a large enterprise. The implications of the delimitations are that similar corporations, in form of having a large IT-department and approximately 10,000 employees within the organization in one site, are of comparable nature.

The adoption of cloud computing will be discussed on the basis of the parameters that will located through interviews and a comparison within the scope of the commonality. To further specify the meaning of adopting cloud platforms, a more descriptive clarification is needed. The adoption relates to adopting a cloud platform to its full extent, meaning that a consumer is granted all the services that the cloud platform has to offer.

Furthermore, due to the complexity of implementing such a technology in an environment where there are development teams and numerous of different platforms and programming languages that separates the teams, the detailed technical implementation will not be covered.

1.4 Outline

The rest of the thesis will be organized in the following way:

Chapter 2: Theoretical Framework - provides a description of related theories within innovation as well as the previous studies related to the topic of adopting technologies. Theories within innovation and lock-in are the main focus in this chapter and the foundation for the following parts of the thesis.

Chapter 3: Methodology - aims at providing readers with sufficient information about the process of writing the thesis. Furthermore, the selection of research methods has been motivated and explained together with a final section about research quality.
Chapter 4: Results - the goal of this section is to present the main results that the interviews have contributed with. In extent to providing the parameters that are central in the comparison, the last section within this chapter is related to an initial inquiry that played an important role in the conclusion.

Chapter 5: Discussion - relates all the results to a comparison between two cloud platforms and discusses issues related to constraints in adopting cloud computing within the involved IT department. An unexpected detail that turned conclusions into initially unexpected remarks.

Chapter 6: Results - concludes all the main points of the discussion provides the reader with summarizing remarks related to the thesis. The chapter ends with a recommendation for future studies.
2 Theoretical Framework

The goal of this section is to provide an encapsulation related theories within the area of adopting technology and of previous work related to the topic of this thesis. Furthermore, except for providing readers with sufficient theories and frameworks, this section will contribute to the understanding of the aim and results of the study. The layout is in form of subtopics that cover similar contributions within the related areas.

2.1 Motivating Selected Theories

The reason why innovations theories have been chosen is due to the correlation between cloud computing and innovations. As it has been mentioned, cloud computing is an emerging technology that has been present for a long time without reaching the level of popularity until recent times. Hence, it can be classified as innovation, with the definition of innovation being any object, idea, technology, or practice that is new. These theories will be of central contribution in the discussion and conclusion of this thesis.

A further motivation is located from Weiss and Dale (1998, who add on the complexity of adopting new technologies, especially when there are other established technologies, which causes discourage in adopting technologies. Cloud computing is at such a stage in many companies that are considering to adopt it and considering that half of all innovations do not succeed in form of reaching the intended market (Tidd and Bessant, 2009), an effort in understanding innovations is of major importance.

2.2 Introducing Innovation

Adopting technologies is often mentioned in the same context as innovations and since this thesis is focused on the mentioned field, there is a need to properly introduce the concept of innovation. As a starting point, Schumpeter is a man worth mentioning since the term ‘innovation’ was brought into attention in the first half of 20th century. He proposed that innovations are of major importance for economic growth and commercial profit (Mutlu and Er, 2003). Utterback and Abernathy (1975) will also introduced to add to the definition of innovations but first, Schumpeter’s (1934) classification of innovations will be brought up.
The classification is divided into two categories, namely product and process innovations. Product innovations can be concluded as being the creation of something new that is more satisfying than its previous alternatives with emphasis on it being a completely new product that provides monopoly position to the creator. The process innovation are related products/consumptions that serve a similar purpose, but costs less (Schumpeter, 1934).

Schumpeter’s theory can in extent to the two categories be further divided into five types of innovations:

Process innovations:
1. A new production-method,
2. Supplying new type of raw material or semi-finished goods,

Product innovations:
3. A new product,
4. A new quality of a product that creates a new market,
5. A new industry standard that leads to the creation or destruction of a monopoly position (Meier and Baldwin, 1957) (Mutlu and Er, 2003).

As mentioned earlier, the contributions of Utterback and Abernathy will be presented to further add on the ambition to define innovations. Instead of introducing their own model related to definition of innovations, citations have been chosen to add to Schumpeter’s two mentioned categories. The definition of a product innovation from the mentioned contributors is that it is “a new technology or combination of technologies introduced commercially to meet a user or a market need”. Furthermore, the respective definition of a process innovation is “the system of process equipment, work force, task specifications, material inputs, work and information flows, etc. that are employed to produce a product or service” (Utterback and Abernathy, 1975).

2.2.1 Diffusion of Innovations

Innovation and ideas are available in all forms with different degrees of uniqueness and availability. None of the two mentioned attributes guarantee a successful adoption of a technology and the indication is that the concept of adopting technologies is not related to
simplicity. Rogers (2003) explains diffusion as being the way an innovation is communicated through channels in a social system. It is related to a social change in form of ideas being invented, diffused and adopted or rejected. The three valuable insights related to the mentioned social change are: the qualities that make an innovation spread, the importance of peer-peer conversations and peer networks and lastly realizing and comprehending the needs of different user segments (Robinson, 2003). The uniqueness of Diffusion of Innovation theory is that it emphasizes on the evolution of products rather than focusing on how individuals can change.

### 2.2.2 Characteristics of Innovation

Rogers (2003) is one of the main contributors to the constantly modified Diffusion of Innovation model that has five attributes recognized as the success of an innovation. These five characteristics are: *relative advantage, compatibility, complexity, trialability and observability.*

![Figure 2: Characteristics of Innovation](image)

*Relative advantage* is the extent to which an innovation is perceived as better than its precursors. The advantages of being better than the precursors are relative in the sense that matters to the users. Such advantages can be economic, social, convenience or satisfaction (Rogers, 2003). Greenhalgh et al., (2004) claims that this attribute is a necessary condition for and that the evidence for it being important is strong. There is no formal definition or rules that state what *relative advantage* is constituted of but it is rather relative to the situation of the innovation and the users involved (Rogers, 2003). The following five attributes play an important role in
adopting innovations. Studies have shown that the variation of adopting innovations is between 49 and 87 percent with the five attributes being the determinants.

*Compatibility* is highly related to the values of the intended users but also norms, beliefs and the perceived needs of innovations. It is the degree of consistency to the mentioned parameters that an innovation needs to be compatible with in order for it to be rapidly adopted (Rogers, 2003). Greenhalgh (2004) states that reinvention might be classified as an extension of compatibility and the degree of modification of the innovation to suit the needs of potential users will determine the ease of adoption.

*Complexity* or simplicity as it may be referred as is the extent to which an innovation is complex or simple to comprehend. Innovations that can be narrowed down into part and adopted progressively have a higher chance of being adopted. Naturally, the new ideas that are simple to understand, compared to ideas that are complex and that require development of new skills, are in general adapted more rapidly Rogers (2003).

*Trialability* refers to the type of innovations that potential users can test and experiment on regularly. These are the type of innovations that are grasped more easily. The degree of trialability with an innovation is directly related to the risk of adapting, with favorable outcomes the higher the degree of trialability is Rogers (2003).

*Observability* relates to the ability of an innovation to be visible and easily identified to others. Naturally, the higher the degree of observability, the higher the probability of the innovation to be adopted. The uncertainty of an innovation is diminished by the visible results that a high degree of observability would have Rogers (2003).

### 2.2.3 User Segments

Research within diffusion has led to a model (Figure 2) that displays the tendency to adopt innovations. The tendency has been divided into five categories from a population, namely: *innovators, early adopters, early majority, late majority and laggards*. Each of the five categories should be viewed as static in the form of having a personality and attitude that will remain unchanged over time Rogers (2003). The selection of the mentioned model and theory is
justified by the relevance in adopting cloud computing and where the comprehension of user segments might ease the understanding of the empirical data and contribute to the discussion and conclusive remarks.

