Universidad de Granada

Facultad de Ciencias Económicas y Empresariales
Departamento de Organización de Empresas
Programa Oficial de Doctorado en Ciencias Económicas y Empresariales

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Doctoral Thesis

Title:

Governance of Cloud Computing in the Context of Contractual Management

Doctoral thesis presented by:

Sarfaraz Ghulam

Thesis Supervisors:

Prof. Dr. Daniel Arias Aranda

Prof. Dr. Vladimir Stantchev

Granada, 2019

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Acknowledgement

To my parents, the way they raised me made it possible for me to reach this position. To my daughters and wife who remained supportive when I wasn't dedicating enough time to them while writing this thesis.

To Professor Daniel Arias Aranda for his support and supervision and providing me an opportunity to become a part of UGR which is a great honor for me. To Professor Vladimir Stantchev, for his guidance and support and for showing me a proper career path which is my identity today.

To my best friend Marco Opazo Basaez, for everything he has done is very special to me and I will always remain grateful for his support, trust and friendship.

Motivation

The desire to bring a change within myself and give something valuable to my family who is the main source of motivation. Also, this is a great responsibility and I will use my knowledge and skills to help and support the humanity either by contributing in teaching or by spreading the knowledge.

What I learned as a Ph.D. student that this is the part of improving and preparation and during our studies in doctorate program, we prepare ourselves for greater research commitments. As a research scientist we work through different challenges and difficulties and keep improving which is the part of realization that we are not perfect in any field and more we invest time, more we learn and improve. We should not undermine others and should always lend hand to those who are weak in their field and need support. By doing this Ph.D. I realized that learning never stop and we should remain open to accept and embrace positive learning opportunities and benefit ourselves and communities from vast fields of science, technology and art.

Research projects contribution and acknowledgement

This thesis is inspired by three research projects and from the learning outcomes of these research projects in which I participated from November 2013 - February 2018. What is applied and discussed here is highly influenced by the research projects mentioned as follows:

1. Optimaler Einsatz von Smart-ItemsTechnologien in der Stationären Pflege, BMBF-Verbundprojekt (OpSIT)

    a. Researching how the medication is delivered to the residential care facilities in Berlin. How medication is prescribed and given to the residents of those facilities. Mapping the entire process while highlighting the involvement and role of the staff of those facilities involved.

    b. Researching the market for state-of-the-art available pill boxes in use by patients and residents of senior care facilities and in general.

    c. Research cloud marketplaces for suitable solutions applicable for the research project.

    d. Researching and testing the applicable sensors and smart devices feasible for the research project.

    e. Researching residential care facilities for possible deployment and setup for smart items.

    f. Visiting residential care facilities in order to note and monitor the medication processes of the patients and designing the product according to the findings and understanding of those visits.

    g. Visits of the hospitals in Berlin and simulating the collaboration techniques between the doctor, patient and nurses while using the smart wearable devices for patients.

2. Cloud and Internet Services with Open Source Software for SME (CISOSS) ERASMUS + KA2 (2015-1-ES01-KA202-015858) – Cooperation and Innovation for Good Practices - Strategic Partnership

    a. Conducting research on selected German Small and Medium Sized Enterprises (SMEs) located in Berlin that what software and applications they use and what are their uses.

    b. Researching the cloud based open-source application, their uses and applications for SMEs.

    c. Creating courses in the area of IT Security, Open Source Operating Systems such as Free BSD and Linux, Enterprise Resource Planning (ERP) and Open Source Cloud Platform and Grid Computing.

3. Information Technology Governance for Tunisian Universities (ITG4TU) Co-funded by the Erasmus+ Programme of the European Union 561614-EPP-1-2015-1-ES-EPPKA2-CBHE-JP

    a. Research contribution in IT Governance in Tunisian universities and higher educational institutions.

    b. Training of the Tunisian Universities responsible in understanding and implementing IT Governance standards in their respective universities.

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List of Abbreviations

Abbreviations	
BPMN	Business Process Modeling Notation
CAQDA	Computer Assisted Quality Data Analysis
CMM	Contract Management Model
COBIT	Control Objectives for Information and Related Technologies
EEA	European Economic Area
eHealth	Electronic health
IaaS	Infrastructure as a Service
IoT	Internet of Things
ISO	International Organization for Standardization
ITIL	Information Technology Infrastructure Library
LAN	Local Area Network
MAN	Metropolitan Area Network
NSA	National Security Agency

PaaS	Platform as a Service
PC	Paper Cubs
QoS	Quality of Service
RFID	Radio Frequency Identification
RQDA	R Qualitative Data Analysis
SaaS	Software as a Service
SLA	Service Level Agreement
SLR	Systematic Literature Review
WAN	Wide Area Network
WBAN	Wireless Body Area Network
WSN	Wireless Sensor Network

“*The vast majority of the world is invisible to our eyes regardless of the brightest of our lights, and we can’t hear more than a tiny bit of the sound of it with our ears, and we can’t feel the subtle textures of it with our fingers. Even with all our instruments, long tubes on mountains, and a Hubble telescope in space, we are blind to the myriad of complex energies that are whirling and vibrating and clattering all around us day and night, year after year, millennium after millennium.”*

Kary Mullis

Chapter 1. Introduction

Topic Overview

1.1. Introduction

The advent of inexpensive computers, reliance on the web, big data, high amount of data traffic, ever increasing demand for storage and smart phones made cloud computing a necessity for almost every user. Second to the internet, cloud computing is another futuristic technology we're using today and will be available as one of the dominant technology in future (Johnson & Kaye, 2004; Kim, 2009; Chee & Franklin Jr, 2010). In recent times, humankind is benefitting from different aspects of cloud computing on daily basis either it is the healthcare sector, natural science, geology, astronomy, education, aviation or any other filed of life, cloud computing is effectively deployed and supporting the needs of entities and individuals accordingly (Shortliffe & Cimino, 2013; Yang, Xu, & Nebert, 2013; Ning & Liu, 2015).

Besides its name, cloud computing itself is a server technology and the only difference is that; instead of users' own servers, user data resides elsewhere in the servers of the cloud computing service providers (Lakra & Yadav, 2015). Cloud computing applies the concept of abstraction where exact location of service origin is not disclosed to the end user and they do not the infrastructure (Mell & Grance, 2009). Concept and application of abstraction layer of cloud computing applies the concept of servitization where one can benefit from the product services instead of buying the product and in some cases even not knowing the origin of delivered product or service. E.g. not buying a car for a predictable and limited use, individuals nowadays prefer to rent a car and pay as per use.

Contrary to a traditional service model, knowledge about the service origin and service mechanism is not completely disclosed to the users who rely on limited service contracts which in majority of the cases are non-negotiable. A restricted contract also restricts end-users to have their opinion or choice in terms of service provision, therefore initiatives taken on regional level or on national level can help in creating a balanced contract and ensure customers protection in service provision. E.g. in Germany it comes under Federal Data Protection Act (BDSG) or in EU it comes under

European General Data Protection Regulation (GDPR). Customers interest and data in these regions are well protected and services provided to them are covered under these laws.

Service contracts can serve as a facilitator for customer and service provider (Alhamad, Dillon, & Chang, 2010). In relation to this thesis, smart contract and governance are the main topic to be explored that; how governance is possible in cloud computing or is it possible to govern the cloud services at all? What is the relation of contract with governance? These are the general questions which knowledge users ask. Research questions are further discussed in later chapters.

1.2. Research importance

Governance is an important element for any enterprise to maintain discipline, accountability and harmony in a manner that the organization can progress in a much more systematic way (Freeman & Reed, 1983). Take for instance the IT governance, it supports the organization in handling the daily IT related tasks and provide a roadmap to those who are using the system and are accountable for it (Weill & Ross, 2004). Governance in cloud relatively has similar function but is much more complex since it's not related to what customer can implement but what a service provider can offer in the contract (Stantchev & Stantcheva, 2011). This reliance on contract make cloud services provision process difficult for the service customer to identify their role in service control. Other complex features such as abstraction contribute to further complexities for ordinary customers to understand the nature of the cloud.

The outsourcing of the inter organizational IT functions is a routine process and very much in practice (Ghobakhloo, Benitez-Amado, & Arias-Aranda, 2011). But the processing of the inter-organizational data outside the organization in some cases could go against data policies of a company (Chow et al., 2009). Take for instance cloud computing and its services, a typical organization is either interested in software as a service (SaaS) where user can use software and applications running on cloud. Platform as a Service (PaaS) which facilitate users to test and rung applications or IaaS where one can rent pacific hardware for test and run purpose. All services are available

to the customers on subscription basis allowing them to access required services without any geographical restrictions[1] (Agarwal et al., 2010).

Cloud computing is an acclaimed technology and its utilitarian nature and compatibility with almost every computing platform regardless of operating system is convincing enough to conduct a study on this subject and shed some light on it (Fu, Sun, Liu, Zhou, & Shu, 2015; H. Liu, Ning, Xiong, & Yang, 2015). Another important aspect of cloud computing is governing the cloud services, that how governance of cloud computing could be made possible which is different than the governance of IT because of its accessibility outside the organization. Taking for instance the governance only, is enough to carry on this research in order to highlight the importance of governance in cloud computing and highlight the available recent trends in practice and as mentioned in studies. Therefore, it's the matter of an extraordinary importance to shed light on all these aspects and address challenges with possible outcomes.

1.2.1. Scope of the research

This thesis aims at highlighting the role of contracts in implementing the governance in cloud computing. This will help in understanding the concept and the importance of contract in cloud computing and its role in implementing the governance by facilitating the entities. Moreover, this thesis will also highlight the strategy to choose and deploy cloud on organizational level while considering a suitable governance model.

Contractual Management Model Berlin (CMM Berlin) by Eichhorn & Schuhmann (2015) focuses on contract management is used in this thesis as a reference model. Furthermore, the focus of this Ph.D. will remain on the; pre-award phase, post award phase and final phase of the contract covering the lifespan of it.

Important areas which will be discussed in this thesis are as follows:

[1] Policies differs region to region and are influenced by the jurisdiction of particular country.

1. What is the scope of governance in cloud computing?
2. How a contract will help in implementing the governance?
3. How the services and the deployment models are covered in the contract?
4. What are the important features of a smart contract?
5. Understanding the post-award phase of the contract and how it will support the customers in the entire lifespan of a service?

1.3. Research objective

The main objective of this research is to provide an understanding about the governance in cloud computing and its possible application via contractual management for cloud customer and cloud service provider.

The entire thesis is designed as follows:

Chapter one is the introduction and provide an orientation about the overall objective and the aim of the thesis.

Chapter two focuses on theoretical framework, definitions, terminologies and application of these terminologies and contain definitions.

Chapter three discusses the research methodologies with detailed overview of the conducted research.

Chapter four is conclusion, discussion and practical implications & suggestion, future studies and result.

Figure 1.1. represent the research outline of this thesis that how it's planned, designed and worked on.

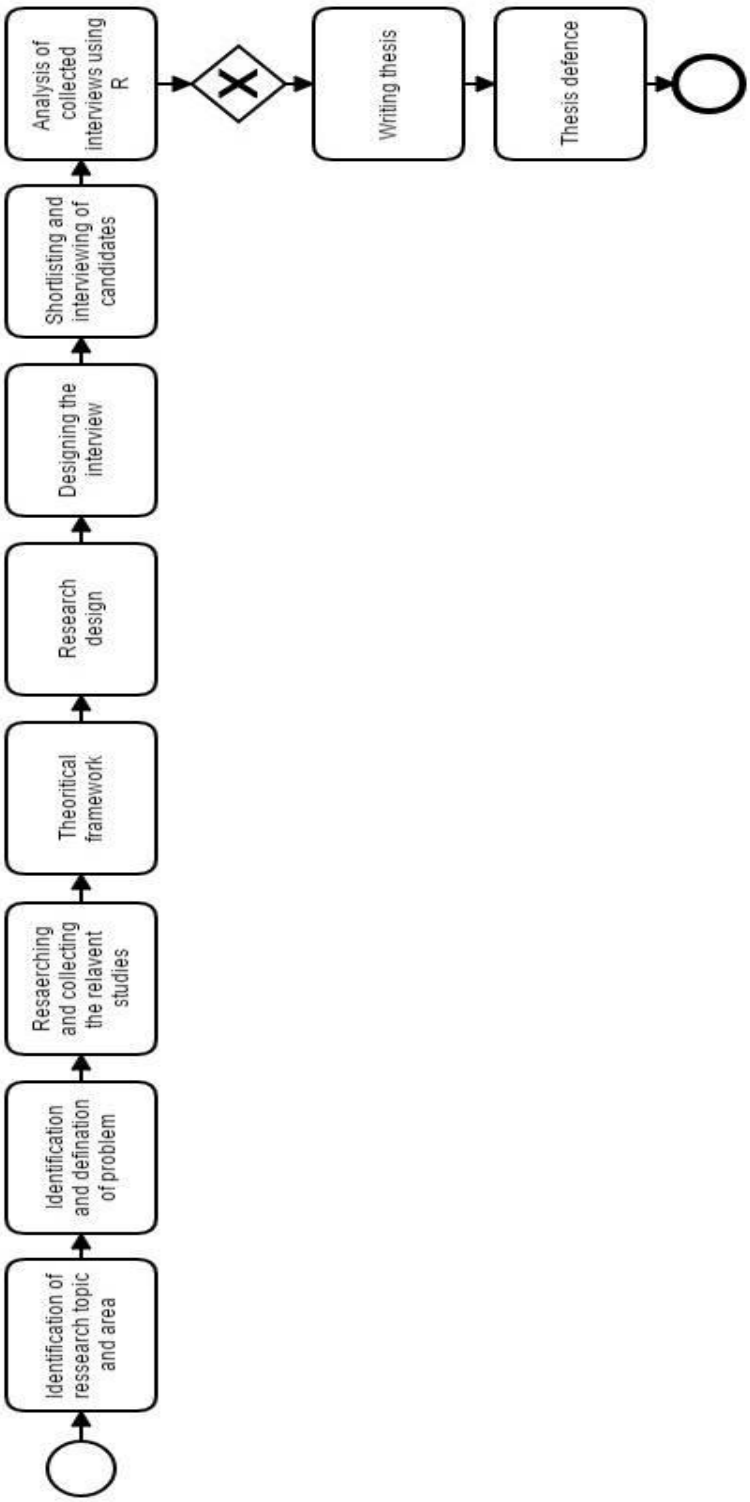

Figure 1.1. Research outline. Source: self-elaboration using BPMN

“anyone who has never made a mistake has never tried anything new.”

