Independent Final Report

# The Cloud over Japan: Journey Towards Cloud Computing in Japan

NAWALAGE Thiwanka

ID No. 52116601

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# Certificate

I, NAWALAGE Thiwanka (Student ID 52116601) hereby declare that the contents of this Independent Final Report are original and true, and have not been submitted at any other university or educational institution for the award of degree or diploma.

All the information derived from other published or unpublished sources has been cited and acknowledged appropriately.

NAWALAGE Thiwanka

2018/05/25

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NAWALAGE Thiwanka

52116601

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# Abstract

Cloud computing is a popular term in the modern era of technology. In the early days of 2006, large companies such as Google and Amazon used the term “cloud computing” to describe the array of services they offered to their customers in which the processing power, storage and all other relevant resources existed in their own data centers. This allows users to use them regardless of the performance specs of their own personal computers. Cloud is the technical term used for providing services for “pay as you go” model and many organizations operate in this business model in digital market for providing cloud services and cloud based training certifications to build up the community. Western countries, especially the United States of America has highly adapted to these emerging technologies like cloud computing in both private and the government sector. They are focused on deploying cloud strategy nationwide by initiating and funding many projects in high-level government organizations such as the Pentagon and the Whitehouse. Projects like these have helped the growth of cloud usage in small to large scale business organizations in the country with focus now being shifted to out-of-box thinking to eliminate security concerns, the most common enemy for cloud adaptation.

Results have shown that Japan has a very bright future in cloud market with foreign investments in small to large-scale organizations. Currently, many organizations in Japan lack technical knowledge and resources to establish a proper cloud infrastructure to facilitate and scale their business requirements. The government too has initiated the cloud journey to enhance the service level with integrated systems.

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## Abbreviations

ICT- Informational and Communication Technology

WWII – World War II

U.S. – United Satiate

AI – Artificial Intelligence

TAM – Technology Acceptance Model

BPM – Business Process Management

CRM – Customer Relationship Management

BI – Business Intelligence

DC – Data Center

DRC – Disaster Recovery Center

ARPANET - Advanced Research Projects Agency Network

MIT - Massachusetts Institute of Technology

NSF - National Science Foundation

NSFNET - National Science Foundation Network

WWW – World Wide Web

CERN - European Organization for Nuclear Research

IPS – Internet Service Provider

CASB – Cloud Access Security Broker

CCPs - Content Collaboration Platforms

HRM – Human Resource Management

ERP – Enterprise Resource Planning

SaaS – Software as a Service

PaaS – Platform as a Service

IaaS – Infrastructure as a Service

NIST - National Institute of Standards and Technology

IoT – Internet of Things

EB - Exabyte

ZB - Zettabyte

CIO - Chief Information Officer

GSA - General Service Administration

NASA - National Aeronautics and Space Administration

GE - General Electronics

IP - Internet Protocols

FTA - Free Trade Agreements

CPU - Central Processing Unit

NRI - Nomura Research Institute

UTODC - University of Tokyo Open Data Center

APPI - The Act on the Protection of Personal Information

# Chapter 1 Introduction

## 1.1 Technology

Technology exists to make our lives easier. In simpler terms, it enables us to do certain tasks in our day to day life in a more easy and efficient manner which we would not be able to do under normal circumstances. Oxford dictionary defines it as *"The application of scientific knowledge for practical purposes, especially in the industry"* (Oxford Dictionaries, 2017). Technology exists in many forms and fields in the present day. Industrial, ICT, Motor mechanics, Robotics, Nuclear science, Renewable energy, Nanotechnology, Pharmaceutical, and Military are several of those. Technologies have evolved greatly over time and continue to evolve at a higher pace. Due to this, many fields in the industry have taken a turn and have adopted new methods embracing technology. Business environment, healthcare, transportation, communication, energy, information availability etc. are some of the things that have rapidly changed with the advancement of technology. These changes have drastically impacted the human lifestyle and business world. The impact of these changes on human life is positive in most cases. However not always. The advancement in nuclear technology is an example to the above statement as it impacts the world in both good and bad ways. Nuclear technology can be used for the military purposes to wipe out an entire nation or it can be used for energy purposes benefitting mankind. Advancement in ICT is the most effective and widely embraced technology in the world as ICT could be applied in every industry and field for progress.

For the last two to three decades, ICT has been evolving dramatically. Internet, Big Data, AI and Mobile technology advancements in the past decade have changed the

business world upside-down. The internet opened the door for the globalization of business across the world. Many companies started new businesses or changed the existing businesses to provide better service by introducing new models through the internet. Due to this, online shopping, online consultations, online banking etc. all became possible. One of the better service models that came to operation due to internet was the introduction of the "pay as you go" service model. This service model has become rapidly popular among customers, due to the many advantages provided by such. One of the most compelling advantages of this model is the pay for only what you use feature. This has initially come in to use in year 2000, to provide software solutions as a service through the internet by Salesforce.com and, Rightnow Technologies Inc. (Finch, 2006). Many companies worldwide embraced this new model and modified same by developing platforms and infrastructure facilities for the use of corporate world as well as individual. This service model has been named as "Cloud Computing" (Regalado, 2011) in 2006.

## 1.2 Technology Diffusion and Adoption

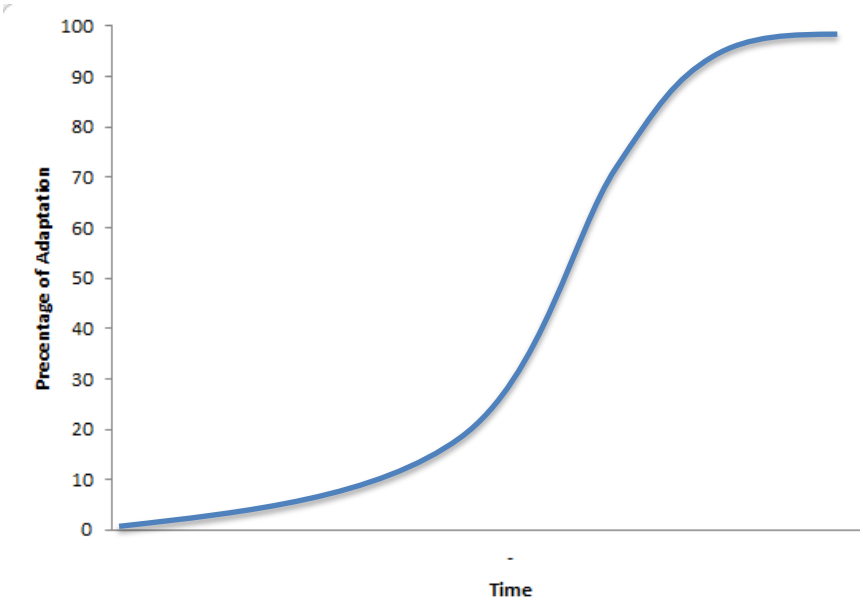
Diffusion is a process that communicates the innovation into members of the social system over time period through certain channels (Rogers, 1983). According to him, there are four main elements in the diffusion process,

01. An innovation
02. Which is communicated through certain channels
03. Over time
04. Among the members of social system

(Rogers, 1983)

In his study, he used the S-shaped diffusion curve to illustrate this theory. This s-shaped curve depicts the number of users' percentage against the timeline to adaptation. Figure-1 shows the sample of S-Shaped Diffusion Curve.

Figure 1- S-Shaped Diffusion Curve




Source: (Rogers, 1983)

Adoption of a new technology depends on various reasons which impact on the pace that new technology is acquired and used by the public. Innovations' following characteristics directly impact on the adoption ratio of new technology,

- Relative Advantages
- Compatibility
- Complexity
- Trialability
- Observability

When people decide to use new technologies, they consider above factors before accepting them. Relative advantage is when people try to compare a new product with

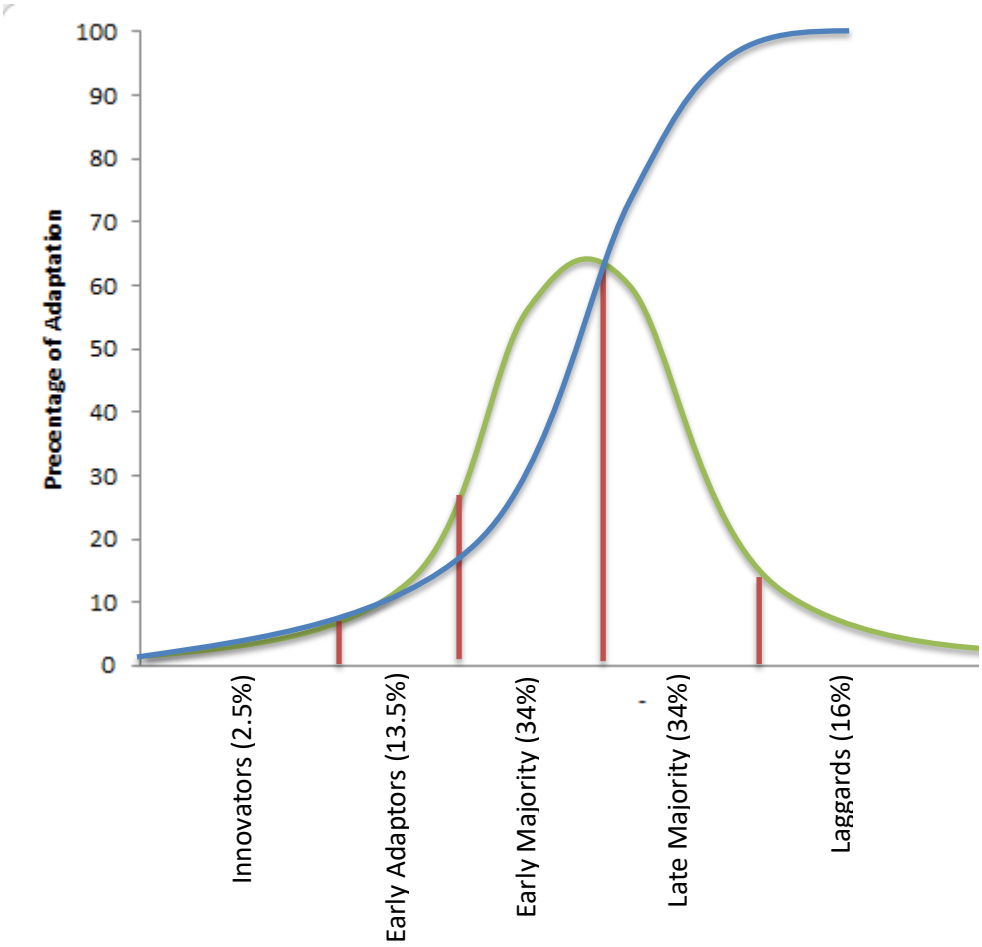
existing solutions. If the new technology or innovation is better than the existing solutions, the majority of the people would start using it. Compatibility is what people think of how these new technologies are compatible with their day to day lifestyle in making things easier. If the new technology is less complex and easier to use and understand, then the adoption ratio will be very high. This is known as complexity. Trialability is allowing the new technology to provide the user a trial period, to enable them to understand the functions of same by using the product. If this trial period is long enough to understand the technology, then acceptance ratio will be high. Observability means that users are able to observe the efficiency and productivity of this new technology by seeing who else is using it and according to those observations, users will be able to accept it. According to Rogers, people or organizations can be categorized into (See Figure 2) innovators, early adaptors, early majority, late majority and laggards based on the time they take to adopt (Rogers, 1983).