Figure 3: Model of the tendency to adopt innovations (Rogers, 2003)

The first group, earlier referred to as category, is known as the innovators. They prosper in the development of new ideas and are of an energetic nature with creative abilities. (Moore, 1999). Technology is usually their main interest and their enthusiasm brings the idea-generation and creativity to dangerously idealistic levels. However, these are the individuals that through their energy and commitment push change programs forward and are central to involve by both providing support and making them partners in the designing of projects (Rogers, 2003).

The early adopters differ slightly in personality and attitude and the unlike innovators, are generally not knowledgeable about technology but they appreciate the advantages of new technologies and ideas. Intuition is the driving force of this group (Moore, 1999) and the benefits need to be illusive in order for the early adopters to engage (Rogers, 2003). They are often leadership-oriented with personal interests in mind that they try to connect to the innovation in the desire to be trend setters. There is no need for too much persuasion due to the personality of the group that is eager to take any chance of getting an economic or social edge (Rodgers, 2003).

The drivers of the early majority is the underlying knowledge, since the group is familiar with technology, they are prone to adopt at early stages given the right amount of well-established references. Since the group of people constitutes approximately one-third of the whole
population, it is of major essence to have the likes of the *early majority* (Moore, 1999). Rogers (2003) adds to description of the group by claiming that they are followers of mainstream fashions with an aim to improve their current alternatives with something simpler and better. Complexity is not favorable and there needs to be a display of obvious rapid results which requires minimum effort of learning.

The *late majority* is another group which needs to be accounted for, given that they constitute an equal share as the *early majority*. The characteristics of this group are that they are not comfortable with technology and therefore are careful when it comes to adopting technologies. The adoption will be fulfilled, granted that the technology has become an industry standard (Moore, 1999). Fear of risks is their drivers and there is a tendency of major influence from the opinions of the *laggards*.

The *laggards* constitute a minority in the population which rejects all new ideas related to innovation and technology. The discomfort related to technology is at maximum levels. (Rogers, 2003). The time of adoption is at stages when there is no other choice but to adopt or when it has been embedded in surrounding systems without their knowledge (Moore, 1999).

### 2.3 Lock-in

Lock-in is concept that is continuously being discussed in the field of adopting technologies. David (1985) talked about the concept in relation to the QWERTY-keyboard and highlighted the focus on three features that evolved the “locked in” the product and design of a keyboard arrangement. The first of the mentioned features were technical interrelatedness which he defines as being the compatibility between keyboard as hardware and the “software” related to the individual touch typist’s memory. The second being economies of scale which represents networks effects that makes a person choose the product based on a previously observed decisions that have favored the product. The third feature being quasi-irreversibility of investment, relates to the high cost of switching to alternate products.

Arthur (1989) did not analyze the concept of lock-in in detail but was one of the major contributors to the rise of the concept. The following citation describes a part of the input that
Brian Arthur had on the concept of lock-in: “When two or more increasing-return technologies 'compete' then, for a ‘market’ of potential adopters, insignificant events may by chance give one of them an initial advantage in adoptions. This technology may then improve more than the others, so it may appeal to a wider proportion of potential adopters. It may therefore become further adopted and further improved. Thus a technology that by chance gains an early lead in adoption may eventually 'corner the market' of potential adopters, with the other technologies becoming locked out. “(Arthur, 1989).

The concept has, as mentioned become a central topic within the area of technology and especially within cloud computing. Armbrust, et al., (2010) recognized the attractiveness of cloud computing providers to create customer lock-in and in contrast, the potential risks it might cause customers. On one side, attempts are made to lock-in customers to the extent that it would be too expensive and time-consuming to switch provider and the other side represents the customers that look for opportunities that would not make them totally dependent on one provider. Lock-in has been chosen due to the frequent discussions related to it within the field of cloud computing (Beslic et. al., 2013, Lewis 2009, Opara-Martins et. al. 2014).

2.4 Previous Studies

The aim of this section is to highlight the related studies within the area of adopting cloud computing and summarize the conclusions of the addressed research.

2.4.1 Impacts of Adopting Cloud Computing

The topic of adoption is relevant in several ways to the research in this thesis. The company involved in the thesis has been familiarizing with the technology that cloud computing has to offer for a long time, but still the progress of adopting cloud computing has yet to reach a firm level of maturity. On the contrast, the level of maturity in the company is at a level where the term adoption is at its peak of importance due to the serious ongoing preparations for the implementation of cloud computing. Cegielski, et al., (2012) mentions that the level of uncertainty within organizations should be weighed against existing information processing capabilities in deciding whether or not to adopt cloud computing.
Impacts can be discussed in terms of positive and negative impacts and it is not always clear in which of the mentioned categories that an impact will fall under. A common notion in research is to categorize the impacts in advantages and barriers of cloud computing. The importance in researching impacts lies in the potential to transform the organization (Qian, 2013).

Avram (2014) contributes with advantages such as the immediate accessibility of hardware resources, with minimal capital investments. The advantage does not only relate to accessibility but will indirectly lead to a faster time to market. The same author brings up two more relevant advantages which relate to innovation and scaling. Sleit, et al., (2013) adds to the topic of accessibility by stating that the dependency of the hardware team within the IT organization is decreased because it will be a commonality provided by the cloud service providers. The time to market is therefore present in this contribution as well, since the application hosting team can focus solely on deployments and leave hardware dependencies to an external part.

The findings of Qian (2013) indicated that the adoption of cloud computing resulted in benefits related to speed and less effort when delivering services and responding to changing business needs. Adopting cloud computing can open up new ways of working and thereby lower IT barriers to innovation. This can be witnessed in the large number of startups that have managed to utilize cloud computing to its full extent (Marston, et. al., 2010). This advantage is related to the dynamic scaling of resources and the immediate accessibility since it might diminish restrictions that were commonly present earlier. Scaling resources is one of the most desired cloud computing advantages (Sleit, et. al., 2013). Organizations have managed to invest more wisely by the possibility of scaling, and invest in technologies that are more value generative due to the deployment of pay-per-use model (Qian, 2013). Scaling services is especially important for enterprises which are reliant on accurate information related to customer demand. The advantage is that the client load can be scaled up and down without the interaction of CSP (Marston, et. al., 2010).

Avram (2014) introduces negative impacts in form of barriers related to the adoption of cloud computing. A critical factor for enterprises is reliability and with the adoption of cloud computing, there are uncertainties related to the management of applications in case of failures.
and disruptions. Reliability needs to be considered and negotiated with the CSP. Interoperability and the ability to move information from different cloud structures and CSP are among the critical factors for adoption. Enterprises are focusing on standardizing processes, data and systems to avoid the lock-in effects that might any outsourced part of IT might bring. The mentioned factor could also be classified as an advantage depending on the level of interoperability (Avram, 2014). Bradley et al., (2013) recognized the same attribute as being one of the prominent inhibitors in form of a lack of integration and interoperability within internal- and provider systems.

Adoption of cloud computing will most certainly involve changes in the IT organization which Avram (2014) argues can be described in two dimensions, namely skills and IT roles. There is a need to acquire knowledge and new skills to be able to deploy and manage the new technology. The second dimension is related to the dealing with how technology changes the roles within the IT organization. Qian (2013) identified the extent of which cloud computing had on the headcount within the IT organization. A small decrease was noticed but there was still the need for the mentioned new knowledge to be dealt with in form of configuring and customizing services for the users. The same author acknowledged the need to use the heads more strategically than focusing on impacting the number of employees.

2.4.2 Organizational Change

Addressing the issue of organizational change is an important part of reaching the goals related to the research questions of this thesis. The literature review on this topic is focused on the change that the adoption of a new technology, especially cloud computing, can have on the organization. Hence, the relevant research has been selected and concluded in the section below.

