



# Adoption of Software-Defined Cloud by companies

Dissertation submitted in part fulfilment of the requirements for  
the degree of  
**Master of Business Administration – Cloud Computing**  
at Dublin Business School

By  
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**Declaration:**

I, Anshul Garg, declare that this research is my original work and that it has never been presented to any institution or university for the award of Degree or Diploma. In addition, I have referenced correctly all literature and sources used in this work and this this work is fully compliant with the Dublin Business School's academic honesty policy.

Signed: \_\_\_\_\_

Date: \_\_\_\_\_

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Last but not the least, huge thanks to my family for their love and support. Without them none of this would ever been possible. I hereby dedicate this piece of my work to my parents.

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Anshul Garg

## **Dedication**

This study is dedicated to my parents, who have always believed in me. They have been my source of inspiration and gave me strength when I needed it the most, and continuously provide their moral, financial and emotional support. This thesis is dedicated to the courage of my father ,who allowed me to take every step I wanted to take in my life and always stood by my side. To my mother, who let me stay overseas for my career and studies .

## **Abstract**

The overarching purpose of this research is to explore how Software Defined Cloud (hereafter “SDC”) impacts data innovation or information technology service providers. Additionally, this research considers the qualitative factors to transitioning from traditional to software defined cloud service provision, its configuration and how it can transform cloud. SDC is a cutting edge proposition which will be at the forefront of technology adoption in 2019. Whilst the application of SDC to cloud is in its nascent phases, already it is deemed to be of particular significance within academic literature and by leading industry experts.

This research will be of interest to the academic community, IT managers, IT technicians, cloud architects and industry experts. Deploying semi structured interview to explore the perceptions of industry experts from Irish Data Centres this research finds that the main barriers to adoption are cost and requirement or need SDC. As SDC is considered as big technological setups, not all businesses can afford or find the need to have such big setups installed. The findings of the research are (i) experiences regarding SDC from a cloud supply-side point of view (ii) benefits that the endeavours procure and (iii) eventual fate of this framework when adopted by ventures. The contribution to academic knowledge is distinctly in regards to transition from traditional to software defined cloud service provision, its configuration and how it can transform cloud. Whereas, the contribution to industry is by providing an overview on the working, general design and architecture of software defined cloud, its virtualised network and various other concepts like software defined environment.

### **Keywords:**

Software Defined Data Centres (SDDC); Software Defined Cloud (SDC); Software Defined Network (SDN); Software Defined Environment (SDE); Virtualized Network.

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## List of Abbreviations

ARPAN	Advanced Research Projects Agency Network
DIT	Diffusion innovation Theory
DSL	Domain Specific Languages
IT	Information Technology
PC	Personal Computer
QOS	Quality of Service
SDC	Software Defined Cloud
SDCM	Software-Defined Cloud Manufacturing
SDDC	Software Defined Data Centre
SDN	Software Defined Network
SLA	Software legal agreements
TAM	Technology Acceptance Model
TPB	Theory of Planned Behaviour
TRA	Theory of Reasonable Action
VM	Virtual Machine

## **Glossary of Terms**

**Cloud computing :** Cloud computing is pool of shared computer systems that can be regularly synchronized with minimum management efforts, over the internet.

**Data Centre:** Data centre is a building or groups of buildings where storage devices are installed. It could be a dedicated space in a building as well. Data centre is used for storing data in huge bytes and hosting servers. It is maintained with high standards of security as valuable data is stored and processed.

**Grid Computing:** Architecture of multiple units of computer system combines to achieve the main objective. All the computers on the network work in synchronization as a super computer performing big tasks together. Grid computing is network of computers and processing units which together makes a power unit with high computational power.

**Hyperscale:** The term Hyperscale is referred to large scale companies who manages the data hosting for their clients.

**Infrastructure as a Service (IaaS):** It is instant computing infrastructure ,which is managed and provisioned over the internet. Service that provides APIs used at high level by network architects. It is one of the four services of other cloud services and has highest control amongst other services. IaaS enables users quickly scale up and down ,which lets you pay only for actual usage.

**Network Topology:** It defines the way all the nodes are interconnected in a network. Network Topology is of following two types, physical and logical layer of the network. Former focuses physical layout of the nodes in the network while later emphasises on way of data transmission.

**Platform as a Service (PaaS):** This service of cloud computing is providing a platform to develop, run, test and manage application without building the in-house development tool. Platforms are of various types ranging for application development platforms to launching and hosting platforms.

**Software as a Service (SaaS)** : It is licensing of a software hosted centrally by the company. A software is licensed to another company for use after respective customization, and providing this service of facilitating and maintaining the software is Software as a service.

**Software Defined Cloud:** SDC is advancement in cloud industry with better flexible features and broad spectrum of services.

**Software Defined Environment:** SDE optimizes entire computing infrastructure – storage and network resources ,aiming to adapt according to type of requirement . Resources are assigned manually to workloads which happens automatically in a SDE.

**Software Defined Networks:** Network management facilitated by cloud services which enables efficient network configuration, aiming to achieve improvement in network performance is called Software Defined Networks.

**Virtualization:** Virtualization is creating “virtual” version of something, like server, desktop, operating system or storage device. It is a technique for sharing a single resource like server with more than one customer at a specific time as per individual requirement to optimize resource and save cost.

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## Chapter One: Introduction

The first chapter acts as an outline to the context and rationale for the study. The primary purpose of this chapter is to outline the components contained therein which comprise of the overview, the background of this study (section 1.1), and objectives behind this study (section 1.2). Moving then to an overview of the two primary types of research: qualitative and quantitative (section 1.3) which leads to an identification of the research approach selected for this study (section 1.4). Section 1.5 depicts the development of Software Defined Cloud (hereafter “SDC”) computing and how it has potentially created opportunities for data framework specialists and organizations whilst outlining how the adoption of SDC. Flowing from this section, the research’s motivation, problem definition and research questions are discussed (section 1.6 and 1.7). These sections present the fundamental research addresses or research questions of this study. The three research objectives are defined. This section explores the underpinning philosophy of this research: an interpretive semi-structured interview approach and outlines the advancement of the study research questions over the various data collection stages. Finally, the chapter concludes by delineating the structure of the thesis through a discourse pertaining the practical and theoretical implications of this study (section 1.8).

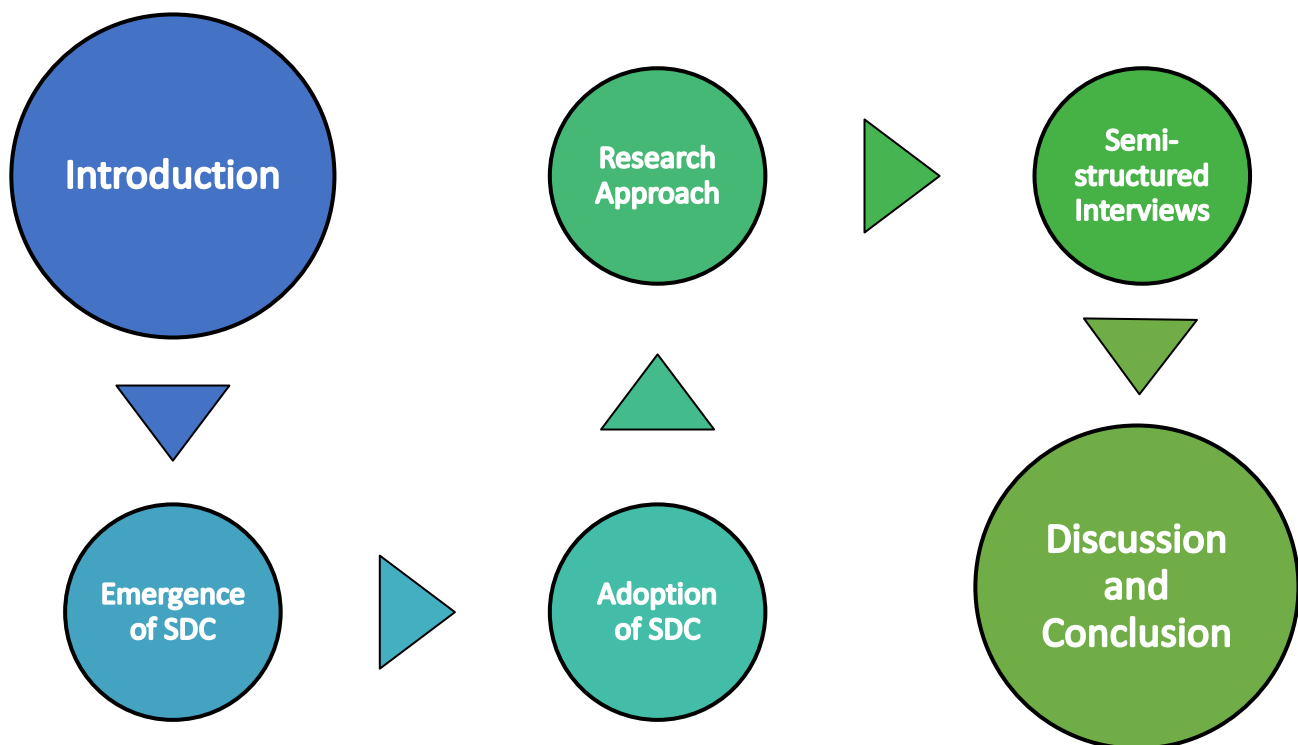


Figure 1: Discourse of practical and theoretical implication of this study

## Overview

Charles Babbage is thought to have invented the first computer in 1822. However, it was the technological advances effectuated during the Second World War where the computer as we know it began to emerge. Computing has progressed at a rapid and often immeasurable pace. Within computing there is cloud computing. With the introduction of Cloud Computing, increasingly data is outsourced to cloud servers from individual users and enterprises (Li *et al.*, 2018). The National Institution of Standards and Technology (2011, p. 3) define cloud computing as “*a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction*”. Contrastingly, Marc Benioff (CEO of Salesforce), “*On the off chance that somebody asks me what cloud computing is, I make an effort not to get stalled with definitions. I tell them that, basically, cloud computing is a superior method to maintain your business.*” Thus, increasingly the use of cloud and indeed the potential leveraging possibilities could be seen as a vital component of a business model and ultimately its success as a going concern and not merely a data storage component.

More recently, SDC has been introduced (Buya *et al.*, 2014). Xu, Wang and Guo (2017) advocate that SDC has transformed the operation of cloud, giving it new parameters and it is observed that many organizations find it much more reliable than the usual cloud. They define SDC as a mechanism which permits different parties, which mostly likely do not even know each other, to share data without a requirement of a centralized administrator monitoring it, and simultaneously also enables an enterprise to scale their cloud usage, performance and working to meet their requirements.

The aims of this thesis are primarily two-fold (i) to explore and discover the barriers and obstacles that organizations confront with cloud and (ii) to unearth if the advances in SDC can mitigate some of the current deficits and shortfalls of cloud computing. In 2016, Hyperscale made up 75% of the total digital hosting capacity in Ireland (McAuley, 2018). The results of this exploration will furnish the essential yet critical data about development of mechanization through SDC alongside the conceivable advancements or administrations that it has in put away for ventures. Likewise, it will give a picture to what degree SDC would be considered as a

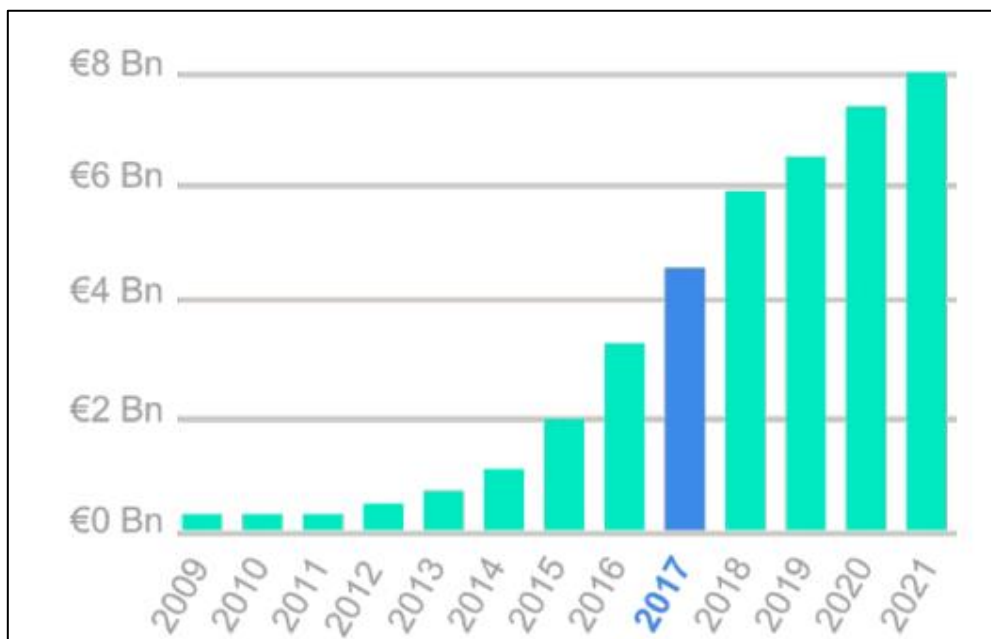
software measure that could be implemented to assist future developments in this largely nascent area. Subsequently, this thesis will explore the research aims, primary research methodologies, the current and extant literature, restrictions and achievable answers for the issues explained concerning this area of research.

### **1.1 Background of the study**

Cloud computing is a recent paradigm change which includes figuring asset administrations, delicate applications of distributed frameworks and data storage (Wu et al., 2012). Consequently, the computing world is rapidly changing toward an arrangement of inferring relative applications for millions to store and administer their data, as opposed to keep running on their personal computers (hereafter “PC’s”). As indicated by extreme market rivalry and a significantly changing business environment, companies have been incited to adopt different best-in-class data advances to enhance their business functions (Pan and Jang, 2008; Sultan, 2010). Heretofore, the term "cloud computing" has been rather limited in its realm. Cloud computing, or the utilization of web based advancements to direct business, is perceived as an essential region for Information Technology (hereafter “IT”) development and advancements (Armbrust *et al.*, 2010). The Internet has brought about virtualisation to many parts of our life (Buyya et al., 2009). Recently, our working environments are virtual, on line shopping, on-line training, entertainment has also been virtualised, and evidently, a significant component of computing has taken the virtual form. Virtualisation is definitely not an unknown notion to computer researchers (Chee and Franklin Jr., 2010). Memory was the first among the computer segments to be virtualised (Christodorescu et al., 2009). Memory was considered the most costly piece of the first range of computers, therefore, virtual memory ideas were evolved during the 1970’s. Storage virtualisation was a characteristic subsequent stage with virtual circles, virtual minimal plate (which are more commonly referred to as CD) drives, directing to the cloud storage today (Jain and Paul, 2013a).

More recently, there have been various investigations into methods for coordinating cloud-based frameworks and person-to-person (hereafter “P2P”) or social networking communication placed into a particular design and assembling space with the view of examining the possibility of Software-Defined Cloud Manufacturing ( hereafter “SDCM”) has also taken place (Thames and Schaefer, 2016). Here, SDCM seeks to propel cloud-based

assembling by presenting an equipment programming deliberation layer between assembling equipment and cloud-based applications, administrations, and stages. The thoughts behind fundamental SDCM are activated by other software defined frameworks, for example, software defined systems. The aggregated results (see Figure 2) indicate that by 2016, €3 Billion had been invested in data centres. There are €1.1 Billion facilities under construction in 2017 (Jones, 2018). The larger goal is to produce more conventional and reconfigurable equipment frameworks that are open and effectively adjusted at the product level (Pan and Jang, 2008; Sultan, 2010).



**Figure 2: Investment in Data Centres 2009 - 2021(McAuley, 2018)**

Over the time, various researchers and literatures have explained about realms of working of SDC is architecture and various other aspects in regards to SDC. But, no literature has ever explained the thoughts taken as account from the major audience who work or interact with SDC on a diurnal basis. Also, with SDC being such salient technology, the chances of transformation and updation of its features and working along the timeline is expected. Hence, even if a researcher follows the same repeated procedure to carry out research over SDC, the research results generated cannot be the same. Hence, this thesis, gives an overview of the emergence of automation through SDC, the adoption along the benefits it has to offer overcomes all the literature gap at this instant. Moreover, it presents the insights of industry experts who operate behind software defined frameworks alongside the fundamental

architecture and engineering of software defined cloud fabricating. In the recommendations section (Section 6.6) of this thesis, conjectures of future work alongside a framework of potential chances and difficulties related with software define fabricating are proposed.

### **1.2 Objectives of the study**

Drawing on the gap in the literature and the developments within the industry outlined in the previous section, this section specifically outlines the objective of this study, which indulges an exploration of the adoption of SDC by enterprises with the view of moving towards a fully Virtualised Data Centre:

1. To explore the emergence of SDC from the traditional methods;
2. To discover the impact and usefulness of the changes effectuated by the emergence of SDC; and
3. To describe the prospect the potential barriers of the adoption of SDC by enterprises.

### **1.3 Quantitative and qualitative**

The philosophical roots of both qualitative and quantitative research emanates from naturalistic and positivistic philosophies. Creswell and Creswell (2018) says qualitative research strategies can be well subsumed under one broad heading 'ethnography'. In the sociologies, qualitative research drafts originated from conventions in sociology and humanism; where the logic accentuates the phenomenological premise of a research, the detailed portrayal of the "signifying" of episodes for the general population or culture under examination. This is alluded to as the 'verstehen approach'. In a qualitative structure, there's often just a single subject, one case, or one unit is the focal point of research over an all-inclusive timeframe. On the contrary, most researchers opine, quantitative research, is mostly considered under the classification that prefers to be a study based on experiments, or statistical studies, as per others. The designs usually incorporate much traditional methods which mainly focus on psychological and behavioural methodology of carrying out the research. In sociology, quantitative modes are considered one of the most overwhelming strategies for research. Quantitative structures incorporate test ponders, semi exploratory researches and others, where control of factors, randomisation, and legitimate or dependable measures are

required and where generalizability from the sample to the populace is the main objective to be achieved. Information in quantitative researches are coded by from the earlier operational and institutionalised definitions (Brewer et al., 1999).

It is most essential in a research, to receive some standard by which one can quantify whether the qualitative, the quantitative, or a continuum that incorporates the two systems is the best mode in achieving truth. We expect the standard of science as a method for knowing.

#### **1.4 Research approach**

The research approach applied to conduct this study, commences with an audit of different ontological, epistemological and axiological positions and research techniques which researchers deploy. The research approach chosen is so as to explore the selected data frameworks in depth. It also clarifies the philosophical positioning of the research. Moreover, the general research process and contextual investigation based on semi-structured interviews examine those areas which has configuration rightly portrayed. Lastly, portrayal of the collection of data and investigation process is exhibited.

The research approach opted for data collection is semi-structured interviews which gives an in-depth analysis of the discoveries, utilizing the opinions, responses and experiences given by the participants which is part of research methodology and data collection. This data is collected from the information acquired amid the field interviews are considered as a focal point later for data analysis and coding. The conclusions or results found through this research which comprise the advantages and difficulties inborn to provisioning cloud innovations would help IT specialist co-op refine their decision making over adoption of SDC.