Albert Einstein

Chapter 2. Literature Review

2.1. Literature Review

2.1.1. Literature search and Systematic Literature Review (SLR)

Systematic Literature Review (SLR) is one of the widely practiced research method among the researchers of different fields including computer scientists (Kitchenham et al., 2009). SLR allows straight forward analysis of the existing studies where authors can summarize the findings from those studies together with their own findings and can present a joint conclusion (Boote & Beile, 2005). Therefore, SLR is a research methodology suitable for examining published studies and help in deriving an opinion on behalf of those studies. Furthermore, SLR addresses the requirements of researchers seeking to provide a comprehensive study and present a reasonable theoretical background to the readers of the study (Okoli & Schabram, 2010). In SLR, it's important that the author identify the goal for the article and provide a balanced review with improved results. E.g. in the field of management, it is evident in studies which support the notion that SLR conducted in management filed can result in improved knowledge management (Tranfield, Denyer, & Smart, 2003).

Furthermore, SLR is also effective in studies in which the authors aims at analyzing primary or secondary data and that is one of the reason that SLR has gained it's foothold in social science as well (Beelmann, 2006). Like the SLR, secondary data analysis helps to analyze the already existing research studies. The reuse of the existing data in secondary analysis shed light on them in a categorical manner that the chosen studies are presented after proper evaluation when they fall in similar category. Certain research practices are mostly popular in the field of the medical science (Tveito, Hysing, & Eriksen, 2004) but now gaining popularity in other fields of research science as well.

In research, where SLR is used as research methodology, the researcher must organize the relevant studies in accordance to the suitability of subject. Once the studies are chosen and collected, the researcher carries on examining the studies for a research agenda. Researchers using SLR can provide balanced insight about the areas where research gap could be filled with already existing studies (Cronin, Ryan, &

Coughlan, 2008). Furthermore, SLR is also applied in systematic reviews of qualitative studies (Mills, Jadad, Ross, & Wilson, 2005).

SLR has its limitations and is not applicable in every scenario which might make it inflexible for studies uses data analysis and quantitative research method. But for studies based on qualitative analysis and studies where the research needs are fulfilled while focusing on theoretical analysis of the existing studies, SLR can be sufficient for providing convincing result and evidence. SLR uses similar techniques as secondary data analysis as it aims at analyzing the theoretical framework of the existing studies but it's at no mean comparable to empirical studies like meta-analysis which is performed on statistical data and relies on the statistical findings. Meta-analysis has gained its ground in the research where research and analysis of the existing studies is the goal such as in clinical trial (DerSimonian & Laird, 1986).

This thesis is exploratory based and SLR is used as a main criterion for literature review. Interviews were conducted and analyzed in **R,** a computer assisted data analysis tool and program together with supporting extension **R Q**ualitative **D**ata **A**nalysis (RQDA) (R. Huang, 2014). The main reason for using text analysis is that, primary and secondary data analysis have their own limitations which makes it difficult to apply in every research (Glass, 1976). In these situations, text analysis turned to be great facilitator to not only carry on the research and produce first-hand result but also it further helps bringing fresh opinion from experts from their respective field while allowing them to discuss about their area of interest and research.

Text-analysis is being used for long in different fields and is constructive in qualitative analysis (Nelson & Kennedy, 2009). It's not suitable for every type of studies and by no mean it's the replacement of other methods, but the benefits of text-analysis still outweigh the disadvantages of using it and this is the reason that text-analysis is favored by the researcher from different walk of life and as well as social scientists, economist and computer scientist. If correctly conducted, the results generated from the text-analysis can help in understanding the research topic much comprehensively and

facilitate the researchers to provide better conclusion and output. Further this topic is discussed in chapter 3.

2.1.2. Literature Search Method

Different procedures were employed to collect and gather the relevant studies for this research. The first technique was using the related keywords like; “contract in cloud computing”, “contracts for cloud services”, “contracts for cloud deployment models”, “governance in cloud computing”, “regional laws for cloud computing” and “cloud computing in general”. In order to keep the topic relevant and up to data, search range was kept as 2014 – 2019 to include the most recent studies. For some other relevant topics, search range was kept open to reach important topics as possible. Manual research was conducted in the libraries by going through relevant research publications and the books. Since the research included a vast amount of studies and research, the most notable journals were; International Journal of Cloud Computing ISSN online: 2043-9997, Journal of Cloud Computing ISSN: 2192-113X and several other similar journals and publications were referred.

Furthermore, any good reference book written on cloud computing was considered. These books were selected on behalf of the online reviews and its suitability to the topic. Some notable publishers included were; Wiley and Oxford publishing and other books by individual authors such as *The Clouds Economy* by Matt Mayevsky ISBN: 978-1-304-47950-1 remained highly helpful to collect conclusive studies in the cloud computing.

Beside the regular search, expert opinion was collected time to time from the experts in cloud computing in Berlin or on social media such as Twitter and Facebook cloud computing groups. Other experts involved are the professors and researchers who were active in their area of research and discussed how they were carrying their research and literature reviews and how to refine the search criteria to make sure that the collected literature is relevant and useful.

2.1.3. Inclusion criteria

For a study to be included in the review, it must meet the criteria like;

(a) A research should be state of the art in the area of cloud computing or most relevant if not recent.

(b) The research possesses significant information in the area of cloud computing.

(c) Cloud computing governance is covered and discussed.

(d) Contractual management of the cloud computing should be well considered and mentioned in the research.

(e) A research should be unique that it leads the readers to new findings.

(f) A research should lead the reader to further significant similar articles. Considering the conditions from a-f, either published or unpublished, studies meeting the above criteria were considered as eligible for the study.

2.1.4. Collection of the relevant studies and data for literature review

To gather and collect the relevant studies for this thesis, the categorization of the relevant studies and research work is done as follows:

1. Area of interest which in the context of this thesis is cloud computing. Furthermore, the research focuses on the following areas:
    a. Cloud computing
    b. IT Governance
    c. Cloud governance
    d. Service level agreements (SLA)
    e. Corporate governance
    f. Smart services usage and usability
2. After carefully identifying the areas of interest, relevant studies and articles were gathered from; scientific journals, white papers such as something published by Microsoft, blogs, books, news articles, articles from world economic forum,

Harvard Business Reviews, EU commission reports on cloud computing, cloud computing groups on social media and as well as from the following sources:

a. Technische Universität (TU) Berlin Volkswagen Bibliothek
b. SRH Hochschule Berlin library
c. Schiller Bibliothek Berlin
d. UGR online library
e. www.google.com
f. scholars.google.com

3. Once the collected studies were gathered, and analyzed, they were classed as A, B, C and D according to the quality of the research. E.g., some studies and research papers were highly relevant as per their titles, but the class or quality of the study was not enough to be conclusive or satisfactory therefore these studies were graded as D. Above D were C, B and A, these studies are the one either carried valuable information on behalf of:
    a. Uniqueness and reliability
    b. Validity
    c. Interesting and making general sense
    d. Leading to the development of readers conclusive remarks and helped in the expansion of the readers vision
    e. Giving more clues to be searched and followed
    f. Contain valuable data
    g. And several other important aspects helpful in carrying the study forward

2.2. Cloud computing overview

2.2.1. Introduction

The demand and the use of cloud computing is ever growing since it was first introduced by then google CEO in 2006 (Qian, Luo, Du, & Guo, 2009). Even though the concept of cloud exist since 1960s but its scope was pretty limited to provide processing power to carry and perform limited tasks such as distribution of the computing power (Jadeja & Modi, 2012). Nowadays, cloud is serving a vast amount of users' interest starting from the gaming and leisure to the complex medical tasks all are performed on

cloud mainly on Microsoft Azure, Amazon AWS, Google and hundreds of other cloud platforms which customers choose according to the feasibility of their projects. Also, businesses are benefiting in a variety of ways from cloud and mobilizing in the great extent. Whereas with he help of cloud analysis, they have better chance to understand their customers and serve them in a better and organized manner (Ghobakhloo, Arias-Aranda, & Benitez-Amado, 2011). Since there is a vast number of tasks available that cloud can do, this also contribute in making cloud contracts complex and difficult to manage. In this chapter we highlight all the significant studies written on cloud contracts and cloud SLA (L. Wu, Garg, & Buyya, 2011).

Cloud has transformed the image of the computing and enhanced the capabilities of the organizations to perform better and serve their customer with much reliable and stable computing resources (Goodburn & Hill, 2010). This didn't only allowed better IT integration but the computing became more convenient, measured, and flexible in a sense that it is scalable, better utilizable and without any limitation which are generally associated to the infrastructure (Mell & Grance, 2011; Martínez, Aranda, & Gutiérrez, 2016). Cloud computing is the computing platform of future which is available today and will completely replace the servers or traditional form of computing in use in recent times (Kim, 2009). But these are not the only option which make cloud computing a better choice, cloud computing is much more than what most users define it, it's a reservoir of resources which allow the users to reshape and redefine the computing according to their ease of use (Petcu, 2014).

Cloud computing is a combination of services and deployment models which are interrelated (Kumar, Gupta, Charu, Jain, & Jangir, 2014). E.g. if customer subscribe for SaaS it's highly likely that this will be available to them on one of the deployment model while service provider will have most of the control over the services (Toosi, Calheiros, & Buyya, 2014). As far as the role of the customers is concerned, they have limited or no control over the service provision. Customer role is limited to the dashboard only where they can see their subscribed services and perform limited actions such as scaling up or scaling down of the services or other limited tasks like controlling the

number of users, adding new users or blocking a service and certain similar other operation (Martinez & Pulier, 2013).

Beside the replacement of traditional infrastructure, the computer systems we are using is also transforming. The physical size is shrinking and also the computing and storage capacity of the computers is becoming limited with narrowing hard disk capacity while reliance is mostly on cloud and on subscription based computing resources available to private and commercial customers (Ferris & Darcy, 2015). And in near future, the internal storage will be totally replaced by the cloud and computing will become possible by using the internet only (Ruj, Stojmenovic, & Nayak, 2014).

The question is; how customers access these services? The customers should meet the minimum hardware requirements in order to access the cloud services. This minimum requirement includes; a client has a reliable internet connection and a capable infrastructure such as terminal and other hardware to access those services. Fundamental services, such as installation packages and online instruction manuals are offered for free to help the users to start with. But the rest of the services such as the applications and the software aren't free and service customers need to subscribe and pay for those services (Zheng, Martin, Brohman, & Da Xu, 2014). The subscription comes with online contracts mainly dictating the policies and service limitations that are set by the service provider with higher restrictions for customers while limiting their choice in choosing or modifying services. These contracts are online, and signatures are replaced by the clicks either on check boxes (click and wrap or clickwrap) or on combo boxes agreeing that they accept the terms (Maarouf, Marzouk, & Haqiq, 2015).

For customers, certain limitations make it difficult to implement governance on broader level. Therefore, governance in cloud is still going through its infancy and must cover a long journey before it gets as mature as the IT governance is today. This could be covered through proper integrations of IT governance and business models as well as the strategic alignment of business with IT.

2.2.3. Cloud Service Level Agreement (SLA)

Contracts in digital goods and services such as cloud computing are complex and managed and handled differently as compared to the traditional or general contracts. Service Level Agreement (SLA) is a contract which cloud service provider and customer agree upon provision of services (Kandukuri & Rakshit, 2009; Emeakaroha, Brandic, Maurer, & Dustdar, 2010). Service Level Agreements (SLAs), are the contracts which allow the cloud customers and cloud service providers to agree upon what is being provided and what is being promised during the active span of the service contract (Demchenko, Ngo, de Laat, & Lee, 2014). The customers and the service providers remain in close contact during active phase of the contract life and are legally eligible to claim their rights during it whenever it's necessary (Dawson, DiLuoffo, Kendzierski, & Seaman, 2016). Furthermore, SLA are binding and bound the service provider to provide standard services as mentioned in the SLA.

A vast amount of research is done in contractual management of cloud computing, these studies shed light over the difficulties, challenges and complexities faced by the cloud customers as well as the cloud suppliers due to lack of clear definitions (Regner, 2004; Leimeister, S 2010). Furthermore, there are studies which shed lights over the regional laws and regulations which influence the cloud contracts (Seddon & Currie, 2013). To understand the cloud contract, it's important to understand what influence these contracts e.g. data security (Kaufman, 2009). Like other contracts, regional and national laws play important role in cloud computing and cloud contracts. Therefore, in this regard, a good understanding of the regional law and contracts can contribute to better understanding of the importance of the contracts in cloud.

Regardless of the type of the digital service is bought; contracts contribute a lot in making things happen (Regner, 2004). Ultimately an effective contract could contribute to a better outcome and strategic benefits for both parties. In SLA, buyers and sellers mutually agree on service provision and optimal resource provision and on procedure of allocation (X. Xu, 2012).

There are studies which advocates the adoption of cloud whereas on the other hand there are counter studies which provide a counter perspective about off-the-shelf technologies that are hosted by third-parties (Sosinsky, 2010). Choosing cloud service is an strategic decision for an entity, organizations choose cloud for a greater benefit as part of their long term business goal and SLA make it possible for these organizations to access these services and achieve their goals via those services (Berman, Kesterson-Townes, Marshall, & Srivathsa, 2012; Bharadwaj, El Sawy, Pavlou, & Venkatraman, 2013).

SLA function as a system and help in maintaining the service quality and service provision and ensure that it contains the following elements (Van, Tran, & Menaud, 2009):

Service availability: The services will be available 99.99% and depending on the service provider and their policies, the service provider will remain liable to pay service penalty if the service is interrupted more often.

Customer support: Availability of hotline to ensure that the customer can get access to service technicians and are in contact to someone in the company who can consult customer in case if there is a need for trouble shooting etc.

Service performance: Performance and quality of the services will remain consistent and equal throughout the lifespan of the contract.

Security of information and data: data will remain secure and the service provider ensure data confidentiality and data encryption. The customer will also be given information about how to access data using secure platform and password.

Timely access to the data: Customers will be given a mechanism to access data anytime they want. Furthermore, they'll be given instruction about how to access it using different device and different location.

Abstraction and data location: Cloud computing applies the concept of abstraction but disclosing the data location is very necessary for cloud customer in order to ensure that their data is operated under certain jurisdiction.

Secure and a clear exit strategy: After the conclusion of the contract e.g. end of contract terms as agreed, customer is given time and support to migrate their data in a specified period which allow them to migrate properly and securely.

Service update, service change and service communication: Any change and update in the service is timely and clearly communicated to the customers with clear instructions, change policy, and documented provision.