Innovators – This category is for the risk takers. They are willing to take the risk of adopting to new technologies. This category often consists people of the youngest age, financially stable and close relation with scientific resources or inventors' population.

Early Adaptors – This is the second fastest adopting category for new technology or innovation. This category consists of groups of people younger in age, financially stable, well educated, higher social status and more socially forward.

Early Majority – This group will take relatively more time than the innovators and early adaptors to make the decision to adopt to a new innovation or technology. In this group, they have a very good relationship with early adaptors to review this new technology before they make the decision.

Figure 2 - Adaption Stages



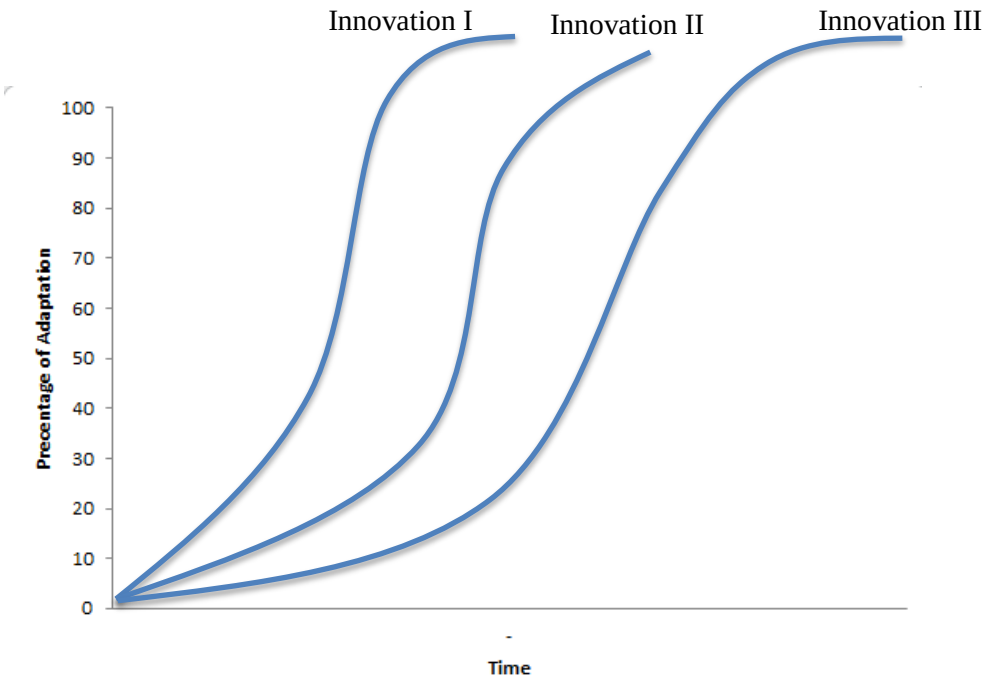

Source: (Rogers, 1983)

Late Majority – This group consists of the people who are very skeptical to adoption to a new technology. They will start adapting to this new technology only when they feel that it is safe to make the change.

Laggards – Last adaptors to an innovation in the social system. They are not enthusiastic to take any opinion or leadership. When they start adapting to the particular innovation, it may be already surpassed by another new idea or innovation.

On the other hand all the innovations will not lie on the same s-curve as the characteristics of the innovation affects the deviation in s-curve. Figure 3 illustrates this in more detail.

Figure 3 - S-Curve analysis of different innovations



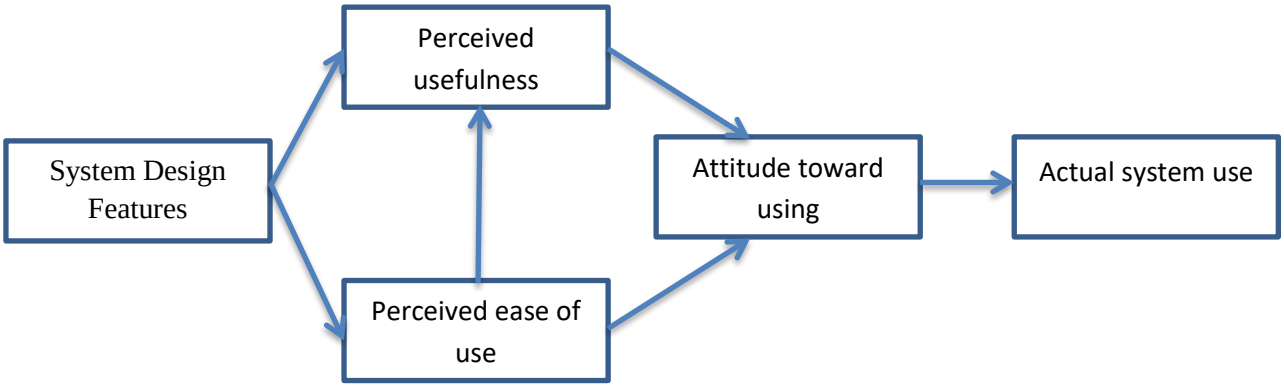

Source: (Rogers, 1983)

Diffusion curves are varied as shown in Figure 3. Innovation I took very less time to diffuse over the social system, Innovation II took a little longer, and Innovation III took the longest time to diffuse in the social system. These changes occurred due to the characteristics of the innovations that was mentioned previously.

Present research uses the Technology Acceptance Model (TAM) to address why users reject or accept information technology and how they are influenced to accept it by the system characteristics (Davis, 1993).

According to Davis, users will accept or reject the system according to the features that the system provides depending on their usefulness in day to day activities of the real work environment and ease-of-use of the said features in the overall system. If these three factors are well balanced inside the system, users will accept the system.

Figure 4 - Technology Acceptance Model




Source: (Davis, 1993)

## 1.3 Demand Factors

There are many benefits that could be gained by organizations and individuals for using new technology. Technology could be benefit to organization to maximize profits. Other than the economic factor, new technology also enhances efficiency, work patterns, way of thinking (Out of box thinking) and new skill levels of the workforce.

## 1.4 Modern Day Business

Modern day business environment is very competitive and complex. To survive in this environment, an organization must be fully equipped with the latest technologies and trends. Early days of businesses focused only on the customer satisfaction and how to expand the market share in a less competitive world. But the current situation has changed completely. In order to meet the consumer expectations of having cutting-edge technologies in goods and services they consume, it has become crucial for the organizations to adopt the latest technologies to win the consumer. As such the organizations must be aware of the latest technologies and need to apply same to boost the market share.

Setting up a business in the modern day digital environment is less complicated than how it was in the early days. For any business that operates today, ICT is a key factor and a facilitator for a smoother business operation. In this environment, every business has embraced ICT and you will not find any business without even a single association with it. In every business, there are two main ICT elements to be considered, first is the infrastructure and second is the software application.

In early day's businesses, if the organization needed to set up these facilities, they were required to have the following resources,

- Locations for Server Rooms, Data Centers (DC), Disaster Recovery Centers (DRC)
- Purchase of relevant hardware equipment (Servers, Computers, Racks, Switchboards, etc.)
- Purchase of relevant software applications to manage the business operation such as Business Process Management (BPM), Customer Relation Management (CRM), Data Analytic tools, Business Intelligence (BI) etc.
- Expert's knowledge.

To purchase the above resources and maintain them for a certain time period, the organization has to bear a significant amount of assets and maintenance cost. But the current situation of setting up a business is entirely different due to the availability of all these facilities in "pay as you go" model. With this technology, organizations do not need to bear a huge initial investment for setting up ICT in their business. At present it is not required to have a physical location to setup server rooms, DC's, DRCs or to purchase physical resources and software applications mentioned above. Everything is

now available as a service to pay only for what you have used. This model provides a hassle-free infrastructure for business to run smoothly along with a cost-effective way to set it up. On the other hand, modern day digital business enables the interconnected services through various businesses. This collaborative global business provides many services to consumers within a single portal. For an example, booking of flights, hotel reservation, and rent-a-car services provide in one application. This is not a single company effort to provide all these services; it is a collaborative approach to providing better service to the customer via high-end technology. As mentioned before as well, modern day marketplace is very competitive and also highly tech-savvy market and consumers are always expecting the technology-enabled fast services. If the organization needs to provide these services directly to consumers or connected with other service providers to facilitate many services, they should have the right technology in place.

### 1.5 Research Questions

Japan is one of the largest economies in the world and is the 2nd largest in the Asia Pacific Region (APAC) (IMF, 2017). Furthermore, Japanese market is considered to be highly tech-savvy (Matsukawa, 2009), due to high usage of technology on industries related to manufacturing (e.g. car, food, electronic devices etc.), transportation (e.g. shinkansen [bullet trains]), energy (e.g. nuclear power plants), robotic technology etc. Cloud computing is considered by many as one of the greatest technological solutions that came into the market to enhance the business processes. This paper focuses on analyzing the reaction of Japanese market towards this new technology. In order to narrow down the focus, following research questions have been selected,

- Up to which level are the Japanese companies aware of Cloud Computing?
- Which Cloud Computing models are most popular in Japan?
- What are the main concern areas for adoption of Cloud Computing?
- Up to which level the Government uses the Cloud (G-Cloud status)?

This report is organized such that; Chapter 2 will address the theoretical background of the study based on previously published research. Chapter 3 will elaborate the research framework and the methodology. Current status of how Japan is positioned in cloud readiness index investigation as per the Cisco and BSA[1] examined in chapter 4. Chapter 5 presents the research findings and result analysis of the data while chapter 6 and 7 focuses on conclusion and the limitation of the study respectively.