#### **1.5 Motivation of study**

With the adoption of cloud increasing each day, the quantity of cloud suppliers and administrations have enormously escalated. Many cloud partners are putting forth benefits in all three administration model-Software as a Service (hereafter “SaaS”), Platform as a Service (hereafter “PaaS”), and Infrastructure as a Service (hereafter “IaaS”). Moreover, there is a wide

cluster of items offered by every supplier for each administration show, and every item can be arranged with various parameters. This exploration can be viewed as a methodology for expanding horizons on not just making beneficial cloud environment by stretching out virtualisation thought to all assets (that includes compute, storage, and systems) of a data centre yet to likewise investigate ideas of SDC.

### **1.5.1 Theoretical Reasons For This Study**

The present literature or the existing papers discuss about the unique architecture of Software-defined cloud and probably also talk about how exactly SDC works. But, there is no much research or research papers that answers businesses' queries regarding adoption or moving to SDC with a direct approach. As businesses are rapidly advancing towards frameworks of record and frameworks of commitment, endeavours are progressively forceful in moving mission-basic and execution oriented applications to the cloud(Nunes *et al.*, 2014). In the interim, numerous new versatile, social, and analytical applications are specifically created and worked on the cloud. Hence, this research would serve the right purpose to clear all the inquiries businesses could have regarding SDC-it's working, architecture, services it has to offer to enterprises of the contemporary world along with the data analysis done on the basis of various professionals who are currently interacting and using SDC a diurnal basis.

### **1.5.2 Logical Reasons For This Study**

Considering many existing research papers and the opinions of people interviewed for this study, there are numerous reasons why the world is concentrating so much on virtualisation. The most essential ones are as per the following.

1. Asset sharing: If we have inactive assets that surpass our requirement then we can build the asset use by parting them among a few virtual machines. The assets can be anything like stockpiling, circles or even connections (Jararweh *et al.*, 2016).
2. Client confinement: In specific circumstances, there is a need to keep a dimension of secrecy between the clients. Utilizing virtualization, every client may have its very own VM, which is isolated from other clients' who their own VMs deployed.

3. Assembling of resources: If an assignment is to be performed, that requires assets/resources past what a particular business has, at that point that business can utilize the virtualization to fabricate reasonable and valuable virtual assets enough, to finish the errand.
4. Dynamic administration and control: The clients prerequisites are changing as often as possible which makes the reaction for these changes in virtualization less demanding than when managing straightforwardly with physical assets.
5. Streamline the administration: Devices to be managed through a layer of software is less demanding than oversee them in a physical layer (Nunes *et al.*, 2014).

### **1.5.3 Ethical Reasons For This Study**

Under this section, the political or industry requirement for this research is discussed. In this thesis, software defined environment (SDE) system is explained that incorporates ability based resource abstraction, objective/strategy based workload definition, and constant improvement of the mapping of the outstanding task at hand to the accessible assets. These components empower SDEs to accomplish dexterity, effectiveness, persistently streamlined provisioning and the board, and consistent confirmation for versatility and security. The interest for administrations and system use is developing quickly. Simultaneously, data centre administrators are confronting colossal development in the quantity of servers and virtual machines, expanding server-to-server correspondence traffic. So as to handle these difficulties, administrators require a system that is productive, adaptable, light-footed, and versatile. Hence, this study will explain all realms of SDC in most simplified manner that could refine decision making of enterprises in regards to the subject- adoption of SDC.

### **1.6 Problem Definition**

The assortment of existing cloud administrations makes a test for all the existing service providers to authorise sensible Software Level Agreements (SLA) expressing the Quality of Service (QoS) and penances on the off chance that QoS isn't successfully accomplished (Li *et al.*, 2014a). Tuning of performance along with management of network is very difficult and blunder inclined with need to achieve manual change of high level-policies into low-level configuration commands while adjusting or adopting to changing system and network

conditions. Moreover, relatively unsurmountable hurdle arrange technicians and specialists confront has been alluded to as "Internet ossification" (Nunes et al., 2014).

Due to its enormous deployment and in the reality it is viewed as a major aspect of our general public's basic foundation (such as transportation and power matrices), the Internet has turned out to be amazingly difficult to advance both in regards to its physical framework and also in addition with its conventions and execution(Jain and Paul, 2013a). Such penances, challenges were needed to be avoided on prime note and it needed to guarantee that the foundational framework worked with least requirement of energy and asset wastage, steady observing and adjustment. This study alludes to Software-Defined Cloud Computing, or basically Software-Defined Clouds (SDC), as a methodology for computerising the procedure of ideal cloud design by stretching out virtualisation idea to all assets in a server and data centres. A SDC empowers simple reconfiguration and adjustment of physical assets in a cloud framework, to better oblige the interest on QoS through a product that can portray and oversee different angles containing the cloud condition (Buyya et al., 2014). This research discusses all the problems that led emergence of SDC and gives a vital perspective of programmable frameworks from early plans to progressing upgrades.

### **1.7 Research Question**

The Information technology field, in the recent times, has started to use software defined frameworks. It is another worldview of reasoning in regards to not just software, but hardware as well, to a great extent empowered by modest, exceptionally practical equipment and virtualisation innovations. Advancements that have risen inside this space incorporate software defined organizing, software defined networking, software defined storage capacity, software defined processing, data canthers that are software defined, software defined radio and designing in construction (Perks *et al.*, 2018).

According to Linthicum(2012), "one on the core problems in cloud industry is that each and every cloud provider believe whatever they are providing are innovative. Hence, the aim of this research is to evaluate this hypothesis, look into the challenges that businesses of the

recent times face, with the current use of the existing or traditional cloud methods. Then, to evaluate how Software-defined cloud can help troubleshooting the hurdles. Through this thesis, companies can have a true idea of what SDC is, its architecture, it's potential and how adoption of SDC could simplify day-to-day mechanisms and tasks.

To evaluate all the above factors, the study is supported with three major questions to achieve three major objectives. Following are the key research question emerged out of the data analysis planned for this study,

**RQ1:** How has cloud computing evolved from traditional methods to the present SDC?

**RQ2:** Is SDC really an innovation for automation?

**RQ3:** How can enterprises benefit from adoption of software defined Cloud (SDC)?

The questions above will be considered as the base of the theory on which, significant focus will be put and which will be useful in pinning down the appropriate results. This thesis has three noteworthy inquiries that will be featured and an inside-out analysis about the equivalent will sum things up discussing every single perspective. It will likewise assure to give enough support and justification for answers found for these inquiries.

### **1.8 Practical and theoretical value of this research**

This study gives cloud specialists working in the computing world with helpful bits of knowledge into the common encounters of their partners. Since, cloud is vastly the technology applied or used in every industry in some way or the other, a specific usage in a specific industry cannot be pinned down. In fact, deployment and optimisation of cloud usage varies from business to business. It is trusted that this research related to adoption of SDC, will add to the developing assortment of information framing on this vital subject and give scientists, researchers and people from academical background, extra experiences and points of view. Also, this work will invigorate enthusiasm for further investigation into the subject.

The research might hold importance with individuals who work in the territory of cloud, especially those working in the corporate associations like technical, project management and many others, for example, government, medicinal, scientists and furthermore scholastic students or teachers. It holds importance with suppliers of logistics and distribution services, for instance, warehousing and transportation, to the IT experts in light of the specific sensitivities that are engaged with the software programming or systems administration while setting up their data according to their necessities and to maintain a strategic distance from a wide range of danger. As the principle target is to keep the data secure and streamline data storage, this study will be theoretically and practically valuable; to every single industry of recent times somehow or another of the other.

## **1.9 Summary**

This chapter summarises foundation of this thesis. First chapter explores background of this research followed by the objectives of this thesis. In this section, objectives are explained in detail i.e. adoption of Software Defined Cloud by companies, followed by glimpse of qualitative and quantitative research approach. Further detailed explanation of both the research approaches are in chapter 4. This chapter introduced methods adopted for the research and also elaborated the discussion on why that is most appropriate methodology for this research thesis.

## Chapter Two: Theoretical Underpinnings Of The Study

### 2.1 Introduction

The decision to adopt a new technology has propelled interest in much research into adoption theories. These theories include, but are not limited to, the Technology Acceptance Model, Technology Acceptance Model 2 and Technology Acceptance Model 3. The Theory of Diffusion of Innovations, the Theory of Reasonable Action (hereafter “TRA”) (Davis, Bagozzi and Warshaw, 1989), Decomposed Theory of Planned Behaviour (hereafter “DTPB”) (Taylor and Todd, 1995), Theory of Planned Behavior (hereafter “TPB”) (Fishbein and Ajzen, 1975). This chapter will provide a survey of these theories with a view to developing a theoretical framework for this thesis (Rogers, 1995).

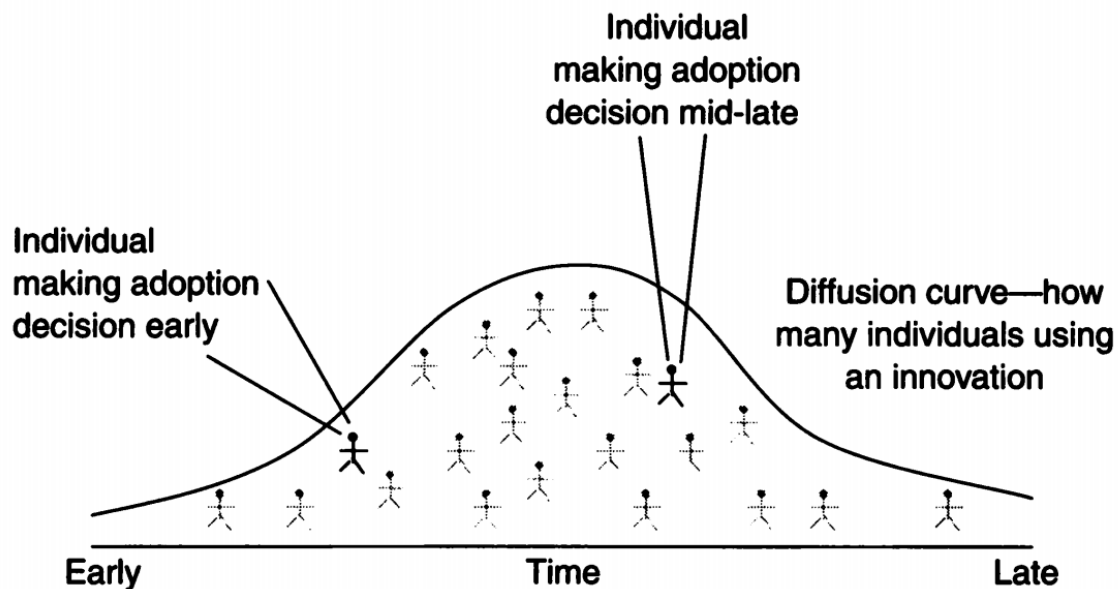


Figure 3: Graph of technological adoption (Straub, 2009)

The speed and timeliness of adoption leads to the adoption curve. Straubs (2009) adoption curve pictorially explains the amount of people entering into the adoption cycle from beginning to end of adoption considering a particular period of an innovation. Early adopters, are seen in small ratio as compared to mid-late, which eventually declines later in the end phase.

## 2.2 Overview Of Theories Of Adoption

Heraclitus the pre- Socratic Greek Philosopher famously is attributed with saying the only “*Nothing is permanent, but change*”. This constant change may create threats to existing business models, along with the opportunities it brings. Leading businesses seek to change the technological applications to benefit corporate purposes. Since the 1980’s in business theory, stakeholder theory has dominated which suggests all actions within a given corporation should be for the benefit of the stakeholders<sup>1</sup>. With the dynamic and advanced growth of technologies, acceptance of these technologies by corporations is dependent on number of factors such as convenience, security, availability of technology, security.

Consumer and corporation’s adoption of new technology has been addressed by number of researchers. In particular a number of theories were discovered and used to explain consumer’s behavior and acceptance for new technologies. These theories include, but are not limited to, the Technology Acceptance Model, Technology Acceptance Model 2 and Technology Acceptance Model 3. The Theory of Diffusion of Innovations, the Theory of Reasonable Action(Davis, Bagozzi and Warshaw, 1989), Decomposed Theory of Planned Behaviour (Taylor and Todd, 1995), Theory of Planned Behavior (Fishbein and Ajzen, 1975). This chapter will provide a survey of these theories with a view to developing a theoretical framework for this thesis(Rogers, 1995). These theories will now be defined and positioned within the extant literature.

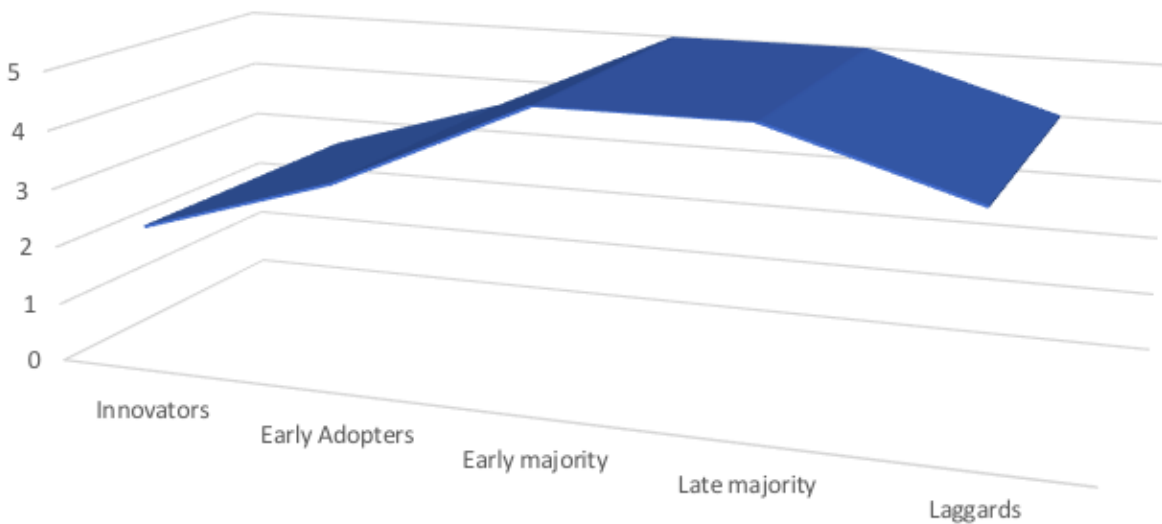
### 2.2.1 Theory Of Diffusion Of Innovation

As proposed by Rogers (1995) the theory of “diffusion of innovation” was the foundation of conducting the research on adoption and acceptance of innovation. Rogers came out with theory of diffusion of innovation for the adoption of innovations among organization and individuals by synthesizing over 508 different studies. The theory presents “the method through which an innovation is circulated via certain channels over time between the members of a social system” (Rogers, 1995, p. 5). Diffusion is a process of communication of

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<sup>1</sup> Freeman (1983) created and developed this theory. For a review of the relevant literature pertaining to this theory please refer to Donaldson, T. and Preston, L.E., 1995. The stakeholder theory of the corporation: Concepts, evidence, and implications. *Academy of management Review*, 20(1), pp.65-91.

innovations to the members of social system through certain channels over a given period in time.

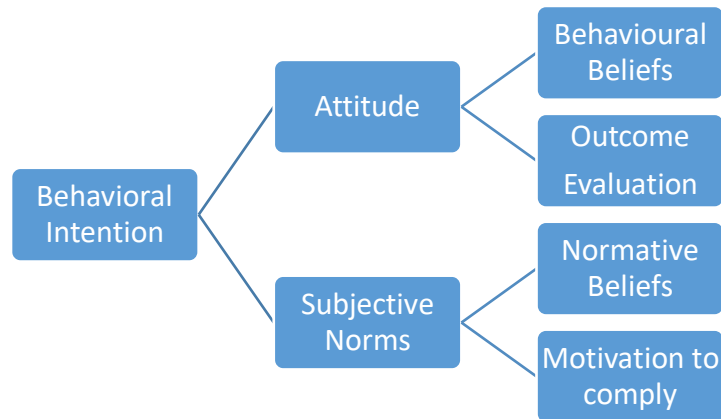


**Figure 4: Curve of S-shaped adoption**

Rogers (1995) theory of diffusion of innovation explained that the adoption and innovation happened after going through several stages including decision, persuasion, understanding, confirmation and implementation that resulted in the development of S-shaped adoption curve of early majority, early adopters, innovators, late majority and laggards as shown in the Figure 4 above.

### **2.2.2 Theory Of Reasonable Action**

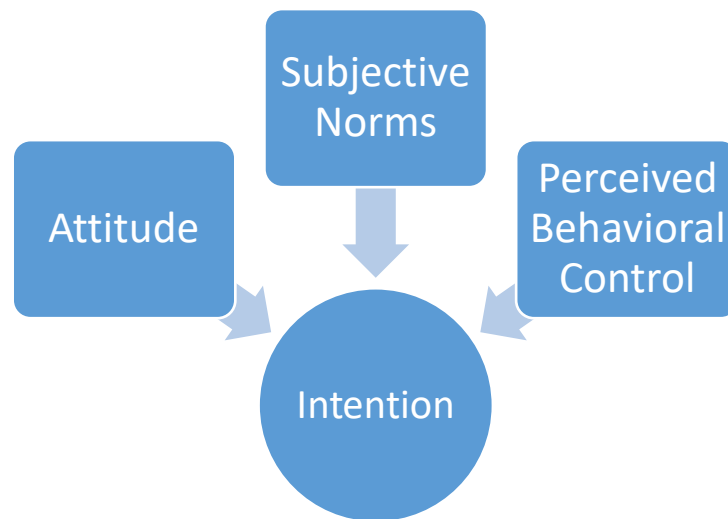
One of the most popular theory within the literature is TRA (Fishbein and Ajzen, 1975). It is about one factor that dictates intention of person's attitude towards that behavior as shown in figure. Belief is defined as link between some attribute and an object and attitude is defined as individual evaluation of an object, and "behavior" is defined as a result or intention. Attitudes are beliefs about object of behavior (e.g.: Ecommerce is convenient). Second factor is subjective norm of the person of how they perceive their community's attitude to a specific behavior (e.g.: my peers have an iPhone, it's a point of status to own one so a consumer or corporation will adopt this new piece of technology).



**Figure 5 Based On: The Theory of Reasonable Action (Ajzen, 1975) ; Source : Author**

### **2.2.3 Theory Of Planned Behaviour**

Ajzen (1991) synthesized the TPB which is about the factor that dictates intention of person's attitude towards that behavior as shown in the figure 5. Initial two factors are similar to TRA. Perceived control is third behavior which user perceive that might limit their behavior (e.g.: Should I buy an iphone on emi, what are the needs?). In accordance to the theory of planned behavior, behavioral intention, together with perceived behavioral control, can be directly used to predict behavioral achievement. At least two rationale can be offered for this. First, the extent of effort to bring a behavior to a final conclusion is more likely to increase with perceived behavioral control. For instance, two different individuals who have equally strong intention to learn singing, and also both try to do so, the one who is more confident that he can excel in the process of learning is more likely to persevere than the one who doubts his own ability. Secondly, reason for expecting a link between behavioral achievement and perceived behavioral control is that perceived behavioral control can be used as a substitute for measure of actual control. Behavioral control might not be realistic when a person has comparatively less information about the behavior, when available resources or requirements have changed, or when new and unfamiliar factors have entered into the situation. Under those conditions, measure of perceived behavioral control might add little to the accuracy of behavioral prediction.