2.3. Definitions and characteristics of cloud computing

2.3.1. characteristics of cloud computing

Advent of search engines like google, made it convenient and easy to find a relevant study or a definition (Chevalier, Dommes, & Marquié, 2015). One can find tens of definitions about cloud computing or even more. People can come up with their own definition of cloud according to their understanding and how they use cloud related services and it's not difficult for them to define the cloud if they are provided few hints about its characteristics. Cloud computing has its unique characteristics which can separate it from other form of computing like traditional servers or distributed systems. These characteristics are as follows:

- On demand self service

  Cloud offers an opportunity to the users to measure and control the network access, storage and other similar services without the intervention of the service provide. This capability allows customers to access those services without any restriction of time or location.

- Broad network access

  Cloud is not restricted to a client, platform and size which makes it accessible on the network like mobile phone, tablets, laptops, desktop and servers etc.

- Resource pooling

  Here, abstraction plays a vital role that the customers aren't informed about the physical location of the servers where the data resides. Resources are pooled on the network from different location and conveniently up scaled or downscaled according to the customers' requirements.

- Rapid elasticity

  The process of service provision is highly flexible that customers can chose from wide range and variety of services.

- Measured services

  Cloud services are measured and metered. This means that the provisioned services are completely monitored and regulated, and the customers are charged only against what they use as their requirements.

Above characteristics are the one which are mostly mentioned in different literature, but these characteristics might vary for different users who use cloud computing for different purposes and according to their own convenience. Beside its technological and monetary benefits, most of the users see cloud computing as a sustainable technology that with multi-tenancy model reduces the requirement for in-house servers and infrastructure which help in reducing in-house energy bills which are mostly produced by running and cooling the infrastructure.

2.3.2. Definitions of cloud computing

Table 2.1. consists selected studies with most suitable and accurate definition of cloud computing.

Definition of cloud computing defined in different studies	
Cloud computing defined	Studies
It's a platform which, with the help of the computer network allows the access to storage and development and application platforms.	(González et al., 2015)
It's enabler which enables entities to delegate their data to the third-party service providers.	(Ryan, M. D. 2011)
It's a system which helps the organizations to outsource their IT tasks to the cloud service providers while reducing the internal cost and resources.	(N Leavitt - Growth, 2009)
In cloud computing, computing resources are available over the network.	(Trivedi, K. D 2013)
It's a pool of virtualized computing resources which is available as on a pay-per-use model where guarantees are offered by service level agreements (SLAs)	(Vaquero, Rodero–Merino, Caceres, and Lindner, 2009)
It's abstracted where the users are not aware of the physical capabilities and the location of the resources they are using and deriving.	(Barrie Sosinsky, 2010)

Table 2.1. Definition of cloud computing

The conclusion of the above-mentioned definitions is as follows:

Cloud computing is a meta term for computing services provisioned via the internet on subscription basis. Like utility model where consumer pay for use against utility services on regular or daily basis like; water, telephone, electricity and other similar utilities product or services (Buyya, Yeo, Venugopal, Broberg, & Brandic, 2009). The term utility model is used here because of the similar nature of billing model for computing resources where customers pay only for subscribed services and part of the

infrastructure is in their use (Foster, Zhao, Raicu, & Lu, 2008). Another example which can fit here is renting a taxi for limited and predictable distance or travel instead of buying a vehicle.

Understanding this, it's not difficult to drive a conclusion that cloud computing has transformed the concept of not only the IT system in general but the overall concept of the computing (Buyya, Yeo, & Venugopal, 2008). It supports the notion that instead of buying, have temporary ownership and use only as necessary for specified amount of time. Indeed, cloud has changed the concept of product ownership to product partnership where the service provider and the service customers are partner and share the stakes related to the services.

Moreover, Cloud computing is a resource efficient technology which uses computer network and internet allowing the users to connect and access the resources. These resources are of wide range which are set very efficiently with the involvement of the service provider. Recent technologies, mobile phones, smart-television, home/office computers are highly dependent on cloud computing or are using some features from cloud computing (K. Xu, Wang, Wei, Song, & Mao, 2016). Either it is a firmware or a software update, storing the data or using a remote application, it's done on cloud. Cloud computing is a utility-based computing model (Sultan, 2014) where the aim is to deliver resources virtually on the distributed network. Cloud computing is scalable (Li, Yu, Zheng, Ren, & Lou, 2013) which refers to the capability of the cloud in meeting customers' expectations with the fluctuation in demand. Cloud is elastic, refers to the capability of cloud computing which allows rapid allocation of resources with minimum or at some cases no interaction from service providers corner (Herbst, Kounev, & Reussner, 2013). Cloud computing applies the concept of abstraction, it's a very unique feature of cloud computing which keeps the technology and the location of the services un-disclosed to the customers (Distefano, Merlino, & Puliafito, 2015). Another valuable feature of cloud computing is its resource pooling allowing the service provider to lend the same resource to the multiple customers (L. Zhang et al., 2014).

2.4. Importance of contracts

Data privacy and data integrity are the most important element for the cloud services (Kshetri, 2013). Cloud services aren't only sold on behalf of the state-of-the-art technology but with guarantee of the quality of security and on conformity of the data protection. Once chosen, the control and security of the data become the responsibility of the service vendor. According to Pearson (2013a) there are three main concerns which are considered most while choosing cloud. Therefore, a good contract clearly mentions data privacy and security clauses which help in retaining customer trust.

Security: It's the major concern of the individuals or entities while considering cloud for their business. With major cloud services and platforms failing in the hands of the hackers and making bigger new, customers are mostly concerned that how cloud service provider can fulfill their promise of securing the data (Krutz & Vines, 2010). It's however notable that the service providers have better security mechanism then the customers own made security mechanisms.

Privacy: After security, privacy is the second biggest concern which raised enough questions that either it makes sense to use cloud for the sensitive data? In the cloud, who has access to the data up to what scale and what is their overall role in the organization and why it's important for them to access the data? Is that going to affect the competition where someone with has the access (Zhou, Zhang, Xie, Qian, & Zhou, 2010).

Trust: Concern about the privacy and the security raise the question about the trust on the credibility of the cloud (Noor & Sheng, 2011). How much trustworthy the cloud is? Is it wise to migrate to the cloud on behalf of the promises of the service provider? How much value is gained by choosing the cloud against the size of the business secret which is compromised? Ongoing increase in data breach by either governmental agencies such as NSA of the USA inside and outside of the USA and frequent attacks from the hackers with different motives raised enough concerns and the doubts which cloud service providers are trying to justify regularly (Pearson, 2013). Table 2.2.

consists of studies which precisely addressed Security, Privacy and Trust most precisely.

Problem addressed	Focused on	Study
Security	Risk related to cloud security	(Almorsy, Grundy, & Müller, 2016)
	Security threats feared by users	(Rong, Nguyen, & Jaatun, 2013)
Privacy	When data is shared with cloud service provider	(Ryan, 2013)
Trust	Limitations due to the trust	(J. Huang & Nicol, 2013)

Table 2.2. Notable studies

2.4.1. Cloud computing contracts

Contracts are the main parameters for acquiring any product or a service where customer are using services regularly without owning them but renting the services (Prokopenko & Troian, n.d.). In the context of the cloud computing contracts are given special consideration because;

- Cloud is based on abstraction, the exact location of the servers and from where the services are provisioned are not known to the customers, and therefore a contract is an only way to maintain the level of trust and confidence on cloud customer (Sareen, 2013; Martinez & Pulier, 2013).

- Contrary to any other service or a product is purchased online, cloud computing deals with personal data whereas the quality of the product is measured on behalf of the quality of contract. This means, a reliable service is backed by a stronger and a good contract that is complete and carries necessary data clauses (Pearson, 2009).

- A contract in cloud is deemed complete when it's capable of addressing the requirements of the customers either a B2B or B2C or any other form of relationship formed for delivering cloud services from one party to another generally a service provider to service customer. And in other cases, a service generator to service broker then to service customer.

- A contract should be aligned with the state law or the national law of any country where service is provided or acquired. Or the contract should acknowledge the applicable laws.

- In case of any predictable or unpredictable scenario, such as any uncertain event like flooding in data center or routine update, the contracts will be the only way to get closer to an agreeable situation among both parties involve or even the cloud broker or any other individual or party involve or effected by the contracts.

- Contracts are also helpful in defining the metrics of the cloud services, which includes:
    - The uptime (the availability of services as promised which is 99.99%).
    - Reliability
    - Speed
    - Security
    - At the end of the contract, three or more months allowing the customer to migrate the data securely.

Hence, a contract will serve the interest of the involved parties in pre-contract award phase, award phase and the post award phase of the contract.

2.4.2. Types of cloud computing contracts

Before we discuss the cloud contracts, it's important to understand the contracts we're using time to time for different online services and agrees with the conditions offered and justified by the service providers with one click ("Computershare Governance Services - ONLINE SERVICE TERMS AND CONDITIONS," n.d.). Some of these contracts are mentioned as follows:

- Terms and conditions or terms of use or terms of services (e.g. amazon kindle unlimited)

- Software License Agreement

- End-User License Agreement (EULA)

In the context of cloud computing services, particularly when the services are purchased, the contracts are provided in the form of service level agreement (Baset, 2012). Once customers decide for which services to go for, they, then contact the service providers to formally purchase the desired services provider and request for the service catalogue or provide their detail specification and enters the contract negotiation phase.

As discussed in chapter 1. of this thesis, that contracts will remain responsible for serving and securing the interest of the involved parties and stakeholders throughout its active lifespan.

As shown in figure 2.1., each phase of an SLA plays a role, during the first stage, that involves decision making process, the cloud service buyers look for confidence and flexibility in the services offered to them. First stage is the qualifying round for the service provider and help in deciding either a service provider qualifies or not according to the needs of a customer (Alhamad et al., 2010).

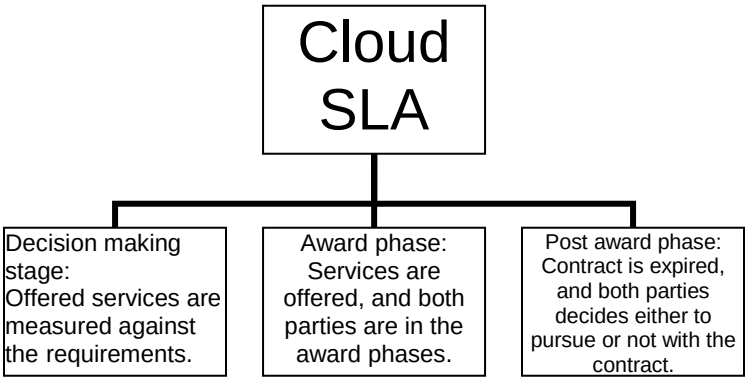

Figure 2.1. Phases of SLA. Source: Self-Elaborated

Once customer agrees on the contract, they enter the award phase where the promised services are delivered to them and both parties are legally bound to fulfill their obligations made in the contract, which is from the customer side is mostly limited to the payment against the services and from the service provider side it is the service delivery (Beugnard, Jézéquel, Plouzeau, & Watkins, 1999).

Third and the last phase is the post award phase, this is either the end of the contract period or in a rare scenario, could be possible that a either party decides to quit the

service. By this stage, the contract is no more valid, and the faith of the contract is decided on the requirements; by the customer or on the capability of the service provider if they can offer similar services.

Governance in cloud is still in its infancy and is not as mature as the Governance in IT (Khorshed, Ali, & Wasimi, 2012). This research is aimed at finding possibilities to integrate governance in cloud computing which is feasible through contracts while considering the service models mainly SaaS and four major deployment models as shown in figure 2.2. and named as follows:

- Public Cloud

  This is a multi-tenancy model open for entities and individuals in a controlled fashion e.g. Microsoft Azure (Firestone et al., 2018).

- Private Cloud

  Privately owned cloud model with single tenant where users have choice to design certain functions e.g. (Serrano et al., 2015).

- Hybrid Cloud

  A possible combination of both; public and private cloud.

- Community Cloud

  A dedicate model which serve the interest of a community.

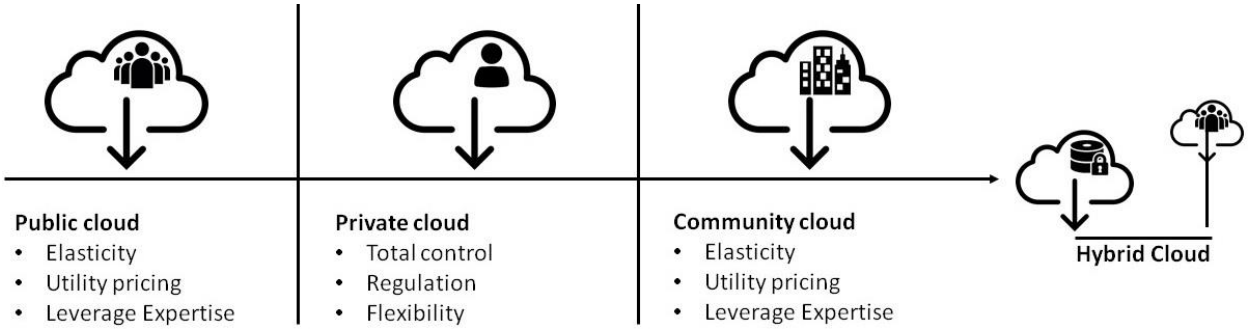

Figure 2.2. Cloud deployment models. Source: (Valacich, 2012)

The three main service models are as follows:

- Software as a Service (SaaS)
- Platform as a Service (PaaS)
- Infrastructure as a Service (IaaS)

Figure 2.3 is the representation of three main service models and shows what is offered with each service model and the interrelated. All three services are interrelated meaning if one is used second is possibly involve such as; PaaS services comes with IaaS and SaaS services comes with PaaS and IaaS.