[1] The Software Alliance

# Chapter 2 Literature Review

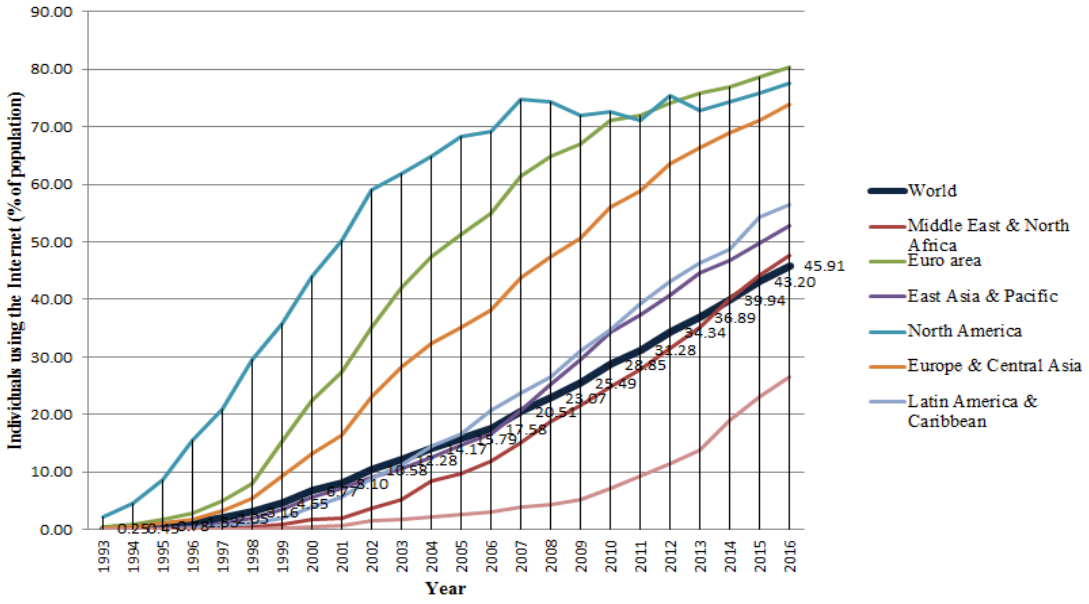
## 2.1 Internet, Cloud & Big Data

The history of the internet begins with the development of electronic computers in the 1950s. The Advanced Research Projects Administration (ARPANET) is the first wide area network originated with several computer science laboratories in United State, United Kingdom and France (Wikipedia, 2017). In 1965, two computers at MIT Lincoln Lab communicate with another using packet switching technology (Zimmermann & Emspak, 2017). The Net diffusiveness and its focus on flexibility, decentralization, and collaboration brought about the Internet as we know it today (Cohen-Almagor, 2011). In 1985, National Science Foundation (NSF) considered how it establishes greater access to the high-end computing resources at its recently established supercomputer centers. Because NSF expected to share this supercomputer resources with the scientist and engineers around the country while linking many research Universities and educational institutes to the center. As a result of this effort, National Science Foundation Network (NSFNET) went online in 1986 and connected the supercomputer centers at 56Kbps link and connected variety of research and education networks to the NSFNET backbone and then extending the Internet's reach throughout the U.S. Any U.S. research and education institute can reach the NSFNET without any cost and at the same time, internet-connected computers grew from 2000 to 2 million from 1985 to 1993 respectively. To handle this data traffic, NSFNET backbone bandwidth upgraded to 45Mbps in 1991. In this same period, there are other innovations start diffusing all over the world that encourage the Internet use, such as personal computers and the launch of the World Wide Web (WWW) in 1991 by Tim

Berners-Lee and colleagues at European Organization for Nuclear Research (CERN) in Geneva, Switzerland. In between 1993 to 1998 period, commercial firms noted the popularity and effectiveness of the growing internet market and build their own networks. NSFNET backbone has been decommissioned in1995 and the year 1998 marked the end of NSF's direct role on the Internet. In that year network access points and routing arbiter functions were transferred to the commercial sector. NSF has been established the international connection services that bridged the U.S. infrastructure with countries, including Europe, Mongolia, Africa, Latin America, Russia and the Pacific Rim (National Scince Foundation).

After transferring the services to the commercial sector, currently the Internet backbone is handled by the following seven companies, UUNET, Level 3, Verizon, AT&T, Qwest, Sprint, and IBM. These companies have been identified as upstream IPSs and anyone who wants to access the Internet must ultimately work with these companies (Strickland, 2008).

Figure 5 - Internet Penetration (1993 to 2016)




Source: (The World Bank, 2018)

Figure 5 shows the regional Internet penetration figures all over the world and according to these figures 45.91% (The World Bank, 2018) of the world population are using the Internet as a tool for connecting to the world.

At the beginning of the 21st century, the Internet was expanding and stretching across the planet. Its communication was through optical fibers, cable television lines, radio waves as well as telephone lines. Network traffic continues to grow at a rapid pace due to the introduction of mobile phones and other communication devices along with the computers to this vast network (Cohen-Almagor, 2011). With the Internet market boosting, many businesses became online service model architecture such as e-commerce, online banking, eLearning etc. These service models have been evolved over the last ten to fifteen years to become a new model called "pay as you go". Cloud computing is one of the innovative idea on this business model that introduced to the world in the 21st century. Cloud has become an imminent utility for organizations to leverage their IT resources and processes. Organizations are moving towards the adoption of the cloud computing as a solution to decrease their IT related budgetary concerns and increase the efficiency and performance of their core business process. Cloud computing has transformed the IT landscape as a computing paradigm shift in term of IT usage and ownership (Gupta & Saini, 2017). As a result of this, organizations able to lower their IT capital expenditure and operating costs by purchasing on-demand cutting-edge technology resources while eliminating the need of maintaining outdated IT infrastructures such as servers, storage etc. (Garrison, Kim, & Wakefield, 2012). When large organizations migrate to cloud, they have a major concern of security and privacy issues of their sensitive data.

To solve this, Cloud Access Security Brokers (CASB) comes in to play for govern this issue and protect sensitive data while building the trust on the cloud. According to Gartner, CASB market has products and services that provide visibility into general cloud application usage, data protection and governance for enterprise-sanctioned cloud applications. CASB primarily govern SaaS back-office applications such as CCPs, CRM, Human Resource Management (HRM), Enterprise Resource Plan (ERP), service desk and productivity applications (for example, Salesforce, Microsoft office 365 and Google G suite) that are used by all the industry verticals. Today's CASB usage is less than 10% and it has been forecasted to grow by 60% in 2020 with large enterprise getting more involved with CASB for governing cloud services (Riley & Lawson, 2017).

In the digital business environment, there are uncountable numbers of digital equipment interconnected with each other for sharing data. The question is how much data is being processed every day? Users create 2.5 quintillion[2] bytes of data every day. To put this into a viewpoint, 90 percent of the data in the world today has been created in the last two years alone with new devices, sensors and technologies emerging and the data growth rate is accelerating even more (IBM Marketing Cloud, 2017). This is known as "Big data", *"Big data" refers to dataset whose size is beyond the ability of typical database software tools to capture, store, manage and analyze* (Manyika, et al., 2011). Big data paves way for many more cloud related business models that would facilitate to structure, analyze, generate stats and predictions using BI and analytics tools. Worldwide BI and analytics market is forecasted to reach $18.3 billion in 2017; this is an increase of 7.3 percent compared to 2016. According to the latest forecast, by

[2] a thousand raised to the power of six ($10^{18}$)

2020 it will grow up to $22.8 million (Moore, 2017). There is strong evidence that big data can play a significant role to benefit not only the private commerce but also the national economies by enhancing the productivity and competitiveness of companies and the public sector by creating a significant economic surplus for consumers (IBM Marketing Cloud, 2017). Where is this data being stored? Almost all of these data being stored in cloud storages. For an example, if you consider Facebook, YouTube, and Instagram etc., user uploaded media such images, videos, text and other content of data are being stored in data centers of their own cloud environments.

Table 1: Data on the Internet each day

| **Facebook** | **YouTube** | **Instagram** | **Twitter** | **Google** |
|---|---|---|---|---|
| 1.2 million new data producing each day | 4+ million hours of upload every day | 67+ millions of posts uploaded each day | 656 million tweets per day | 5.2 billion Google searches each day |
| 1.32 billion daily active users | | | | |
| 4.3 billion messages posted daily | | | | |
| 5.75 billion likes per daily | | | | |

Source: **(Schultz, 2017)**

## 2.2 What is Cloud Computing?

The definition of cloud computing,

*"Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers,*

*storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction"* (Mell & Grance, 2011).

"*Cloud computing can be defined as a new style of computing in which dynamically scalable and often virtualized resources are provided as a service over the Internet.*" (Furht & Escalante, 2010).

According to the National Institute of Standards and Technology (NIST), this cloud model consists of five essential characteristics.

- On-demand self-service: Consumer has independent power of provisioning computing capabilities, such the network storage and server time without any human interaction with each service provider.
- Broad network access: Capabilities available over the network and access through a slandered mechanism such as mobile phones, laptop, tablet, and workstation.
- Resource pooling: Provider's computing resources are pooled to serve multiple clients using multi-tenant model.
- Rapid elasticity: Capabilities can be elastically provisioned or released, in some cases automatically, to scale up or down rapidly according to the customer need.
- Measured service: Provider charge form the consumer that only the services utilized time or capacity such as a server or compute time and storage capacity used.

### 2.3 Cloud Services and Deployment Models

There are mainly three service models and four deployment models in cloud computing, Service Models,

- **Software as a Service (SaaS)**

  This facility provides the consumers to use provider's applications running on a cloud infrastructure. Consumers can access these applications either via the thin client interfaces, such as web browser (web-based email), or a programme interface. In this case, the consumer does not manage the underlying infrastructure, such as servers, storage, and networks (Mell & Grance, 2011). salesforce.com is an example for this model.

- **Platform as a Service (PaaS)**

  This capability provides the IDE including data security, backup and recovery, application hosting, and scalable architecture (Furht & Escalante, 2010). The consumer does not manage or control the underline infrastructure, such as operating systems, networks, servers or storage, but can control over the deployed applications and able to configure the application hosting environment (Mell & Grance, 2011). Google App Engine is an example for this model.