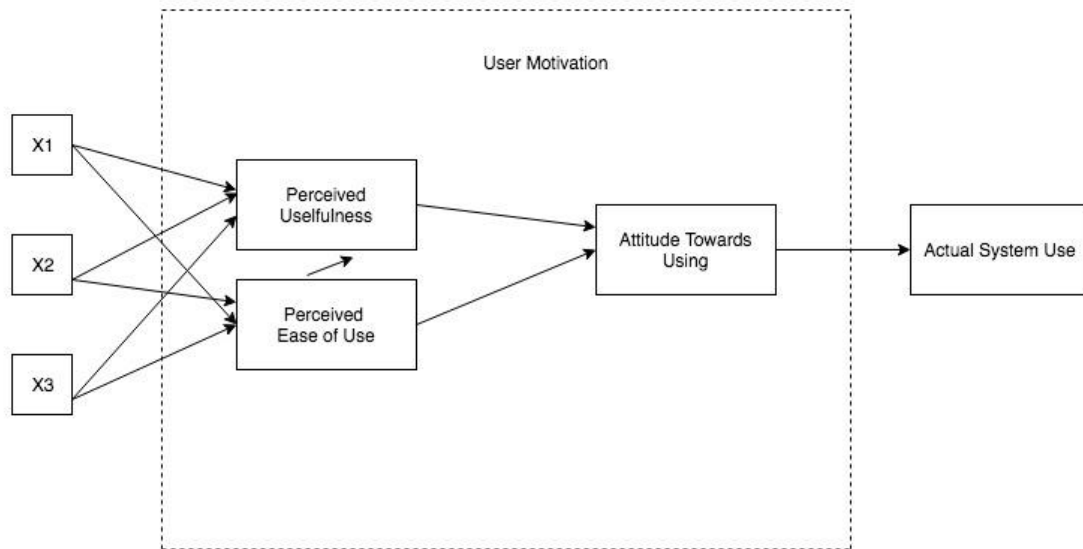
**Figure 6 based on : The Theory of Planned Behavior (Ajzen, 1991); Source : Author**

#### **2.2.4 Decomposed Theory Of Planned Behaviour**

Taylor and Todd (1995) introduced the decomposed theory of planned behavior. The decomposed TPB includes 3 main factors which influence actual behavior adoption and behavior intention which are subjective norms, attitude and perceived behavior control(hereafter “PBC”). By means of the TPB and Decomposed TPB, Fang and Shih (2004) examined the adoption of internet banking.

There had been a good research on the Theory of Planned Behavior (Ajzen, 1991) , Theory of Reasoned Action (Ajzen & Fishbein, 1980; Sheppard, Hartwick, and Warshaw, 1988) and Decomposed Theory of Planned Behavior (Taylor and Todd, 1995) but mostly used for already existing products in a particular marketplace and also included society’s view.

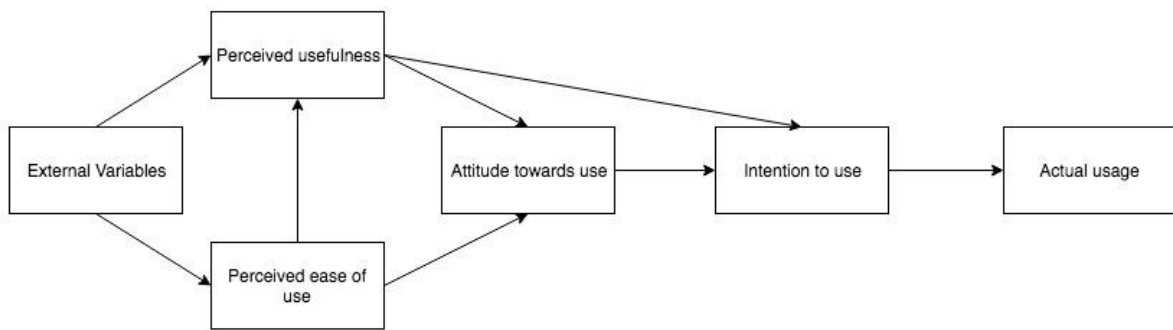
## 2.3 Acceptance Model



**Figure 7:Original Technology Acceptance Model (Davis, 1986)**

In 1986, Fred Davis introduced technology acceptance model for his doctorate proposal as shown in above figure 7. Technology Acceptance Model is designed specifically for modelling users' acceptance of technologies or information systems. Technology acceptance model(hereafter "TAM") explains attitude toward use ,the motivation of users by these factors; perceived ease of use, perceived usefulness. Therefore, not only Business Intelligence (hereafter "BI") would be contained in technology acceptance model but also, two chief beliefs like perceived ease of use and perceived usefulness have considerable impact on attitude of the user. These can be explained as favourableness and unfavourableness toward the system. Sometimes, different factors known as external variables (system characteristics , the implementation process nature ,user training and user participation in design and the implementation process nature) are also considered in technology acceptance model. Probably, TAM is one of the most cited model in technology acceptance field. In the past few decades, TAM has received substantial empirical support. TAM has its limitation to be applied beyond workplace ,because it ignored social influence on adoption of technology (Taherdoost, 2018).

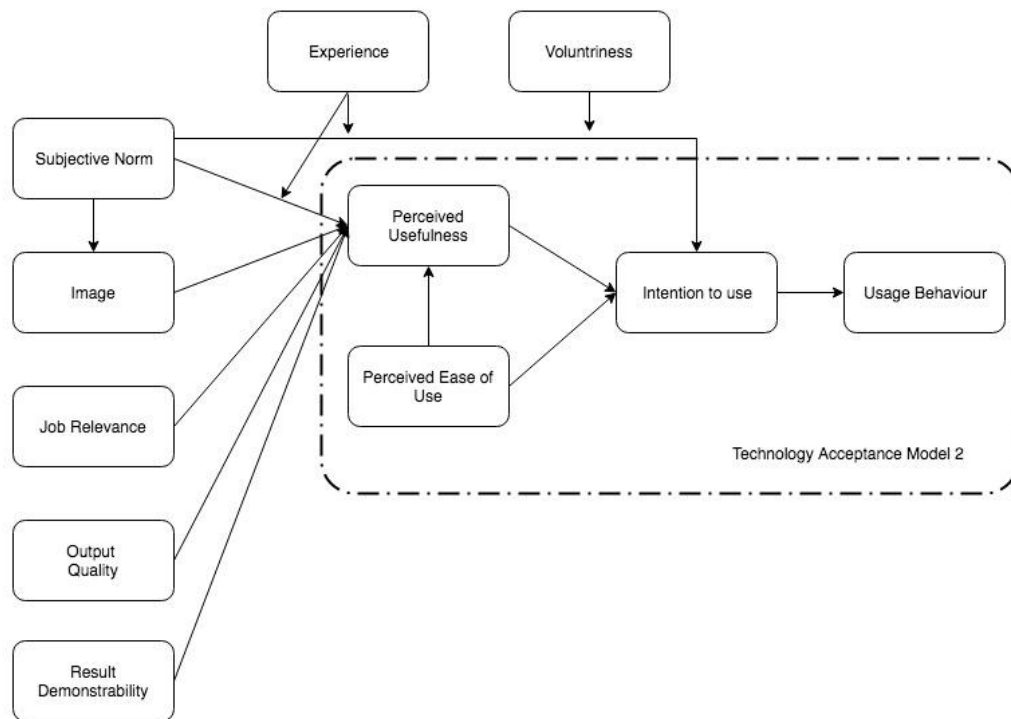
### 2.3.1 Technology Acceptance Model



**Figure 8: Technology acceptance model (Davis, 1986)**

Davis used technology acceptance model in 1989 to explain behavior of computer usage as shown in above figure 8. The goal is to explain the general determinants of acceptance of computer that lead to explaining the behavior of users across a broad range of user population and end-user computer technologies. The basic technology acceptance model included and tested two specific beliefs: Perceived Ease of use (PEU) and Perceived Usefulness (PU). Perceived ease of use is defined the degree to which target system is expected to be effortless by the potential user (Davis, 1989). Perceived Usefulness refers to subjective likelihood of the potential user which will increase his/her action (e.g.: Single Platform E- Commerce System). A person's belief towards a system may be influenced by other factors which can be referred to as external variables in technology acceptance model. Behavioral intention would be included as a new variable in the further development of TAM which would be influenced by perceived usefulness of the system. Davis et al. (1989) suggested that there will be cases where , any specific system which was perceived useful, some individual might form a keen behavioral intention to use the system without pre-assuming other attitude , eventually leading to the newly upgraded version of TAM.

### 2.3.2 Technology Acceptance Model 2



**Figure 9:Technology Acceptance model 2 (Wu et al., 2011)**

Venkatesh and Davis (2000) proposed the Technology Acceptance Model 2 as shown in Figure 9. The research provided more detailed explanations for the reason the users found a specific system useful at three stages: three-month post implementation, one-month post implementation, pre-implementation. Technology acceptance model 2 theorizes that users' mental assessment of the match between repercussion of performing job tasks and important goals at work serves as basis for forming perceptions in regard to usefulness of the systems. TAM2, as per results, performed well in both mandatory and voluntary environment. TAM2 also added a value to capture the social influence (e.g., from bosses or colleagues) that compels end users to evaluate and accept IT which is called subjective norm (SN). The internalization effect mentioned in both TAM and TRA implies that one's perceived usefulness and intention to use a technology may get influenced by subjective norms; furthermore, it affects one's attitude, constructs of the TRA model subjective norms, and perceived ease of use and perceived usefulness in technology acceptance model. Davis advocated that the on behavioural intention to use effect of subjective norms could be ignored; hence, any variables of subjective

norms were not considered in technology acceptance model. However, later, at the time of extension of TAM, TAM2, Venkatesh and Davis revisited these variables (Wu et al., 2011).

### 2.3.3 Technology Acceptance Model 3

Venkatesh and Bala (2008) combined perceived ease of use and its determinants with technology acceptance model 2, and developed an integrated model known as Technology acceptance model 3 (hereafter “TAM3”) as shown in figure. The authors synthesised technology acceptance model 3 by four different determinants of perceived ease of use and perceived usefulness, which are system characteristics, individual differences, facilitating conditions and social influence. In TAM3 model, perceived usefulness to perceived ease of use, perceived ease of use to computer anxiety and perceived ease of use to behavioural intention were monitored by experiences. The technology acceptance research model 3 was tested in real-world infrastructure of IT establishments. Technology acceptance model 3 presents a nomological network of the determinants of individuals’ IT adoption and use (Venkatesh and Bala, 2008).

### 2.4 Implication For This Study

Year	Theory	Developed by	Determinants of adoption
1995	Theory of Diffusion of innovation	Rogers	Compatibility, Trialability, The innovation, communication channels.
1975	Theory of reasonable action	Fishbein & Ajzen	Intention, Attitude, Behaviour, Subjective Norm.
1991	Theory of planned behaviour	Ajzen	Perceived Behavioural Control, Behavioural intention, Subjective Norm, Attitude.
1995	Decomposed theory of planned behaviour	Taylor & Todd	Perceived ease of use, Perceived usefulness, Self-efficacy, Peer’s Influence.

**Table 1 : Theories Of Adoption**

*Source: (Help University, Malaysia and Lai, 2017)*

Post-analysing all the theories, key implication, which includes Theory of diffusion of innovation developed in 1995 focusing on compatibility and communication channel, theory of reasonable action developed by Fishbein in 1975 focuses on intention and behavioural attitude. Theory of planned behaviour developed in 1991 by Ajzen focuses on perceived behavioural control and behavioural intention. Perceived usefulness and perceived ease of use is determinant of decomposed theory of planned behaviour developed by Taylor and Todd in 1995.

## **2.5 Summary**

The above concept, application, discussion and development of technology adoption models based on literatures built different interpretations and views. The literature review differentiate between theories and technology adoption models with different research problems, theoretical insights, variables and measurements. The formulation of new research depends on a number of considerable factors but is not limited to the following: gap analysis, the objectives, the research problems , the organizations' goal, the target market and the understanding of adoption models based on available researches and other material. To enable the interested parties(e.g.: researchers, government, academics ,organization, students) to relate with both practical and theory aspects of technology adoption model, it is vital to have such understandings. These conclusive reviews will throw some light on potential applications for future researchers to comprehend, distinguish and conceptualize the theories and underlying models that may affect the future, current and previous applications of technology adoptions.

## Chapter Three: Literature Review

### 3.1 Introduction

In the past decade, virtualization has been a standout amongst the most vital advances, and which is considered to have a broad being in a flash embraced over the globe. Cloud computing has emerged out of numerous organizations' vision of utility registering (Goyal, 2014). There are different models that cloud offers today in type of administrations like Software as a Service (SaaS), Platform as a Service (PaaS), and foundation as a Service (IaaS). Therefore, distributed computing or cloud computing is named as conveyance of a set of administrations like-databases, servers, programming, storage, investigation or significantly more and the majority of this is over Internet ("the cloud"). The figure below gives an idea how cloud supports businesses.

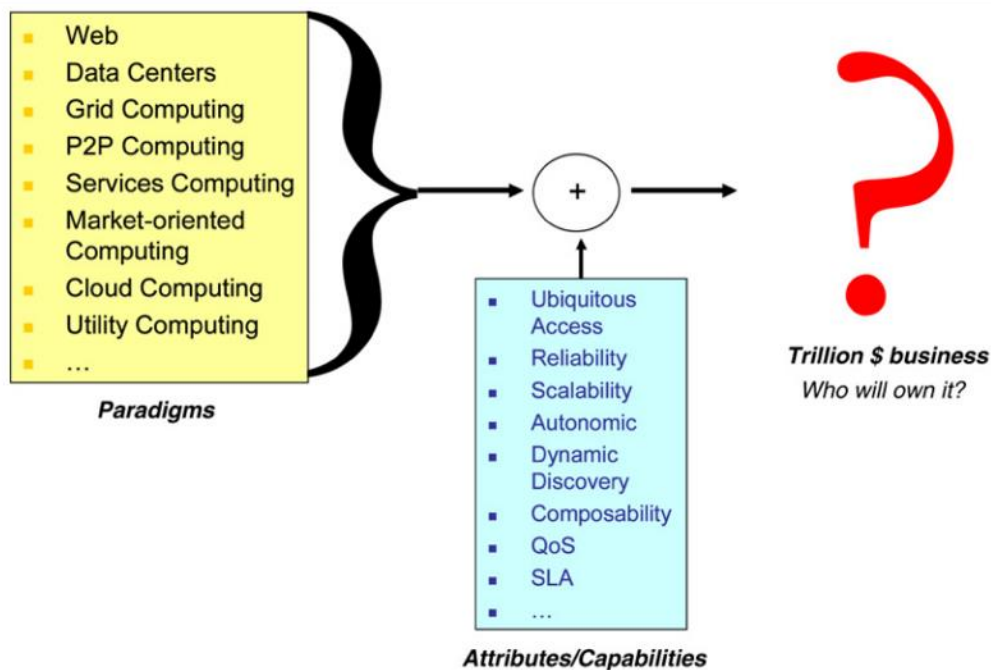


Figure 10: Various paradigms promising to deliver IT as services (Buyya *et al.*, 2009)

The review of the writing endeavours to outline the exploration the subject of Software defined Cloud, how it evolved, its key architecture and what does it have instore for enterprises that adopt SDC.

### 3.2 Traditional Data Centres

Leonard Kleinrock(2005), one of the chief scientists of ARPANET(Advanced Research Projects Agency Network), in 1969 said: “Starting now, computer networks are still in their early stages, however as they grow up and wind up advanced, we will probably observe the spread of 'PC utilities' which, similar to display electric and phone utilities, will benefit individual homes and workplaces the nation over”. This vision in regard to technology or computing utilities was dependent on an administration provisioning model that predicted the enormous change of the whole computing industry in the 21st century. It also predicted that these computing services will be promptly accessible to answer individual's needs, just like how other utility services are accessible in the present society(Armbrust et al., 2010). But things weren't that easy since always. In the past, on location storage was the only information/data backup alternative that most organizations considered, and it wasn't the most advantageous.

Weiss (2007) says, there were times when it could get as dreary as keeping careful physical records in the event of a framework disappointment. The writer further continues, any individual who went to school when cloud computing was just introduced or even before, got a look of their secondary school's storage facilities; probably the long lines of file organizers as well that basically had bulky folders or registers that accommodated everything except the most careful spectators with fear. Historically, data didn't mean of the same importance to people, organizations, or even governments as compared to what it means to everyone now. Therefore, not all data was closely monitored. One of the prime instances of conscious from the early on-site storage can be followed back to London's Jewel Tower, where the House of Lords started putting away parliamentary records in the late sixteenth Century (Khajeh-Hosseini et al., 2010). The English record guardians made a huge effort to ensure their files, venturing to such an extreme as making their tower flame resistant to the point that it was the only building to endure a fire that burnt the majority of Westminster in 1834. Then came a time where people, businesses started to put hard drives to use, which resulted in a folder or a closet full of backup hard drives. However, these strategies were considered as tiresome as their antecedents.

Finally, the era of cloud computing started. While its simple rule of pay-per-use attracted most businesses, others were impressed with the services or advantages it offered namely- data redundancy, storage, safety, security and many more (Goyal, 2014). Cloud storage services have data stored on physical servers situated far and wide, enabling one to get to it whenever they need as long as they are connected to the internet and consequently opening up space on your hard drive. Dropbox, Google Drive, and Box are services that can oblige an individual's storage needs or handle collective data storage for organizations, which enables management and organization in the same manner as a local server (Kim and Korea, 2009). In this day and age, despite the fact that cloud computing and its off-site putting away capacities have turned into the more regularly utilized technique for data storage, a few organizations still choose nearby capacity over off-site options, tolerating the inalienable dangers required to spare a couple of dollars. The strengths and difficulties that come with cloud has been picturized rightly in the figure below,

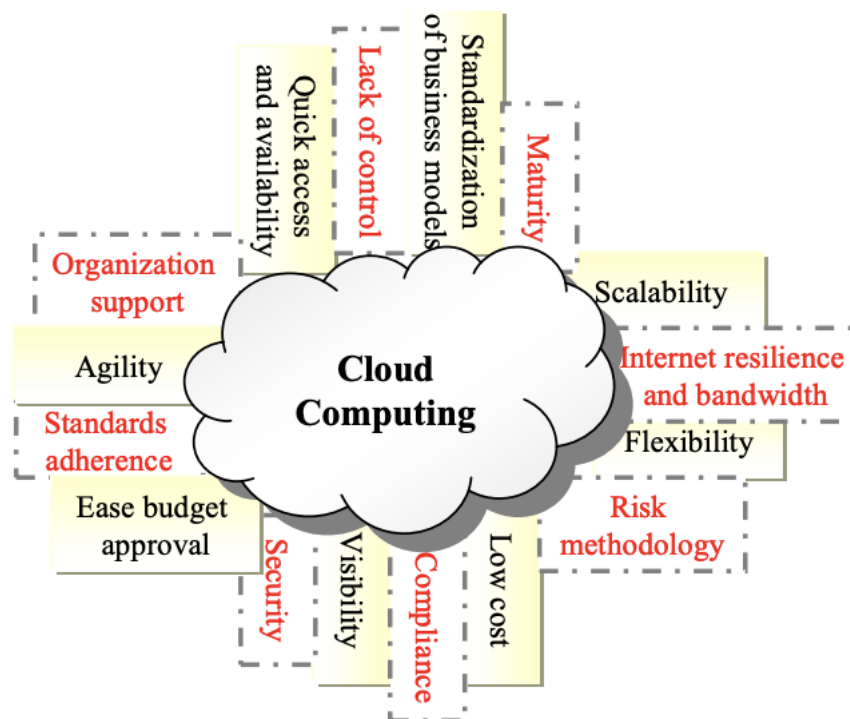


Figure 11:Strengths and Challenges of Cloud Computing (Berkowitz et al., 2009)

Asset depleting server rooms are extraordinary for data management on a local network, but as cloud computing turns out to be further developed and open, the challenges of on-site storage are ending up increasingly observable(Duijvestijn et al., 2010). Again, several

industries have had mixed opinions about technologies of different times. For instance, consider cloud, the fact that it allowed enterprises to scale their usage as per their business needs was the most favourable. Expanded interest in cloud computing is nearly shepherding in another influx of cloud applications. But soon another challenge came forward when enterprises had doubts regarding how to plan their cloud usage. In other words, when to scale upwards and when to go opposite, started to become a major problem. This was the time technology evolved again to find Software-Defined-Cloud (SDC) as a solution to this (Jararweh et al., 2016b). The first wave of cloud computing was observed to have begun with server centralization and virtualization—bringing about a perspective change that changed how data is put away and how programming or software is utilized. Then the rising second wave, software-defined networking (SDN), introduced network centralization and virtualization, and particularly network control, into the cloud. In the wake of rising in datacentres, SDN organization has grown up into the systems administration as-a-service (NaaS) cloud service providers currently offer to big business and private supporters (Lin et al., 2014).