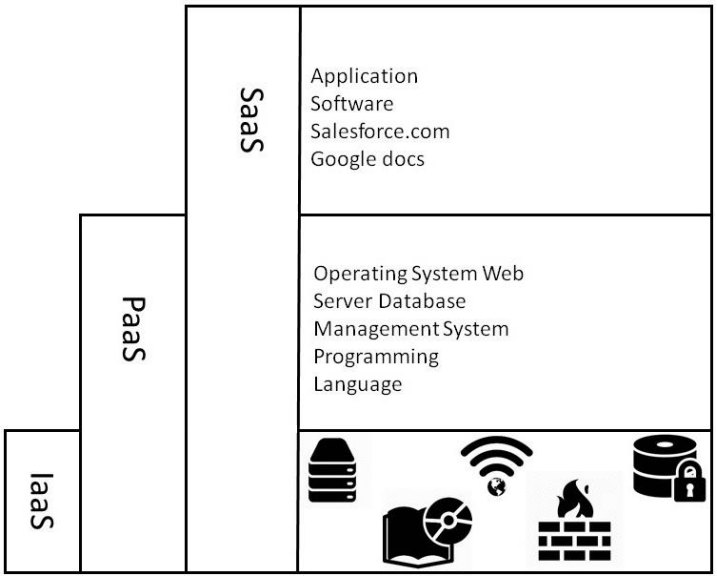

Figure 2.3. Cloud services models. Source: Inspired from (Valacich, J., & Schneider, C., 2012)

In the trade of cloud computing, an ideal contract is still a desire for the customers, but a proper, reliable and understandable mechanism will be helpful in avoiding the unnecessary confusions associated with the cloud and may also help in developing a better relation between the cloud brokers, service providers, and the customers (Wang & Ranjan, 2015). Therefore, by the end of this thesis, a proper conclusion will be presented which will help in better understanding and utilization about integrating the governance in the contract of the cloud.

“Education is our passport to the future, for tomorrow belongs to the people who prepare for it today.”

Malcolm X

Chapter 3. Research Methodology

3.1. Methodology and Results

3.1.1. Research Methodology

This research is exploratory based, and the research methodology used in this thesis is qualitative where expert in the area of cloud computing were interviewed to reach a conclusive statement (Kvale, 1994; Stebbins, 2001). Exploratory research is aimed at highlighting, investigating and exploring topics and conducting in-depth reviews of the existing and similar studies and materials available in the area of interest which help authors in providing another improved perspective of the subject.

Computer assisted qualitative data analysis is performed for this study where a thematic text analysis on **R** carried out for evaluating the expert interviews (Kelle, 2004; Fereday & Muir-Cochrane, 2006). R is a computer programming language and an environment which is popular among statisticians and research scientists who primarily use R for data analysis and graphical representation of data (Diedenhofen & Musch, 2015). The interview participants were selected on behalf of their work and experience in the field of IT and cloud computing. The collected interviews were then processed using **R** **Q**ualitative **D**ata **A**nalysis (RQDA) which is an **R** package for **C**omputer **A**ssisted **Q**uality **D**ata **A**nalysis (CAQDA). It's a reliable extension and is successfully used for text analysis and could be done by following a systematic procedure which involve coding and labeling of the text from each interview (Chandra & Shang, 2017). Moreover, this is one of the highly reliable procedures available to analyze the text in different research areas including computer science, law and other disciplines (O'Keeffe, Buytaert, Mijic, Brozović, & Sinha, 2016).

The usefulness of RQDA makes it a likely option to be used since it allows the constructive approach of qualitative research with quantitative analysis and helps in making the research much more authentic and meaningful (Vogt, Gardner, Haeffele, & Vogt, 2014). As compare to any other method used for the qualitative research, RQDA is more convenient and useful since it provides a proper orientation to the researchers throughout the phases of research.

The interview was conducted on one-on-one basis with each candidate after getting appointment. During each interview, all the participants were asked the same question and had to answer 3 open questions. For overall study, 9 participants were interviewed for the survey.

The three questions that each participant answered were:

1. How do you see the governance in cloud computing and how it's different than IT Governance?

2. Are currently available contracts such as; click and wrap are enough to ensure governance in the cloud or something else could be done to ensure it?

3. How could contracts be improved to ensure the governance in cloud computing?

These questions are inspired from studies that are focused on cloud governance and addressed the terms and conditions of cloud or the conceptual framework of SLA for cloud. Some of these studies are mentioned in table 3.1.:

Topic addressed	Focused on	Study
Privacy and security challenges in cloud computing	Data loss data storage and breach	(Y. Liu et al., 2015)
	Legal, regulatory issues and governance	(Hashem et al., 2015)
Compliance, risk and governance	This study addresses the compliance related matter of the cloud	(Farrell, 2010)
SLA	Contract related challenges	(Morin et al., 2012)
	Conceptual SLA framework	(Alhamad et al., 2010)
Information security and cloud governance	Governance framework	(Rebollo et al., 2015)
Governing cloud computing	Cloud and IT governance	(Prasad & Green, 2015)
Contract for cloud	Comparison of terms and conditions	(Bradshaw et al., 2011)

Table 3.1. Directional studies

The purpose of limiting the questionnaire to three questions only is to keep the study simple as possible and maintain the focus on the core topic such as the governance and the contracts. The clickwrap contract is chosen as the main form since it's frequently used for services like accepting the terms and conditions or click to accept. Once click to agree customer acknowledge that s/he went through terms and agree to carry on the services under with offered terms.

During expert talks and seminars in years 2015 – 2017, at SRH Hochschule Berlin, around 60 participants shared their opinion about the types of online contracts they subscribed or accepted for cloud-based services or social media such as LinkedIn or any other service uses cloud or associated with cloud. The respondent couldn't answer what contract they accepted or in what types of terms they are in with the service providers? This, at one side highlighted the unfamiliarity about the services in use and the importance of the contract that how the contract has lost its value against when made easy such as scroll down and click accept the terms. This is certainly one example that how user behaviour changed by transforming the contract from traditional to digital such as click and wrap.

This chapter is focused on research methodology and the research techniques used in this thesis. The main methodology involved is interviewing expert in the area who've worked for more than 10 years in IT. All participants answered three questions about cloud computing and cloud governance which were mentioned above.

Table 3.2. is the outcome of the analysis of the expert interview conducted in Berlin during late 2017 and early 2018, all interviews are processed in **R** using **RQDA**.

3.1.2. Analysis of the interviews and explanation of the table 3.2.

Table 3.2. is the outcome of the analysis of the interviews. RQDA allows to extract and save it as a table which contains multiple columns, starting from the left, the first column is for serial number which has no label, and the second column indicates the **R**ow-**I**D pointing to the row that a code belongs to. The **cid** denotes to the **C**ode **I**D which indicate the specific code, **fid** denotes the **F**ile-**I**D represent file from which a code is taken such as code 1 belongs to file one. Codes are selected keywords chosen from each interview. Furthermore, **i**ndex 1 state or indicate the start of the coding whereas **i**ndex 2 state the ending of the coding and the indexes indicate the relation between coding and coding length indicate the difference between index1 and index2. Each interview is saved as a file and all interviews are saved as separate files.

For every question the interviewees could talk to an open length, and their answers were noted in computer or written in a journal whereas distanced participants sent their answers via email (Egan, Chenoweth, & McAuliffe, 2006; Smyth, et al., 2009). Each interview is numbered as it took place according to the schedule and appointments which is a systematic approach while conducting interviews and for doing a qualitative research. Once the **c**orpus was ready, it was analyzed in **R** with **RQDA** and each interview is analyzed separately with code chosen from interview (Chandra & Shang, 2017). These words are the keywords from each interview where interviewee emphasized on a topic or put weigh on particular words and used them frequently.

Words from the interviews were categorized as negative or positive. During the interview, the candidates used both negative and positive words. Words like, weakness, complexities and complex models are categorized as negative whereas words like state of quality, capabilities and usability are taken as positive (Meyer, Hirsch, Hamer, & Terlau, 2016). The purpose of using positive and negative words helped in identifying both aspects of the cloud contracts according to the expert opinion. As concluded from the outcomes of the interviews which indicate that recent and modern online contracts are not enough to ensure governance in cloud computing or related services. Therefore, there's a requirement for modification and improvement in contracts and service level agreements which can integrate and ensure governance on every level of a service.

Code Categories according to each interview conducted								
	rowid	cid	fid	Codename	filename	index1	index 2	coding length
1	1	1	1	Control	Interview 1	104	188	84
2	2	9	1	Customer Preferences	Interview 1	96	102	6
3	3	11	1	IT Governance	Interview 1	193	265	72
4	4	12	1	Manaement	Interview 1	193	265	72
5	5	13	1	Infrastructure	Interview 1	193	265	72
6	6	2	1	Usability	Interview 1	421	457	36
7	7	3	1	Contract Type	Interview 1	459	493	34
8	8	4	1	Click and Wrap	Interview 1	459	493	34
9	9	6	1	Bilateral Contract	Interview 1	495	578	83
10	10	14	1	Negotiated Contract	Interview 1	495	578	83
11	11	7	1	Content Definition	Interview 1	661	701	40
12	12	15	1	Cloud Governance	Interview 1	661	701	40
13	13	15	1	Cloud Governance	Interview 1	703	895	192
14	14	8	1	Cloud Services	Interview 1	703	895	192
15	15	10	1	Application of Governance Model	Interview 1	703	895	192
16	16	17	2	Challenges	Interview 2	123	131	8
17	17	11	2	IT Governance	Interview 2	96	123	27
18	18	13	2	Infrastructure	Interview 2	130	177	47
19	19	1	2	Control	Interview 2	178	272	94
20	20	18	2	Authority	Interview 2	178	272	94
21	21	19	2	Personal Opinion	Interview 2	428	434	6
22	23	20	2	Charectiristics	Interview 2	490	509	19
23	24	19	2	Personal Opinion	Interview 2	511	602	91
24	25	6	2	Bilateral Contract	Interview 2	511	602	91
25	26	21	2	Hybrid and Dynamic	Interview 2	603	719	116
26	28	23	2	Cloud based Electronic Contracts	Interview 2	819	890	71
27	29	22	2	Digital Contracts	Interview 2	802	861	59
28	30	24	2	Weakness and Drawback	Interview 2	860	1890	30
29	32	19	2	Personal Opinion	Interview 2	891	1199	308
30	33	23	2	Cloud based Electronic Contracts	Interview 2	891	1199	308
31	34	26	3	Customer Centric	Interview 3	97	193	96
32	35	27	3	Capabilities	Interview 3	194	300	106
33	36	11	3	IT Governance	Interview 3	194	300	106
34	37	15	3	Cloud Governance	Interview 3	301	436	135
35	38	24	3	Weakness and Drawback	Interview 3	301	436	135
36	39	15	3	Cloud Governance	Interview 3	592	639	47
37	40	24	3	Weakness and Drawback	Interview 3	592	639	47
38	41	28	3	Need for New Practices and Standards	Interview 3	721	839	118
39	42	29	3	New Definition Required	Interview 3	721	839	118
40	43	19	4	Personal Opinion	Interview 4	96	233	137
41	44	25	4	IT and Cloud Governance are Same	Interview 4	96	233	137

42	45	16	4	Application of Governance	Interview 4	96	233	137
43	46	31	4	Contract Management	Interview 4	388	543	155
44	49	24	4	Weakness and Drawback	Interview 4	545	836	291
45	50	32	4	Incapability of Click and Wrap Contract	Interview 4	545	1836	291
46	51	7	4	Content Definition	Interview 4	919	1147	228
47	52	29	4	New Definition Required	Interview 4	919	1147	228
48	53	6	4	Bilateral Contract	Interview 4	919	1147	228
49	54	28	4	Need for New Practices and Standards	Interview 4	919	147	228
50	55	15	5	Cloud Governance	Interview 5	96	212	116
51	56	33	5	Complexities and Complex Models	Interview 5	96	212	116
52	57	34	5	Similarities in IT and Cloud Governance	Interview 5	213	473	260
53	58	15	5	Cloud Governance	Interview 5	475	749	274
54	59	35	5	Service Strength	Interview 5	475	1749	274
55	60	36	5	Click and Wrap Strength	Interview 5	905	13	98
56	61	37	5	Click and Wrap Weakness	Interview 5	1005	1148	143
57	62	38	5	Smart Contracts	Interview 5	1230	426	196
58	64	39	6	State of Quality	Interview 6	96	401	305
59	65	2	6	Usability	Interview 6	96	401	305
60	66	24	6	Weakness and Drawback	Interview 6	403	509	106
61	67	37	6	Click and Wrap Weakness	Interview 6	665	780	115
62	68	40	6	Enforcing Compliance	Interview 6	782	1943	161
63	69	41	6	Introducing New Measures	Interview 6	1026	193	167
64	70	33	7	Complexities and Complex Models	Interview 7	96	354	258
65	71	42	7	Cloud Governance is Subset of IT Governance	Interview 7	96	354	258
66	72	43	7	Abstratction in Cloud	Interview 7	96	353	257
67	73	37	7	Click and Wrap Weakness	Interview 7	509	819	310
68	74	4	7	Click and Wrap	Interview 7	509	819	310
69	75	44	7	Click and Wrap is Not Sufficient	Interview 7	509	1819	310
70	76	45	7	Service and Quality Control	Interview 7	902	148	146
71	77	44	8	Click and Wrap is Not Sufficient	Interview 8	805	1117	312
72	78	29	8	New Definition Required	Interview 8	805	1117	312
73	79	45	8	Service and Quality Control	Interview 8	1200	1453	253
74	80	46	8	SLA	Interview 8	1200	453	253
75	81	25	8	IT and Cloud Governance are Same	Interview 8	155	649	494
76	82	46	8	SLA	Interview 8	155	1649	494
77	83	46	5	SLA	interview 5	1230	425	195

Table 3.2. outcome of code categories and analysis of the interview

3.1.3. Research statement

The following statement is related to first stage of the research which was conducted while writing the thesis proposal:

To establish a methodology for a reliable cloud contract, which addresses the clarification needs of the service providers and the customers, for a transparent transaction of different services and deployment models of cloud. The research question itself is general and open. The objective is to suggest an alignment between the requirements of the users and the possibility to address those alignments. Therefore, the research question is formed after investigating the requirements of further exploration and explanation of cloud computing. Observing the recent developments, contracts in cloud emerged as one of the potential concerns of the customers who see it as a challenge while subscribing for the service contracts.

3.1.4. Research background

Qualitative data analysis or qualitative data science is one of the most used research methodology (Grbich, 2010). In general research, most of the emphasis is given to data based on numerical collection. For this research, text analysis is used which is a technique to analyse the content from the text that is gathered from sources such as the interviews and examine the underlying meaning from the text which help in describing the content and function of the text (Schmidt, 2004). Text analysis is a methodology which is feasible for research where statistical analysis is least applicable or is not desired or useful (Willse et al., 2007). Therefore, as a best alternate, the text analysis is used to extract meaningful information from the written interviews or collected data and words from different sources and converted into readable text.

In text analysis, interviews in the forms of text files are processed and different code categories are formed from those interviews. The purpose to categorise those words is to further identify the interrelation and asymmetry between the interviews.