Adopting new technology in large enterprises is anything but simple since there are many computing systems that have evolved over a long period of time. These systems often depend on different technologies and have different “owners”. The complexity does not only involve the technical changes that relate to the dependencies of systems and different platforms, but also the organizational changes that the adoption will bring. Individuals within the enterprise that have a holistic view over the IT organization are perhaps the most suitable to discuss first steps of
adopting a new technology. However, problems arise as the same individuals are not fully engaged in the detailed processes within each division and can therefore not make a thorough recommendation about the adoption (Khajeh-Hosseini, 2010)

There are many reasons for why organizational changes take place and one of the drivers is to generate value, being it economic or another type of value. The inability to realize value from IT investments, which cloud computing is considered to be, partly comes from the lack of alignment between the business and IT strategy. To generate value is a goal of all organizational changes and degree of fulfillment when it comes to the goals of the change do inevitably varies depending on many factors. The importance in making such choices related to organization change should not be underestimated because the choices made by one business enterprise will evoke a chain of similar decisions in the future (Henderson & Venkatraman, 1999). There is a tendency for managers to adopt strategies and make decisions that benefit their division and naturally, there are clashes in interests related to this (Khajeh-Hosseini, 2010). The clashes do not necessarily need to have a negative effect on the organizational change in form of adopting cloud computing. Morgan & Conboy (2013) claim that organizations that adopted cloud computing resulted in a better collaboration within their supply chains, improved team engagement and communication inside the organizations. Marston et al., (2010) recommends that there should be a ‘cloud committee’ within every large organization that undergoes change in form of cloud computing adoption. The advantage of having such a committee would be in form of continuous development and evaluation. The independence of the committee will assure that the tendency that was mentioned by Khajeh-Hosseini (2010) will be diminished and more improvements like Morgan & Conboy (2013) mentioned could be developed.

2.4.3 Comparing Cloud Platforms

Since the aim of this study is to draw conclusions based on a comparison of cloud platforms, relevant previous studies have been summarized in the following section.

There are studies in which CCPs are compared with respect to applications or performance tests. Sabri et al., (2013) are among the authors of studies that compared public clouds with respect to
performance and to find the best candidates for building high performance computing and fast deployment.

Sleit, et al., (2013) describes the challenges that the growth of cloud computing faces and relates these challenges to a comparison between Amazon EC2 and Windows Azure. These challenges were in form of availability, scaling resources, data deletion, data lock-in and data security. The results based on the comparison led to a conclusion where Amazon EC2 had better offerings than Windows Azure with remarks that selection of cloud computing platform has much to do with the needs of customers.

Tajadod et al., (2012) contributes to the topic by a study in which Amazon Web Services and Windows Azure are compared with respect to security. Both CCPs have security measures which make them attractive to customers but Microsoft are standing out with their Cryptographic Cloud Storage due to the high levels of data integrity and confidentiality. The scope of the study within security led to comparing parameters in form of confidentiality and availability of data. Based on the mentioned parameters, Tajadod et al., (2012) concluded that Microsoft offers a higher level of data security.

Regårdh (2013) performed a similar comparison as the one intended in this thesis. A technical comparison on Windows Azure and Amazon EC2 was presented results indicated how the CCPs could be evaluated. The findings indicated that time and effort efficient evaluation was not possible due to complexity. Applications that handle critical data or that is computationally intensive are of such kind that is not appropriate in a cloud setting.

2.5 Introducing Cloud Computing

Cloud computing is as mentioned, an emerging technology that has been known but has recently bloomed. It seems as the time is right for the technology, due to the development of high speed internet connectivity and decreasing cost of storage (Qian & Palvia, 2013). The goal of utilizing this emerging technology is to bring together distributed IT resources and transform how IT services are delivered and managed (Bharadwaj & Lal, 2012). The power of introducing a new technology should therefore not be underestimated because it has the potential to transform an
organization. It has the possibility of generating cost- but also business related benefits such as an increased focus on core business, decrease delivery time and increase business flexibility (Qian & Palvia, 2013).

The layers that cloud computing is based on are commonly known as service models (see figure 2). There are several factors related to the migration to cloud computing. The initial step is to decide on which type of service model to choose for the organization. The decision can be based on the following categories: technical, financial, strategic, organization and risk (Kavis, 2014). Since the proposed thesis is focused on comparison Windows Azure and Amazon EC2, the aspect of choosing a service model is not a central issue but will nonetheless be weighed in the research and conclusions. NIST (2011) is a commonly cited organization that provides accurate and in-depth definitions and the figure below is an example of such a definition.

![Fig 4: NIST model defining cloud computing (Kavis, 2014)](image)

To understand the broader picture of cloud computing, there are three areas which need to be comprehended, namely essential characteristics, service models and deployment models.

### 2.6 Essential Characteristics

The following sections will introduce the main characteristics with cloud computing and reasons why the technology is a popular emerging technology.
2.6.1 Broad Network Access

The first part of the essential characteristics is the broad network access which stands for the promised and intended capabilities being available all over the network (Kavis, 2014). The capabilities are made available through standard mechanisms and platforms such as mobile phones, laptops, tablets etc. (Passos da Costa & Rosado da Cruz, 2012).

2.6.2 Rapid Elasticity

The second relates to rapid elasticity, which stands for the fulfillment of customer needs through adjustments and flexibility that is offered through the cloud (Kavis, 2014). It is related to capabilities being elastically provisioned to, what seems to be an unlimited extent, based on the customer demands (Passos da Costa & Rosado da Cruz, 2012).

2.6.3 Measured Elasticity

Measured service relates to the ability of measuring the utilization of the cloud through by controlling, monitoring and reporting (NIST, 2011). It is a very useful and practical characteristic, both from a provider- and consumer perspective. Cloud service providers can control and optimize resource use adapting to all different kind of consumers (Passos da Costa & Rosado da Cruz, 2012).

2.6.4 On-Demand Self-Service

The fourth part of essential characteristics is the on-demand self-service which stands for computing capabilities that consumers are provided with from the cloud service providers. Examples of such capabilities can be in form of network storage or server time (Kavis, 2014). The opportunity and advantage of this characteristic is that all the mentioned capabilities can be unilaterally provisioned without the intervention of CSP (Passos da Costa & Rosado da Cruz, 2012).

2.6.5 Resource Pooling

The fifth and common category under which the mentioned four characteristics fall under is resource pooling, which relates to sharing the capabilities and resources across the consumer base through networks (Kavis, 2014). By providing clients with a multi-tenant model, computing
resources such as storage, memory, network bandwidth and processing are pooled by the CSP, to be made available to numerous consumers. The clients are normally unaware of the location of the provided resources, nor do they have control of it (Passos da Costa & Rosado da Cruz, 2012).

2.7 Service Models

The service models have earlier been introduced and they differ depending on what cloud computing platform that is discussed. The three service models are: Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS). These service models offer different levels of service when it comes to building and deploying systems. The opportunities in these service models are related to leasing a service and the level of abstraction is what separates the different layers (Kavis, 2014).

2.7.1 Software as a Service (SaaS)

SaaS is a service model that offers scalable resources in form of applications that are under the responsibility of the vendor and it is delivered by licensing where the software is centrally hosted. This type of delivery model has its benefits in reducing costs related to IT by outsourcing both hardware and software to a cloud service provider (Chandrareddy, 2012). Instead of offering customers as software packages, software applications are made available as a service (Motahari-Nezhad, Stephenson, and Singhal, 2009). The basic idea behind this offering is that consumers from multiple organizations, by virtualization technologies, share a single instance of an application and providers segregate customer data and maintain the privacy (IBM, 2010).