### **3.3 Emergence Of Automation**

The worlds of cloud computing have been observed to be experiencing advancement each day and the ascent is clearly, as organizations have been learning and making themselves mindful of different advantages that it offers. As indicated by Forbes Report-IDG Enterprise's 2016 Cloud Computing Executive summary, nearly 70% of US organizations have been widely accepting cloud computing, may it be public, private, hybrid or mix of various cloud models (Council, 2017). The outline additionally talked about couple of key defects in the structure of distributed computing and the greatest difficulties a business may need to defeat when moving to cloud. Few of the most widely recognized difficulties that organizations nowadays confront are time, cost, security, individuals and procedures. Numerous organizations do a poor job at assessing the genuine expenses of administrations that they will bring about once they opt cloud. In the event that we have a more profound take a gander at the cloud arrangement show, storage, the foundation, the infrastructure, organizing is altogether is offered to the organizations or the client in a way that they will dependably need to scale them up or down as per their interest, need and their use. The figure underneath explains the cloud infrastructure,

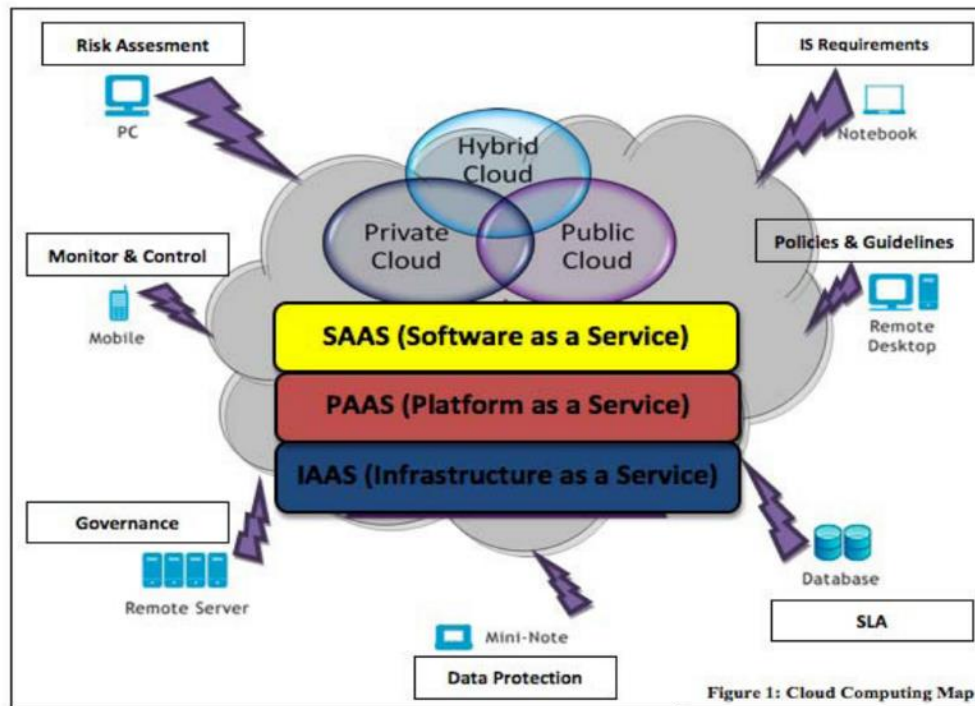


Figure 12: Cloud Deployment Model (Nadeem,2016)

While the conventional data centres or the ongoing cloud suppliers have been efficiently offering an entirely distinctive level of services to the organizations that assist them effortlessly to handle their errands of securing, accessing and storing data in most optimum way. However, enterprises are seen empowering the shift of the value proposition of cloud computing from cost decrease to contemporaneous agility and optimization(Li et al., 2014b). These necessities are driving the ongoing problematic pattern of software defined computing, for which the whole cloud infrastructure or virtualization-compute, storage and network is transforming to be dynamically programmable or software defined. In view of the patterns toward moving both mission-basic and performance-sensitive tasks to the cloud deployment prototype and the union of portable, social, and investigation outstanding burdens on the cloud, we see a move of the value proposition of cloud computing from cost decrease to concurrent readiness and enhancement. While decrease in costs to a great extent are over the virtualization of foundation (IaaS, or framework as an administration), agility focuses around the capacity to quickly respond to changes in the cloud environment and outstanding tasks or workload(Ramachandran et al., 2015). Streamlining data or optimization revolves around distinguishing better results inside a cloud environment as for the estimation of the administration, the expense of the required assets, and the danger of failure in an erratic domain and under continuous utilization changes (Temple et al., 2011). This requires a high level of

mechanization and programmability of the framework itself. Subsequently, this shift prompted the ongoing troublesome pattern of programming characterized figuring for which the whole framework infrastructure-compute, storage and network-is transforming to become software defined and powerfully programmable.

Software designed cloud is originated from the compute environment through which the computing resources are being managed and also virtualised as the virtual machines. It also enables the higher resource utilization and the mobility as various machines are already collocated on the same server. It is also being collocated on the same variable resources requirements which are being mitigated since it is being shared through the virtual machines. In other words, this can conclude that SDN, an abbreviated form of Software defined networks, SDDC, an abbreviated form of software defined data centre and SDE which is an abbreviated form of Software defined everything collectively make Software designed cloud. SDC has two most important concepts which are network function virtualization and control plane. Few basic yet key characteristics are as follows:

- Simplified Packet Forwarding: In SDC packets are forwarded by data plane, based on policies which are usually handled by control programs.
- Centralized network control: In a network, all the switches are connected by central network operating system directly. It is even capable of providing global network topology with real-time network status.
- Software based network function implementation: Originally, network functions implemented in a switch or light box are implemented in SDN as control process.
- Virtualized Network: In virtualization of network, network topology is hidden from control programs so that function developers can focus on implementation of the functionality (Kreutz et al., 2013).

Implementation of Software Defined Cloud Network affects attack defence in both directions. On one side, SDC makes it easier to implement rich subsequent processes and advanced detection logics. And, on the another side, originally distributed middle boxes and devices have to be located above NOS in the network. As compared to software processes packets, hardware based packet processing are much faster. The traffic overhead and network delay caused due to communication between the control programs and DDoS defence.

According to the defence schemes, switches may become all together a new attack surface (Wang et al., 2015).

Software defined Cloud or software defined computing gets impressive concentration across the scholarly world and ventures (Kreutz et al., 2013). Software defined cloud computing evolved from the compute environment in which the processing resources are virtualized and managed as virtual machines (Li et al., 2014b). According to Kreutz, network operators is enabled through Software-defined networking with greater adaptability to program their systems. With SDN, organization and management of network moves from systematizing functionality in terms of low-level configurations of devices that help build program, enhance programming that encourages debugging and network management. The author opines, by isolating the unpredictability of state distribution from network specification, SDN gives better approaches to take care of long-standing issues in systems administration and networking — directing, for example — while at the same time permitting the utilization of security and trustworthiness methods, access control or multi-way.

### **3.4 Architecture Of SDC**

Software defined cloud is a term with combination as well as contribution of SDN (Software Defined Network), SDDC (Software Defined Data Centre) and majorly SDE (Software Defined Environment). This research broadly explains all about SDC along with the scope of it amongst various enterprises (Lin et al., 2014). SDN- software defined network- SDN refers to Software defined network and these networks work by moving away the network control and management planes from hardware packet switches to the servers in order to improvement of extensibility, security and making it more efficient. The main aim of the SDN is to reduce the cost and improving the user experience (Bernardos *et al.*, 2014). However, it can be possible only by automating the full range of network service from the end user to the network element. There are few principles which involves in the process and these are, centralization of control, decoupling of control from traffic processing and forwarding and capability of applications and customers to interact with the network control directly. It helps in letting the network manage, secure, optimize and configure the network resources easily (Kreutz *et al.*, 2013). This will be done via automated SDN programs which can be written as they do not depend on any proprietary software. SDN is also used in simplifying the

operations as instead of the vendor specific devices, the instructions will be provides through SDN.

Secondly, SDDC- software defined data centre- are those abstraction layer of software which helps the user to compose the resources according to their needs as the user defined services. In order to execute this they also present a pool of physical resources and virtual resources as the data centre. In order to support SDDC, the management cluster also runs the components which are used for monitoring, infrastructure and management services. For operating the best performance, the management cluster also offers resource isolation(Perks *et al.*, 2018). Different organizations have workload, or multiple process clusters that help optimize the tasks and deploy them. According to the customer environment, there is a possibility of one or more process cluster to exist as well as working in parallel to another (other than the shared edge) and it is this process cluster which gives the delivery of the customer workloads. Both process cluster and shared edge supports those network devices

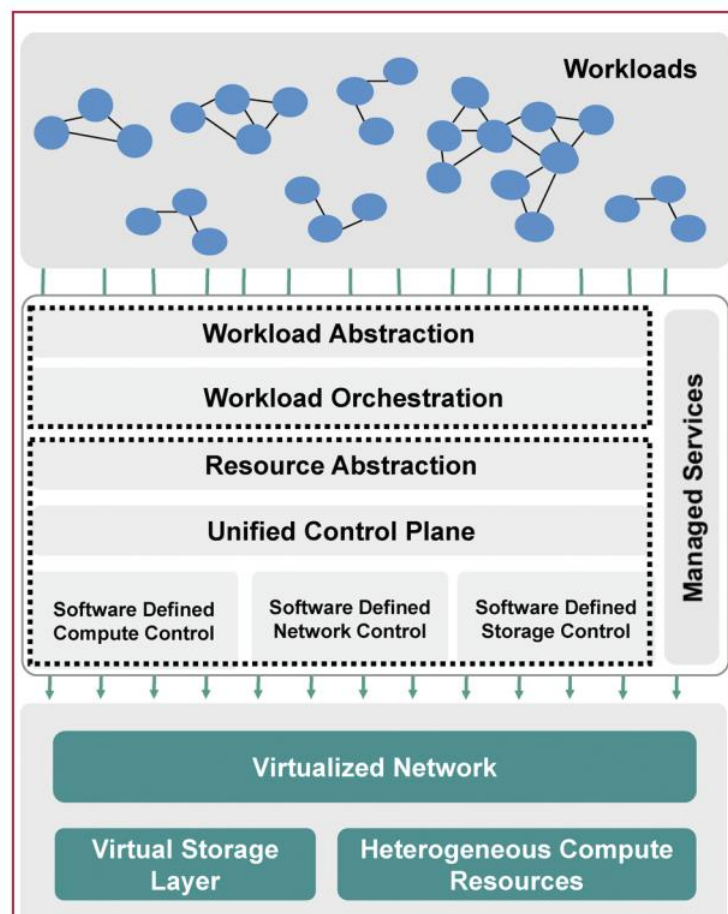


Figure 13: Workload on SDCs (Bawa *et al.*, 2015)

which offer the interconnectivity service of environments and virtualized infrastructure services. SDE- software defined environment, help in bringing the software defined process, storage, network and in unifying the management and control planes from each and every software defined components(Shannon, 2003). By the software defined resource, abstraction of network, storage of system and compute which is also well known as workload optimized system, these unified control planes get assembled. But before that, it has to meet the requirements of the individual workloads to change the business requirements. It also has to enable the dynamic optimization as well(Li *et al.*, 2014). The figure proposed by Li, explains the architecture of Software defined environments in detail.

### **3.4.1 Advantages and Disadvantages of SDC**

It is quite imperative for an enterprise to examine the advantages and disadvantages that SDC offers before it decides to adopt such eccentric paradigm(Bawa *et al* ,2015). Below mentioned are few advantages and disadvantages that help an individual or business to frame a decision about SDC which has its classified parts-SDN, SDDC and SDE(Kim and Feamster, n.d.). Firstly, the advantages,

1- Abstraction can be counted as the advantage of SDN as it does not let the underlying data plan issue occur and the central controller abstracts the network.

2- Since Abstraction derives the virtualization, one can get the work done without knowing where the resources are. SDN simply uses the same set of physical resources and deploy the multiple virtual networks on the same network with an ease.

3- In order to modify the flow tables of thousands or maybe of few devices, it will need one API call from the application layer to the control. The whole process will be done by orchestration.

4- Automation makes the work easier and better. It will also save from the huge cost in networks and by using SDN, automation of various things can be automated including Feature addition, new protocol support, policy enforcement. Apart from this, applications such as traffic engineering methods, load balancing and capacity optimization will be deployed through the software design network (Bawa *et al* ,2015).

5- The new protocol also helps the designers to develop their designs in easier and convenient technique.

6- Software defined data centre brings the agility through which innovation becomes an easier task and it also reduces the cost. Apart from this, it also increases the level of operational efficiency of new services.

There are very few disadvantages when compared to the advantages that SDC has to offer,

1-The support from the router companies is the major challenge to face as the giants like Cisco would not provide the support for the devices and it will make the consumer in trouble. Apart from this, everything about SDN is in the favour and none of them creates the trouble for the user.

2-No holistic view of physical and virtual service delivery environment when the monitoring tools focus on a specific silos(Shannon, 2003).

3-Since SDDC configures the virtual applications, maintains the multi-tiered services and front end servers, it also adds the IT complexity here which becomes a tough task to understand.

### **3.5 The Improved Cloud Computing Adoption Framework**

In order to show the illustration of the framework approach of cloud computing, there are various researches done. One such paper has described the usage and development of technology, organization and environment framework as the cloud adoption framework(Baars and Kemper, 2010). This research has a similar approach put in practice, the qualitative approach which involves interviewing the decision makers. Strategic headings need to be set and conveyed to guarantee that all future and developing administrations, or Everything as a Service (EaaS), also to blend, manage and oversee security and business arrangement. EaaS incorporates structure, deployment and rule for Infrastructure, Platform and Software as a Service(Ramachandran et al., 2015).

Khajeh (2012) presented a case study to show the similar framework. According to the case study, they have explained the major strengths and the weaknesses of adopting cloud computing. Contrastingly, they have also shown the ways to improve the efficiency and reduce the cost. Now since they do not have any guidelines in order to help the organization at various level of adoption, their major focus is not on calculations of the cost involved in the cloud computing adoption. At the time of publication, there is a need of developing the services in various types of clouds and in order to advice and approach with the best recommendation, IBM has already developed their IBM Cloud Adoption Framework. All and all, this sums up

why the collaboration with the individual researchers are beneficial for the whole cloud computing research. The improved cloud computing adoption framework could result in some different benefits like opportunities for organizational growth, to develop new skills, manage income and outgoings, to offer new products and services and improves satisfaction of work and status(Khajeh-Hosseini et al., 2010).

### 3.5.1 SDC as Business Intelligence

Business Intelligence deals with integrated approaches in management of support. In many cases, the integrated infrastructures that are subject to Business Intelligence have become costly, complex and inflexible. One of the instruments that can provide efficiency to an organization is Cloud Computing. Cloud computing Business Intelligence approach combines results from outsourcing and BI. Cloud computing refers to a business model based on an Internet based service provider. The term cloud computing isn't just about a single definition. Two themes emerge of which one is a business theme and other is the technical theme(Khajeh-Hosseini et al., 2010). On one hand, it is an internet based service provided free of cost and on the other it is a distributed net based architecture where resources can be dynamically rearranged.

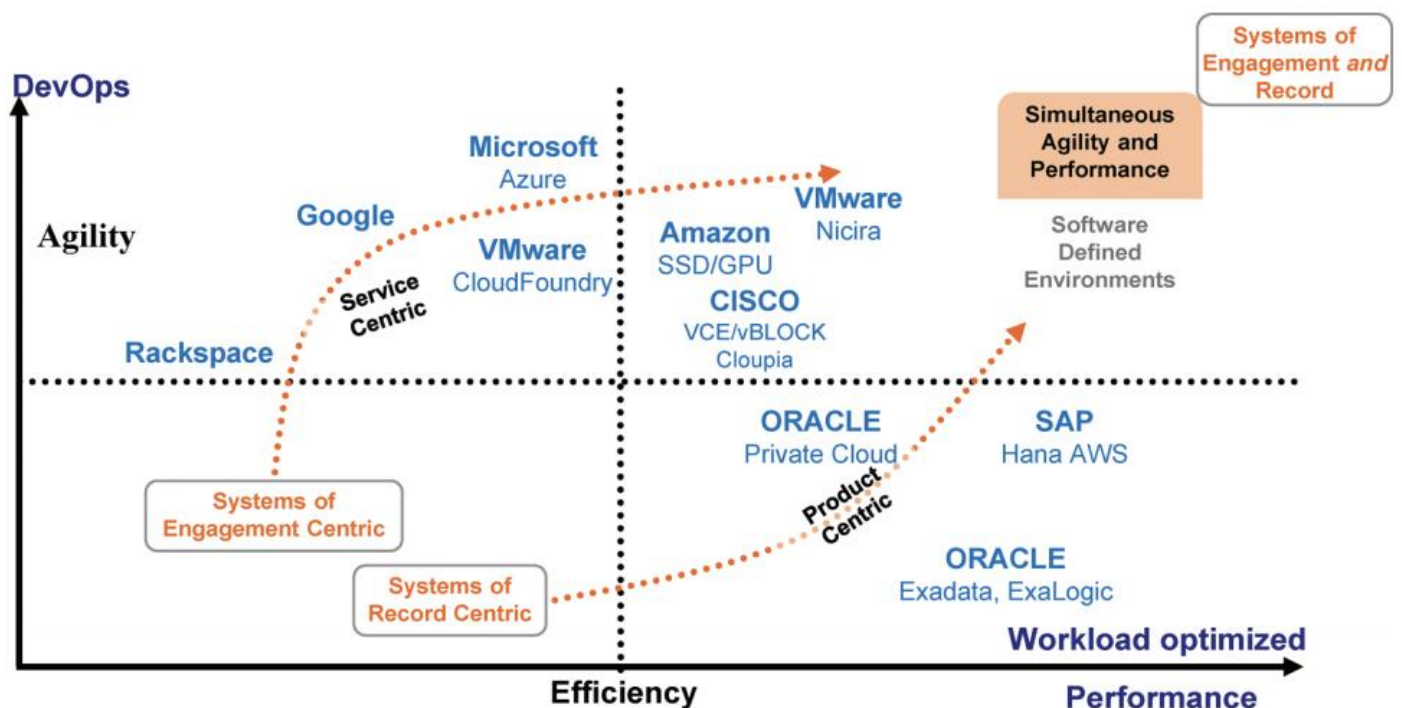


Figure 14:Recent trends of Software Defined Environment (Li et al., 2014)

The graph above explains, how the industry responds to the recent trends inclined towards continuous and spontaneous agility and efficiency through a product driven and

service driven approach. There are two crucial paths that are inclined towards agility and efficiency- a) service driven, which is commonly trailed by contributions that are frameworks or systems of commitment centric, and (b) item driven, which is regularly trailed by contributions that are frameworks of record centric(Jain and Paul, 2013b).