- **Infrastructure as a Service (IaaS)**

  This provides the consumers the ability to provision for processing, storage, servers, networks and other fundamental computing resources where a consumer is able to deploy and run arbitrary software, in which operating systems and applications can be included. The consumer does not manage or control the underline infrastructure but is able to control over operating systems, storage and deployed applications (Mell & Grance, 2011). Amazon Simple Storage Service (S3) can be considered as an example.

Deployment Models,

- **Private Cloud**

  The cloud infrastructure provisioned for exclusive use by a single organization, providing services for multiple users within the organization (e.g. business units). This infrastructure is owned, managed and operated by the organization, the third party or combination of both. Private cloud infrastructure deployment mainly consists of two ways, off or on premises (Mell & Grance, 2011).

- **Public Cloud**

  Public cloud, also known as external cloud, is the most common form of cloud computing model, which is available to the general public in a pay-as-you-go model. The cloud consumers access these services through the internet and the services are provided by a third-party cloud provider who shares their computing resources for many consumers (Furht & Escalante, 2010). Public cloud infrastructure is owned, managed and operated by a business, academic, or government organization, or combination of them (Mell & Grance, 2011).

Table 2: Public vs. Private Cloud

| | Public Cloud | Private Cloud |
|---|---|---|
| Infrastructure ownership | Third-party cloud provider | Organization, third-party or combination of both |
| Scalability | Highly scalable | Limited to available infrastructure |
| Control and management | Limited control and management of the resources | High level of control and management over the resources |

| | | |
|---|---|---|
| Cost | Very low | High cost, including space, energy consumption, and hardware cost |
| Performance | Unpredictable, depend on the internet quality and multitenant environment | Guaranteed performance |
| Security | Concerns regarding data privacy | Highly secure |

Source: (Furht & Escalante, 2010)

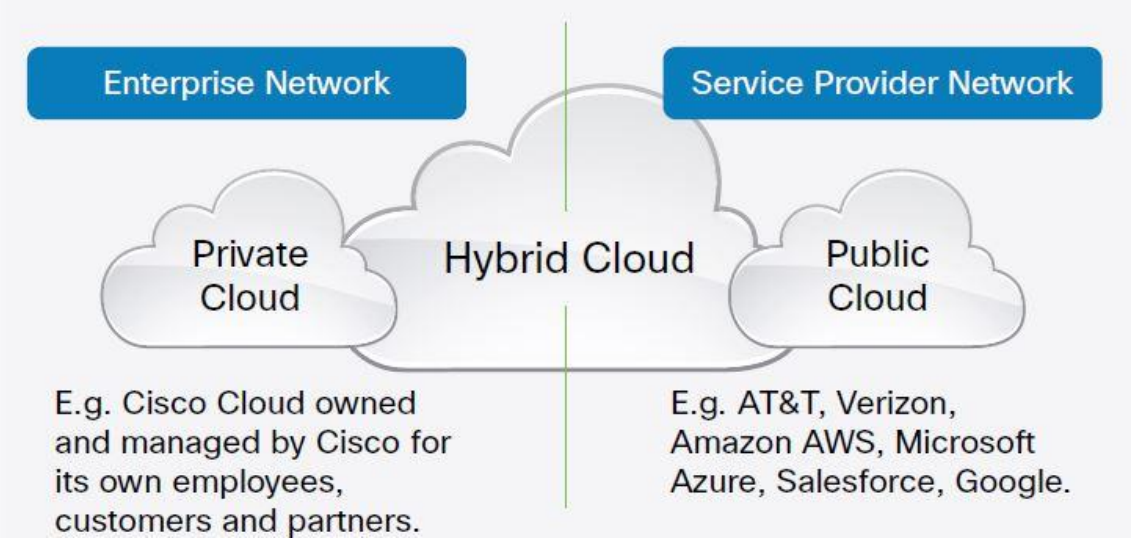
- **Hybrid Cloud**

  A combination of both public and private cloud is called a hybrid cloud. A private cloud enables the organization to maintain their high-availability of services, while public cloud enables the highly scalable resources when the organization is in need of rapid workload fluctuation or during hardware failure. In this model, the organization is able to host their critical data and applications inside the private cloud and non-critical data and applications in public cloud (Furht & Escalante, 2010).

- **Community Cloud**

  In the community cloud, we can see as a set of characteristics provisioned for exclusive use by a specific community of consumers from various organizations who have shared concerns (e.g., mission, policy or compliance). In this model, infrastructure has been owned, managed, or operated by the organizations or a third-party provider, or combination of all (Mell & Grance, 2011).

Figure 6: Public vs. Private vs. Hybrid




Source: (Cisco, 2016)

## 2.4 Hype Cycle of Cloud

When a new technology is revealed to the market; there are many possibilities for this technology to either succeed or fail in the market. As mentioned in Chapter 1, all these new technologies do not diffuse into the social system. There are many classic examples in history; Sony's Betamax hit the market first and offered a better technology to compete with Matsushita's VHS standard. Yet Sony lost the market, due to its failure to support emerging video rental retailers like Blockbuster (Anthony, 2008). BlackBerry was everyone's first smartphone, providing the ability to connect to the Internet, send and receive e-mails, chat, etc. They were able to sell more than 50 million devices in 2011. But the company stubbornly kept sticking to their physical keyboard rather than changing it to a touchscreen keyboard, which quickly became fashionable. Due to the lack of innovativeness in the company, BlackBerry failed in the market. In 2016, they were able to sell only 4 million devices (Eadicicco, et al., 2017).

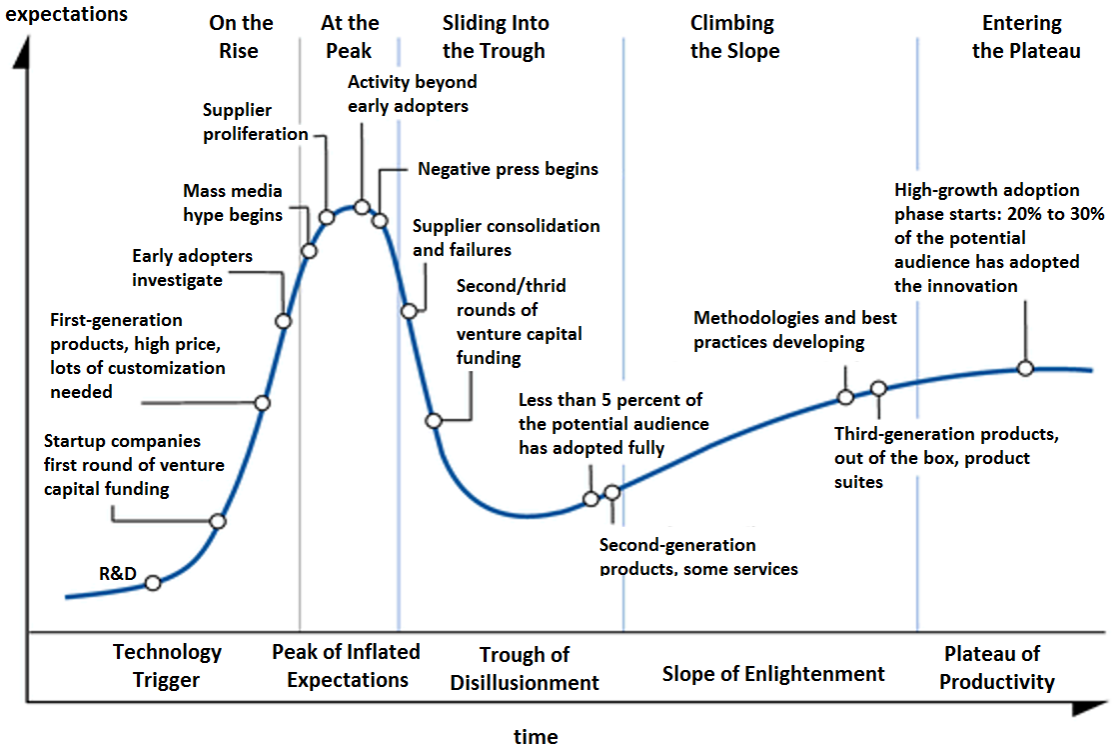
Gartner have introduced a methodology called “Hype Cycle” to analyze the emerging technologies or applications that evolve over time, providing a flawless source of insight to manage its deployment within the context of specific business goals. Clients are able use Hype Cycle to get educated about the emerging technologies or applications within the context of their industry and risk-taking capacity. Hype Cycle provides answers for following three main questions,

- Should you make an early move? If the investors are willing to take a higher risk as early adaptors category. An investor might reap the rewards of early adoption.
- Is a moderate approach appropriate? Moderate understanding of the emerging technology for an early investment but also insist on analysis of cost/benefit when a new way of doing things is not yet proven.
- Should wait for further maturation? If there are unanswered questions around the commercially viable emerging technology, better wait until others have been able to deliver a tangible value (Gartner).

Hype Cycle does in depth analysis of five key phases of the technology life cycle.

- **Technology/Innovation Trigger**: New technology or innovation concept model reveals to the public for the first time. In this stage, mostly startup companies will be involved with the first round of venture capital. Usability or commercial viability is not proven.
- **Peak of Inflated Expectations**: The technology is implemented, especially by early adopters. At this stage, some innovation takes a chance to be build success stories but some may not.