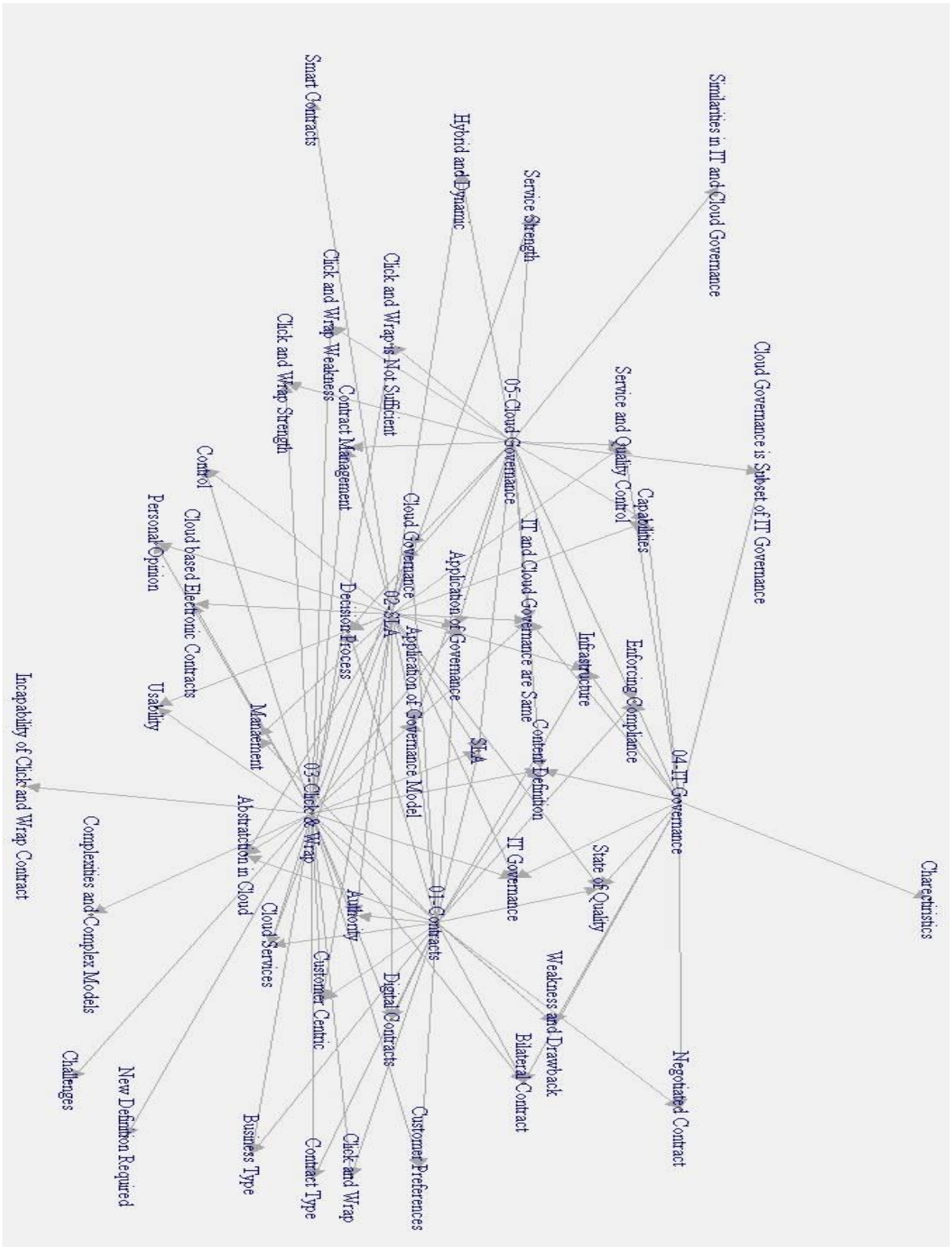

Figure 3.1. Codes categories created using R package RQDA after analyzing the interviews

Figure 3.1. Show the codes and their association with different categories as well as their correlation with other codes of different interviews (Chandra & Shang, 2017). The codes and the categories were picked from the written text of the interviews, the outcome of the coding as represented in figure 3.1. summarizes that almost all categories possess similar importance and are somewhat relevant to maintain and define the relationship together (Estrada, 2017). Also, each interview suggests that the governance in cloud computing is a complex subject and only possible with the consent involved stakeholders in the contract. Therefore, it is important that both the cloud service provider and cloud customers should show some flexibility to make it possible to introduce a governance model for the services offered. The is much possible and approachable when the service customer is buying a big amount of services which is convincing enough for the cloud service provider to sit together with their customer to draft and design a service. While on the other hand, for the smaller customers, a preplanned option would suffice with multiple choices in it.

In the overall interview, the most emphasis was given to the words Governance and cloud computing. Besides that, the other concern remained on the contracts or contract, customer, click wrap, services and service contracts as shown in figure 3.2. word cloud. The other words such as the resources, control business, need and other similar words were used but less frequently.

Figure 3.2. The word cloud. Source: self-elaborated using R

The word cloud in figure 3.2. is a categorical representation of the used words in a manner that bigger the word is the more it's used. Use of **R** also facilitated in finding the most frequent words used in the interviews with a graphical representation and helped showing words which are most relevant. The frequent words are shown horizontally, and the word frequencies are shown vertically.

Almost all participants emphasized on cloud, governance, contract(s), customer and services. As shown in the **f**igure 3.3. The **m**ost **f**requent **w**ords used were **c**loud and **g**overnance which the participants used more than 35 times followed by contract(s) and services. This helped in deriving a proper conclusion on behalf of the statistic and the result of the studies.

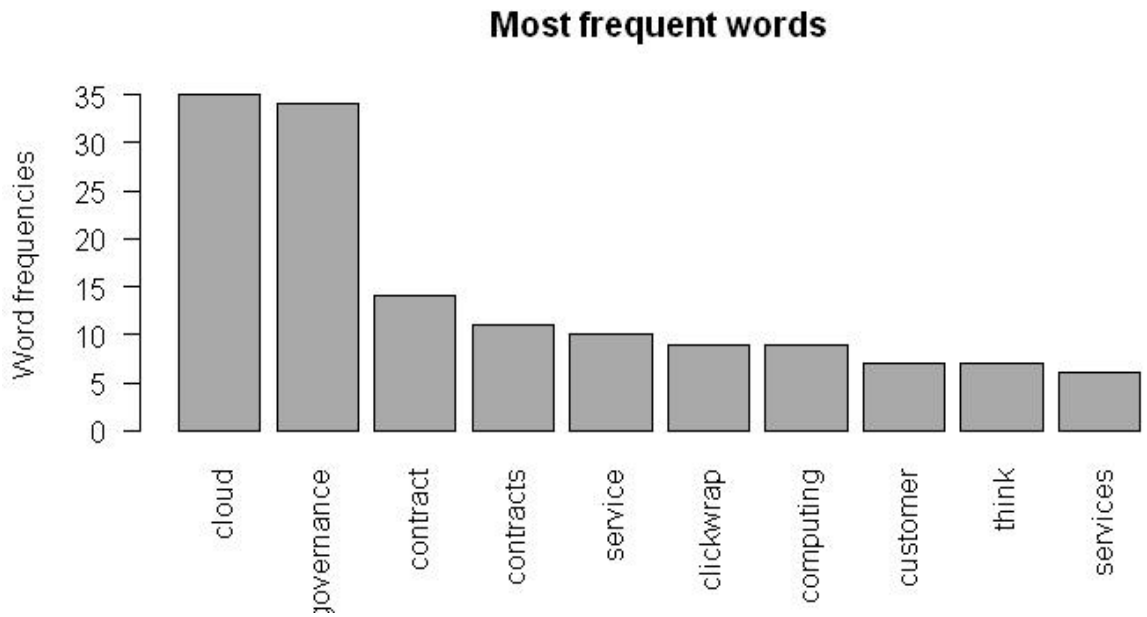

Figure 3.3. Most frequent words. Source: self-elaborated

3.2.1. The Click and Wrap Case – Contracts' Relevance for the Adoption of Cloud-Based CRM Applications

Contract management plays an important role in every organization and serves as a dashboard for monitoring the recent and active contracts (Cheung, 2016). Firms' use different contract management tools to assist them in handling variety of contracts. But the digital contracts such as the click and wrap contracts are different than the traditional contracts and are monitored by the help of an algorithm without human involvement.

The case study; *The Click and Wrap Case – Contracts' Relevance for the Adoption of Cloud-Based CRM Applications* focuses on a similar situation where the newly hired manager John Douglas of Paper Cubs (PC) faces a situation that his firm doesn't allow digital contracts in their service and in the end, they reach a situation where their typical governance model turns least useful in a manner that it restricts the PC to grow any further and doesn't allow them to accept any contract which is not signed by human. In certain situation the internal policies of the PC block them to accept state of the art cloud computing service which uses smart contracts.

The business model of the PC is based on a promise that their data is processed in house and kept private. But the system they are using is outdated whereas the competitors of the PC are using much-advanced systems capable of meeting the modern requirements. Adapting the new system from a third-party service provider is quite difficult for the PC since it's against their corporate governance policy as well as their business model which is based on processing and handling of data in-house without third party involvement.

3.2.1.1. Research Framework

3.2.1.2. Click and wrap contracts or clickwrap contracts

Click and wrap contracts are legally binding and effective (Davis, 2007). Online and digital contracts are more convenient when issued in big numbers and it's relevant for companies whose customers are subscribing in hundreds or on daily basis where manual preparation and handling of contracts for each customer is impossible. This become difficult for the firms to reach each customer individually and in this regard online SLAs especially in cloud are more convenient and helpful (Alhamad et al., 2010). The higher the number of the customer is, the bigger is the challenge in reaching them by limited number of the staff. Therefore, companies rely on contractual solutions such as the online contracts[2] or subscription-based contracts where customers get access to important and relevant information by one click and access to dashboard where they are able to manage and scale their services themselves (de Chaves et al., 2010). Moreover, click and wrap are legally binding globally and are proven effective in-service provision online.

The biggest obstacle in this area is not the contract but the customers. E.g. in social network users, instead of reading the contract rather click to agree it and proceed in some cases scroll down only when the customer can proceed to next step until they scroll down to finish the contract (Kuo, 2011; Obar & Oeldorf-Hirsch, 2018). Another challenge here is that the customers ignore the important facts due to lack of interest in reading or due to a general behavior toward the contracts and proceed for possibly

[2] Terms and conditions, privacy policy and clickwrap

unwanted condition such as; any update in future which might conflict with initial service agreement for cloud related services and could cause a problem for the company in a way that an update might change the way the services are delivered and in certain situation customers are caught in a defenseless position because they checked to agree for terms which were not in their best interest. Moreover, the handy nature of the click and wrap contract make it more desirable and acceptable among the large audience who seek immediate solution and services without waiting for long.

What makes click and wrap controversial among users is its nature of eliminating human factor in the contract and replacing it with an algorithm. This limits the human role also by limiting any possibilities of a negotiation involve in the pre-contract phase. Certain limitations to negotiate, modify or change a contract according to customers will is not limited to the click and wrap contract but other digital contract uses similar approach where the customers has no option to negotiate their terms and must accept whatever is given to them.

3.2.1.3. IT Governance

IT Governance is the subset of corporate governance (Buchwald et al., 2014) and comprise of the set of standards which are defined and compatible with corporate Governance and are taken from different standards available and can assist entities to align their organizational standards together with the IT standards (Rubino & Vitolla, 2014). Whereas IT management standard is referred to a set of processes that cooperate to ensure quality in IT services, according to. Governance sits over other level of management domains such as systems management, network management, systems development, and on many process domains like change management, asset management and problem management". Some of the notable IT governance standards are named as follows:

- Control Objectives for Information and Related Technologies (COBIT)
- Information Technology Infrastructure Library (ITIL)
- ISO 38500

Listed above are among the main governance standards which are widely discussed and applied as the most known standards of the IT governance. These standards are supportive when they are applied to govern the IT in the organization. Whereas in the context of cloud computing these are least applicable (Sareen, 2013).

In the case of the PC the focus is not the IT governance but the organizational governance which has to be changed to make space for cloud governance and allow the organization to embrace new services from the third-party service providers. Therefore, the overall decision that PC introduced is to make reforms in their corporate governance policy which allow them to be flexible enough for choosing any service. IT Governance Institute (ITGI) provide the following definition for IT governance (Simonsson & Johnson, 2006).

"IT Governance is the responsibility of the Board of Directors and executive management. It is an integral part of enterprise governance and consists of the leadership and organizational structures and processes that ensure that the organization's IT sustains and extends the organization's strategy and objectives."

Other than a standard practice, IT governance conveniently help in identifying roles in different decision-making process. As shown in table 3.3. users are identified according to their role in an organization and how much authority they have in making decision for IT. E.g., officers or lower management staff has no power or role in deciding anything in IT whereas departmental managers have limited role. IT management and IT managers have full role in decision making process.

Governing and making decision in IT department						
	IT expansion	IT budget	IT upsizing and downsizing	IT Management	IT payment	IT planning
Higher management	Yes	Yes	Yes	Yes	Yes	Yes
IT Manager	Yes	Yes	Yes	Yes	Yes	Yes
Departmental Management	No	Yes	No	No	No	No
Non-IT admin staff and officers	No	No	No	No	No	No

Table 3.3. Decision making process

3.2.1.4. Cloud Governance

Contrary to the IT governance where governance is the integral part of management, in cloud computing governance is different and difficult since in the service provision two different entities which are; the service provider and the service customers (De Haes & Van Grembergen, 2004; Stantcheva & Stantchev, 2014). Therefore, both the service providers and the service customers have their own mechanisms. The maximum control the customer gets is on interface which either run on the web or on the application provided with control limited to access the services only. Cloud governance is based on the collective capabilities of the service provider and service customer (Manuel, 2015). Collaboration is very necessary in this regard since it help them to reach an agreement for a possibility to govern services in a manner that service execution become possible with joint efforts of involved parties (Ren et al., 2015). Whereas un-attained governance goal in cloud is contributed by several reasons such as unclear vision about services and service goals from involved stakeholders e.g. a customer change their business

strategy could influence the use of technology and its relevancy (Brabra, Mtibaa, Sliman, Gaaloul, & Gargouri, 2016).

Nowadays, almost every cloud-based service is accompanied with a dashboard which allows the customer to manage, monitor and handle the services at the possible extent (Ren et al., 2015). The access to the dashboard is possible through the service contract/agreement where service customer get updates about the available services and mandatory orientation about accessing and using those system.

A concepts presented in Dzombeta et al., (2014) as shown in figure 3.4. is a simplified version of the selection process and choosing better services starting from the selection of the service provider, negotiation, monitoring & governing and planning.