### **3.5.2 Cloud Computing in Regard to IT Sourcing**

IT-outsourcing needs to be considered as a complex and multi-layered phenomenon . This feature of IT-outsourcing makes it clear that it will be more reasonable if a selective approach is adopted rather than the total outsourcing. The choice of the service partner and design and management is of vital importance for the success of outsourcing. IT-outsourcing has several non-monetary benefits including high flexibility and system quality. These benefits are also the central aims of Cloud Computing(Chang, 2014).

### **3.5.3 Business Intelligence Infrastructure**

Chang proposed that, Business Intelligence Infrastructure shows a wide variety of layers of business intelligence which will be affected by Cloud BI. Some of these layers are- Data Layer- The basic purpose of that data layer is to restore structured and unstructured data for support in management(Jararweh et al., 2016). Secondly, logic layer- The logic layer analyses the validity and acceptability of the structured and unstructured data. It furthermore supports the distribution of knowledge among different users. Using cloud computing, this layer become very interesting. Lastly, the Access Layer- The access layer allows easy operation of logic layer. The Access Layer is established with some sort of Portal software that also provides a web based interface. Furthermore, Business Intelligence Services(BIS) is broadly classified into the following parts,

**3.5.3.1 Hardware** – Hardware involves running of the required computing, storage, and network equipment which is necessary to operate multiple components of BI. Virtualization leads to flexibility for both the assigned resources and physical location like storage or CPU power. Hardware abstraction facilitating portability and scalability and at times it might give medium sized enterprises access to hardware power that would have otherwise been out of reach.

**3.5.3.2 Software Tools** – It relates to the BI software, from ETL(Extract, Transform, Load ) tools for data visualization packages. In order to enable cloud computing services with the help of software tools, users will need to incur a SaaS approach. The resolution of the portfolio of managed components needs to be adjusted to individual needs. A facilitator applying Cloud concepts on tool level is the reason that most of the art of BI software now come with rich web interfaces that are equivalent for better than the former stand-alone clients. However, with respect to the distribution channel of Cloud, it is needed to be considered that many tools on the data analysis layers still lack abilities(Bawa *et al* ,2015).

**3.5.3.3 Templates** – Templates are considered as prearranged contents and preconfigured applications which can be adapted to individual requirements. Server with bigger BI suites deliver ready-to-use framework and include features to build their own. Templates have become a powerful tool in BI in order to reduce impose rules ,development cycle time, and foster reuse regarding application development . However, they are tightly bound to the software tool products of BI. Deallocation of the layers is currently not of much relevance for Cloud BI(Duijvestijn et al., 2010).

**3.5.3.4 Content** – Content pertains to the real business semantics. A provider who makes operations on this layer has the responsibility for the definition, gathering, structuring, transformation and presentation of data.

### **3.6 Future advancement**

SDN has become a widely adopted solution for many companies. It helps in raising the performance, security challenges, robustness and scalability(Kim and Korea, 2009). It also has the needed potential in order to facilitate the management and the deployment of network service and application with a better level of efficiency. To promote the centralized control mechanism which is not very well suited for the level of disruption, decentralization and delay

present in no infrastructure environment, SDN always target the infrastructure based network.(Kreutz et al., 2013)

In order to understand the benefits of an organization by adopting the SDN technology, we first need to identify the benefits and drawbacks of the same as there are many challenges the organization has to face. The adoption of the cloud computing will make a huge amount of change in the organization which will affect the people who work there. There are certain measures which can become a barrier(Ramachandran et al., 2015).

### **3.6.1 Cost Optimization**

It is difficult to understand the operational cost of public cloud as compared to the hardware acquisition, the utility billion model of cloud is different from operational budgeting to the capital(Chang, 2014). And as a result, it makes the non-trivial situation to estimate. There are some uncertainty also there which includes the deployment option used by the system which directly affects the cost as a resource and the actual amount of resources consumed by the system which can be determined by the load. One more uncertainty includes the cloud service provider's scheme of pricing which keeps on fluctuating all the time (Marinela Mircea, n.d.). It is also a tough task to understand the operational cost of private cloud as the carbon emission and energy costs are increasing. To understand this statement better, we can take a help of an example. Assuming the fact that it has been predicted that the operational cost of the infrastructure of IT can exceed the capital cost over a 5 year life cycle. Hence, the rising energy cost concerns can also be exacerbated by the government. As the centralized resource sharing paradigm can be leveraged in order to optimize the efficiency of energy, this challenge can be an important one for the cloud computing network(Khajeh-Hosseini et al., 2012).

### **3.6.2 Organizational Charge**

To make the adoption of cloud computing in an organization successful, the major deciding factor is the maturity of organizational and cultural processes including the legislative one. Assuming that, the process can be as long as 10-15 years, it will be prolonged process. In these huge years, the number of changes can vary. Some common factors which will surely change are the accounting and security (Baldini et al., 2012). Since the network infrastructure and hardware is not procured upfront, it would be paid like a utility and pay/consume like a

service. Security will also change as virtualisation will introduce some new vulnerabilities and having said that, it can lead to the conflicts between the providers and customers. Other than these, Compliance and project management will also change as for the long term usage of companies with the data privacy and therefore, there will be difficulty in knowing the geographic location of the data in the cloud. And for the project management, it will also change as the authorities of the IT department can be eroded because of cloud computing(Nunes et al., 2014).

The adoption of cloud in the company is quite challenging as there are many socio political and practical aspects added(Ramachandran et al., 2015). All the organization will establish the heterogeneous computing environment which are based on the organizational cloud and dedicated servers and not just with a single cloud service provider. The distribution of application platform depends on many factors which are concerned with control, cost and confidentiality. In order to make it successful, there are some major challenges to address which are to support the risk management, providing the accurate information on the cloud and to ensure that between the risks and benefits, the deciding authorities are able to make informed trade- offs easily. After going through all the aspects, we can conclude that the adoption of software design cloud will not just help in reducing the cost of an organization but also to help the companies for the betterment of their future(Armburst et al.,2010).

### **3.7 Summary**

This chapter has covered the literature review and examines previous study of traditional methods of cloud computing ,which showed emergence of an innovation called SDC. Also, it aimed to build a theoretical foundation and to find gaps in the literature. Definitions of SDC and its subsequent variants is discussed. Industry innovations and upgradations are reviewed from the lens of IT researchers and published papers on SDC, which directs towards the research gaps. The research gaps identified in Chapter Two will be further investigated within the cloud advancements and requirements, which will finally lead to the research questions.

## Chapter Four: Research Methodology

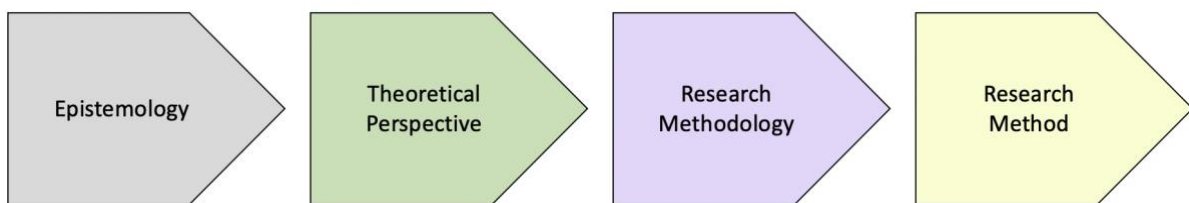
### 4.1 Introduction

The previous parts portrayed and assessed the hypothetical underpinnings for the study. The main objective of this chapter is to first explain all the research objectives mentioned in Chapter 1. Secondly, this section brings forth certain discussion over all the philosophical assumptions made by the previous researchers in regard to adoption of cloud. Then several terminologies and philosophies such as positivism, interpretivism are outlined (section 4.2) that are trailed over detailed analysis related to epistemological and deductive stance adopted for this study (section 4.3). Then, a brief comparison between qualitative and quantitative research is placed (section 4.4). Section 4.5 outfits a diagram of the research strategy utilized for this study. At that point, the information gathering techniques conveyed are depicted (section 4.6). Next, the information coding and investigation strategies are characterized and delineated (section 4.7).

Academic Research can be defined as a procedure of gathering, analyzing, breaking down and explaining the data to answer all research questions framed or solving a particular issue that is chosen by the researcher (Saldana, 2013). The author continues by the thought, a research can be qualified into a good or great research only when a particular procedure is followed that includes certain attributes and properties. Many believe that research has both challenges and perspectives that are crucial to refine most decisions for research methodology. Bell and Thorpe (2013, p. 1) observe how scientific methods to management research can be summoned by the phrase- *“to bureaucracy and the notion of goal displacement.”* The point to be noted here, is that the true essence or the primary aims of the whole research could be lost by following the procedure too sharply. ‘*Research onion*’, another popular model that serves as a great aid to picturize research philosophies along with its strategies, approaches and methodologies (Saunders et al, 2003). It is observed that this model is vastly used as most researchers and students find their research strategies and approaches much linked to the model Knox (2004). For an instance, an interpretation of the interpretivist philosophy is that it directs an inductive approach which on the whole directs a qualitative method of data collection. It is

not necessarily the case that Saunders et al have drawn a conclusive line through their model, but they still play a significant part in most parts of writing.

Contrastingly, Crotty (1998) proposes that there are two most important questions to be considered initially when structuring a research- (i) What methods should be used?(ii) How to legitimize this decision? Moreover, Creswell (2003) asserts that “*practice of research*” is upheld with four principal beliefs- epistemology, theoretical perspective, research methodology and research method. The final segregation of qualitative and quantitative research presides at the last hierarchy of methods.



**Figure 15 based on: Hierarchy of Methods ; Source: Author**

## **4.2 Research Philosophy**

### **4.2.1 Ontology**

The next section will define and elucidate the ontology which underpins this study. It is Crotty (1998), it is defined as “the study of being”. It revolves around the sort of world we are researching, with the idea of presence, with the structure of reality in that capacity. Researchers consider ontology primarily as the first step for formulating a successful information portrayal framework. Whilst there are various reasons for selecting an ontology it is believed that the term ontology was derived in philosophy which alludes to the methodical clarification and investigation of the idea of presence (Creswell, 2018). The table below explains the differences between ontology, epistemology and axiology through various factors,

<u>Assumptions</u>	<b>Ontology</b>	<b>Epistemology</b>	<b>Axiology</b>
<u>Question</u>	What is the nature of reality?	What is the relationship between the research topic and researcher?	What is the role of values?
<u>Characteristics</u>	Reality is subjective as seen by contributor in the research.	Researcher attempts to lessen the distance between himself and the objective.	Researcher acknowledges the fact that research is valued and that biases are present.
<u>Implications</u>	Researcher uses themes and quotes in words of participants and provides proof of distinct views.	Researcher participates, spends time in field with contributors, and becomes one of an insider.	Researcher discuss values that shape the future and includes his own conjunction with the interpretations of participants.
<u>Positivism</u>	External, objective and independent of social actors.	Only observable phenomena can provide credible data, facts. Focus on causality reducing phenomena to simplest elements.	Value free and etc. Research is undertaken in a value freeway, the researcher is independent of the data and maintains an objective stance.
<u>Realism</u>	Objective: Exist independently of human thoughts and beliefs or knowledge of their existence but is interpreted through social conditioning.	Only observable phenomena can provide credible data, Information, facts. Focus on explaining within a context or context.	Value-laden and etc. Research is value laden, the researcher is biased by world views, cultural experiences and upbringing.
<u>Interpretivism</u>	Socially constructed, subjective may change.	Subjective meaning sand social phenomena. Focus upon the details of situation,	Value-bond and emic. Research is value bond, the researcher is part of what is

		the reality behind these details, subjective meanings and motivating actions.	being researched, cannot be separated and so will be subjective.
<u>Pragmatism</u>	External, multiple, view chosen to best achieve an answer to the research question.	Either or both observable phenomena and subjective meanings can provide acceptable knowledge dependent upon the research question.	Value-Bond and etic-emic. Value plays a large role in interpreting the results, the researcher adopting both subjective points of view.
Source: Saunders et. al (2009, p.119), Guba and Lincoln (2005), and Hallebone and Priest(2009)			

**Table 2: Comparative study of Ontology, Epistemology and Axiology**

## 4.2.2 Epistemology

There are multiple and multifarious definitions of epistemology. This section will define epistemology from the extant literature and then outline the epistemological foundations of this study. Whilst (Hirschheim, 1985) defines it as '*science or theory of knowledge*'. Contrastingly, Lee (2004, pg. 6) hypothesizes it as "*a wide and abnormal state diagram of the thinking process by which a school of thought plays out its exact and sensible work*". Epistemology is the philosophy of learning and how we look at knowledge and focuses on what is known to be true. Epistemology could be related to every part of research, be it- sources of limitation of knowledge or the nature or possibilities (Bryman and Bell, 2011). To conclude, a study of criteria through which you can classify between what and what does not constitute the knowledge is epistemology (Darlaston-Jones, 2007). It is a study of knowledge under which, one can raise questions pertaining to -(i)the nature of truth , (ii) the limits of what we think or ought to know (iii) the reliability of knowledge .

There exist three epistemological factors which contributes to the knowledge acquisition and these are the justification, belief and the truth (Tracy, 2012). On the basis of these three factors, one can reach to an answer as "*knowledge can be defined as- Justified true belief*", whereas "*truth is an occurrence in which there are no false propositions*" Maynard (1994, p. 10). Epistemology can be further distinguished primarily into various types: positivism, realism, pragmatism and interpretivism

### 4.2.2.1 Positivism

Bryman and Bell, (2011, p. 16). furnish one definition of positivism as "positivism is an "epistemological position that advocates the use of the techniques for the characteristic sciences to the investigation of social reality and past" *Researchers who follow the positivism paradigm are known as functionalist or realist. They adhere by the belief, "that a solitary genuine reality as of now exists on the planet and is holding up to be found"* (Tracy, 2012). The research is conducted e in a largely bias -free way, where the researcher maintains an objective stance and is independent from the data. This philosophy is highly recommended when a research is to be done using quantitative research method when the research deals with large samples and the research seeks to determine cause and effect.

#### **4.2.2.2 Realism**

Whereas one definition of philosophical realism states as, “ a view that substances exist freely of being seen or autonomously of our speculations about them” (Phillips, 1987, p. 205). Realism and positivism are closely aligned in a way that, whilst positivism attests that reality watched is understandable, basic authenticity acknowledges that reality is just a method for realizing. (Maxwell, 2012, p. 5) maps various variations of realism and opines that in the end critical realism seems to be much aligned to interpretivism.

#### **4.2.2.3 Interpretivism**

Interpretivism *"is predicated upon the view that a procedure is required that regards the contrasts among individuals and the objects of the common sciences and subsequently requires the social researcher to get a handle on the abstract importance of social activity"* (Bryman & Bell, 2011, p. 19). Generally, interpretivist researchers are quite fondly known as constructivist, constructionist or naturalistic (Tracy, 2012). Hence, it is observed to pursue constructive ontology which makes is closely related to social constructionism. Researchers opt for such philosophy when a research has its emphasis on subjective meanings and social phenomena. This makes is best for qualitative research method as it has its prime focus upon details of situations, or the reality behind each detail or motivating actions. The main essence of this philosophy is to gather information by interpreting the other person and what he wants to convey in the true sense by means of series of interviews and observations. The answers we obtain through means of this philosophy in are often by means of forming and underpinning multiple interpretations of each individual’s point of view or opinions.

#### **4.2.2.4 Pragmatism**

Bernstein(1992) states pragmatism to hold an elective liking to the utilization of blended techniques in research which in other words is popularly known as “ mixed methods”. According to Creswell (2003), pragmatism evades the petulant issues of truth and reality, acknowledges, logically, that there are solitary and various substances that are available to observational request and arranges itself toward tackling reasonable issues in this present reality. Hence, it is also observed that, unlike pragmatism, positivism confines its “elective affinity” to quantitative approach on the contrary interpretivism confines to qualitative

approach (Mutch, 2004). The research onion model by (Saunders *et al*,2009) has a specific research philosophy layer that amends hypothetical point of view along with epistemology of Crotty. It is a researcher's utmost responsibility to position epistemology in such a manner that it interprets or predicts the idea of reality in social association which faces the changes constantly impacted by the on-screen characters and activities involved. Therefore, epistemological foundations of this research is purely from the interpretivist perspective.

#### **4.2.2.5 Interpretivism versus Positivism**

Within extant literature there has been an ongoing debate and discussion concerning the merits of both interpretivism and positivism. While positivism adheres by human experience of the world mirrors a goal, autonomous reality which gives a stage to human information on the contrary, interpretivism adheres by knowledge that is purposefully established. As per Weber(2004), the distinctions between the two are often contestable and could most often result in confusion. Most researchers recommend interpretivism when the study has to deal with small samples (Bryman & Bell, 2011). Hence, for this particular thesis, the philosophy that suits the best is "Interpretivism". It understands and helps interpret humans along with the social reality. The answers we obtain through means of this philosophy in are often by means of forming and underpinning multiple interpretations of each individual's point of view or opinions.

#### **4.2.3 Axiology**

Axiology pertains to value's nature and captures a worthwhile value question (Saunders *et al*, 2009). It refers to the aim of the research. It focuses on what provides the ethical the value in the research priority. Axiology covers the role of researchers' values in the scientific process. The fourth feature of a research, axiology, throws some light on "*values of being, about what human states are to be valued simply because of what they are*" (Heron & Reason, 1997, p. 287). Positivists and realists keep the concern for the case, so that there is no place for sentimental values in the research method. Like a chemist works in a laboratory, the psychology researcher similarly should remain detached emotionally from all the inquires of the investigation. One's feelings, expectations, values and hopes to have no space in a scientific research. By using systematic, standardized investigative processes, the researcher strictly controls or eliminates any impact he might have on the research process or the contributors.

Though during an investigation, positivist and postpositivist researchers contain their value biases very carefully (Al-Debei and Fitzgerald, 2010). The values are reflected in the selection of the research objective. For example, a researcher's choice to research on poverty may reflect an image of social world and society. Each research philosophy adds up value to research making complete depending of the research approach chosen by the researcher. As there are a variety of research philosophies and research approaches available, there can be several permutation and combinations formulated to carry out the research.

### **4.3 Research Approach**

Research approach can be defined as an arrangement of collections or conditions. How one forms research questions is imperative and there are two fundamental types of research question- descriptive research, explanatory research. While descriptive has its focus on all the “what” questions on the contrary explanatory research is all about the “why” questions. In order to have the correct research questions formed it is of paramount importance to have a well-structured research design. Research approach is a design which is more than just a “work plan”. In more recent research, it is said that- *“The function of a research design is to ensure that the evidence obtained enables us to answer the initial question as unambiguously as possible”* (Bell and Thorpe, 2013).