Figure 7: Gartner Hype Cycle




Source: (Tarkovskiy, 2013)

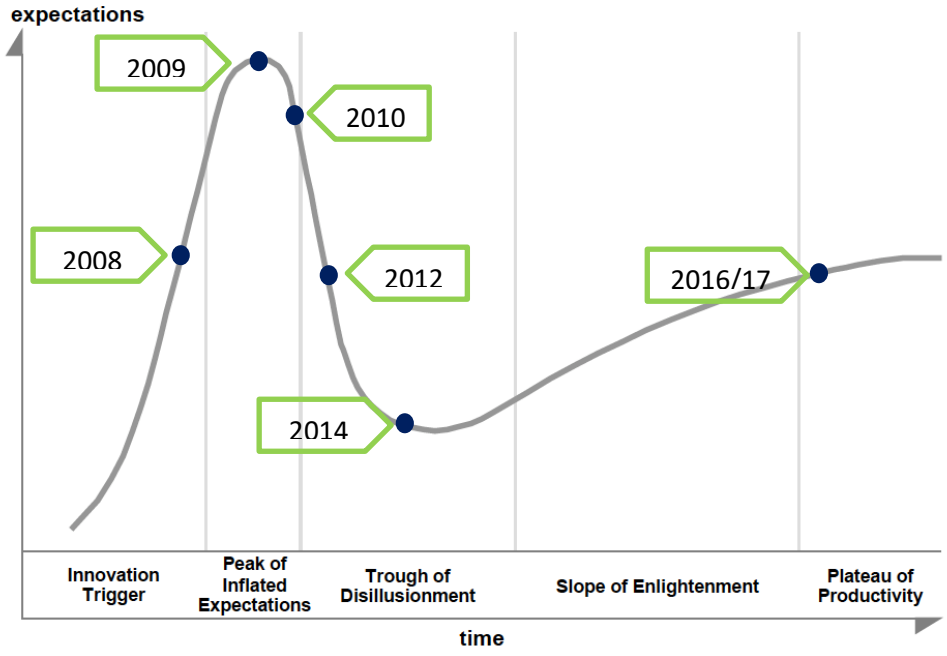
- **Trough of Disillusionment**: This is the stage of a turning point for the technology or innovation to be successful. Companies should decide whether to continue or not on invest for improvements of their product or services for cater the next generations. If the company fails to improve the product, it will disappear from the market.
- **Slope of Enlightenment**: Clearly and widely understood of how the technology can be benefited for the enterprise. Third generation products will hit the market from technology providers.
- **Plateau of Productivity**: Technology adoption starts to take-off. Commercially viable product or service is available in the market.

  (Gartner)

Cloud computing was introduced to the world in 2006 as an emerging technology and it has been developed over the last decade while passing all these stages. The following Figure will illustrate how cloud computing has passed through these five stages over the last few years.

Figure 8 illustrates that cloud computing concept was climbing the hill in 2008 and went to the peak level in 2009. From the beginning of 2010 to 2014, the cloud computing concept was passing through the stage of the trough of disillusionment. Currently, the cloud business is rapidly moving towards the plateau of productivity stage by providing many services to the business environment (Barnes, 2017).

Figure 8: Cloud Computing Hype Cycle




Source: Gartner

Currently there are many companies in the cloud business providing distinctive services. Amazon, Microsoft, Google, and IBM are the major players in this industry.

## 2.5 Global Cloud Business and Trends

The Salesforce.com was the pioneering provider for introducing pay-as-you-go model for the business environment in 1999 (Salesforce). After seven years of the introduction of this model to the world, it has been evolving ever since and became known by the public as "Cloud Computing" in 2006 (Regalado, 2011). In the same period, one of the largest online retailers in the world Amazon, entered into the cloud business by forming a new business service called Amazon Web Services (AWS) (AWS). After a few years of the launch of AWS, Google, Microsoft and IBM launched their own cloud platforms; Google Cloud Platform (GCP) (Meier, 2017), Microsoft Azure (Trefis Team, 2014) and IBM Cloud (Wikipedia, 2017) in 2008, 2010 and 2011 respectively.

In context, there are two types of cloud service providers; proprietary and open source. The companies mentioned above paragraph are mostly providing the proprietary services with unlimited features according to the client's requirement with price plans. Open source providers also provide similar services such as storage, Big Data analysis, Databases with some limited resources and capacities. The following table has categorized the main differences between proprietary and open source services,

Table 3: Proprietary vs. Open Source

| | **Proprietary** | **Open Source** |
|---|---|---|
| Pricing applicable | Yes | Free |
| Services & Resources | Unlimited | Limited |
| Support | Unlimited | Limited |
| Source Modification | Restricted | Open to modify |
| Responsibility on frailer | Provider | None |

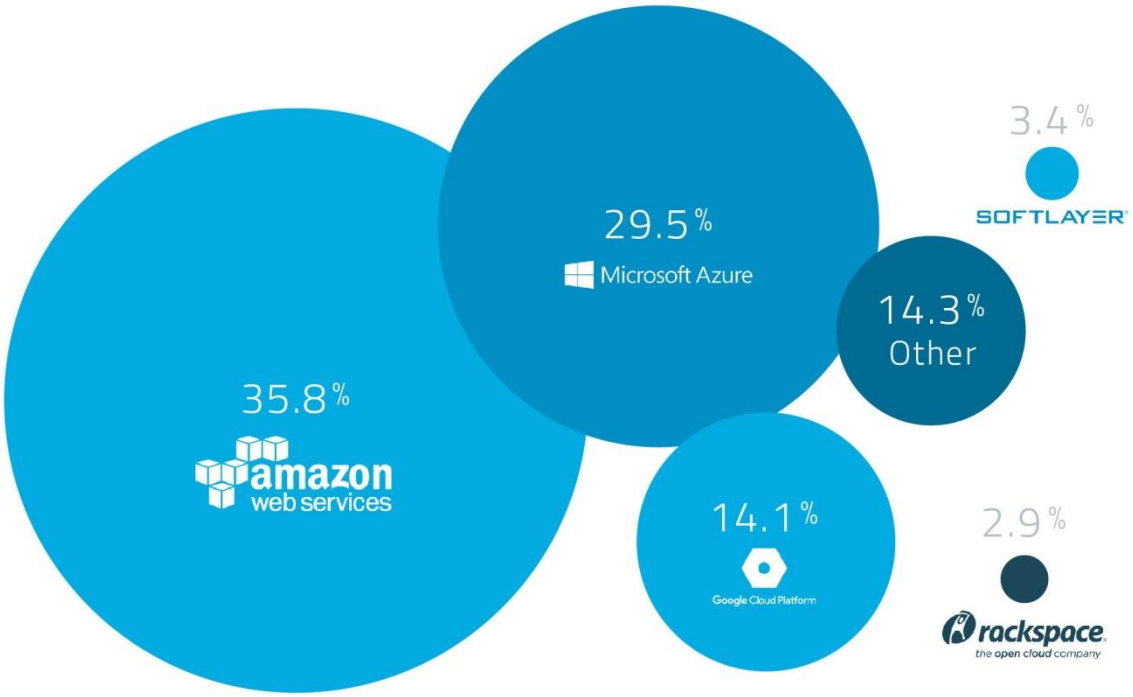
There are many companies providing open source facilities such as; OpenStack, Cloud Foundry, Docker, OpenNebula, DigitalOcean, Apache Mesos etc. Some of these open source facilitators also provide the pricing versions of the cloud while some of the proprietary facilitators provide open source cloud services. For example, DigitalOcean have a commercial version of cloud services (DigitalOcen Price Plan) while IBM Cloud provides the open source version of IBM private cloud (IBM Private Cloud Community Edition ).

Global public cloud service market is projected to grow to a total of $246.8 billion, up from $209.2 billion in 2016; this is an 18% annual growth rate compared to 2016. The highest growth rate comes from the (Infrastructure as a Service) IaaS platform, which has a growth of 36.8% in 2017 compared to 2016 which reached $34.6 billion (Pettey & Goasduff, 2017). Public cloud market of IaaS platform market share distributed among the major players such as AWS, Microsoft Azure, Google and, Softlayer (IBM Cloud) with 35.8%, 29.5%, 14.1% and, 3.4% respectively while the rest is distributed among niche players (Skyhigh, 2016).

Private cloud adoption has slightly fallen down by 5% compared to 2016 which shows a decline of the adoption from 77% to 72%. Also, the use of hybrid cloud had fallen down compared to 2016 from 71% to 67%. Overall cloud usage is around 95%[3] (Rightscale, 2017).

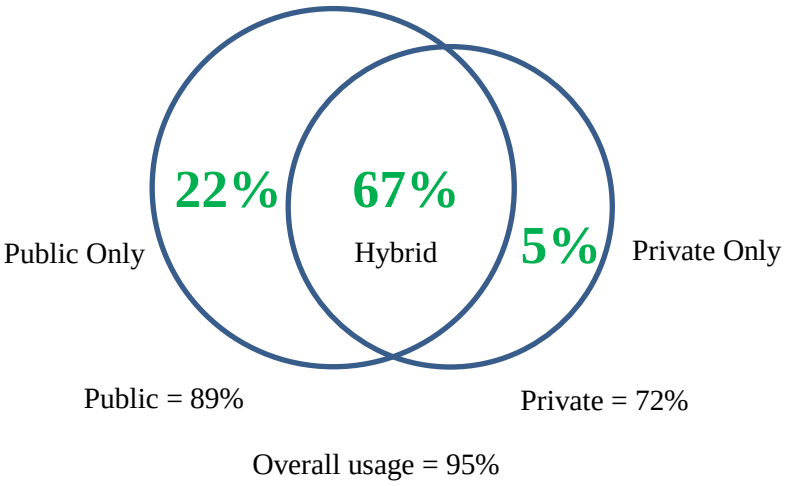
[3] The 1,002 respondents range from technical executives to managers and practitioners and represent organizations of varying sizes across many industries including both users (20 percent) and non-users (80 percent) of RightScale solutions.