- **Selection of the provider**

Here the service customer looks for a reliable service provider who can meet the service requirements and is capable of compliances to the offered services, location of the data center where the data is being processed or stored along with information security management system, concepts and current certificates.

- **Negotiation**

The negotiation involves the steps which comes pre-agreement where involved partners discuss the definition of the services, discuss the rights of control and protection of the mandate and service level agreements.

- **Monitor & Govern**

Control, monitoring and security measures and ensuring that they are truly and efficiently enforced.

- **Plan**

Control identification of the affected data, regulations, risk, threat and barriers. It’s a generalized and a conceptual opinion based on authors understanding which one could

conclude as an understanding of their own that how they see it happening and functioning in an organizational setup.

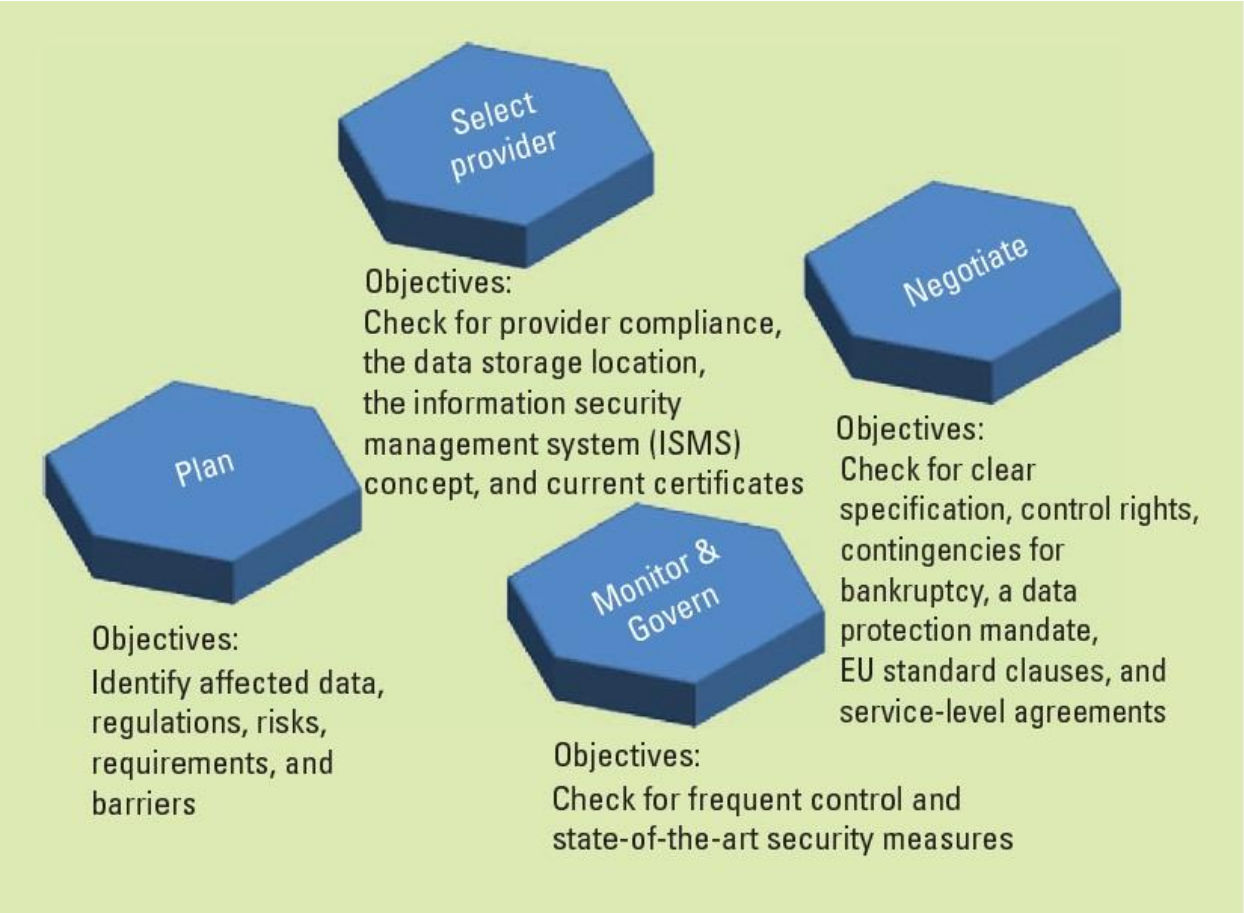

Figure 3.4. Selection process. Source: (Dzombeta et al., 2014)

3.2.1.5. CMM Berlin Model

CMM Berlin model is an inspirational and universal model which focuses on contract management, transaction management, corporate management and risk management (Schuhmann & Eichhorn, 2017). With three corners of the cube visible, this model assists entities to understand the foundations of the contracts and is easy to apply in a corporate setup. Furthermore, its nature to be absorbed in the existing governance model of an organization makes it desirable for an organization to adopt and implement it as the part of the learning management where the organization can benefit from the best practices (Eichhorn & Schuhmann, 2015).

As shown in the figure 3.5. the front part of the model represents the process management of the contract, the right side of the model represent the transaction management and the enterprise management, and the top of the model address the

core aspect of the model such as; knowledge management, transaction management, corporate management and the risk management.

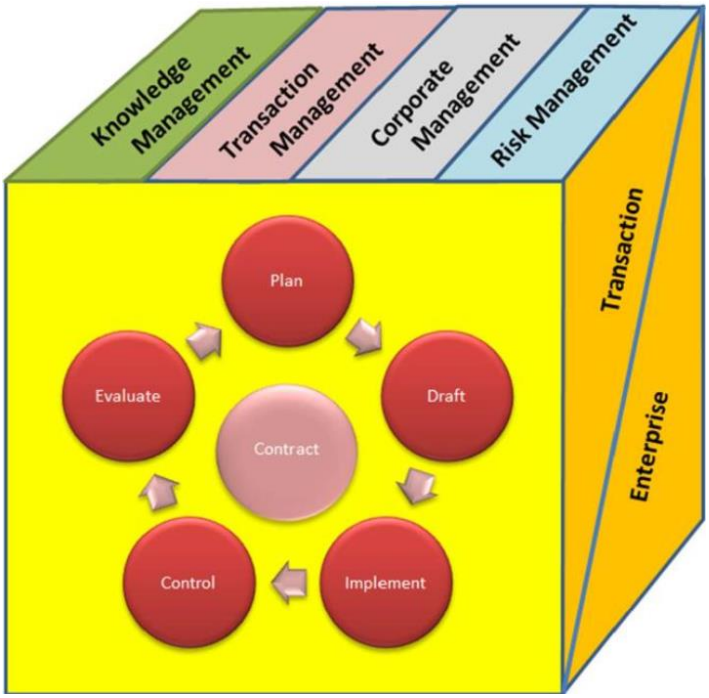

Figure 3.5. CMM Berlin Model. Source: (Eichhorn & Schuhmann, 2015)

Hence, the CMM model (Eichhorn & Schuhmann, 2015) is a suitable model to be implanted in an organizational setup to measure and monitor the associated risks and challenges related to a contract.

3.2.1.6. Application and limitation of the CMM Model for cloud and smart services

As discussed above, smart services are brought from the external service provider until unless they are designed inhouse. Therefore, in this context the application of the CMM Model is only possible at the customer side not at the service provider side or both parties can implement it on their own corner. The flexibility of the model makes it much easier to adapt it according to their setup and exploit it at maximum extent.

The overall concept of considering the Berlin Model is to ensure that all the relevant aspects of the contract are well covered, and nothing is compromised or neglected, and the associated risks are sufficiently addressed.

3.2.1.7. Case Result

The clickwrap agreements are in use for variety of services and applications as well as for cloud computing and serve as the great facilitators for the service providers (Condon Jr, 2003). The handy nature of the clickwrap contract make them a better candidate for meeting higher demand of customers in shorter period and instantly. These contracts are one sided and almost all customers go through similar conditions without a chance to negotiate but only choose/select upscale or downscale the number of the services.

As there is no possibility for the PC to change or modify the contractual terms, therefore the only option available to them is to reconsider their corporate governance policy. Without necessary amendment in their governance policy, the PC cannot achieve their business goal which is getting access to state-of-the-art technology and gaining competitive advantage in the market. This amendment provides them an opportunity to redefine their business terms with their business partners and gaining access to better services by making business partners by outsourcing their functions to them.

The CTO of the PC must ensure that his support help the company to implement the best practices and encourage them to take bold decisions which open the doors for new technologies and allow the PC to accept services coming with smart contracts. This is against their corporate policy and slogan which state that: “your data is in our hands” but the reward is much higher and change it to “your data is in safer hands”.

3.3.1. A roadmap towards smart services in healthcare

3.3.1.1. Introduction

3.3.1.2. Application of Cloud Computing in Healthcare scenario

Cloud computing as discussed earlier is a utility-based computing model which allows the users to use resources on metered basis (Distefano et al., 2015). Cloud computing comes with dual aspects of positivity which is creating more jobs, while on the other hand, it is creating ease for enterprises and entities to accomplish tasks which is not their core competence (Misra & Mondal, 2011). One example is the application of cloud computing in healthcare scenario where the cloud is used for collection and retrieval of records. These records are collected from different sources including the smart devices which are designated to perform and carry on same assignment all the time. An example here is the monitoring of medication adherence and sending the collected record of medication to the cloud where doctor can analyze the data and carry on the studies accordingly (Hiremath, Yang, & Mankodiya, 2014).

Moreover, cloud computing is resource efficient and has replaced the traditional computing model to one which is completely infrastructure and personnel independent. Automated business solutions, which are independent of personal interaction and use allows the entities to outsource tasks which aren't coming under their core competencies (Arias-Aranda, Bustinza, & Barrales-Molina, 2011).

3.3.1.3. Research Framework

3.3.1.4. Smart devices and smart healthcare services

Smart devices are the micro-computers with limited capacity and capabilities are designed to perform a single repeated task only (Bohn, Coroamă, Langheinrich, Mattern, & Rohs, 2003). In the healthcare system, there are several devices employed depending on the type of the treatment is required or provided (Hussain, Wenbi, da Silva, Nadher, & Mudhish, 2015). These tasks can be of different scope and type. Examples are; ECG, pulse meter, posture monitoring, digital thermometer and several other services which are monitored by the smart devices and collect information from these devices and the environment (Gupta, Agrawal, Chhabra, & Dhir, 2016).

The smart items are the enabler of the IoT, big data other related technologies which can collect data from designated environment and send it to the database where collected data is further analyzed and turned into information and use for further analytical purposes (Want, Schilit, & Jenson, 2015). The collected data are further use to make informed decision to improve the services and the delivery of the services by better understanding the patterns and underlying meaning of the generated data (Alharbi, Atkins, & Stanier, 2015; Hsu et al., 2016). Smart devices are not only the enabler of IoT but also enable the devices to communicate on wide range which include the Local Area Network (LAN), Metropolitan Area Network (MAN) and Wide Area Network (WAN) where devices are capable to communicate with each other such as; sensor to sensor communication and sending information to the distance located data centers with limited or no human interaction (Jarmakiewicz, Parobczak, & Maślanka, 2016; Ma, Zhang, Wan, Zhang, & Pan, 2015).

Quality, consistency and accuracy is another feature of the smart items which give them a higher hand over manually collecting data. These devices perform specific or selected tasks autonomously that are predictive. In healthcare, the opportunities are enormous and countless where smart sensors can further eliminate the chances of error by improving the accuracy and consistency (Kateraas & Medelius, 2015; Chen et al., 2017). Furthermore, the ever-increasing use of smart items can make the treatment process much faster by reducing the time of collection of reports which are done by human such as measuring the pulse and transmitting the data to the cloud accessible to the doctors and the healthcare staff. While on the other hand, if done by the human, this will increase the time of the treatment and report generation(Stantchev, Barnawi, Ghulam, Schubert, & Tamm, 2015).

3.3.1.5. Cloud computing in healthcare

As in any other field, cloud computing in healthcare is the enabler for data driven technologies we are using, either mobile based or isolated sensor based (Hashem et al., 2015). All the communication passes through different mediums such as the gateways and lands in the cloud and the cycle repeats (Botta, De Donato, Persico, & Pescapé, 2016). Affordable and attractive marketplaces make cloud feasible for

companies of almost all sizes where the entities can get hands on the services they need (Ferris, 2015).

Cloud marketplaces are the online storefronts where cloud-based services are offered and purchased making the cloud services as accessible as possible (Garcia, 2015). The customers are free from hosting any services themselves, but all become the responsibility of the service providers. The marketplace usually offers services and deployment models where customers can fill their online shopping carts. All cloud services are tied with one or more deployment models, For instance, subscribing to SaaS meaning subscribing to a part of a deployment model too (Hahn, Röher, & Zarnekow, 2015).

Using cloud services together with cyber/physical systems (Lee, 2008) for healthcare system definitely improve the quality of the care provided and allow the hospitals and clinics to gain more insight about patient health with better data management and backup system (Y. Zhang, Qiu, Tsai, Hassan, & Alamri, 2017). Cloud is also an enabler for big data which is in itself is a great advantage while allowing the practitioners to understand their underlying cases of illnesses more clearly (Hossain & Muhammad, 2016). Medical treatment centres that are operating at different scales benefits from different features of cloud, e.g. immediate access to data about the patient and their medical diagnostic history in a cost-effective manner (Hassanalieragh et al., 2015).

Cloud computing allows the doctors, nurses, patient, and the relatives of the patients (the stakeholders) to monitor the care processes and maintain their records on mean time. All stakeholders get access to the patient record and learn about the progress of the treatment (Solanas et al., 2014). The accessed record is secure with access rights limited to the designated stake holders while eliminating the chances for any unauthorized user to access the medical history (Sultan, 2014). With remote access to data, the patient and the healthcare staff access the data remotely and carry the treatment from remote location (Schubert, Ghulam, & Prieto-González, 2015). The overall idea is to reduce the time in providing care, improve the quality of treatment and reduce the cost.

3.3.1.6. Results

Smart items, such as RFID, WSN and WBAN are widely used in medical fields and help healthcare institutions and healthcare professionals to improve the treatment process and the communication with the patients and provide on-time and immediate update about the treatment. Together with the cloud, it's more convenient to provide professional care to the patients in rural and urban areas with reduced time and better communication results. Figure 3.6. is the summarization of the study showing data of the patients stored and accessed in the cloud, data about the patient represents data analytics, customer information is referring to customized service offering and collected data from patients is are taken from sensors.