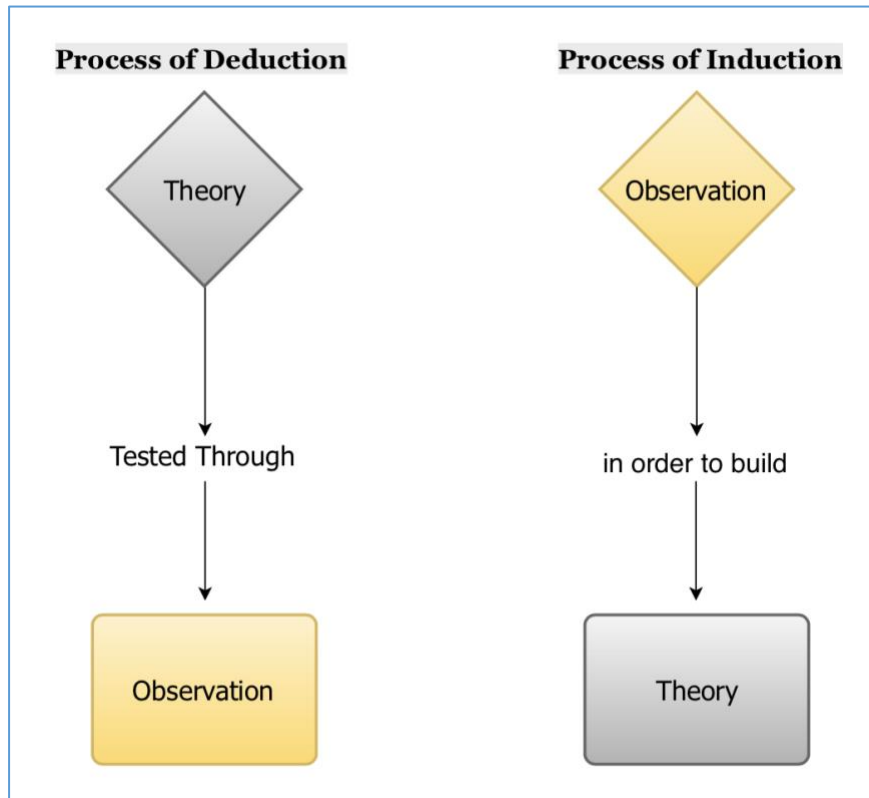
Generally, in the ‘research onion’ (Saunders et al, 2003) it is observed that the research philosophy layer is placed above the research approach layer. Furthermore, the study is well broadened into two types- deductive and inductive. Some researchers opine that deductive and inductive approaches are aligned to positivism and interpretivism respectively. Hence, those who advocate mixed methods approach are found patrons of a third approach-abductive approach. This approach is well suited for pragmatist philosophy where the process could be quite iterative/cyclic especially in data collection phase. Reichertz (2009, p. 9) discusses that post data collection, speculations are made, hypothesis is created, further information is gathered, and so forth. Depending on the type and nature of research, research approach is broadly classified into inductive and deductive approach.

### **4.3.1 Deductive approach**

A deductive study is related with developing a hypothesis based on the existing theory and then designing a research strategy to test the hypothesis. Deductive generally means reasoning from being particular to general. If we are to differentiate between the two, the inductive and the deductive approaches can be classified in the simplest manner. A deductive approach is a tested theory whereas the inductive approach is concerned with the new theory emerging from the data. In a deductive approach, the approach usually begins with some hypothesis whereas in an inductive approach, we use the questions which research the scope of study. It is vital for researchers who opt deductive approach to take hypothesis into consideration as part of their research which indicate a causal connection between factors (Gill and Johnson, 2010).

### **4.3.2 Inductive approach**

The inductive method involves the implementation of a information gathering technique, after which the information is analysed to choose out the emergence of patterns or themes out of which generalizations or even theories may be generated. Gray (2004) is cautious to make it point of note that induction does not push out or ignore pre-existing idea. It takes pre-existing data into consideration . Inductive approach discovers the real theory that is hidden in observations and findings. With induction, the general process is gathering of data succeeded by generation of theory. “The procedure of induction entails drawing generalizable inferences out of observations” (Bryman and Bell, 2011, p. 14). Bryman and Bell (2011) additionally factor out that in a few times the outcome of the studies is not theory however “empirical generalizations”.



**Figure 16: Deduction vs Induction (Gill and Johnson, 2010)**

Inductive approach is mostly used with qualitative research however the deductive ones are commonly used in quantitative research (Gray, 2004). But there is no certain rule of doing it this way as there are many qualitative researches, where the deductive approach is implemented. Hence, it isn't mandatory that we have to use inductive method only, if we are working on a qualitative research. It can be used according to the research and the requirement. Since the requirement of the project is to use a deductive study, we are going to use deductive study here. The deductive approach involves making a hypothesis and also to test if the given theory is valid enough in the particular situation, deductive studies are the best suited for this research. Also, if one has to consider in terms of an approach which is closer to the logics, deductive is the one.

#### **4.4 Research Methods**

The definition of research methodology- "procedure or plan of activity which joins techniques to results" (Creswell, 2003, pg. 5). Primary research and the way it is carried out

plays a key role to make this thesis complete. In general, the concept of research methods is widely classified into a “qualitative approach” and a “quantitative approach”. The next section will outline the two methods and then determine the method used in this study; describe why it is the optimal method to answer the research questions.

#### **4.4.1 Qualitative Method vs Quantitative Method**

In every thesis, the first battle, which the researcher fights is when he has to choose whether to carry out a qualitative research or quantitative research. According to Myers, qualitative research can be characterized as a procedure that involves naturalistic inquiry consisting of in-depth comprehension of circumstances. Qualitative methods has its origins in the social sciences in which it became cultivated to examine social and cultural phenomena of their 'natural' context, the use of methods which include case study research, movement research and grounded idea (Myers, 2013, pg. 8). Quantitative method has its origins in the natural sciences where it was developed as a research technique for studying natural phenomena. Qualitative method covers a "pluralism of research paradigms (positivist, interpretive, realist) within which there are many research methods which includes case research, discipline research, ethnography, and action"(Carroll and Swatman, 2000). Properly established and conventional methods of quantitative studies in the social sciences consist of survey techniques and laboratory experiments, numerical strategies and formal strategies. Within the literature researchers have been observed to be arguing over the dissimilitude between both the researches that their core epistemology of the two is just not alike (Borrego, Douglas, and Amelink, 2009). Qualitative data or research has huge dependency on how the data is collected and a methodology of any thesis basically requires clear identification as well as deployment of the most significant approach that answers the problem (Kaplan, 1964). The thesis that involves qualitative research needs multiple systems of enquiry for studying the human phenomena, case study, discourse analysis, ethnography, phenomenology, biography and historical analysis rather than statistical or logical procedures. It is also observed that a researcher has various questions framed to put such a research into action, for example: (i) How will I gain access to and recruit participants, (ii) How will participants respond to my questions? These questions are essential as it helps one begin their investigation (Jackson et al., 2007). Qualitative research has its most emphasis/focus on “what is said” and also “how something is said” which in researchers’ terms is called content analysis and conversational

analysis(Creswell, 2013, p. 39). Data collection or the methods applied to collect the data in this approach also has a vital role to play. Some of the frequently used methods are,

#### **4.4.1.1 One-on-one Interview**

It is commonly known as the easiest method of making the qualitative research. Here, you need to interview the potential customer in depth and collect the meaningful data (Berg, 2001).

#### **4.4.1.2 Focus Groups**

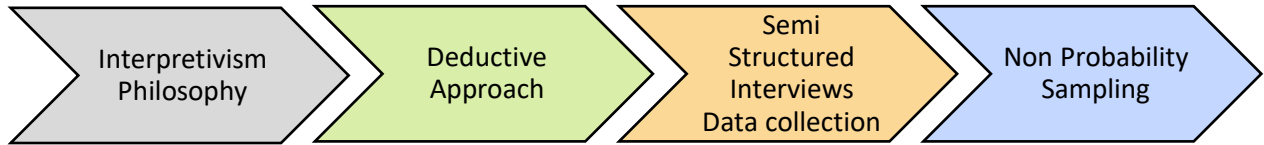
In this method, the interviews can be conducted online as well. Here, you need to find the answers like why, what and how (Basch, 1987). All you can do is by sending the survey questionnaire and the group will fill it and send it back to you. Since it is comparatively costly method, it is used in complex process only like market research or when testing a new product or service (Kitzinger, 1995).

#### **4.4.1.3 Ethnographic Research**

This method involves the most in-depth observation(s) (LeCompteandGoetz,2005). There are many other methods available to carry out this approach. But most important fact about qualitative research is that it tests trustworthiness through variables like dependability, credibility and reliability. The main nature of quantitative studies is "deemed an excellent suit for deductive processes, in which a theory or speculation justifies the variables, the motive of assertion and the course of the narrowly defined research questions" (Borrego, Douglas, and Amelink, 2009).

Hence, qualitative research will be the best approach to carry out this thesis as it allows to interact with experts and gurus who will give a brief account based on their observations and experiences and also, it is considered the best approach when it comes to understanding people's attitudes.

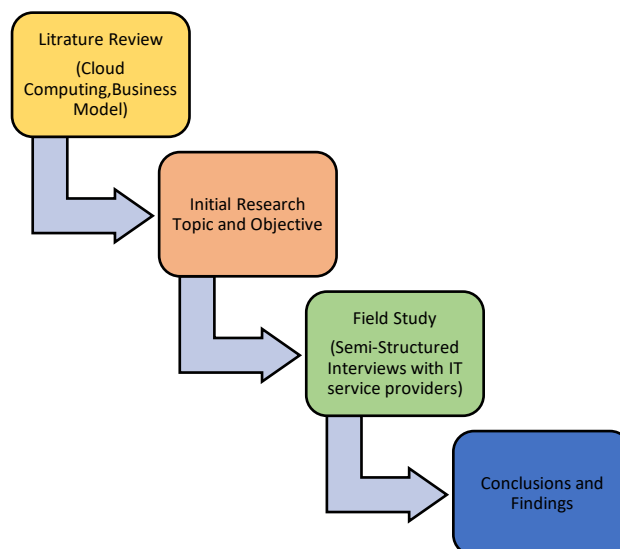
## 4.5 Research Strategy



**Figure 17:Flow of Research Strategy (Harigan ,1983)**

Since this research involves cloud computing concepts, the business model covering such vivid concept comprises hard to quantify constructs which can fluctuate from association to association inside a similar industry. In situations like these, Harigan (1983) suggests the investigation to be carried out with a “multi-site, multi-source examine technique for the motivations behind getting generalizability in revealing discoveries while not losing the subtleties of every association's unique situation”. The following diagram below gives an idea how the research would be carried out,

Other than this, the figure below explains further regarding the research design for the following study



**Figure 18:Overall research design of the study**

## **4.6 Sample Selection and Size**

For a well accomplished qualitative research, appropriate strategies that involve the right sample size is crucial. Therefore, the most important terms for data collection are population and sample. While population can be seen as the whole arrangement of individuals about which the exploration expects to make speculations, sample can be defined as “subset of the population that are chosen to take an interest in the exploration” (Zikmund, 2000, p. 387). Many researchers believe that an appropriate sample size in a qualitative research is imperative as it answers the research question to a satisfactory level. For instance, Crotty (1998) advocates that the identification of the nature of the data is vital step for data collection methodology. There are majorly three broad mechanisms to selecting a sample for a thesis- convenience sample, judgement sample and theoretical sample(Marshall, n.d.).

Sampling has two broad classifications-probability and non-probability. According to Zikmund (2000), when considering probability sampling technique- *“each component in the population has a known, nonzero likelihood of determination”* while in non-probability sampling, *“the likelihood of a specific individual from the populace being picked is obscure”*. In this thesis, sampling will be done by putting a “Non-Probability Sampling” method into practice. In this method, although many samples are accumulated, it does not give every one of the people in the populace level with equal chances of being chosen. The samples are chosen at sole discretion of the researcher based of various factors.

## **4.7 Data Collection**

### **4.7.1 Semi Structured Interviews**

The semi structured interviews are one of the most common form of interviews which is being used to interview people. Semi structured interviews are conducted with a fairly open framework which gives you the access of conversational, more focused and two-way conversation communication. It can be used for both give and receiving the information. interviewer has to follow the guidelines while taking the interview however they are also able to follow some topical trajectories in the conversation which might stray away from the guide.

It is a thoughtful process which requires a lot of planning including various steps. While taking the interview, the interviewer creates some instant questions which were not decided before but are now because of the flexibility have in their jobs. If needed, extra questions can be planned in the midway of the interview if and when required (Diefenbach, 2009).

#### **4.7.2 Number of Interviews**

The number of interviews can never be determined before taking the interview as it purely depends on the information you are gathering. In order to receive most of it, there are plenty of questions that must be considered for deciding on the number of interviews to conduct. If the semi structured interviews are the only source of information, there must be a good amount of interview which should be conducted.

#### **4.7.3 Preparation**

In order to conduct, analyze, transcribe and prepare the semi structured interview for a scientific research, there is a lot of time needed. One more considerable fact about the preparations of semi structured interviews is that since the key informants are mostly the stakeholders and hence are not always available.

#### **4.7.4 Stages of Semi Structured Interview**

While preparing for such interview, it is requisite to understand the stages of the process of semi structured interview (Rubin and Rubin, 2011),

1- Arrival- to make sure that the first meeting between the interviewer and interviewee is smooth and positive. Otherwise, it might ruin the whole interview session due to some uneasiness.

2- Introduce the research- In this step, the interviewer has to make the things clear to the interviewee so that they can get a clear idea of the purpose of the research and also has to make sure that their consent has been taken before initiating the interview.

3- Beginning the interview- In this segment, the aim is to collect the background facts of the interviewee to know more about them which can become the base of the research.

4- During the interview- It will be the theme of the interest which will aim the interviewee to think about such topics which they hardly do in their daily lives. It will become the body of the interview.

5- Ending of the interview- Since the interview is about to come to its end, the participant has to realize it and make sure to give all the proper important information so that they don't go with any regrets.

In this thesis, in order to make the best research, people targeted are associated or have good knowledge (Tracy, 2012, pg. 139). Considering all the above-mentioned factors, semi structured interviews have been considered as the best fit to collect all the required data. To maintain true professionalism, it is best to ensure that the other person is comfortable, and the questions asked fall in their comfort zone for them to answer.

#### **4.8 Summary**

Chapter Four, Research Methodology, describes the methodology of data collection and analysis that was used to answer the research questions. First of all, paradigm adopted was introduced, and then explained why qualitative method was the best method for this thesis, followed by the methods used to analyse the collected data. Then the research described the coding procedures for data analysis and introduced its population and sampling frame. The following chapter will advocate the best method for research for this thesis and explain briefly the three research questions with the table and the figures.

## Chapter Five: Data Analysis

### 5.1 Introduction

Data analysis is most empirical part of any research. Each step taken in the process of research or the way each of the research questions is approached matters as it helps create an outline of the whole research. Saldana(2013) explained how each step in data analysis of a research is important,

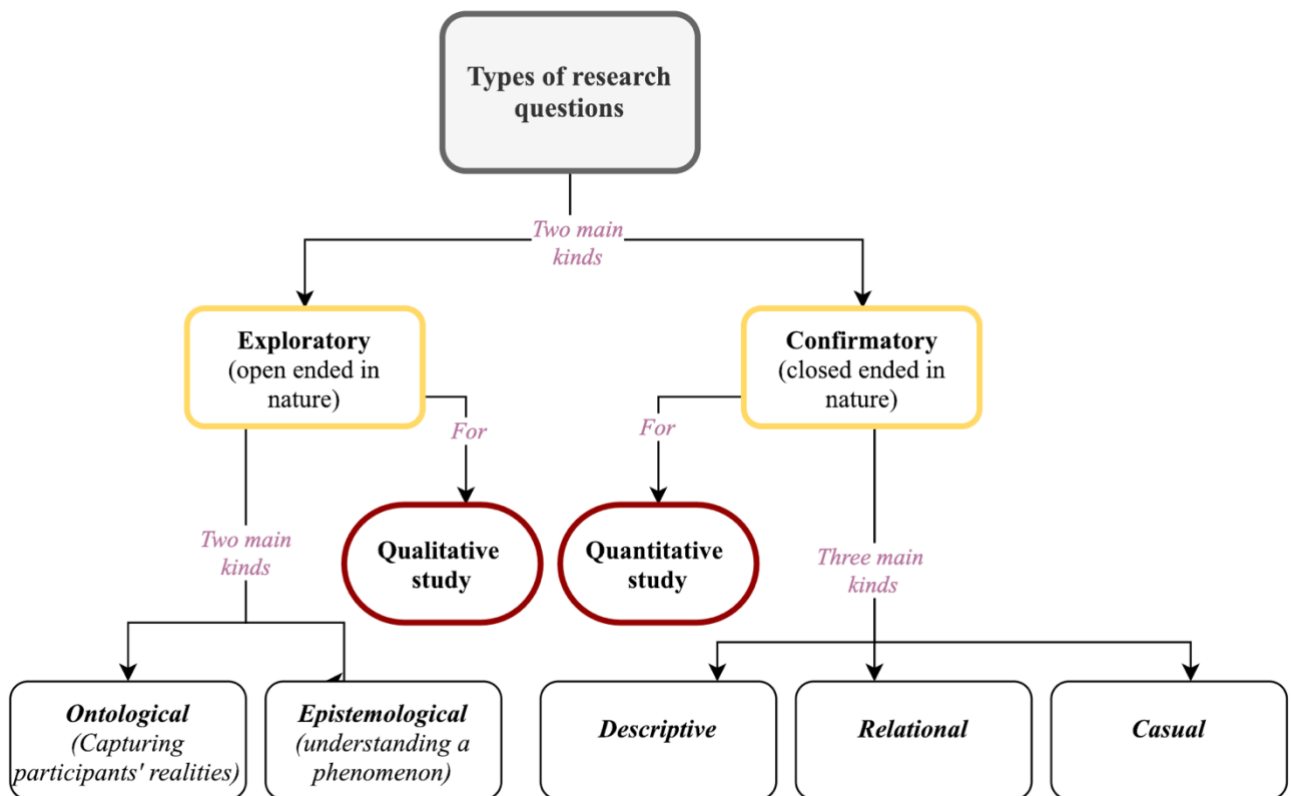


Figure 19 based on : Types of Research Question (Saldana 2013); Source : Author

The following sections will give a brief account on how data for this research was collected and what are the interpretations drawn from the experiences or stories or responses shared by the participants or target audience of this research through the medium of semi-structured interviews conducted.

## 5.2 Data Analysis

Data analysis is the process of systematically applying statistical techniques to evaluate data. In order to reach the ultimate objective, it is required for the researcher to analyse the gathered data in a systematic way so as to conduct the research in a subjective manner. According to the viewpoint of Taylor, Bogdan & DeVault (2015), there are mainly two kinds of data analysis methods and these are all about qualitative and quantitative data analysis. This research follows qualitative data analysis, as it refers to the non-numeric information and thereby, it is closely associated with the statements, feelings and emotions of gathered information that are non-quantifiable. Such kind of qualitative data analysis method involves surveys or interviews with open-ended questions. The researcher has used an analytical narrative data analysis process that incorporates coding methods like Open and Axial coding recommended by Strauss and Corbin (1990; 1998) and Saldana (2013). Narrative data analysis process is an iterative technique where (as indicated in table 3 and figure 21) categories are revised, dimensions are found and specified which result in final theories are developed. Hence, there's a constant pattern of categorizing, sorting and synthesizing is performed over data to explore new clues or codes which finally evaluate the assumptions and help reach to conclusions (Ritchie et al., 2003; Myers, 1997; Urquhart, Lehmann and Myers, 2010; Saldana, 2013). The primary tool used by the researcher to validate the data and structurize the findings is NVivo 10 software.