2.7.2 Platform as a Service (PaaS)

PaaS is the next level of abstraction that offers a platform with the possibilities of deployment and development of applications. Platform as a Service is also outsourcing parts of the IT in form of operating systems, network capacity but also hardware (Chandrareddy, 2012). This type of service model supports customers with development in the form of implementation, design, debugging, deployment, operation and testing. The common utilization is through Internet browsers that are used as the development environment (Motahari-Nezhad, Stephenson, and Singhal, 2009).
2.7.3 Infrastructure as a Service (IaaS)

IaaS offers and infrastructural model which makes the cloud service provider responsible of providing hardware and to some extent even software. Data center, server and network are examples of such provision (see figure 3) (NIST, 2011). It is, as the name indicates, an outsourcing of the infrastructure where the cloud service providers are responsible for delivering the equipment, running and maintaining it (Chandrasekhar, 2012). The opportunity within this service model enables businesses to rent the mentioned resources in contrast to spending money to account for all the resources. Amazon contributes with offerings in form of S3 for storage, EC2 for computing power and SQS for network communication in turns of IaaS (Motahari-Nezhad, Stephenson, and Singhal, 2009). IaaS also provides flexible scaling on the amount of required resources by allocating computational power and hardware resources on adjustable levels to meet the as-needed basis. The need for such flexibility is common in organizations that have uneven computational needs. (Motahari-Nezhad, Stephenson, and Singhal, 2009).

![Figure 5: Cloud Stack (Karvis, 2014)](image)

Figure 4 illustrates an overview over the service models and their respective scope of stack components. The vendor/customer responsibilities are displayed in a similar way with the service models being the direct impact to this relation.
2.8 Deployment Models

The third part in understanding cloud computing is to analyze the deployment models: public-, private-, community- and hybrid cloud. The following paragraphs will briefly introduce each of the deployment models with a goal to build on a broader understanding of the cloud.

2.8.1 Public Cloud

The public cloud is a service to the general public where the offerings can be in form of applications or storage, such as Dropbox or Facebook (Sleit, et. al., 2013). This deployment model exists on the premises of the CSP. Hence, it implies that the operation and management of the cloud is under the responsibility of the CSP (Passos da Costa & Rosado da Cruz, 2012). The advantages related to the public cloud are that there is no vendor lock-in concerns and the resource requirements are low (Naganathan, 2012).

2.8.2 Private Cloud

The private cloud is a service that is meant to appeal to single organizations where the data remains under the control of the organization. It is not accessible to the public and the organization usually operates their own data center (Sleit, et. al., 2013). The infrastructure may exist on or off premises and in cases where it is not operated by the organization itself, a third party or a combination of the both mentioned may be present (Passos da Costa & Rosado da Cruz, 2012). The pros of adopting a private cloud are that there is an optimal utilization of an organization’s existing assets. The security is at high levels due to alignment with internal regulations and the configuration is within the organization’s firewall (Naganathan, 2012).

2.8.3 Community Cloud

A community cloud is among the least popular of the deployment models where the cloud is shared among multiple organizations that have the similar computing requirements (Sleit, et. al., 2013). The community of consumers that usually share concerns has its management and operation of the cloud by a third party or a combination one or more of the organizations involved. Similarly to a private cloud, it can exist both on and off premises (Passos da Costa & Rosado da Cruz, 2012).
2.8.4 Hybrid Cloud

The last deployment model is related to a hybrid solution where two or more cloud computing infrastructures are combined to one solution. A cloud service provider can be responsible and handle a part of the resources while an organization handles the other part (Kavis, 2014). Windows Azure, that will be a central topic and platform in the proposed thesis has hybrid as the deployment model due to the provision of both IaaS and PaaS. Figure 3 illustrates the respective responsibilities that cloud service providers (vendors) and customers have (NIST, 2009). The advantages related to this deployment model are that it enables data and application portability between clouds (Passos da Costa & Rosado da Cruz, 2012).

2.9 Cloud Computing Platforms

Few studies have tried to compare different cloud platforms due to the vast difference in offerings. It is hard to find commonalities to base the comparison on due to the blurring of different service models on the cloud platforms. The existing studies that have dealt with the mentioned area have arrived at conclusions that each cloud platform has its own strength and that there will always be unsolved issues regardless of the choice of platform (Peng, et. al., 2009). The goal of this section is to introduce the two cloud computing platforms that are central in this thesis, namely Windows Azure and Amazon AWS.

2.9.1 Windows Azure

Windows Azure is Microsoft’s offering in the domain of cloud platforms and it was introduced in 2008. This platform is classified as an IaaS and a Paas. Windows Azure promotes their cloud platform by calling it a hybrid cloud in the form of a mix between the two mentioned service models (Microsoft, 2015).

Azure is a product that offers solutions that fall under the category of a hybrid cloud where consumers may choose to involve their own datacenter and the public cloud for their enterprise solutions (Microsoft, 2015). The cloud offerings in Azure are providing developers a set of services for application development. The main components of Azure are illustrated in figure 5. From the perspective that is illustrated on the figure, the full scope of the platform is not
presented in the form of services that customers are offered. However, similar to Amazon AWS, which is introduced in section 2.9.2, these four components offer an environment optimized for storage and running applications on Windows Azure, relational data services on SQL Azure, an infrastructure for cloud-based or on premise based applications on AppFabric and lastly Azure Marketplace that offers purchasing applications and data in the cloud (Chappell, 2010). Azure is a language-independent managed environment that is an intermediate between application frameworks and hardware virtual machines like Amazon EC2 (Armbrust, et. al., 2009). Further aspects on Windows Azure will be discussed in the comparison and discussion.

Figure 6: The components of Windows Azure which together with the cloud marketplace support applications, data, and infrastructure in the cloud (Chappell, 2010)

2.9.2 Amazon Web Services

Amazon Web Services (AWS) was introduced in 2006 in the goal of offering IT infrastructure in the form cloud computing by Amazon.com. AWS is constituted out of many building blocks that consumers can customize to support any workload. One of the building blocks is the possibility to deploy and run programs on virtual machines (Motahari-Nezhad, Stephenson, and Singhal, 2009) on a large commercial and cloud known as Amazon Elastic Compute Cloud (EC2). It is a web service that provides resizable compute capacity and is designed for developers to make web-scale cloud computing easier. It is operated by Amazon.com and a part of Amazon Web Services that offers consumers computational, storage and communication infrastructure and
EC2 is the part of AWS that offers service virtual machine instances (Juve, et. al., 2013). The aim with EC2 is to have complete control of computing resources (Amazon, 2015). An instance of EC2 looks similar to a physical hardware where users can control most of the software stack (Armbrust, et. al., 2009). EC2 is one of the cornerstones of Amazon cloud services and it first intended use was internally but its potential was soon realized and the technology grew rapidly (Amazon, 2015). The next building block of AWS is related to storage, in form of Amazon Glazier, S3 and EBS. The last two building blocks are related to databases and management and monitoring tools. Offerings within the database building block are Amazon Redshift, -Dynamo DB, -ElastiCache and RDS. The last building block is constituted of Amazon CloudWatch, AWS IAM, AWS CloudFormation and AWS Elastic Beanstalk (Amazon, 2015). Amazon AWS does not promote a clear distinction in which service model or deployment model that the offerings fit into. The blurring of service models increases the complexity in trying to compare the two on the mentioned models.

As it can be seen on figure 6, the mentioned blocks are divided into categories and subcategories. Many of the products are not described in the section above but they will however be mentioned in the results of the comparison and in the discussion.
3 Methodology

The purpose of this section is to highlight the process of the work on the thesis, describe the comparison and to justify its validity, reliability and generalizability. The figure displayed beneath illustrates an overview of the process while a more descriptive description will follow in section 3.1 – 3.6

Figure 8: Process of writing the thesis
3.1 Pre-study

The pre-study was one of the main contributors for finding the foundation of the thesis work. Through three unstructured interviews, the commonality in form of a process was identified. The type of research that the proposed thesis is categorized as a combination of two of the mentioned types of researches, namely analytical and predictive. Analytical research relates to identifying and controlling the variables in the research activities with ambitions to better explain links and characterizations of the results (Collis and Hussey, 2009). The analytical part of the research relates to identifying a commonality and parameters for comparison. By collecting data using unstructured interviews, questions were able to be modified in the goal of finding common characteristics within the IT department that had holistic features and was transparent. The later mentioned commonality was chosen on the bases of possessing holistic and transparent features that involved many parts of the IT department without overly representing any subunit or group.