Figure 9: The Top IaaS Platforms (2016 4th Quarter)



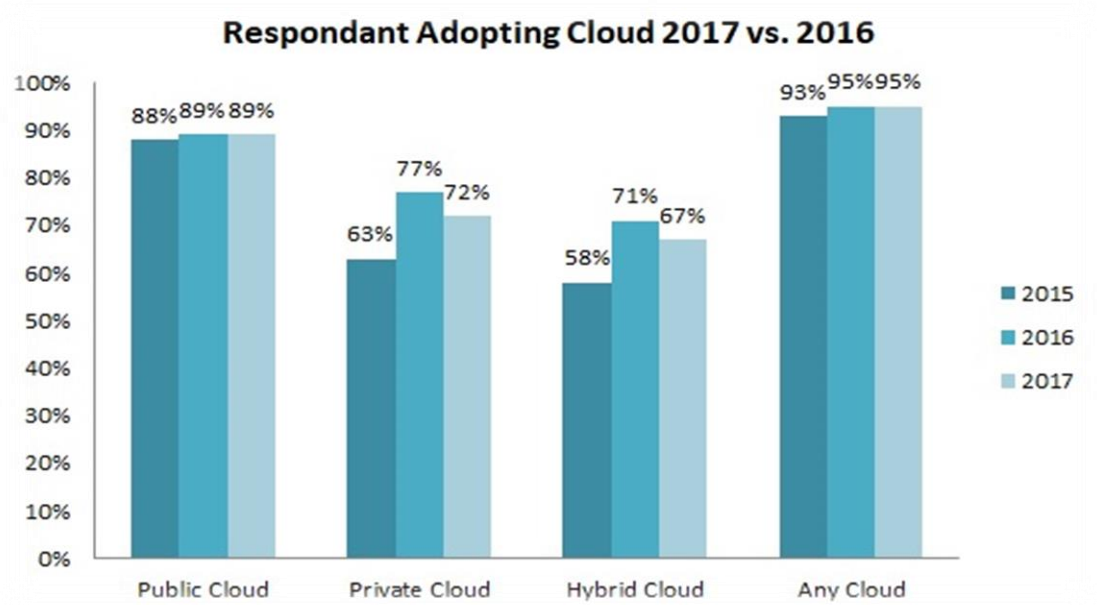

Source: (Skyhigh, 2016)

Figure 10: Public, Private, & Hybrid Cloud Usage



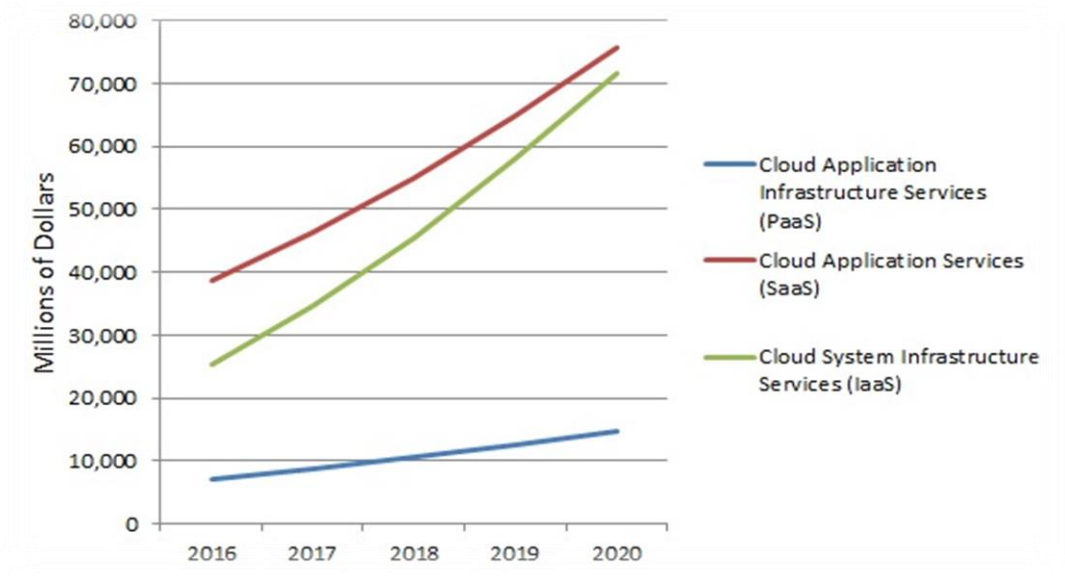

Source: (Rightscale, 2017)

Figure 11: Cloud Adoption 2017 vs. 2016




Source: (Rightscale, 2017)

Figure 12: Worldwide Public Cloud Services Forecast (Millions of Dollars)




Source: (Pettey & Goasduff, 2017)

Large companies currently use multiple IT suppliers for global expansion and IT services. This situation will be more intense when the organizations start migrating to

the cloud platform. Enterprises will increasingly start using multiple cloud providers to enhance their IT capabilities (Munroe, 2016). According to Ahuja, this proceeding is called the multi-cloud world. A key trend for the organizations to be a focus on next couple of years is facilitating secure connectivity for cloud platform, and managing the pile of data generated from mobile and connected devices (Munroe, 2016). Globally, data stored in data centers will reach upto 950 Exabyte (EB)[4] in 2020, up from 171 EB in 2015. Data created by the Internet of Things (IoT) will reach upto 600 Zettabyte (ZB)[5] per year in 2020, up from 145 ZB per year in 2015. Data center traffic will increase due to the high volume of data as well as number of connected devices. Global data center traffic is forecasted to grow up to 15.3 ZB by end of 2020, from 4.7 ZB per year in 2015 (Cisco, 2016).

## 2.6 Cloud Success Stories (Case of U.S.)

The digital transformation of business and services are expanding everywhere in the world today. The public sector and private sector giants are moving towards the cloud by enhancing their service levels as well as improving the ease of management of IT capabilities. To understand this scenario, this section is going to discuss about the US government cloud transformation strategy and the efforts of U.S. private sector enterprises on digital transformation.

Country's first Chief Information Officer (CIO) Vivek Kundra, started the early effort of shifting IT to the cloud across the U.S. federal government. Vivek Kundra attempted to implement major changes in federal information technology area with massive strategic changes in both, mindset and operations (Wyld, 2010). The CIO

[4] 1 EB = one billion gigabyte
[5] 1 ZB = one trillion gigabytes

position has been created through e-Government act of 2002. First CIO has been appointed in 2009 by Barack Obama and over the last 9 years, there have been six CIO's who have been appointed to fulfill this position (Wikipedia, 2018). Latest appointment for this position is Suzette Kent in January 2018 (Mitchell, 2018). The CIO Council is the principle of managing and improving agency practices related to information technology (www.cio.gov). Following are the few federal agencies that are currently engaged in the cloud transformation effort,

- General Services Administration (GSA)

  The GSA is playing an active role in cloud transformation as a provisioning hub for the future. GSA is expected to cut down the agency's administrative costs for the sites and its infrastructure costs by 90 percent from shifting workload to the cloud. GSA provides the IaaS facility on demand for all federal agencies through prequalified vendors who have been certified for their security, privacy and, operational capabilities. In mid-September 2009, GSA launched its https://apps.gov storefront that facilitates agencies to quickly find cloud solutions (Wyld, 2010).

- National Aeronautics and Space Administration (NASA)

  NASA launched its NEBULA cloud that provided greater transparency and public involvement with space effort. NASA's NEBULA aimed for seamless, self-service platform with consolidated web offerings into a single portal while enhancing NASA's capacity of computing, storage, network connectivity, virtualization and, scalable approach to minimize cost and energy efficiencies (Wyld, 2010).

- The White House

  The White House has taken steps to integrate cloud applications into its operations. They deploy Google Moderator for taking public opinions through voting to select which questions need to ask from the President in an online meeting (Wyld, 2010).

Figure 13 illustrate how the CIO council put their effort on the cloud first strategy in the federal government. Futhermore, Table 4 shows the top technology investments in Government.

Figure 13: CIO Council 2017 Accomplishments


Source: (www.cio.gov)

Table 4: Top Technology Investments in Government

| Showing Technology Areas That Were Mentioned Within the Top Three Most Often by U.S. Federal Government Respondents | U.S. Defense and Intelligence (n=33) | U.S. Federal Government (n=46) |
|---|---|---|

| | | |
|---|---|---|
| Cloud service/solutions | 36% | 48% |
| Infrastructure and Data center | 39% | 28% |
| Cyber/Information security | 33% | 28% |
| BI/Analytics | 24% | 28% |

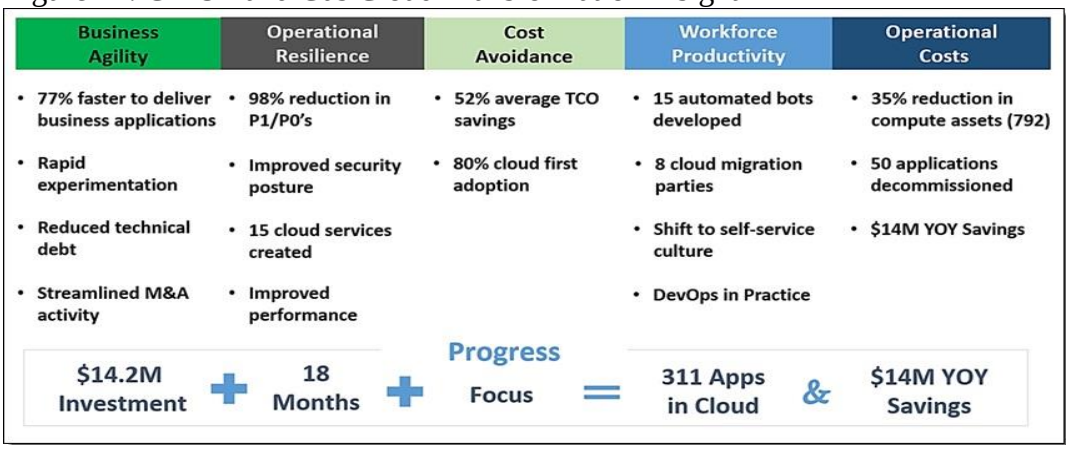
Source: (Blanton & Holgate, 2017)

Apart from the Government side, private enterprises and startup businesses put forward the "cloud-first" strategy to migrate their IT solutions into the cloud. Following examples provide the evidence of cloud first strategy in private sector.

- General Electronics (GE)

GE is one of the oldest and biggest companies in U.S. **(Forbes, 2017)**. It operates in 170 countries with over 295,000 employees worldwide and conducts nearly 10 different business segments such as Aviation, Energy, Lighting, Transportation, Health Care etc. **(GE, 2016)**; they have been deploying more than 9000 applications across GE **(Barr, 2016)**. By 2020, GE is expected to migrate 70 percent of their applications to the cloud environment. They are also expected to reduce the data center operation costs by 10-40 percent from embracing cloud-based solutions **(Miller, 2017)**. Following Figure shows the insight of GE Oil and Gas cloud transformation.