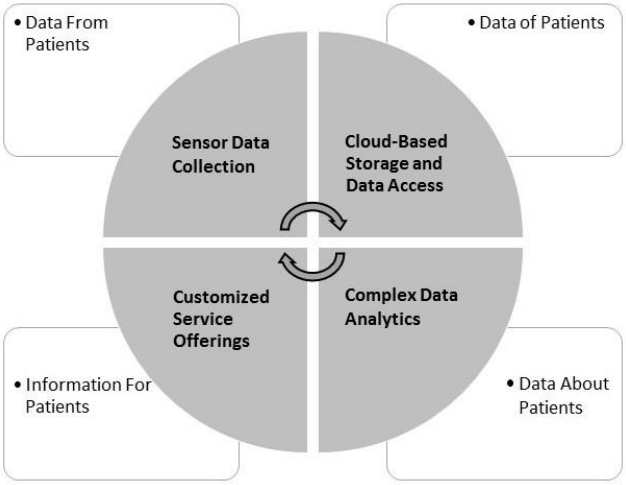

Figure 3.6. smart services customization process (Opazo Basaez et al. 2017)

3.4.1. Smart Items, Fog and Cloud Computing as Enablers of Servitization in Healthcare

Antecedent of study

Healthcare institutions and systems are employing cloud computing in a variety of ways like; with the integrations of the smart items like Radio Frequency Identification (RFID) help in providing better care by making adherence possible. Adherence is a big challenge and a report once from WHO stated that a reasonable number of patients do not adhere to the medication processes which make the treatment highly difficult and reaching the desired result would become impossible without patient adhere to the medication (Saleh, Mumu, Ara, Hafez, & Ali, 2014; Park, Howie-Esquivel, Chung, & Dracup, 2014). As in other entities, cost in healthcare also plays a vital role in deciding

to adapt. This is same for the healthcare industry such as clinics and hospitals. Cloud has dual benefits for the healthcare institutions: allowing them to reduce the size IT infrastructure and gain access to the state-of-the-art technologies and solutions available to them.

The traffic of the data from the user devices to the cloud and back has also created challenge in a sense that data traffic should be handled securely, effectively and efficiently (Jadeja & Modi, 2012). In order to address these challenges, the CISCO has addressed the problem very specifically with FOG computing which is a layer below the cloud computing and work as an intermediary between the cloud and the devices such as the computers and the sensors. In certain situation, where the computing capacity is pushed toward its edge, it's called Fog Computing. Beside service as an intermediary, Fog serve as a localizer between the devices at the edge of the computing. The project "Optimaler Einsatz von Smart-ItemsTechnologien in der Stationären Pflege", Germany (OpSIT) aimed at senior residential facilities in Germany was designed on similar concept where the concept was to deploy the smart items in order to monitor the health parameters of the residents as necessary (Stantchev et al., 2015). Figure 3.7. is an illustration of the position of fog between sensors and cloud.

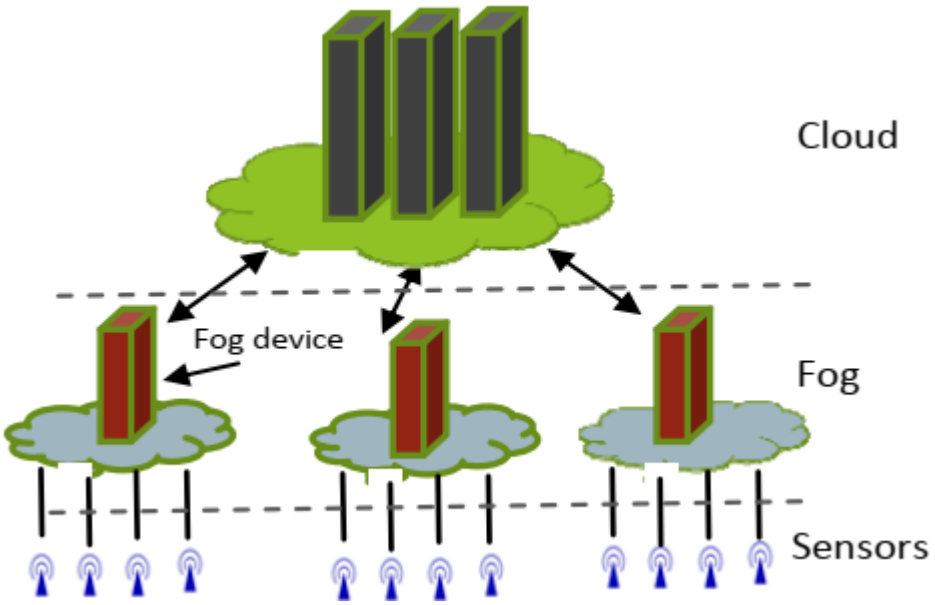

Figure 3.7. a conceptual model of Fog Computing (Stantchev et al., 2015)

3.4.1.1. Research Framework

3.4.1.2. Cloud and Fog Computing

Cloud computing is discussed few times earlier, therefore here it's skipped to avoid repetition. In Fog Computing, the devices are deployed in the center of the infrastructure that the frontend serves the cloud and the backend serves the sensors, therefore the sensors uses the Fog as the service point. In addition to that, the Fog layer serves and functions as the network device. The sensing part comes from the connectivity of the sensors and the signaling of the devices and as far as the networking is concerned it could be the dedicated as peer to peer network.

3.4.1.3. Governance in Fog and Cloud Computing

Integrating technologies such as the Fog and the Cloud computing in any environment need long term and strategic planning (Bharadwaj, El Sawy, Pavlou, & Venkatraman, 2013). Attaining milestones related to cloud computing are relatively easier by understanding the requirements of the organization and their capacity to use the technology and properly analyzing how a new technology could be positioned in required setup; such as healthcare facilities or hospitals (Kuo, 2011). An entity willing to adopt cloud computing also need a governance standard or a mechanism to control and monitor the particular services (Bhagat, 2012).

Information handling and information security and governing the services are the main conditions for managing and controlling the cloud services (Veiga & Eloff, 2007). As referred in the case of the Paper Cubs, cloud governance is focused on control of logical data as which in IT governance is more infrastructure oriented and accountability (Kaufman, 2009; Felici, Koulouris, & Pearson, 2013).

3.4.1.4. Servitization and eHealth

Modern products are not limited to the physical parts and existence only, but they are the combination of tangible parts that one can touch and see the logical parts such as the intangible aspects of the product that are the associated services e.g. dedicated programs like an specific software application (Porter & Heppelmann, 2015). Hence, e-

health is the combination of the smart devices and smart items such as the sensors and digital items used by the healthcare service providers and the cloud computing where the services are derived from the cloud such as collection, processing and retrieval of records. The blend of digital services such as the cloud computing together with the smart devices has emerged as the provision of the novel services in the healthcare sector.

3.4.1.5. Architectural model of smart services

As shown in figure 3.8., the conceptual model of the cloud is a graphical representation of the smart healthcare services mainly designed for senior residential facilities. The main concept is about collection of data from the main source (patient) which is then forwarded to the gateway and then to the cloud from there it become accessible to the designated doctors, nurses, other relevant care staff and to the patient (Xhafa et al., 2015). Collected data from a patient could be pulse of patient, images, body temperature and in certain cases can also be voice if relevant (Lo'ai, Mehmood, Benkhlifa, & Song, 2016). Moreover, the distribution and access right to the data is further defined in the governance of the organization according to defined data access policy. Relatives are also given access as needed either with the consent of the patient or in other cases only when necessary.

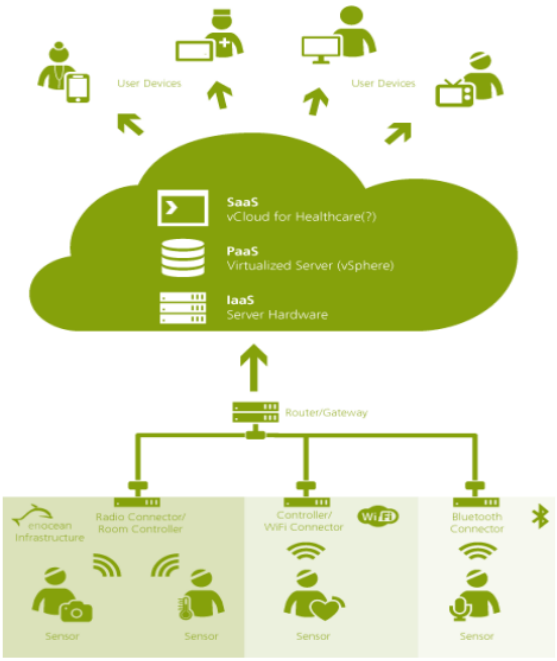

Figure 3.8. Overview of the cloud-based services (Stantchev et al., 2015)

3.4.1.6. Process Oriented View

Figure 3.9. is a Business Process Modeling Notation (BPMN) designed using Modelio (Allweyer, 2016). It is an enhanced graphical representation of the overall care process employed in any hospital or care facility where the medication process is in three lanes starting from the sensing if the medication is taken or not or medicines are taken. The smart pill box notifies the cloud via the sensors connected in the blister dispenser that if the medication is taken or not taken then the care staff intervene and notify the patient to take the medicine accordingly.

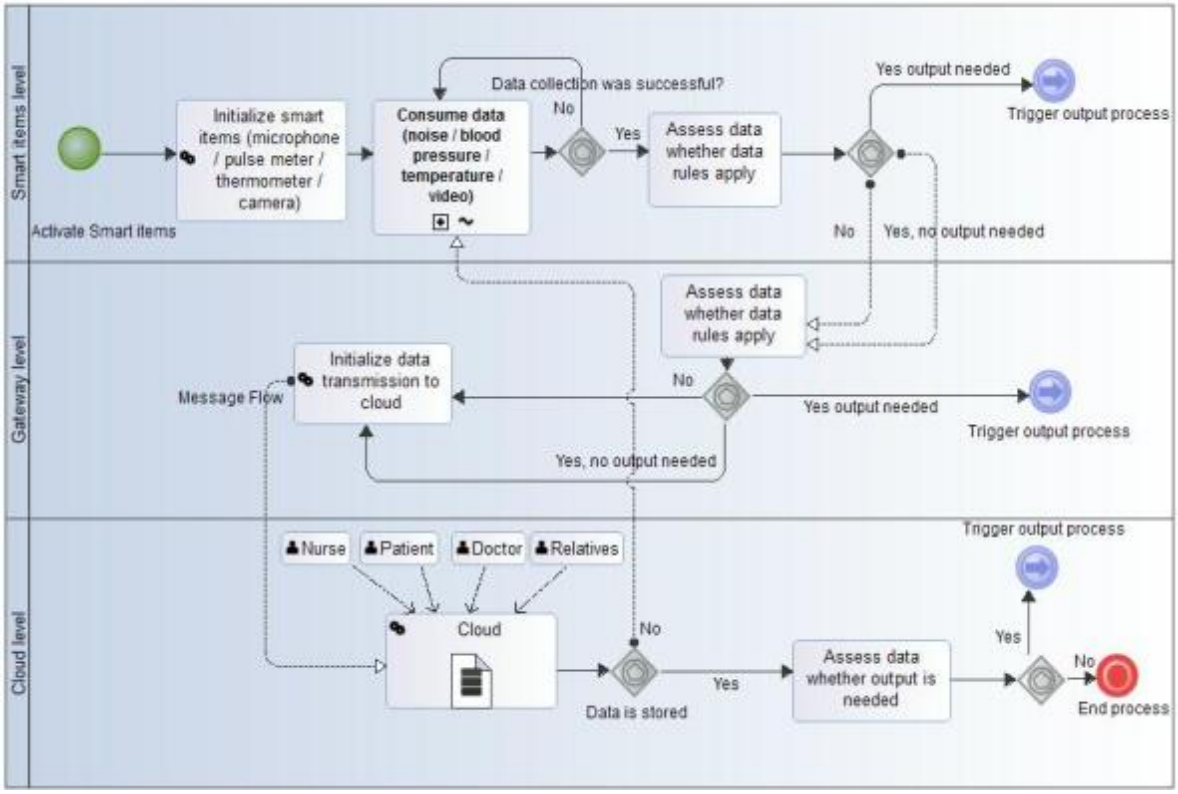

Figure 3.9. BPMN model for underlying application scenario taken from (Stantchev et al., 2015)

3.4.1.7. Smart care at home and in hospital

Only two decades ago smart homes were limited to conceptual models only but now they are realities and changing the way we used to live (Miller, 2015). These houses are equipped with tens of tiny computers in form of sensors (Vujović & Maksimović, 2015). The sensors are available on users' choice that what area of their routine living should be covered or not. This range from controlling the lights to monitoring the utility and food

consumptions mostly available in in residential facilities of senior citizens or those living independently (Ni, García Hernando, & de la Cruz, 2015).

Defining smart homes while considering the healthcare; smart homes denotes to a house or an apartment equipped with sensors and smart devices which can monitor the residents' vital parameters and save it to the cloud for further analysis by the healthcare professionals and the residents will have access to this data (Datta, et al., 2015). These data are collected from different vital parameters like; blood sugar, heartrate, $C0_2$ level in apartment or in a particular room, how much steps are taken and covered and what were the living and sitting patterns (Appelboom et al., 2014).

Moreover, the smart hospitals denote to the one which are well equipped and modernized and are capable of providing the better treatment to the patients (Rahmani et al., 2018). For instance, in the context of E.U. these are counted as the availability of modern care facilities together with digital infrastructure possibly a cloud based patient database (Stantchev et al., 2015).

Technology is just a tool. In terms of getting the kids working together and motivating them, the teacher is the most important.

Bill Gates

Chapter 4. Conclusion

4.1. Conclusion, Implication and Limitation of the Study

4.1.1. Introduction

This thesis focused on the role of governance in cloud computing and how contracts can help in implementing governance in cloud. The research emphasised the enhancement and the improvement of cloud governance and the role of contracts in implicating and introducing a better governance model and mechanism (Norta, 2015). The interviewed experts came with different answers agreeing that governance in cloud is not same as IT governance and could be difficult or complex depending on specific requirements, environment, application as who is the user where it's being used and for what purpose? Healthcare is one example discussed in this thesis but almost any institute can benefit from cloud (Kasemsap, 2015). Therefore, a complete contract management and a standard for cloud computing governance can help anyone interested in cloud related applications.