3.2 Case Study

The proposed thesis is classified as a case study and therefore falls under the interpretivism paradigm (Collis and Hussey, 2009). The motivation for the proposed methodology and paradigm is that it is a single phenomenon that is being studied using a variety of methods (Collis and Hussey, 2009). The involved corporation is a good representation of a company in search of adopting a new technology, namely cloud computing. There is a high level of interest related to adopting a cloud platform and hence the reason of selecting theories within the area of adopting technologies and a case study as a part of the methodology. While a certain phenomenon is being studied by interviews and a comparison, the goal is also to understand the phenomenon within a certain context (Collis and Hussey, 2009). The phenomenon is the reoccurring goal of choosing a commonality with a perspective that is aimed at finding parameters that will constitute the comparison. The interviews lead to parameters that are based on vital aspects of the process and bottlenecks that might be improved by a transition to cloud computing. The nature of the interviews was designed to solely collect qualitative data. An important aspect to mention is that the discussion is based on interviews and related research. The combination of official information (official webpages of Microsoft and Amazon) and
earlier research contribute to the ambition of answering the research question is the foundation of the discussion.

The intention of the proposed thesis is to contribute with academic value to the knowledge area of cloud computing in form of analyzing a chosen commonality within an IT department and comparing two cloud platforms. This type of research is regarded as basic research due to its nature of improving the understanding of general issues without emphasis on immediate application (Collis and Hussey, 2009). It can be argued that the case study view categorizes the outcome of the research as applied research, which is aimed at solving a specific (Collis and Hussey, 2009) and consultancy-like problem. The distinction between these bases of research can be complex and hard to separate. However, since the case study is not concerned with the commonality per se, it has been conceptualized to identify problems in form of bottlenecks and vital characteristics. The conceptualization has led to the justification of conducting basic research with the intent to make the academic contributions general rather than specific.

3.4 Identifying the Commonality

The commonality is a reoccurring and central part of this thesis. The process of identifying this commonality was through the pre-study which was constituted of three interviews with individuals that each had more than 10 years of experience working at the IT department. These individuals were chosen on the basis of experience and knowledge from multiple areas within the IT department in the goal of identifying a commonality that would constitute a common ground within the IT department and directly or indirectly involve as many individuals as possible. In extent to the mentioned criteria’s, it should possess characteristics that make it possible to analyze it in form of finding comparable parameters related to cloud platforms.

3.3 Interviews

The research data is collected in a stage that has resulted in primary data of the kind that has originated from interviews (Collis and Hussey, 2009). The interviews are of an unstructured kind where questions were formulated in an unstructured way in order to comprehend the commonality. The interviews were based on qualitative research where the study has been designed to collect qualitative data and then analyzing it using interpretive methods (Collis and
Hussey, 2009). Since the step-by-step logic of adopting cloud computing is not clear, the initial step of conducting unstructured interviews is an appropriate method of collecting data (Collis and Hussey, 2009).

3.3.1 Selection of Interviewees

The selection of interviewees for the first stage was on the basis of the pre-study where the process was discussed and identified. The second important contribution to the selection are the interviewees themselves, especially INT1, INT2 and INT3 who shared the same type of positions and contributed with guidance on the selection.

<table>
<thead>
<tr>
<th>Interviewee (*)</th>
<th>Position</th>
<th>Area of Knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interviewee 1 (INT1)</td>
<td>Maintenance Manager</td>
<td>Initiating part of the process</td>
</tr>
<tr>
<td>Interviewee 2 (INT2)</td>
<td>Maintenance Manager</td>
<td>Initiating part of the process</td>
</tr>
<tr>
<td>Interviewee 3 (INT3)</td>
<td>Maintenance Manager</td>
<td>Initiating part of the process</td>
</tr>
<tr>
<td>Interviewee 4 (INT4)</td>
<td>Head of Information Security</td>
<td>Security</td>
</tr>
<tr>
<td>Interviewee 5 (INT5)</td>
<td>Development Methodology</td>
<td>Optimization</td>
</tr>
<tr>
<td>Interviewee 1 (INT5)</td>
<td>Energizer</td>
<td></td>
</tr>
<tr>
<td>Interviewee 6 (INT6)</td>
<td>Change Manager</td>
<td>Holistic view of process</td>
</tr>
<tr>
<td>Interviewee 7 (INT7)</td>
<td>Senior Change Manager</td>
<td>Implementation of process</td>
</tr>
<tr>
<td>Interviewee 8 (INT7)</td>
<td>DevOps</td>
<td>Optimization of process</td>
</tr>
<tr>
<td>Interviewee 9 (INT7)</td>
<td>SOA - coordinator</td>
<td>Integration</td>
</tr>
</tbody>
</table>

*shortenings have been appointed to ease the referencing of interviewees

Table 1: Interviewees

3.3.2 Initial Inquiries

With an ambition to compare adoptions of the cloud computing platforms Azure and AWS among large Swedish corporations, four interviews were planned to contribute with concrete results to the thesis. However, the vast amount of time invested in finding large Swedish corporations led to information that ruled out the initial contributive thought of analyzing similar adoption processes of Azure or AWS. The process behind the initial inquiries was aimed at
finding all possible candidates in Sweden that could be compared to the involved corporation in the number of employees. Three large Swedish corporations that officially announced the cooperation with one of the mentioned cloud platforms were located and the information extracted was through "initial inquiries". The meaning of initial inquiries in the context is that the data was gathered through e-mail communication in an unstructured matter, due to the unexpected results. The unexpected results that section 4.3 addresses were limited to the extent of comprehending the level of adoption related to Azure and AWS. The mentioned section will make the structure and importance of initial inquiries more comprehensive.

3.4 Literature Review

This is inevitably an important part of the essay which has provided with a context for the research questions and developed the subject knowledge (Collis and Hussey, 2009). The aim and content within this section is aimed at guiding and demonstrating the relevant literature that has been selected and analyzed (Collis and Hussey, 2009). The main theories, frameworks and most contributive conclusions from other studies have been summarized. The gaps in the literature have been located and mentioned in the literature review as a motivation for the proposed thesis. The research question and methodology was formed on the basis of the literature review, in an attempt to fill in gaps and a contribution to the area of cloud computing from a different perspective.

3.5 Comparison

The last part of the data collection will be in the form of a comparison. The aim of the thesis is to arrive at conclusions that state the most appropriate cloud platform from the perspective of a case study. The comparison is based on previous research within the field of cloud computing and through official information provided by the cloud service providers. The resulting comparison will therefore be constituted of a narrow selection of previous research, where the results of the mentioned research are contributive in the goal of answering the proposed research questions. AWS and Azure the two cloud platforms that are being compared on the basis of the mentioned sources. The comparison will directly involve the results from the commonality in form of parameters which are the comparing factors of the two mentioned cloud platforms.
The motivation of why Amazon AWS and Windows Azure have been chosen for the comparison is that these are the two leading cloud service providers (Synergy Research Group, 2015). Sleit, et al.(2013) made an comparison that put Amazon EC2 in favor but the selection of cloud platforms has much to do with the needs of the customers which is lacking in the mentioned conclusions. Hence, the chosen approach sets the needs of the customer in focus, rather than any other preferences.

3.6 Research Quality

In an attempt to provide the readers with firm motivation of the research quality, the following two sections address the validity, reliability and generalizability.