Figure 14: GE Oil and Gas Cloud Transformation Insight




Source: (Barr, 2016)

- Airbnb

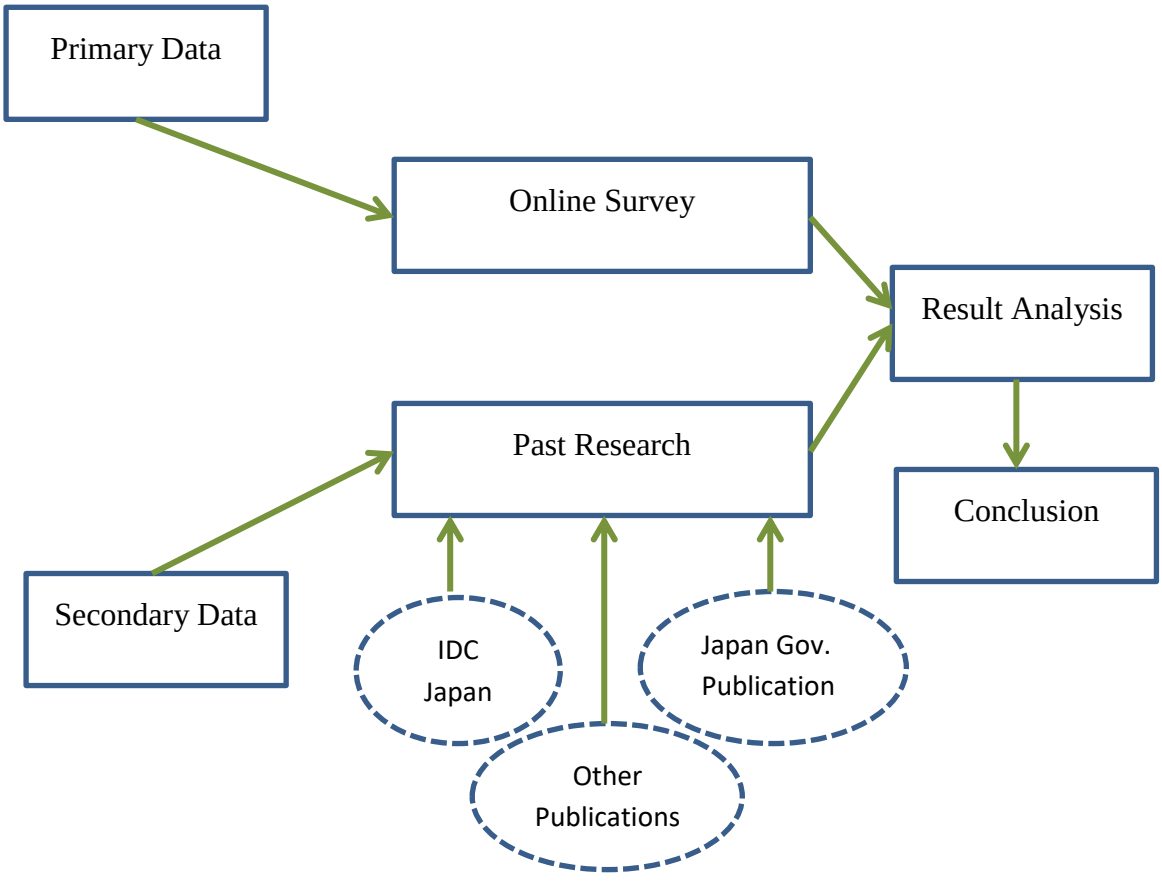
  Airbnb was founded in 2008 with three co-founders to accommodate community marketplace and provide access to millions of unique accommodation facilities all around the world. Currently, it is operated in 191+ countries and, 65,000 cities facilitating more than 4 million facilities for accommodation (Airbnb News Room). This startup business has been using cloud platform from day one. Airbnb website uses the hosting of accommodation facilities with high-resolution images. These images need to be stored in the Airbnb data center with accumulation capacity. In 2010, they used only 298 GB of storage for images, but within 3 years (in 2013) it grew up to about 50 TB. This was handled with AWS S3[6] elastic facility helping Airbnb to expand its storages automatically. Airbnb is also using many other services of AWS to manage and improve their internal services as well as external services (AWS).

[6] Simple Storage Service

# Chapter 3 Methodology

According to the Gartner hype cycle, present-day cloud computing is moving into the mature stage of adoption and usage. With this in mind, this research is going to do an analysis to get the insights of cloud computing usage, adoption and concern areas of the Japanese organizations. This study is based on data analysis from a survey and use of secondary data from the previous researchers. Following figure illustrates the study framework.

Figure 15: Study Framework



Primary data was collected through a survey questionnaire (see Appendix 1) which consisted of 10 questions related to the awareness, usage, concerns and future plans of cloud adoption of the Japanese organizations. Due to time limitation and budget constraints, the questionnaire was sent out to the organizations through an online survey tool instead of the traditional way of posting. To send out the questionnaire, e-mail addresses collected from various sources such as Japan Exchange Group (JPX) listed companies, Japan External Trade Organization (JETRO) and other online sources were used. SurveyMonkey online survey tool is used for primary data collection.

SurveyMonkey was founded in 1999 as a cloud-based SaaS Company. Each day this platform is being used by over 3 million people to send out surveys around the world. SurveyMonkey's online survey platform is facilitated with many options to easily conduct a survey. It also provides a dashboard which shows a snapshot of the survey results as well as many options to export the data such as Excel, CSV, PPT (PowerPoint Template) or SPSS formats (SurveyMonkey). Therefore SurveyMonkey was used as the preferred online platform.

In order to collect primary data deciding the sample size is important. Since people working in big organizations are very busy and have a tendency to not respond to surveys. Therefore, this research has used online survey method to send out questionnaire via email to as many Japanese companies as possible to cover up most of the business segments.

Online questionnaires were sent to 2560 Japanese companies within a period of one month (from December 2017). Responses were collected over two months from January and February, 2018. For better understanding, this questionnaire was presented in bilingual (English and Japanese) format (see appendix 1). The total number of

responders within that period was 69 and out of them, only 43 responders were selected for analysis after cleansing the data. Microsoft Excel was used for data analysis and creating graphical representations. Secondary data was collected through online research publishers such as IDC Japan, JETRO and other related web sites mentioned in the study framework. Based on the outcome of results and previous research data analysis, the conclusions have been presented in chapter 6.

# Chapter 4 Global Cloud Indexes Analysis

Many reputed companies do research on cloud readiness of countries all around the globe, to find and grab the foreign investments as well as to understand the level of technology used in each country. These studies mainly focus on the following areas which are, global data center traffic, cloud-based Internet Protocols (IP) traffic, and virtualization as well as international policy landscape for cloud computing. To understand the Japanese cloud readiness, this paper selected to do the analysis of following two cloud indexes,

- Cisco Global Cloud Index: Forecast and Methodology, 2016–2021
- 2016 BSA Global Cloud Computing Scorecard

The reason behind selecting these two indexes are because Cisco is the world leader in networking industry; and according to the BSA index, Japan is ranked at 1st place for cloud readiness.

## Cisco Global Cloud Index: Forecast and Methodology, 2016–2021

Cisco Systems Inc. is the world leader in networking for the internet. The company was founded in 1984 by two computer scientist from Stanford University. Currently, the company operates in 115 countries by employing 35,000 people worldwide. Cisco solutions provide connection devices for computer networks, allowing people to access or transfer information across the world (Cisco).

The Cisco global cloud index is an ongoing effort to forecast the growth of global data center and cloud-based Internet Protocol (IP) traffic. This study also includes measuring the “Cloud-Readiness” of each global regions through investigating a sample set of basic, intermediate, and advance businesses and consumer cloud

applications. To do this analysis, data has been gathered representing more than 200 countries around the world, covering a span of 2 years. Cisco global cloud index focuses on eight main factors including members of Generation (Gen) Y (born: 1977-1994), percentage of Gross Domestic Product (GDP) per capita spend on fixed internet, electricity production, percentage of households with a computer, mobile subscriptions per household, percentage of fiber subscribers compared to all fixed broadband subscribers, percentage of 4G subscriptions compared to all mobile subscriptions, and download speed, upload speed, and latency under three categories as mentioned in the table below,

Table 5: The Cisco Global Cloud Index: Factors

| | | |
|---|---|---|
| Demographic cloud adoption factor | **1** | Members of Generation (Gen) Y |
| Economic cloud adoption factors | **2** | Electricity production, kWh per capita |
| | **3** | GDP per capita spent on fixed internet |
| Network cloud adoption factors | **4** | Percentage of households with a computer |
| | **5** | Mobile subscriptions per household |
| | **6** | Percentage of fiber subscribers compared to all fixed broadband subscribers |
| | **7** | Percentage of 4G subscriptions compared to all mobile subscriptions |
| | **8** | Download speed, upload speed, and latency |

Source: (Cisco, 2017)

Gen Y, also known as millennials, push for the public cloud and innovation. According to Microsoft and Wakefield, millennials are moving into the IT decision making role and they push their organizations to grasp the public cloud and adjust the IT policies to enable a flexible IT environment (Cisco, 2017). Therefore, Gen Y is one

of the deciding factors when it comes to consideration of cloud adoption in a country. According to the Cisco study, Japan has 24% of Gen Y population. Compared to the other APAC countries, Japan is somewhat behind (India – 35%, China – 31%, Bangladesh – 37%) for considering this factor for cloud readiness. Furthermore, Japan is also facing higher rate of aging population that negatively impact technology adoption.

Internet is the key element for cloud computing growth and adoption. The internet charges and the money spent by individuals on the internet is one of the factors to be considered for technological development in a country. Percentage of GDP per capita spent on fixed internet is the measurement of individual usage of internet and it gives the indicator for technological infrastructure facility in the country. According to Cisco, most of the APAC countries' percentage of GDP per capita spent on the fixed internet is very less compared to two countries which showed a very high percentage, Kiribati and Solomon Islands. Considering Japan, this percentage is very low due to the increase in GDP; in Japan, average internet charges are around $ 41.46 (Numbeo, 2018) and the GDP per capita is $ 38,252 (The World Bank, 2018) so the calculated percentage is around 0.11%. This is a positive indicator for Japan's technology infrastructure development.

Cisco index focuses on five network cloud adoption factors which could measure the internet quality level and percentage of usage. Following two tables show the findings;

Table 6: Network Cloud Adoption Factors

| | Japan | U.S. | China |
|---|---|---|---|
| Percentage of households with a computer | 92% | 76% | 53% |
| Mobile subscriptions per household | 3 | 3 | 3 |
| Percentage of fiber subscribers compared to all fixed broadband subscribers | 76% | 13% | 87% |
| Percentage of 4G subscriptions compared to all mobile subscriptions | 60% | 65% | 57% |

Source: (Cisco, 2017)

Table 7: Download speed, upload speed, and latency

| | Average Download (Mbps) | Average Upload (Mbps)[7] | Average Latency (ms)[8] |
|---|---|---|---|
| Japan | 78 | 83 | 32 |
| U.S. | 83 | 31 | *[9] |
| China | 70 | 20 | * |

Source: (Speedtest, 2018)

In the above comparison, U.S. is selected because it is outside the APAC region and has a very high tech-savvy market. China is selected because of its large economy in the APAC region. According to Table 6, Japan's household computer ownership is more than 90% and, fixed fiber connection is 76% and, 4G subscriptions are around 60%. Compared with the U.S. and China, Japan is at a very higher level of technology usage. According to Table 7, quality of the internet is also high compared to the U.S. and China. The factor analysis of Cisco's index clearly reveals that, Japan's cloud readiness is highly desirable. But the only problem and the most important factor where Japan is lagging behind in the cloud journey is the human factor (Gen Y).