4.1.2. General Conclusion of the Study

Governance stands for reliability and accountability for available and designated services in any setup (Gonzalez et al., 2012). Existing governance standards are limited to IT governance and addresses the internal setup only. Cloud on the other hand is not covered under existing IT governance, therefore there is always a need for strategical planning whenever an organization undertake a change especially in terms of technology and want to replace their internal setup which is in their control and domain to something which is provided by a service provider where entire control shifts to service provider. Same happens when an entity selects any cloud service such as; SaaS, PaaS and IaaS or a deployment model. These services are available to customers on cloud store-front or on online marketplace where they can subscribe for a desired service and start using these immediately. Any service of the cloud replaces the internal governance model. The only condition to start using these services is going through terms and conditions and click to accept these conditions to start using those services. These contracts are called clickwrap and work accordingly and once chosen, customers start using them immediately (Garrison, Kim, & Wakefield, 2012).

Cloud computing has capacity to address the diverse needs of customers. Services are available immediately with minimal effort require to start. This is most desirable by customers of cloud nowadays and certain features give cloud services an edge over in-house solutions (Khan & Malluhi, 2010). The utility model is the key feature for cloud computing which makes it an easy option to adapt (Weinhardt et al., 2009), whereas the concept of abstraction is somewhat responsible for doubts exist regarding cloud computing (Buyya et al., 2009).

With certain ease and facilities in hand, cloud computing is a technology for mass to choose. But user friendliness and ease of use isn't enough to address all requirements of the customers. They demand control over services at certain degree and need to govern as possible. The aim for having a governance on cloud-based services is to provide better understanding and control mechanism which can bridge the gap between the user and the services (Tewari & Sharma, 2012). Furthermore, the relation between the contract and the governance for better service delivery and solution mechanism is highly relevant for a successful service realization (Poppo & Zenger, 2002). Contracts which are open, better defined and well explained helps in better understanding of the service term and related conditions and retain customer confidence. While on the other hand, brief and abstract contracts remain responsible for doubts and in some cases ends in dissatisfaction of the customers and poor customer feedback (Brousseau, 2000). In this context, the contracts are proved to be very potent and potential in provision of transparent and clear services. This is a significant and straight forward approach which allow the customers to fully exploit the potential of the offered services. Therefore, certain offers serve as the service enabler and are crucial better integration of services to happen whereas both service provider and the service customer can achieve their business goals.

Moreover, as far as the outcome of this thesis is concerned, it's summarized as offered services are only meaningful if they are backed by a proper service guarantee that comes in the form of the service contracts.

4.1.2.1. Governance

Governance is an important element and helpful for entities to achieve their objectives and defined goals (Nugroho, 2014). Organizations and people who are working for those organizations can perform better if they know the goal beforehand (Stoker, 1998). An effective governance helps in omitting any confusion in objectives and provide clear agenda that what the company should achieve with a straightforward road map and direction. Governance comprises of processes, process definitions and process mechanism that are helpful in finding answers to the questions such as; what happen if the system fail? Who is responsible for the failure related to the infrastructure? How to achieve the financial objectives? How to get the best from the investment made on the infrastructure (Rau, 2004). The clearer the governance model is, the better the people get understanding about their role and responsibilities and also help in better business value creation (S. P.-J. Wu, Straub, & Liang, 2015).

4.1.2.2. Contracts and smart contracts

Contracts are the vital tools to get two parties agreed upon delivery of a single service or a set of services (Lang, Wiesche, & Krcmar, 2016). Contracts are the outcomes or the result of the negotiation which two parties involved and discussed upon (Cohn, West, & Parker, 2017). The outcomes of the negotiation will decide how those services will be delivered? For how long these services will be delivered and upon what terms & conditions these services will be delivered (Dove et al., 2015).

Furthermore, a complete contract contains all the necessary and applicable legal and constitutional clauses which make them valid and enforceable by law (Raskin, 2016). This validity attracts the customers to use offered services and the service provider to undertake the responsibility (Reim, Parida, & Örtqvist, 2015). Also, contracts are tools which can mitigate the associated risks related to a service or services. Unlike an insurance, contract does not help the customer to reimburse the defined damages[3], but the contracts can safeguard the interest of the involved parties and possibly provide them a safe exit when the service definition aren't achieved. The bigger the service is,

[3] Unless it's part of the agreement

the higher the associated risks are and therefore the contract become more valuable with the size of the associated contract. This research focused on the importance of the contract as well as the digital contracts and the services namely the click and wrap contract for SaaS.

Unlike the traditional contracts, smart contracts such as clickwrap aren't available as signed which a customer can put in files. But they are available to the service customer to read and click accept and proceed. A good majority of the customers aren't satisfied with such contracts because to them, service terms are not clear. Hence, like a traditional business, modern digital business also needs contracts to carry their routine tasks, therefore for them contracts possess equal and similar importance and are deemed as vital as they are in any other business.

4.2.1.1. Main conclusion and result

The main conclusion for this thesis is derived from the studies discussed and presented in chapter 3.

According to first study; Smart Items, Fog and Cloud Computing as Enablers of Servitization in Healthcare*,* shed light on the role of smart items and cloud computing in healthcare and focused on the role of fog computing serving as an intermediary between devices and the cloud. The combination of the devices and the setup form an environment for rendering better services from the cloud including data analysis and data processing.

The application of cloud is dynamic as per the nature of any business. Entities use cloud computing for accessing computing resources like storage, processing, platform and resource pooling and for several other reasons. Whereas the root of the Fog could be traced back to the approach in enabling end to end IoT deployment. Therefore, the main conclusion of the study is derived as that the fog can serve as an intermediary and a bridge between the devices and extend it to the edge of the network while allowing the extension of the applications and integration of IoT.

Second study; A roadmap toward smart services in healthcare: Taxonomy of technologies for services generation. Like the first study, this study focuses on the improvement of healthcare services using smart devices connected with cloud computing and enhancement of the care services which could bring better reform in the service provision and improve the care quality. The concept is like the IoT because of the involvement of inter communicative devices but different than Fog which is a separate layer standing between sensors and the cloud.

Smart healthcare solutions based on cloud computing have a great role in improving the quality of the care provided which will improve and enhance with time. Wireless devices serve as an intermediary to transfer data from one position to another or in inter device communication. The overall system is meant for improving the quality of care services in residential care facilities as well as in the hospitals.

Moreover, the study also highlights the usage and usability of devices in rural areas making it possible for the patients to access the quality healthcare services without geographical limitation or visiting the hospitals but take equal benefits and retain best services from those devices. Although, smart devices are tangible and comprise of physical components, but together with better integration of cloud computing, they are the good example of servitzation.

Third publication is a case study; The Click and Wrap Case – Contracts' Relevance for the Adoption of Cloud-Based CRM Applications. The study focuses on the situation of change in an organization where organizational culture, business model and the governance policy go against use of off the shelf software and cloud services. This strategy locked the Paper Cubs (PC) in their own policies and limit their capabilities in providing reliable services to their customers. The case aimed at highlighting the adverse effect of policies which are short-term and could affect the quality of services in the long run. Therefore, the organization should have enough space and policies which can allow them to obtain best services.

The case also shed light on the need and the requirement of having a flexible system allowing companies to adapt a new system whenever there is a need for it. This

flexibility is achievable by proper amendment in the existing governance model and the contracts. Governance serves as a model and a guideline for organizations by providing an orientation to those who are responsible in making decision. Whereas the contract serves as a reminder that what is being discussed or agreed upon and promised before the signing it and starting the service delivery. Since the digital contracts are one sided, therefore it's not possible to promise a lot but to deliver what is being discussed with no possibility to negotiate.

Hence, overall focus of the case is on systematic approach of governance by contract management. The contract could be more explanatory and customer centric defining the liabilities and limitations of the services. Contrary to the online contracts which are mainly focused on the interest of the service providers and securing their interest and weighed more on liabilities of the customers. This could change by being more balanced and defining and explaining shared liabilities on either side. Therefore, contracts should be transparent and bilateral and not a dictation from what service providers perceive is valid or not also the contracts should be flexible to involve the consent of the third party or the end user if there are more parties involve such as brokers.

4.2.1.2. Limitation

Governance in cloud is different than IT Governance. IT Governance could be the part of the corporate governance and could easily be implemented without a complication (De Haes & Van Grembergen, 2009). But the cloud governance is located on another layer of control which is not easy to implement since the service provision is under control of the service provider and the abstraction nature of the cloud make it further difficult to achieve the goal (Takabi, Joshi, & Ahn, 2010).

Implementing a Governance in cloud is quite challenging, the possibility to have governance implemented in cloud is via the contracts. Contracts are the platform to acknowledge that what involved parties agreed to deliver and receive and write it on a legal document. Therefore, contrary to the IT Governance, where the emphasis is on the corporate governance and on governance frameworks such as **I**TIL and **C**OBIT (De

Haes & Van Grembergen, 2004) or any other relevant standard, the cloud governance is more reliant on the instruments like contracts.

Contract can be clear, lengthy, and explanatory to provide more insight and be helpful to the parties to understand anything involved for what is delivered and what is asked for (Bradshaw et al., 2011). Governance could also be covered and could be explained to the user including the service category, the service plans, the service policies, service roles and service cycle. Certain elements can fulfill some aspects of the governance which customers might be looking in the cloud.

Contrary to the IT governance, where the organization is the sole responsible, in cloud governance, both the service provider and the service customer share the responsibilities. The higher responsibility comes on the shoulder of the service provider who must fulfill the expectations of the service customer and to deliver the best what they can offer and promised to be offered. Meeting the expectations and what is being promised and advertised make a huge pressure on the service provider to deliver the best and meet the market standards.

Available cloud computing service contracts aren't sufficient, majority of organizations expect something more tangible and fulfilling (Spring, 2011). Therefore, an enhanced, improved and better version of SLA or other online contract could be a better fit for the customers. This can help and gain their trust and involve them as the service partners in service provision during the active phase of the contract (Goudarzi & Pedram, 2011).

4.2.1.3. Research challenges

The research topic for cloud governance is an open topic where existing research are not enough to address the associated challenges and there exist a wide research gap which needs to be filled such as implementing and introducing standards for governance for cloud. Therefore, a comprehensive research in this area to address the Cloud Governance and underlying problems can help since majority of the available studies focuses on technical aspect of cloud only (Oliveira, Thomas, & Espadanal, 2014). Also, there is a vast need for research funding and research projects in the IT and cloud governance like the **I**nformation **T**echnology **G**overnance for **T**unisian

Universities (ITG4TU) Co-funded by the **E**rasmus**+** Programme of the **E**uropean **U**nion 561614-EPP-1-2015-1-ES-EPPKA2-CBHE-JP. ITG4TU is a unique and a suitable example which include high tier universities researching best practices in governance in Tunisian universities.

4.3. Policy planning on continental level in EU and on organizational level

4.3.1. Future of Cloud and EU

Cloud computing has the capacity to meet diverse computing requirements for enterprises, organizations as well as the commercial and private customers (Hashem et al., 2015). These requirements are of different nature and size. Cloud reduces the requirement for internal software, platform and infrastructure related setup. E.g., SaaS cloud is one of the main reasons for entities to come forward and embrace cloud and exploit the best from it. This increase in demand is also observed in the Europe and the member states of the European Union. Higher demand mean more jobs opening in the area of cloud computing and this results in higher mobility of skilled and expert labor in the European Economic Area (EEA) which can lead to higher satisfaction rate among the EU residents (Ross & Blumenstein, 2015). Moreover, this will also provide opportunity to experts from non-EU countries to come to EU and benefit from the already established and emerging market.

The Members of the European Union states should invest more in the cloud-based technologies originating from Europe and develop a European cloud model. This model should be presented to attract investments and creativity. Europe has edge over other continents since it has clear data regulations which are designed to secure customer interests and to provide transparent services to them (Pearson & Benameur, 2010). European Data Centers should be open to the non-EU customers and should house data from different disciplines like; medicine, space, education, agriculture, health, transportation, weather or from any other field of science, technology, life, society etc. All this in return can create more research opportunities, resulting in harmonization of cross border technology integration. Moreover, placing the data centers in the northern Europe can help in reducing the cost for electricity where weather can work as the

natural cooler and replace the air-conditioners and dramatically cut the cost associate with cooling (Mastelic et al., 2015). Placing the data center under the ocean is another option which is done by the Microsoft recently, but under ocean data house could be expensive.

Without a standard capable of defining the measures for alignment, it's quite difficult to align the cloud with the organizational governance (Hashem et al., 2015). Therefore, the European Commission should support in forming governance framework addressing cloud computing applicable for enterprise customers and private customers operating in EU and this should be a for European cloud.

Moreover, application of cloud governance is not the concern of the organizations only but it's a growing concern and question which should be addressed by standard authorities and regulatory bodies. Either it is the governance of data or governance of services or overall cloud ecosystem, it's a complete chain of interconnected system which demands equal effort and focus on better utilization of system. Without addressing those needs, the firms might not be able to best exploit the benefits of the cloud.

The involvement and interest of the European Commission in research projects addressing cloud computing can help in creating more jobs and opportunities in Europe in coming years and can lead the Europe in cloud reaserch. With a proper business model, Europe will be able to export cloud related services on global scale. Cloud market size is growing exponentially, and in the future, economies will benefit from revenue generated by selling cloud services.

4.3.2. Policy planning for companies and organizations

Considering the governance for cloud as it is now, policy implication on corporate level solely depends on internal efforts of customers together with the cloud service providers. The lack of policies and regulations make it extra efforts for the users and the customers to decide on their own that what kind of governance model they should have, and they act accordingly.

In cloud, from the customers' perspective, governance is associated to retaining better services and gaining more from the service providers. Whereas from the service providers side, it's related to getting more customers and selling them most of their services with established setup. In such context, the governance and governing of cloud is not clear but it's mostly about retaining customers and delivery of services with established service definitions.

Hence, there is a great space to be filled by the policy makers on national and regional levels which can make cloud easily understandable and approachable and this can better determine the fate of cloud computing on the longer run.

4.4. Future work

This research work was conducted to understand the relationship between the smart contracts and cloud computing governance. It helped to explore the existing weaknesses in cloud computing contracts and the associated risks such as understanding from the customer side (McGillivray, 2014). Therefore, there exist a great potential to further exploit this area and one can explore and provide much better understanding about the cloud computing governance and further address the role of governance. The existing contributions made in this area aren't enough in number as well as in information, therefore further research contribution can help in understanding the existing barriers and overcome related challenges. Improved, clear and standardized smart contracts can lead to integrate governance and more options can offered to the customers by increasing their role. In future research, the aim is to continue to explore possibilities for making governance more realistic by providing better outline for user friendly cloud computing contracts which can further extend the role of customers in contracts.

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