## 5.3 Data Analysis Method

Data analysis especially with respect to qualitative methods has three dimensions- "*understanding context, understanding people and understanding interaction*" (Trochim, 2006). Through semi-structured interviews some crucial data was assembled which resulted in few subject specific findings. Firstly, regarding evolution of SDC from traditional process. Ages ago enterprises followed ways of simple storage, in pen drives and Hard Drive Disk(HDD)s. Then came an era of utilizing new innovative technology when cloud was first introduced and it followed introduction of its wide range of features and services. Ever since cloud was introduced, people started utilizing cloud majorly for data storage. Hence, cloud replaced Hard drive disk but the only difference here is that cloud played the role of a HDD which is maintained by a cloud provider. According to the participants, these cloud providers

would charge companies according to its usage. This charge can be based on electrical, mechanical, maintenance, operation or function fee. It served as single source of truth as this storage device is accessible from anywhere through any device via Internet and similarly any data can be stored automatically on to cloud with use of Internet. But, slowly companies came across a drawback. The drawback was that since the data centres deployed by companies were running 24x7, they were billed accordingly.

This is when SDC was introduced as a breakthrough. SDC allowed the companies to program their data storage system in a way that the data centres and their usage are scaled according to the need of companies (Bawa *et al* ,2015). In other words, traffic is well managed and this will reduce the cost. For example, consider a Sports channel, they would face huge amount of traffic when there's an important cricket match or popular game event telecast. Hence, deployment of SDC would help them save time and money by controlling scalability factor of their data or networking. This is advantageous to the company as they will only get billed when they use a cloud provider's services on that day instead of getting billed on a daily basis. All this was made possible by few cloud providers with general cloud as well. There still didn't evidently need SDC. But with general cloud, not all enterprises could predict what level of scalability they required and when it had to be implemented. Hence, it resulted them into either of the situations. One, where companies had to choose to keep the scalability factor on for 24x7. Else, they had to manually try and manage their data having a person employed to manually control their use of cloud. This was the true reason behind emergence of Software defined cloud. SDC or Software defined cloud came as a real breakthrough as extended version of what cloud's scalability had to offer (Kim and Korea, 2009). Companies who adopted SDC observed that SDC, automatically deploys new servers whenever needed and turns them down when there's no requirement. Hence, saving time, manual efforts and huge costs for companies. This is a brief on emergence of SDC from traditional process based on several research papers and participants of the interviews conducted for this research.

The research methodology and data analysis methods implemented in this research by researcher answered all the research questions aimed in the initial section 1.8. Particularly, the qualitative approach along with literature reviewed successfully met the objectives aimed by the researcher in the section 1.3. Further, every data analysis method works in a particular

manner. Qualitative data analysis can be classified into further categories namely- content, narrative, disclosure and framework.

### **5.3.1 Content Analysis:**

Content analysis can be defined as a process of categorizing verbal or response-oriented or behavioural data which is summarized, tabulated and presented by the researcher as per the requirement of the research or study (Saldana, 2013).

### **5.3.2 Disclosure Analysis**

The Disclosure analysis method is most suited for natural procedure of talkings and all types of written formatted text that is most likely appropriate for official use (Saldana, 2013, p.29).

### **5.3.3 Framework Analysis**

Framework analysis method is considered the most advanced method as it comprises various stages such as identification of a thematic framework, coding, charting, categorization, mapping and finally interpretation.

### **5.3.4 Narrative Analysis :**

Narrative analysis consists of rigorous reformation of recitals or stories narrated by respondents or participants in such manner that each case, each experience of each respondent or participant is accounted by researcher (Hani, 2009; Saldana, 2013). This method suits the best for this study as it helps with revision of entire primary qualitative data without a single miss over details of secondary data collected by researcher.

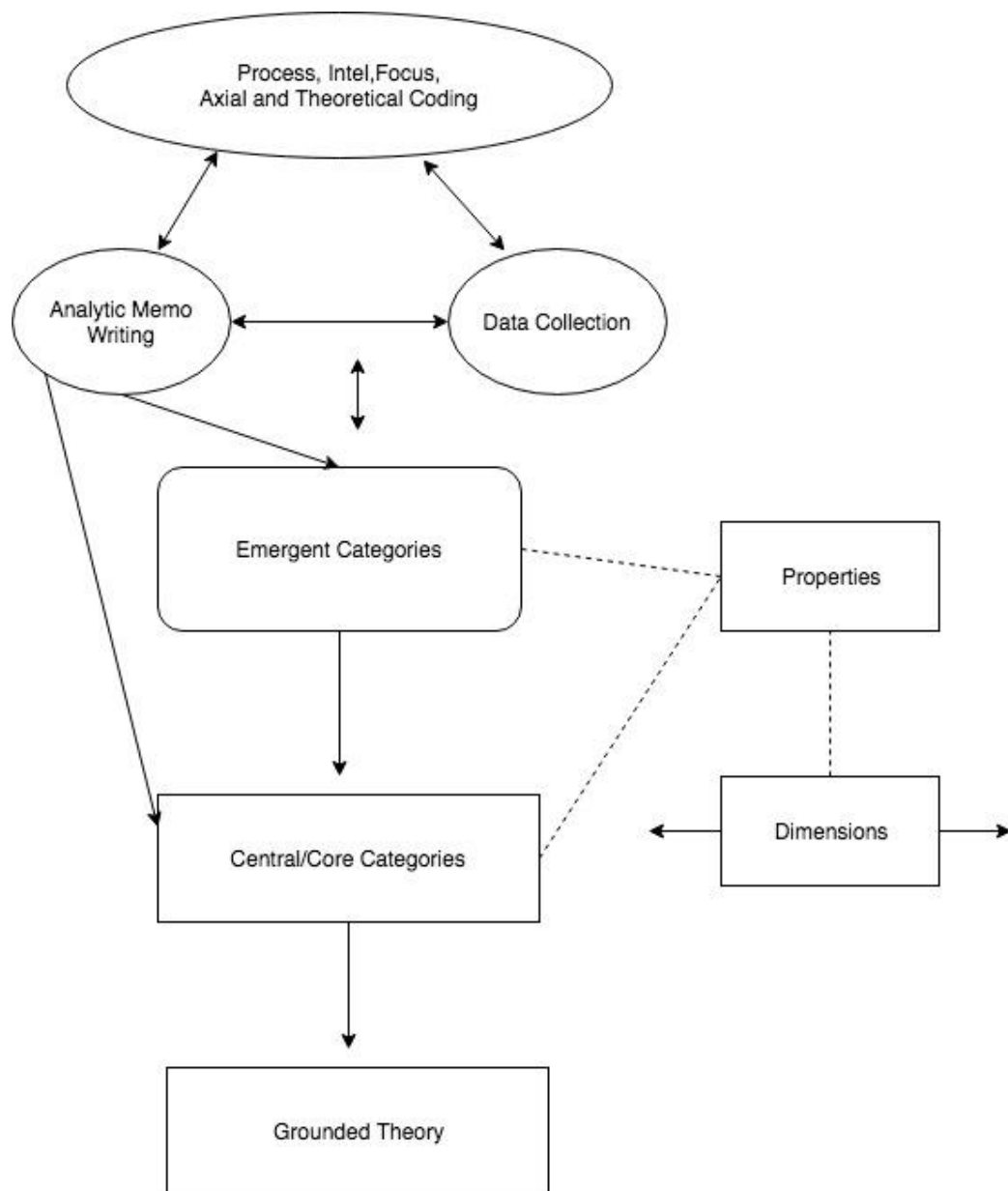
Types of Narrative Analysis	Study starts with	Timings of definition codes and keywords	Source of codes or keywords
Conventional analysis	Observation	Codes are defined during Data Analysis	Codes are derived from data
Directed Analysis	Theory	Codes are defined before and during data analysis	Codes are defined through theory or relevant findings
Summative Analysis	Keywords	Keywords are defined before and during data analysis	Keywords are derived from interest of researchers or review of literature.

**Table 3: Coding Difference Among Approaches to Narrative Analysis (Saldana, 2013)**

Narrative analysis along with coding schemes help synthesize theories that can be inferred as relevant findings.

#### 5.4 Coding

Coding can be defined as categorization of data. In other words, a ‘code’ can be any word, a small phrase or anything that represents a particular theme or an idea. In general, codes are most efficient when used to create a “grounded theory”. The flowchart below explains Saldana (2013) theory on formation of grounded theory,



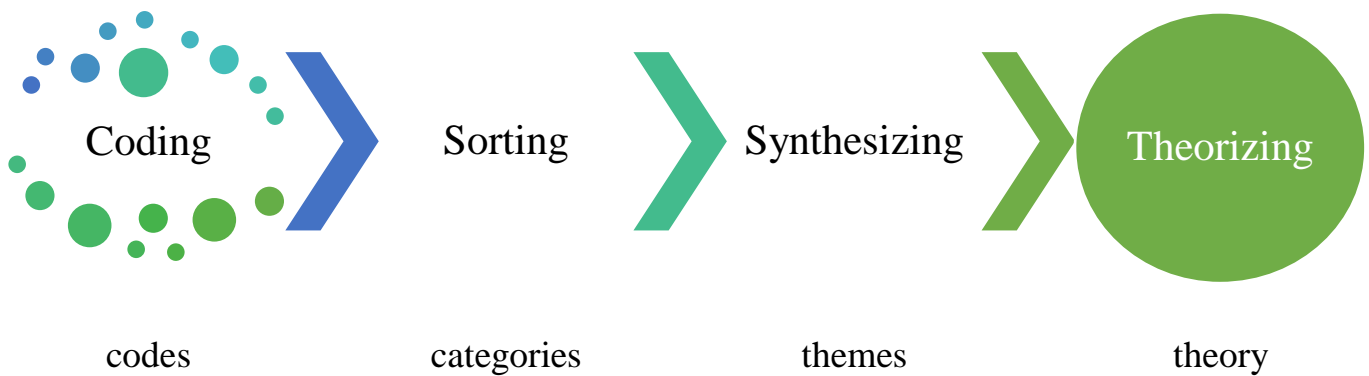
**Figure 20:Grounded Theory(Saldana,2013)**

The traditional methods of research witnessed manual coding that involved tools like, notes, pencil, pen and then slowly switch to word document which were utilized to save the artefact. But, the researchers found themselves limited to use such coding technique to only work on small data and these techniques were a lot more time consuming. The transformation of this technique to use of Electronic coding through usage of data analysis softwares like Nvivo, CAQDAS helped researchers to overcome the limitations (of manual coding), making their research more dynamic in nature. The following table explains the exact comparison between the two methods (Saldana, 2013).

	Manual Coding	Electronic Coding
Tools	Paper pencil, note card. Hard copy of transcript , artefact of the coded  Words document using excel spreadsheet	NVIVO, Atlas Ti, and Transana are Computer Aided Qualitative Data Analysis Software
Usability	Easy to use especially when data is not a lot	Need to familiarize with the functions of the software before starting analysing data
When to use	<b>Small Data</b> At initial stage of data analysing – when familiarizing yourself with data	<b>Large data</b> Audio and Video included that have not been transcribed.
Organization	Time Consuming	Easy to run code frequencies ,organize codes , explore the relationship between codes.

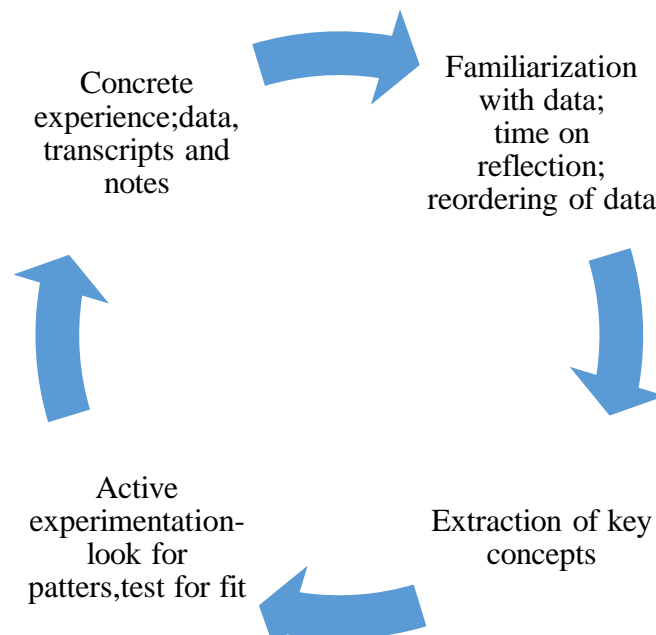
**Table 4:Manual or Electronic Coding(Saldana,2013)**

Each code formed must have an assigned meaningful title. The major difference between qualitative and quantitative methods with respect to coding is that in qualitative data analysis there is absolutely no such universally applicable technique that can directly help in generating findings. Analytical and critical thinking skills of each researcher is the most significant factor for data analysis in such qualitative studies. Hence, Miles and Hubermann (1994) says that no qualitative study can be iterated to produce the same results. The process of coding is carried out in this method- first wide range of events, behaviours, activities, meanings are analysed and transformed to codes. Then categorization of the same is done, followed by converting or synthesizing these into themes and finally these are presented in the form of themes in every research by the researcher.



**Figure 21: Mechanism of Coding (Miles and Hubermann, 1994)**

The above mentioned paragraphs briefly explained the mechanism of coding and codes. In this research, first level categorization of data was performed by the researcher through literature papers in the literature review. All the data was re-ordered according to the themes formed and key concepts were formed. Then all the concepts that still remained unclear or need to be evaluated were re-framed into interview questions. Active experimentation mentioned in the figure 22 below was achieved through semi-structured interviews conducted. Although only three interviews were conducted, the interviews resulted in Concrete experience, data transcripts and notes making the whole process a cyclic one (as described in the figure 22 below).



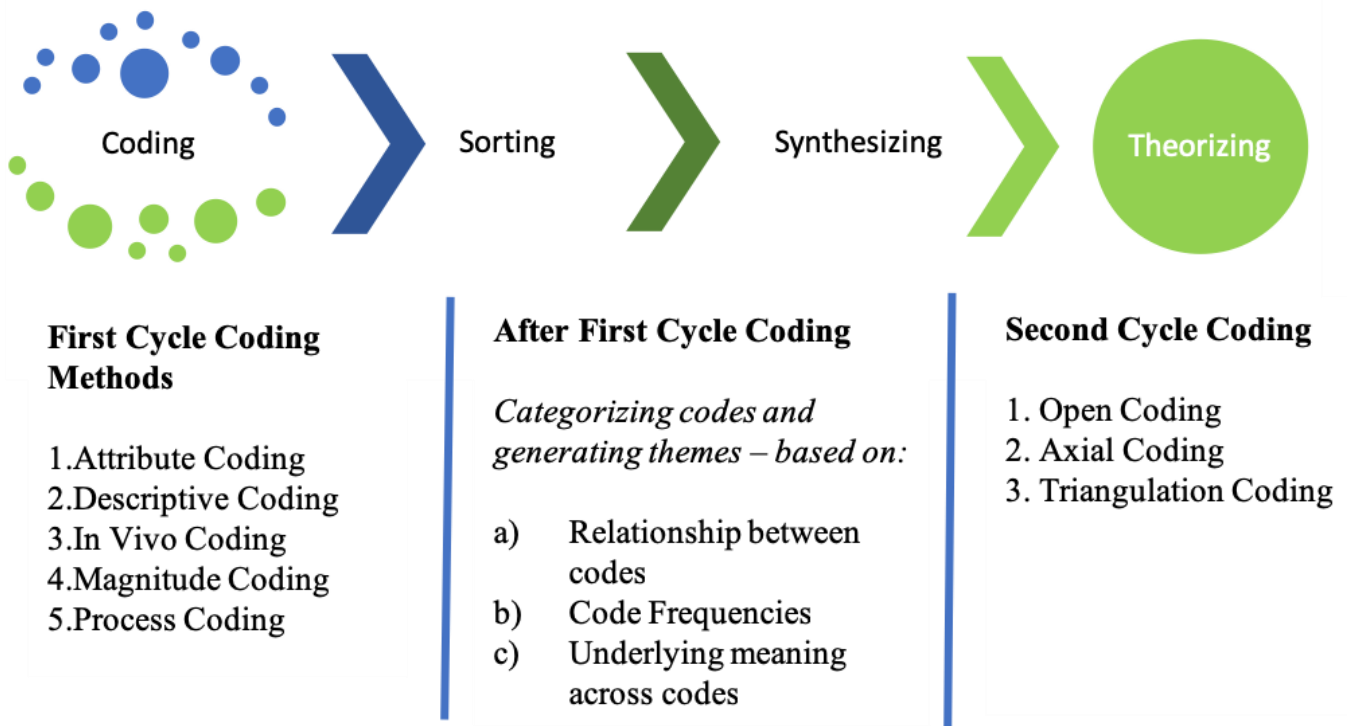
**Figure 22: Cyclic Process Of Data Refining (Myers, 2013)**

The results were answers for the research questions mentioned in section 1.8. As the first research question (**RQ1**) was answered earlier in the data analysis method section, the clear findings of the other two research questions are tabulated below (based on various literature paper and experiences shared by participants),

S.No	Research Question	Findings
<b>RQ2</b>	Is SDC really an innovation for automation?	Indeed. Companies can now automate as well as customize their server deployment according to their requirements or time constant (based on participant's verdict in interviews by researcher). They can scale their servers up or turn the services down which saves cost, time, effort; making SDC completely automated(Lin et al., 2014; Bernardos <i>et al.</i> , 2014; Perks <i>et al.</i> , 2018; Shannon, 2003).
<b>RQ3</b>	How can enterprises benefit from adoption of software defined Cloud (SDC)?	It can be considered primarily as business intelligence infrastructure that helps save cost, time, less manual interference in management of data centres, helps manage data and optimizes organization of data(Baldini et al., 2012; Khajeh-Hosseini et al., 2012; Chang, 2014; Jararweh et al., 2016b).

**Table 5: Research Questions vs Findings**

The overview of the mechanism of coding till theorizing is specified by the figure 23 below.



**Figure 23: Overview of Mechanism of Coding (Saldana, 2013)**

According to Saldana (2013), there are three main categorization of coding that are implemented in this research-

#### **5.4.1. Open**

It deals with the initial organization or management of raw data to help get a clear understanding of it. All data sources were recorded, imported, transcribed and then analysed through semi-structured interviews conducted. Open coding helps analyse the data, summarize it using a concise code (Myers, 2013, pg.107). This followed by proper categorization and evaluation of data (Charmaz, 2012). The researcher has used descriptive type of open coding scheme to identify codes or rather concepts from each and every interview transcript.

### **5.4.2 Axial**

This helps with inter-relation and linkage of all the different unique categories of codes formed. Axial coding helps to re-assemble data that was previously fragmented in the open coding scheme. A recursive coding paradigm of causal strategies, conditions are performed which lead to development of re-assembled axial categories along their sub categories. The categories are sometimes noted as “tree nodes”( Myers, 2013).

### **5.4.3 Triangulation**

It refers to a certain practice of utilizing multiple sources of data or stories formed and formulating them in a way to display them as themes via various connections made among the categories (Charmaz, 2012; Saldana, 2013). To testify the data representativeness, especially after coding process is over, the coded headings formed are triangulated and evaluated to elucidate every possible similarity and differences found. Such repetitive process was utilized at each phase of this research which resulted in development, refinement of each research objective with its respective research question.