3.6.1 Validity and Reliability

Collis and Hussey (2009) are stating that “validity refers to the extent to which a test measures what the researcher wants it to measure, and the results reflect the phenomena under study”. With the provided definition in focus, it becomes obvious that the arguing for high validity when conducting a case study is not easy. The procedure of identifying a commonality, which was a central part of the thesis, was conducted through unstructured interviews in a pre-study. The argument for high validity related to the pre-study is that it was chosen on the basis of an interviewee that possesses a decade of experience within the IT department. To further add to the validity, the remaining nine interviewees were not all acquainted and had different knowledge areas.

Similarly, Collis and Hussey (2009) define reliability as “accuracy and precision of the measurement and the absence of differences if the research were repeated.”. The argument for high reliability is that there is a well-documented chapter above on the type of interviews that were carried out. By having different sources and individuals with different interests within the company, as the well-documented chapter specifies, the chances of retrieving reliable results are greater. The results were not based on a single observation, they were rather based on the input on multiple sources, recurring data and thereby relates to high reliability.
3.6.2 Generalizability

The conclusions that were drawn are mostly based on theories introduced in chapter 3, which means that similar conclusions are likely to be drawn in similar studies. This is due to the nature of the chosen theories and similar research which is based on other founding theories, as diffusion of innovations to mention one example. Given the common theories and research that have been carefully chose, the level of generalizability should be on a firm level. However, it needs to be mentioned that a case study of this kind is hard to generalize due to the interpretivism paradigm that the methodology is categorized as. This thesis brings up common reoccurring factors related to the adoption of technologies, but with a distinctive angle related to a commonality. The conclusions that were drawn are mostly based on previous studies that have showed reoccurring results and theories that are widely referenced and introduced in chapter 3. This implies that similar conclusions are likely to be drawn in similar studies. Collis and Hussey (2009) define generalizability as “the extent to which the research findings can be extended to other cases”. The previous motivations are related to this definition and the extension to other cases can further be motivated by the case study being conducted in a large corporation that has carefully chosen processes, decades of knowledge and experience. This extension to other cases is therefore related to other IT departments within large corporation that share similar goals of the proposed thesis.
4 Results

The goal of the following sections is to provide the readers with the empirical results that the interviews have led to. The process will be described with explanatory figures and parameters that are aimed for comparing the two proposed cloud platforms. The first part of the results, namely 4.1 and 4.2 are purely results from interviews while 4.3 are the results from the initial inquiries.

4.1 Commonality - Identified Process

The process that has been identified has been abstracted to three subsequent stages, namely Change Request, Sprint and Request for Change. The level of abstraction related to the process is set to the mentioned three stages due to it being sufficient for the identification of the process and for relating the parameters to it. However, some of the results will be presented with more depth within each stage.

The first stage is where a change request is created. A change request is simply a change in a system that will need attention, development and possibly involvements of other parts of the process. The change request can be initiated by customers or internally by one of the groups within the IT department. The involvement of maintenance managers (INT1, see table 1) in the process is in initiating such changes on behalf of their respective group of developers. The essence of this stage is that the change request is formalized by the maintenance managers in form of adding it to one out of the two programs involved in the process, thus making the change request visible to other parts of the process.

The second stage is the sprint where the estimation, development, system testing and acceptance tests occur. This stage is very dependent on the nature of the change request and the magnitude of it. The mentioned sub-processes within the stage are goal-oriented steps towards fulfilling the requirements of the change request.

The third stage is where the change request is formed into a Request for Change, as the stage is referred to. This is the stage where the change manager gets involved (INT6, see table 1) and
where the second program in the process is involved to prioritize the request for changes (RFC) based on their complexity and dependencies. The complexity varies in how common the RFC is and directly to how many dependencies it has to involve.

The characteristics that the identified and recently described process possess are shared common ground, involves many different groups and a shared way of working within the involved IT department. It is also a process from which parameters can be extracted and used for the comparison. Another important aspect is that all parts of the process are not dependent on each other and it is therefore possible to get different aspects and opinions through interviews.

4.2 Parameters for Comparison

The following parameters are the results of interviews conducted with individuals (see table 1) that have shared their knowledge and experience in corresponding part of the process in focus. The following sections are of a descriptive nature in which each parameter is described and introduced. The same parameters will be the basis of the comparison between AWS and Azure. The parameters are not ordered in a specific matter, however their degree of importance will be discussed and taken into account when arriving at conclusive statements about the mentioned cloud platforms.

4.2.1 Data Security

Data security is a common issue related to cloud computing that has the ability to decelerate the adoption of technologies in general. The most contributive interviews related to security, were the Maintenance Managers and the Head of Information Security. The firstly mentioned, contributed with an understanding of the sensitive data that is involved in the process and that is
classified in the following order: Secret, Confidential, Internal and Public. The classification itself is not being focused on, since the issue of which category within the classification would be appropriate to move to the cloud is beyond the scope of the issue. The emphasis is rather on the fact that there is sensitive data involved in the process in form of customer information. This is the sort of data that cannot be displayed to the public and therefore the level of security needs to be at a high level. Most of the interviewees operated with sensitive data in some way and it was obvious that the commonality involved sensitive data throughout all the parts of it.

4.2.2 Standardization

On all parts of the process was this concept spoken about with different levels of commitment. This parameter, to define it specifically, was spoken about in terms of software development with a goal to decrease the time to market of developing products and their sub-units. It is however a general view within the organization to standardize processes and create a general way of developing. The size of the IT department which is constituted of more than a thousand employees who each are part of a group is factor for the highlighting of this parameter. In extent to having individual and group goals, the IT department has a common goal of nurturing the well-being of the organization and this is why standardization has been made into a daily routine of working. The essence of standardization is to implement practice of constant integrating during development to decrease integration problems and at early stages detect errors. There is a goal in doing this continuously and implementing this way of thinking and developing across the whole IT department, in every development team.

The concept of standardization relates to striving for making all changes (during development) deliverable and releasable. This increases the transparency in the process by never leaving anything half-done. It is also a part of the goal of decreasing the time to market by constantly having releasable material. To further strengthen the importance of this parameter, interviewed individuals (see INT5 and INT8) had standardization as an extensive part of their role at the company.
4.2.3 Lock-in

Lock-in is a widely known term and theory which is the extent to which customers are locked in within a certain brand or product. The term naturally appears due to the importance in not being tied to certain supplier or product but rather being able to switch between products without additional complications. These parameters are closely related to the previously identified parameter of standardization. The process in focus is of such nature that there are several groups that use different technologies and programming languages. The mentioned size of the IT department is contributive factor in addressing the aspect of lock-in as a parameter for comparison when adopting cloud computing. The number of specialized groups which collectively work with a specific programming language or system is growing and each of these groups has their preferences related to adopting new technologies. The level of interoperability between systems and products therefore needs to be on high firm level but the lock-in parameter might bring consequences to both interoperability and standardization.

This has raised conflicting priorities which demands appropriate cloud computing solution with minimal level of lock-in. The several dependent technologies and conflicting priorities among different parts of the process have made this aspect into a parameter that will be one of the bases for comparison.

4.3 Initial Inquiries

The results indicated that the adoption was not even close to the level of adoption as it was anticipated to ground a comparison and analysis on. The information that led to the involvement of the identified companies was misleading for the purpose of this thesis. The underlying base of adopting cloud platforms in this thesis has been mentioned to be the full extent of adopting the mentioned technology. By full extent, it is meant to be able to utilize all the offerings that Azure or AWS have. The initial inquiries indicated results that were not suitable for the purpose of comparing adoption processes due to the minimal involvement of the respective cloud platforms. The special solutions that three corporations involved in the initial inquiries had goes beyond the scope of this thesis when it comes to adopting technologies. The results were however useful in deriving other conclusions, which will be seen in the discussion, especially section 5.4.
5 Discussion

The aim of this section is to discuss the concepts and theories that were introduced in the theoretical framework and relate them to the findings and analysis of this thesis. Each of the parameters that were the subject of the results is going to be discussed with an emphasis on the order, starting with the most important parameter.