Analytical Process in NVivo	Objective	Iterative process throughout process
<b>Step 1:</b> Open Coding	<b>Explanatory Accounts</b> (Extrapolating deeper meanings, drafting summary statement and analytical memos through NVivo)	Assigning data to redefine concepts to portray meaning
<b>Step 2:</b> Axial Coding		↑
<b>Step 3:</b> Triangulation Coding	↑	Redefining and distilling more abstract concepts
<b>Step 4:</b> Findings Development	<b>Descriptive Accounts</b> (Open coding, Axial coding, Reordering and annotating through NVivo)	↑
		Assigning data to redefine themes/concepts to portray meaning
	↑	
	<b>Data Management</b> (Review, Familiarise and Interrogate raw data)	Assigning Meaning
		↑
		Generating themes and concept

Figure 24: Steps of Coding(Charmaz, 2012)

### 5.5 Summary:

The findings of this particular research is facilitated with a method named-‘memoing’. According to Miles and Huberman (1994), a memo represents-“theorizing of codes as they strike the researcher, while performing coding. Hence, it is based on the data with conceptual elaboration”. Following guidelines of Miles and Huberman (1994), researcher has given priority throughout the whole research to assure secure retrieval. These were presented as reports and valuable feedback was elicited by researcher that was received during peer debriefing. This assisted well in refinement and development of the entire research. Further note on how the objectives of this research were met, are tabulated below,

S.No	Objective	Findings
1.	To explore the emergence of SDC from the traditional methods	The reasons that led to emergence of SDC: <ul style="list-style-type: none"> <li>• Wastage of resources</li> <li>• Unavailability of servers in case of unexpected traffic</li> <li>• To overcome drawback of cloud</li> <li>• To have fully automated data centres data centres deployed</li> </ul>
2.	To discover the impact and usefulness of the changes effectuated by the emergence of SDC	The changes effectuated: <ul style="list-style-type: none"> <li>• SDC has made system more cost effective</li> <li>• Less manual interference in data management</li> <li>• Time effective</li> <li>• More reliable- both hardware and software wise</li> <li>• Hence, overall profits starting to rise</li> </ul>
3.	To describe the prospect the potential barriers of the adoption of SDC by enterprises.	The most evident potential barrier visible over the research is cost and requirement. Neither all businesses can afford to have such big setups nor all businesses have the requirement to install such setups.

**Table 6: Objectives vs Findings**

## **Chapter Six: Conclusion**

### **6.1 Introduction**

This study reviewed the definition, emergence, significant profits that enterprises will benefit, a portion of the key types or components of software defined cloud (SDC). Later, the research further outlines the adoption status, issues, and perspectives of the intended interest group on them. Next, it offers certain visualisation of how the market may develop, and a rundown of research issues. For instance, on account of the convincing points of interest, and due to the status of the empowering advancements, it is normal that software defined cloud (SDC) will turn into a key registering worldview for the following 5 to 10 years. It will have extensive outcomes on the distribution model for software, and even hardware. It will likewise make it less demanding for small to medium businesses to offer new administrations, as the present new companies that are seen to be presently offering SaaS benefits on Amazon's Web Services.

### **6.2 Discussion**

Software Defined Cloud Computing is developing because of advances in the zones of cloud computing, framework virtualization, software defined networks (SDN) and network virtualization. Before SDCs turn into a reality, numerous difficulties should be survived. This research exhibits an architecture empowering SDCs concentrating on assortment of applications including data intensive and computing related applications in Web, mobile, and undertaking situations. The research also discusses about the diverse components that contain the engineering and assessed through recreation the capability of SDCs in two use cases—QoS-mindful data bandwidth allocation and bandwidth-aware, energy-efficient VM relocation. Further, discussions about the open hurdles and openings emerging from this developing territory. This research explained the major difference between what SDC had to offer, from the scalability of cloud. SDC uses historical data whereas traditional cloud's scalability behaviour doesn't have this feature, which make SDC much more advanced and innovative in nature. As SDCs and the empowering advancements progress, new difficulties are anticipated to emerge and new application situations to rise that will make SDCs a standard innovation with applications in all the business industries.

SDC will enable us to accomplish exceptional dimensions of operational efficiencies and quickened development in profitability. Another significant findings of this research is that “operational expense” is present in cloud-SDC but “capital expense” is zero because companies rent the services from companies and not buy. New kinds of further improved manufacturing and modern procedures that are encircled around machine-human collaboration will rise. Moreover, unpredictability and the management oriented difficulties need to be primarily tackled so as to take full favourable advantage of the SDC that it can offer, along with its innovative manufacturing. Specifically, the areas to be focused are the architectures, systems, and designs intended to handle these multifaceted nature and the challenges related to management which need to be further explored. This study has presented a streamlined software defined cloud architecture which can be used and developed to address multiple challenges.

### **6.3 Practical implication to the research**

#### **6.3.1 Push strategy**

Awareness of software defines cloud services is important in early adoption stages. As SDCs are new to many industries and companies, effective adoption presentations are using various types of web pages, brochures and corporate recommendation will be beneficial to introduce to potential users and educate wider audiences about the flexibilities of SDCs. To access more potential adopters, information about must be shared which should include key benefits as “cost saving” and “automation”. Recommendation for Push Strategies is to build customer recognition of cloud services. Take the most advantageous feature of SDC in to consideration, which is “cost saving and automation.

#### **6.3.2 Pull strategy**

Cloud companies must develop cloud diffusion strategies by adopting “pull” strategies. Increased diffusion will increase number of SDC adopters as they are always looking for better automation. Effective co-operation for cloud companies has to be delivered. Increase service

by collaborating with cloud service providers and increase cloud services horizon horizontally and provide education on the use of SDCs in cloud computing.

#### **6.4 Academic contribution of this study**

The research has disclosed that a large number of the difficulties looked by researchers are common. However, the industry in general would profit by the improvement and also selection of SDC. Much experimental research in the zone of cloud-empowered plans with SDC incorporated has a great extent concentrated effect on cloud computing from an adopter's point of view. Firstly, the study contributes to the interpretation of the cloud computing concept, by giving an extensive literature review of cloud computing theory and practice. Transformative capacity of cloud computing is highlighted in a way in this research that it answers and contributes to bits of knowledge on the transformative nature of new innovations in the computing field (See Veit et al., 2014; Ostwerwalder and Pigneur, 2013; Iyer and Henderson, 2012; Venters and Whitely, 2012). Therefore, this research endeavours to broaden primary research contributions by identification of a specific objective and respective research questions which were utilized for looking at an explicit research theme which encompasses interrelated research domains consisting of cloud computing, SDC, its emergence, benefits that it offers to enterprises when adopted.

#### **6.5 Limitations for the research**

Accomplishing the vision of Software-Defined Cloud Computing requires wide imaginative key indicates with respect to its working, which will be quickly talked about in this segment. Favoured market and assessing models are more than "one size fits all" are imperative to engage SDCs. For example, the picked cloud supplier could offer the administrations for better expenses if the customer request could be imperceptibly acclimated to enable dynamically beneficial and in addition balanced use of physical resources. Achieving the vision of Software-Defined Cloud Computing requires wide imaginative work in key focuses, discussed in the straggling leftovers of this region. Qualitative research can be susceptible to "various sources of analytic bias which can weaken or even invalidate" the

overall research inferences. For instance, when conducting interviews with senior management, they possess certain number of authorities, which can result in the manifestation of elite bias. This happens when a researcher neglects to pick up a thorough comprehension of the more extensive concept by "overweighting data from articulate, well-in-formed, usually high status informants" (Miles and Huberman, 1994, pg. 263). To minimise such impacts of bias regarding the analytics, this study has various recommended tactics deployed that ensure the legitimacy and dependability of the research design. Research on the most ideal approach to provide for customers natural and clear techniques for portraying all of their necessities are required. In this sense, spotlight could be on ontologies for depiction of SDCs or on Domain Specific Languages (DSLs) that get all of the complexities of a SDC. This study's primary research is supported with semi-structured interviews, where the interview participants' perspectives are an impression or can be considered as reflections over SDC, of this specific moment in time. Another gap for this research is that, to find out the true essence of SDC, academic research is not sufficient. True nature of SDC can be known only through industry research. This is exceptionally applicable given the exploratory nature of carrying out the research. As cloud technology is a fast pacing innovation that develops and turns out to be progressively installed within businesses/enterprises, it is anticipated that these points of view, most likely, are prone to change in the near future, making SDC a sustainable researchable topic

## **6.6 Recommendations for the further studies**

The concept of software defined cloud producing and related architecture are setting the phase for another thread of research for the upcoming researchers and authors. Work coming up in future, will be centred around further refining the operational parts of the design's components and estimating its adequacy crosswise over trademark parameters, for example, try and protect or advance the ability, agility, interoperability, configurability and programmability. This section broadly discusses different drawbacks of SDN, which can be considered as future research headings, in particular: controller and switch plan, adaptability and execution in SDNs, controller-benefit interfacing, virtualisation and cloud benefit applications, data driven systems administration and empowering networking using heterogeneous method with SDN. Future research can also include up to what level of cost investment is required for a company to adopt SDC. Whilst past work has analysed the

utilization of SDN in remote situations, the scope has fundamentally centred around a framework that's based on arrangements. Future studies will likewise explore the software defined cloud's design's capacity to initiate new paradigms of cybersecurity.

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## **Appendix 1: Reflections and Learning Logs**

### **Reflections on Learning**

There were many reasons why I chose to undertake MBA and not continue with my decent paying job. Since I completed my 4 years of graduation in computer engineering, before getting my first job. In the corporate job roles where I was working, my job roles drifted from technical roles to project management roles. Which then required me to learn a whole new skill set of management. As I checked outline of MBA courses, most of them aligned with the skills I had to learn, which included financial planning, international business, corporate ethics, professional development and marketing. Being from IT, I chose cloud computing as specialization which would be beneficial for my professional and personal growth. I was aware of the path ahead and commitment it would demand. Out of all learnings, my biggest learning would be change from less organized to organized professional.

### **MBA Program and Dissertation Process**

Since my bachelor's degree was in Computer Science, which was mostly filled with technical subjects, MBA slant introduced me with non-technical challenges which enabled me to grow my management skills. The interactive and rigorous process of repetitive evaluation on different modules taught me time balancing, which is bigger than time management. Importance of thesis was introduced in the beginning of the session, which enabled me to keep myself on right pace. As I am an international student, all the subjects gave me insights of Irish Industry which was completely new for me and I learned many new facts about all new economy. The course curriculum has many assignments because of which I learned to quickly acquire and develop the best way to study throughout the year. The general topic of the thesis was figured out after many researches about the current market trends and needs, I wanted to research onto something which is futuristic. When this idea was introduced, I had to make a lot of researches to validate the use and emergence of the topic. This helped me in learning how to research from various sources and how to differentiate between a good and average paper. Researching under the guidance of my mentor, I have developed a habit of fast reading with quality understanding. As I began to explore the subject, I figured out that the concept of SDC was emergent in the cloud world. Before the advancements could be researched, it became prominently important to know more about this emergence to understand the challenge itself. Later, in this I learnt how every IT technological advancement is directly or indirectly dependent on other. Which gave me another learning, to keep yourself updated about various verticals of technology advancement around the globe. Since, this was a new innovation and not a lot of companies have adopted SDC, there was limitation to access to data at academic research level. This research could not be completed at academic level and hence needs industry level research. This was an unexpected outcome of the research, which triggered many potential paths for further research as outlined above.

After meeting other MBA students from different business schools, and by conducting some superficial research, it appears that different academic institutions have different approaches for MBA. Some institutions favours a more academic approach, like DBS, with focus on academic style research based on peer-reviewed literature. Other institutions follow a more practical approach expecting their students to conduct business research or consultation. In my opinion, DBS possess a good blend of academic and practical projects with many assignment, which gives students opportunity to deeply touch all aspects of MBA. Finally, my most important take away from this program would be the increased level of self- awareness I have developed, the importance of critical thinking which I have learned throughout the year, and the friendships/network I have developed with my fellow MBA students and professors.

<b>Description</b>	<b>Comments</b>	<b>Theoretical Underpinnings for Learning/Education theories</b>	<b>Citations</b>
What went well	<p>1. I learned the fact that in entire IT industry, every innovation ignites a new innovation like a chain of reactions.</p> <p>2.Cloud led to SDC, and SDC will benefit developments in Artificial Intelligence . I learned how technological advancements are inter related and I need to keep myself updated with all the innovations of the worlds to keep myself up to date in the industry.</p> <p>3. I developed myself as a more organized person. As, research demands you to be organized and committed to quality.</p> <p>4. My mentor, taught me importance of time and punctuality. She is a teacher, other are educator. And</p>	The Soft Art of Being a Tough Leader	(Parmananda Chabungbam, 2005; Punia, B.K. ,2005)

	hence, she harvested dairy entry and punctuality habits in me, which help me keep myself organised.		
What went not so well	<p>1.I learned, Not everything goes as per the plan, especially in qualitative research many a times limitations could be access to real data.</p> <p>2. I believe , this could be due to lack of access or due to unavailability of experts when innovation is new. But then, sometime there are limitation which could not be solved at academic research level.</p>	NA	
What I would do differently were I in the same or similar circumstances again	<p>1. I would try to get access of people who developed the technology, as they would know the best about their innovation.</p> <p>2. Now that I have learnt the concept of Double-Loop learning, I would apply it to understand a better method to collect more data when similar situation.</p>	1.Single and Double Loop Learning	(Rosete and Ciarrochi, 2005; Anderson <i>et al</i> , 2002)
Technical Skills acquired or improved upon	<p>1. I got hands-on experience on NVIVO, for producing data analysis diagrams. It can now make complex diagrams with better representations.</p> <p>2. Microsoft Visio helped me make explanatory diagrams. Now I can make most complex diagrams.</p>	NA	NA
Soft/Non-technical skills acquired or improved upon	1. I did learn about Emotional Intelligence(EI) and its immense importance. Now I know EQ is more important than just IQ.	1. Double Loop Learning 2.Emotional Intelligence at Work	(Singh, 2006; Kerr <i>et al</i> , 2006; Pescosolido, 2002; Cartwright, 2002)

	<p>2. I learnt this ,because during data collection times, not many people were available for interviews which was going to be a problem in data analysis for the thesis for concluding the results. But then, my mentor helped me understand importance of EQ and how to use your EQ to keep going.</p> <p>3. I read papers and books on “EQ at work” and its impacts on work, because of which I could not only complete my thesis successfully but also learn how to use you EQ for all the situation in life.</p> <p>4. I believe one’s EQ plays more important role towards success of a task than IQ of the <i>person</i> performing it.</p>	<p>3.Leadership &amp; Organization Development Journal</p>	
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**Table 7:Learning Log Table**

## Appendix 2: Interview Questions

Question Number	Question	Citation	Comments	Literature Theme
1	How long have you been working in the company?	N/A		
2	What department do you work in?	N/A		
3	Could I ask you what your job profile is?	N/A		
4	How long have you been working in this sector/industry?	N/A		
5	What is your opinion on advancement/evolution of data centres over the last 5 to ten years?	(Jararweh <i>et al.</i> , 2016)		Traditional Data Centres
6	Do you think cloud has helped in anyway?	(Goyal, 2014)		Emergence of automation
7	Do you know if cloud has any loopholes/downsides?	(Duijvestijn <i>et al.</i> , 2010)		Emergence of automation
8	Are you aware of the new advancements around Software-Defined Clouds (SDC's)?	(Li <i>et al.</i> , 2014)		Emergence of automation

9	Do you consider that SDC is/could be a solution to the existing loopholes in cloud?	(Ramachandran <i>et al.</i> , 2015)		Emergence of automation
10	Are you aware if your company has adopted SDC?	(Temple <i>et al.</i> , 2011).		Traditional Data Centres
11	If yes, how would you consider SDC have changed the face of Data centres?	(Li <i>et al.</i> , 2014)		Architecture of SDC
12	Why do you think companies are adopting SDC/SDN/SDE?	(Buyya <i>et al.</i> , 2015), (Ramachandran <i>et al.</i> , 2015)		The improved Cloud Computing adoption framework
13	What do you think are the reasons that companies do not adopt SDC?	(Kim and Korea, 2009)		The improved Cloud Computing adoption framework
14	Do you feel SDC could be the “Cloud for all”?	(Chang <i>et al.</i> , 2012), (Khajeh-Hosseini <i>et al.</i> , 2010)		The improved Cloud Computing adoption framework
15	What kind of companies/business in your opinion, would gain the most out of SDC?	(Kreutz <i>et al.</i> , 2013), (Khajeh-Hosseini <i>et al.</i> , 2010)		SDC as Business Intelligence
16	Depending on the requirement of your company, what would you choose between the two-cloud/SDC?	(Duijvestijn <i>et al.</i> , 2010)		SDC as Business Intelligence
19	Which among these, do you think is the best service offered by SDC-Automation, Cost or Security?	(Duijvestijn <i>et al.</i> , 2010), (Ramachandran <i>et al.</i> , 2015)		The improved Cloud Computing adoption framework

20	<p>What in your opinion, would be the future of SDC?</p> <p>Lastly, what's your best experience or what in your opinion, is the most favourite characteristic of Cloud/SDC?</p>	(Ramachandran <i>et al.</i> , 2015)		Future advancement

**Table 8: Semi-Structured Interview Questions**

### Appendix 3: Table of Literature Themes

Author	Year	Main findings	Methods	Population	Sample (N)	Use for this study	Yes/No	Theme
Jararweh <i>et al.</i>	2016	>History	Assuming Quantitative(as surveys were used as research methodology)	500	22	What methods helped companies in the past to manage their data/data centres	yes	Traditional Processes
Duijvestijn <i>et al.</i>	2010	>processes /types of data storage used until now		95	6	To find what data storage methods were put in practice by companies until now(IBM).	yes	“
Li <i>et al.</i>	2014	>how it originated? >architecture: SDN, SDDC, SDE >advantages & disadvantages	qualitative	-	-	Introduction of the topic in literature review.	yes	Software defined environments: Introduction
Armbrust <i>et al.</i>	2010	>architecture				Explain software designed data centres	Maybe	“
Duijvestijn <i>et al.</i>	2010	> advantages &				Discuss the pros and cons of SDC.	yes	“

		disadvantages						
Ramachandran <i>et al.</i>	2015	>need for SDC	qualitative			What led to the adaptation/introduction/development of SDC?	yes	Emergence of automation
Lin <i>et al.</i>	2014	>evolution of SDN	NA-ieee	-	-	How did SDC evolve?	yes	“
Buyya <i>et al.</i>	2010	>Characteristics of SDC	qualitative	-300	-8	All about SDC	yes	“
Ramachandran <i>et al.</i>	2015	>The improved Cloud Computing adoption framework	qualitative			Discusses how SDC was considered one of the new “improved cloud computing” methods.	yes	SDC was introduced and was to check its usage/adoption in the world.
Chang	2014	>SDC a business intelligence?	quantitative			Can SDC be considered as one way of business intelligence to be delivered?	May be	“
Chang <i>et al.</i>	2012	>SDC a solution for cost?				Discusses how adoption of SDC by enterprises can help on cost saving	yes	“
Khajeh-Hosseini <i>et al.</i>	2010	>How migration to SDC or adoption of SDC could help companies				>How migration to SDC or adoption of SDC could help companies in future. >What is the future of SDC	yes	Futuristic outcomes and results.

**Table 9: Literature Themes**