5.1 Data Security

It is not hard to motivate the parameter of data security within the chosen process, whether it being a large corporation or a small company. Most organizations possess and operate sensitive information that can threaten their existence if leaked. The interviews revealed that the chosen process is no exception, there is a flow of sensitive information in form of customer sensitive data that needs to be protected by law. Even though there is minimal data that is of major competitive importance, the level of data security is nonetheless a parameter that will be discussed and compared between the two chosen cloud platforms.

The emergence of cloud computing has due its lack of maturity caused uncertainty about how security at all levels can be achieved. The ability of cloud service providers to adequately address privacy regulation has been called into question and raised among the top obstacles in adopting cloud computing (Avram, 2014). Data security is however a large area that can be divided into several categories. The relevant categories that can be identified through the results of the interviews are data availability and confidentiality (Tajadod, et. al., 2012, Chen and Zhao, 2012). Marinescu (2013) identifies as availability of cloud services as major concern since system failures, power outages and other similar disasters could make the cloud services unavailable. This would be disastrous for the chosen process since the production lines are dependent on the process. The importance related to data availability is that the cloud services are operational and available at all times (Tajadod, et. al., 2012). Availability Zones and Elastic IP Addresses are the realizations of availability offered by Amazon. Availability Zones enables copies of applications to be stored on separate infrastructures, making sure that natural disasters such as floods and fires do not affect the stored data (Sleit, et. al., 2013). Amazon S3 also allows users to choose the location of where their data will be stored (Amazon, 2015). The possibility of
spreading servers into multiple zones is a way to build trust and offer reliable web services. Amazon EC2 Service level Agreement commitments guarantees customers 99.95% availability for each of the locations that can be chosen (Sleit, 2013). Elastic IP addresses are designed for dynamic cloud computing in form of remapping the address to another instance in the customer account to mask the failure of one instance (Amazon, 2015). The advantage of this technology is that applications can still be reachable even if failures of certain instances occur (Sleit, 2013).

Windows Azure provides availability in form of replicating data stored in Blobs, Tables and Queues three times in the same data center to decrease the resiliency against hardware failure. Similar to AWS, the replication of data also takes place between two data centers with large distances in between them. The storage services within Azure can be accessed from applications within Azure but also directly over the web from applications that can send and receive HTTP/HTTPS request/response (Sleit, 2013). Azure has an availability of 99.9% compared to Amazon’s 99.95% according to the Service Level Agreements (SLA). The concrete time related to these availabilities are up to 43 minutes for Azure and up to 23.5 minutes per month for Amazon EC2 (Tajadod, et. al., 2012).

Confidentiality relates to data security in cloud computing by assuring that data must be assured whether it is stored in the cloud or in conveyance (on its way to or from the cloud) (Sleit, 2013). Tajadod, et al., (2012) defines confidentiality as being the ability to not disclose sensitive information to unauthorized persons, processes or devices. The flow of sensitive data in the chosen process makes this perspective an important one to discuss. The common solution for offering data confidentiality is through encryption (Chen and Zhao, 2012) and the offerings that Azure and AWS have will be discussed in the following section.

Amazon offers customers an Identity and Access Management (IAM) where multiple users can be created and permissions for respective user can be managed within an AWS account (Tajadod, et. al., 2012). Permissions can be granted to new users but the core function is that each user is an identity with unique security credentials that allow the usage and access to AWS resources (Amazon, 2015) (Tajadod, et al., 2012). Multi-Factor Authentication (MFA) is another technology provided by Amazon for the mentioned purpose that provides users enhanced control.
over the account. The enhanced control is permitted through a six digit single-use code that is provided in extent to the username and password. Hence the “multi-factor” relates to the factors that are checked before access is granted. The third attribute to the data confidentiality is the Key Rotation AWS that enables keys and certificates to be rotated without any disruption in availability of the applications (Tajadod, et. al., 2012)(Amazon, 2015).

Azure provides their degree of confidentiality through Identity and Access Management which ensure that only properly authenticated entities are allowed access to the resources (Mahajan and Singh, 2014). The access is controlled by the customer’s Windows Live ID and a password which grants full control of all the services within that subscription (Tajadod, et. al., 2012)(Microsoft, 2015). Isolation is another degree of confidentiality that minimizes interaction with data by keeping it logically and physically separated (Mahajan and Singh, 2014). Encryption is the third attribute of confidentiality that Azure offers with an ambition to protect control channels and is an option for customers in need of rigorous data protection capabilities. Data encryption is made available in relation to storing and transmission purposes (Microsoft, 2015) and also made implementable for developers that can easily implement encryption, hashing and key management functionality for stored and transmitted data (Tajadod, et. al., 2012).

5.2 Lock-in

Cloud computing is as mentioned, in an early stage of maturity and this has led to some consequences when it comes to the development of lock-in. The level of standardization is at low levels and has therefore contributed to potential adopters of cloud computing being concerned about being locked in with a vendor. Furthermore, the lack of maturity has led to cloud service providers developing their own solutions for access to resources and services which makes vendor lock-in an unavoidable issue (Opara-Martins, 2014).

The pre study interviews gave the first indications of the importance related to not being locked in with a vendor. Lock-in has been introduced and discussed theoretically to a certain extent but the concrete indications from the interviews were that there was an collective opinion related to lock-in. Considering that the interviewees represent different parts of the analyzed process, it is
an unquestionable important parameter that was spoken in terms of cautiousness and proactively working to not being locked in. The interview with INT7 displayed serious ongoing attempts at actively avoiding lock-in by maximizing standardization during development (coding). The results indicated that avoiding lock-in is referred to as a minimization of the complexity with potential adoptions of new technologies and maximizing the opportunity to question and substitute current technologies in use.

Marinescu (2013) are among the authors that recognizes the obstacle with vendor lock-in and more concretely illustrates a case where vendors might increase prices and charge more for computing cycles, memory, storage space or network bandwidth compared to other cloud service providers. The obstacle becomes obvious when the customer considers the option of switching provider due to the large volume of data. It would be a costly affair that inclines charges for the network bandwidth. (Beslic, et. al., 2013) mentions the same issue with dissatisfaction or disagreement with a vendor that might need to involve a switch to a different vendor and this would require complications related to adapting software that is locked-in with specific APIs and data storage proprietary implementations.

As previous studies have indicated and as it has been confirmed in the interviews, enterprises are focusing on standardizing processes, data and systems to avoid any lock-in concerns (Bradley et. al., 2013, Avram 2014). Interoperability is one important attribute that Bradley et al., (2013) recognized as being one of the worrying reasons for adopting cloud computing. The lack of integration and interoperability within internal- and provider systems is a worrying issue that makes the topic of lock-in an important one. Opara-Martins add the importance of interoperability with suggestions that APIs need to be standardized to allow higher linkage, not only between different cloud platforms but also between cloud layers. Standardization has proven to be a repetitive term and way of working within the analyzed company and is one important factor when comparing cloud platforms, in extent to vendor lock-in.

As the importance of vendor-lock in is being realized through literature, previous studies and interviews, there are questions that arise to whether it is possible to avoid the issue of vendor lock-in. Before discussing the AWS and Azure in more detail, the vendor lock-in issue between
these two becomes obvious when realizing that it is hard to classify both of the platforms into one category. As it has been mentioned earlier in the rapport, there is a blurring of service models, especially with AWS which cannot be classified as solely one type of service model. It takes no deeper analysis to realize that this constellation of technological offerings relates to higher degree of vendor lock-in. The lack of standards has led to the mentioned situation and there is continuously being announced new services that are highly tied to the vendor, AWS GovCloud is one example that was launched in October 2012 (Marinescu, 2013). There are traces of initiation of open source technology, such as Gluster which is software-based open source NAS file system that provides centrally managed storage pool that supports customers to move to the public cloud or between the other deployment models. It is however deployed within AWS (Sleit, et. al., 2013).

As the case is with AWS, Azure does not provide a standard API but rather different APIs that complement the core services of Azure. These APIs are used locally for developing Azure applications and are not used by any other cloud service provider (Sleit, et. al., 2013). The situation is such that the parameter of lock-in cannot be avoided, rather it other of the recognized parameters that shall enhance the best contender related to process in study. If it is taken for granted that AWS and Azure are the two most popular cloud platforms due to the respective offerings, switching in between them is a highly complex issue due to the lack of standards. The lack of standardization becomes obvious when comparing the storage solutions offered by respective cloud service provider in question. Amazon Simple Storage Service (S3) is a storage solution that can be used alone or in combination of a range of other Amazon offerings (Amazon, 2015). The customers are locked with a well-defined set of tools and the best achieved performance is by using respective provider’s storage solutions. Windows Azure is using Azure Table to store data which differs from Amazon storage solutions (Beslic, et. al., 2013). In conclusion, the vendor lock-in issue cannot be avoided, rather it has to be accepted with ambitions to either initiate cooperation with one of the cloud platforms with a long-term plan or to investigate how to use one of the platforms with minimal vendor lock-in.
5.3 Standardization

Standardization is one of the identified parameters that proved to be of importance to the company involved in the thesis. Standardization has been mentioned several times in this thesis and it is undoubtedly a term that has been raised to attention within the academic world. In relation to standardizing technologies, terms such as interoperability and lock-in have been brought up. Bradley et al., (2013) recognized the attribute of interoperability as being one of the prominent inhibitors in form of a lack of integration within internal- and cloud service provider systems. The essence of standardization is to be optimizing integration and avoid lock-in. By previously discussing lock-in, it has become obvious that standardization within AWS and Azure is limited when it comes to interoperability between these two. Opara-Martins (2014) has mentioned that lack of maturity of cloud computing has led to the mentioned situation where cloud service providers are creating their own customized solutions for their customers. The current situation of cloud computing does not prohibit attempts at reaching high standardization levels but rather focuses the standardization into vendor lock-in situation. As Marinescu (2013) mentioned, new services are being developed and launched from cloud service providers which can arguably increase the level of standardization within an organization by adopting the offered services of respective cloud service provider.

To not mislead the development of open standards within cloud computing in general and within AWS and Azure, there have been efforts to achieve some open standards. The term open in the context refers to standards that are open source and shared outside the boundaries of respective services within each cloud provider. OpenID is an example of such an open standard that enables users to be authenticated in a decentralized way. Accounts are created with an OpenID identity provider which can then be used to authenticate all web resources that accept OpenID authentication. The reason for mentioning this standard is because Azure supports this technology (Lewis, 2009). AWS also supports a security standard that is called WS-Security and that is used for message authentication (Lewis, 2009). The minimal initiatives of supporting such open standards do however not rule out the degree of vendor-lock that would await an organization willing to adopt one of the cloud platforms.
5.4 Adoption Constraints

To contribute to the research question of identifying constraints of adopting technologies, three factors have been identified from the identified commonality (process). The three factors are as follows: 1) Different ambitions related to adopting cloud computing. 2) Prioritizing cloud platforms on individual and group preference. 3) The involved corporation falls under the user segment *late majority*

Through interviewing individuals who possess different types of knowledge related to the mentioned process, it was obvious that there was skepticism present to whether or not cloud computing should be adopted. A majority agreed but had different ambitions related to interest and involvement in the adoption. This factor has been chosen as a constraint since the process is a commonality that is interpreted as being a firm representation of different opinions within the IT department of the involved corporation. Considering that the level of ambition is at different levels the adoption might suffer with lack of involvement.

The second factor indicates that one of the two discussed platforms is being preferred in relation to personal or group advantages. When the magnitude of adopting technologies grows, in form of involvement of different departments, so does the number of opinions and mentioned preferences. The complexity in choosing the technology to adopt is transforming into the likings of individuals with different preferences rather than rational comparisons. The adoption is being initiated in small scales throughout the process. The meaning of small scales in this context is that group leaders of development are pushing their preferences hard while others lack the interest of getting involved or have less of an opinion related to the subject. The initiatives could speed up the process of adoption but could at the same time create conflicts on which cloud platform to adopt.

The third factor will involve model of the *tendency to adopt innovations* (see figure 2.1.2) and the section 4.2.5. The initial inquiries showed indications of the lack of adoption related to Azure and AWS in large corporations in Sweden. It shows traces of the earlier mentioned lack of maturity related to cloud computing, especially in Sweden. Furthermore, the interviewees showed clear indications of characteristics related to *late majority* from the mentioned model of the tendency to adopt innovations. The part of the definition that especially resembles
corporation in question is “The adoption will be fulfilled, granted that the technology has become an industry standard” (Moore, 1999). Most of the discussed research together with the initial inquiries indicate the technology of cloud computing is not an industry standard, despite its popularity. Given this reasoning, the current situation is a constraint for adopting cloud computing for the corporation in question.
6 Conclusion

To following section will summarize the main points of the thesis and also suggest future studies based on the outcomes of the proposed work. This summary will except for highlighting the main findings of this paper also relate them directly to the research questions.

One of the main goals of this thesis was to find a commonality in the involved IT department within the big corporation. From the perspective of having an extensive and complex problem to successively reaching indications of appropriate directions to take, this study can be categorized as a pre-study of adopting cloud computing. It is on this basis that the chosen commonality is a firm starting point in choosing a cloud platform. The process that was chosen within the involved IT department suited the characteristics of a commonality by having representatives from multiple knowledge area and also a good foundation for choosing parameters for adopting a new technology such as cloud computing. The underlying parameters that were identified through interviews are: data security, standardization and vendor lock-in. The chosen commonality was sufficient enough to identify the mentioned parameters for comparing cloud platforms. However, a case study comparing Windows Azure and AWS is not enough to base a decision on what cloud platform is most appropriate for the corporation involved. It is more of an initial step towards adopting one of the mentioned cloud platforms. The comparison of parameters has led to conclusion that have highlighted the importance of discussing constraints of adopting cloud platforms and made the choosing of cloud platform a secondary priority. The reason for this being that important parameters such as vendor lock-in cannot be avoided and therefore makes the issue into an adoption constraint rather than focusing on choosing one of the platforms.

The advantage of the chosen commonality is that it identified clear adoption constraints that would add on the complexity of adopting a technology and perhaps prolong the process. The clearly identified constraints are 1) Different levels of ambitions related to adopting cloud computing, 2) Initiatives of adopting carried out in small scale with spread opinions and preferences and 3) Cloud computing as an innovation is not yet an industry standard, which based on type of corporation involved is too early to fully adopt such a technology.
6.1 Future Studies

This section will address research limitations that future studies can be based. The suggestions are made on the basis of the findings of this thesis and the ambition is that the suggested future work will be able to use the proposed results as a foundation to further contribute to the knowledge area of adopting technologies/cloud computing.

As mentioned earlier in conclusive part of the thesis, the results should be considered of the pre-study kind that targets and answers questions related to choosing a commonality to base the decision on which cloud platform to adopt on the basis of resulting parameters. The commonality and parameters led to constraints that turned the changed the prioritization of research question. The future studies are therefore recommended to address the possibilities of adopting cloud computing in the extent to where vendor lock-in can be minimized and controlled. This type of research would, unlike this thesis not focus on adopting cloud platforms to its full extent but rather find opportunities in alternate ways of adopting the mentioned technology. The constraints could be identified and focused on primarily in order to address the main issue of adopting cloud platforms without making the constraints as a barrier.
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