[7] Mbps - megabits per second
[8] ms - millisecond
[9] Data could not be found

## 2016 BSA Global Cloud Computing Scorecard

BSA | The Software Alliance (www.bsa.org) is the leading advocate for the global software industry before governments and international marketplace. Currently, the company is operated in more than 60 countries around the world. BSA provides compliance programs for legal software use and advocates for public policies that encourage technological innovation and boosting the digital economy (BSA, 2016).

BSA cloud computing scorecard is based on specific examination of 24 countries that account for 80 percent of the global IT market. Countries are scored and ranked according to the seven areas related to IT policies, laws, regulations and infrastructure that support and growth for the digital economy and cloud computing. The following table shows the seven areas, basic fact-finding questions and how it scored for ranked the countries.

Table 8: BSA Cloud Scorecard question and weight levels

| Theme/Questions | Weight | Value (Out of 100) |
|---|---|---|
| Data Privacy | 10% | 10 |
| Are there any laws or regulations that governing for collecting, use or processing personal information? | 30% | 3 |
| Is there an effective regulator for enforcement of privacy law? | 25% | 2.5 |
| Are data controllers free from registration requirements? | 20% | 2 |
| Are cross-border transfers freed from registration requirements? | 15% | 1.5 |
| Is there a breach notification laws? | 10% | 1 |

| | | |
|---|---|---|
| Security | 10% | 10 |
| Is there are any regulation or laws for electronics signature clearings? | 20% | 2 |
| Are Internet Service Providers (ISPs) and contain service providers free from mandatory filtering or ban? | 20% | 2 |
| Are there laws for digital data hosting and cloud service providers? | 20% | 2 |
| Are there laws for specific security audit requirement for digital data hosting and cloud service providers? | 20% | 2 |
| Are there security laws for technology products (specific certifications)? | 20% | 2 |
| Cybercrime | 10% | 10 |
| Are there cybercrime laws in place? | 50% | 5 |
| Are cybercrime laws consist of Budapest Convention? | 30% | 3 |
| What levels of encrypted data access have for the law enforcement authorities? (by data hosting providers, carriers and other service providers) | 10% | 1 |
| How does the law deal with beyond the local territorial violations? | 10% | 1 |

| Intellectual Property (IP) Rights | 20% | 20 |
|---|---|---|
| Is the country is a member of the TRIPS [10] Agreement? | 10% | 2 |
| Have IP laws implemented according to the TRIPS? | 10% | 2 |
| Is the country party to the WIPO[11] copyright treaty? | 10% | 2 |
| Have the laws implemented according to the WIPO copyright treaty? | 10% | 2 |
| Are civil authorizations available for unauthorized posting of copyright work on the internet? | 10% | 2 |
| Are criminal authorizations available for unauthorized posting of copyright work on the internet? | 10% | 2 |
| Are there laws governing ISP liability on trespass copyright? | 5% | 1 |
| Is there a basis for ISPs to handle on trespass copyright found on their sites or systems? | 5% | 1 |
| Is ISPs having the power to take down the unauthorized copyright content by informing to the copyright holder? | 5% | 1 |
| Are ISPs required to inform subscribers of unauthorized copyright? | 5% | 1 |
| Is there a clear legal protection for misappropriation of cloud computing? | 20% | 4 |

[10] Trade-Related Aspects of Intellectual Property Rights
[11] World Intellectual Property Organization

| | | |
|---|---|---|
| Support For Industry-Led Standards & International Harmonization Of Rules | 10% | 10 |
| Are there laws for establishing a standards-setting framework for interoperability and portability of data? | 30% | 3 |
| Is there are an authorized part of standard development for the country? | 10% | 1 |
| Is there electronic commerce law in place? | 30% | 3 |
| Is the downloading of digital content from foreign cloud service providers freed from trade barriers? | 10% | 1 |
| Are the domestic standards more restricted than international slandered? | 10% | 1 |
| Does the government practice in the international standards-setting process? | 10% | 1 |
| Promoting Free Trade | 10% | 10 |
| Are there any policies or regulations in place that implement technology neutrality in government? | 20% | 2 |
| Is cloud computing services able to operate free from laws or policies that mandate the use of certain products? | 20% | 2 |
| Is cloud computing services able to operate free from laws or policies that establish preferences for certain products? | 10% | 1 |
| Is cloud computing services able to operate free from laws or policies that discriminate based on the nationality of the vendor or service provider? | 50% | 5 |

| IT Readiness, Broadband Deployment | 30% | 30 |
|---|---|---|
| Is there a national broadband plan? | 13% | 3.75 |
| Percentage of personal computer usage (2014) | 3% | 0.75 |
| ITU[12] ICT Development index (2015) | 20% | 6 |
| International Connectivity Score (2014) | 20% | 6 |
| World Economic Forum Network Readiness Index (2015) | 15% | 4.5 |
| IT Industry Competitiveness Index (2011) | 10% | 3 |
| Internet penetration (2014) | 5% | 1.5 |
| International Internet Bandwidth (2014) (bits per second per Internet user) | 3% | 0.75 |
| International Internet Bandwidth (2014) (total gigabits per second [Gbps] per country) | 3% | 0.75 |
| Fixed broadband subscribers percentage (2014) | 5% | 1.5 |
| Active mobile broadband subscriptions per 100 inhabitants (2014) | 5% | 1.5 |

Source: (BSA, 2016)

BSA calculated this scorecard for every three years to rank countries for cloud computing readiness. According to BSA, Japan became first in years 2013 and 2016 with scores of 84.1 and 84.8 respectively. The following two table shows the points scored in each area and rank among countries for the year 2013 and 2016.

[12] International Telecommunication Union

Table 9: BSA Cloud Computing Score for Japan, U.S., and China

| | Japan | | U.S. | | China | |
|---|---|---|---|---|---|---|
| | 2013 | 2016 | 2013 | 2016 | 2013 | 2016 |
| Data Privacy | 8.8 | 8.8 | 6.5 | 6.5 | 4.7 | 4.7 |
| Security | 8.4 | 8.4 | 7.6 | 7.6 | 2.8 | 2.4 |
| Cybercrime | 10.0 | 10.0 | 8.8 | 9.0 | 4.6 | 4.6 |
| Intellectual Property (IP) Rights | 17.2 | 17.2 | 16.6 | 16.6 | 13.6 | 13.6 |
| Support For Industry-Led Standards & International Harmonization Of Rules (SIS & IHR) | 8.8 | 8.8 | 10.0 | 10.0 | 7.8 | 7.0 |
| Promoting Free Trade | 9.2 | 9.2 | 8.0 | 10.0 | 4.8 | 1.0 |
| IT Readiness, Broadband Deployment | 21.7 | 22.4 | 22.2 | 22.7 | 13.2 | 14.6 |
| Total Score | 84.1 | 84.8 | 79.7 | 82.4 | 51.5 | 47.9 |

Source: (BSA, 2016)

Table 10: BSA Global Cloud Computing Scorecard Country Rank

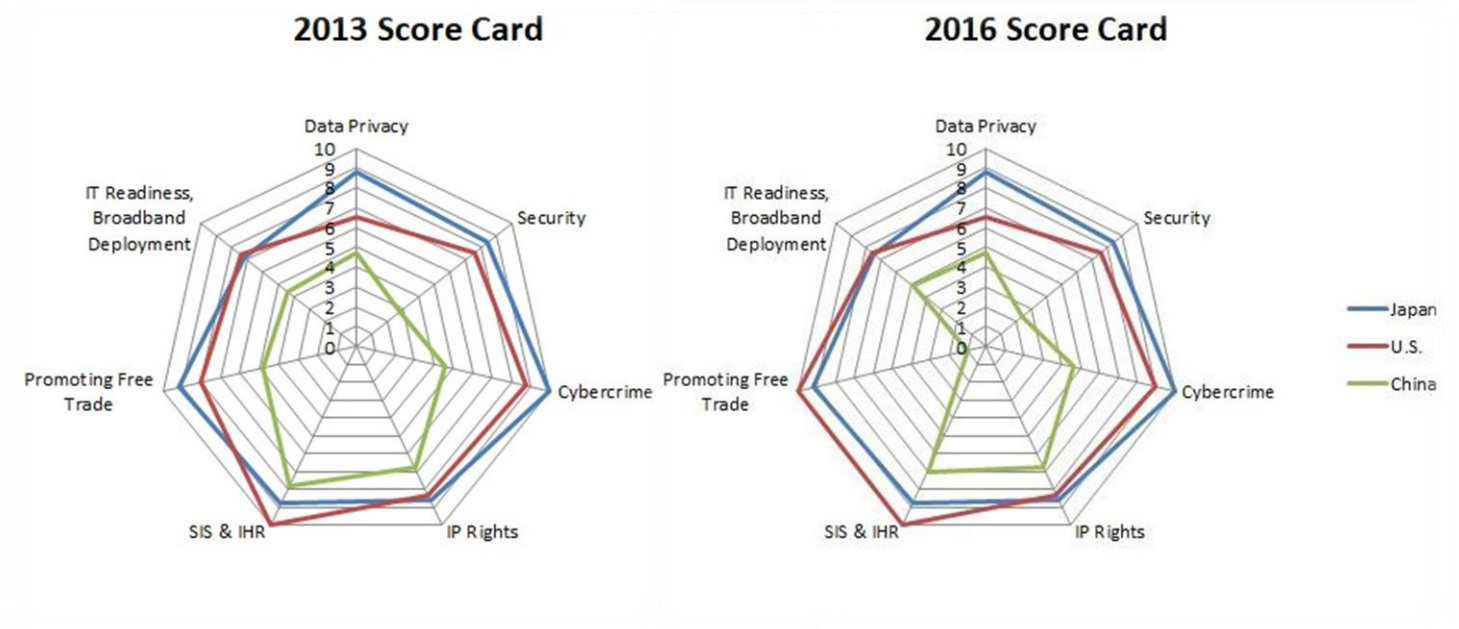
| Country | 2013 | | 2016 | | Change in Rank |
|---|---|---|---|---|---|
| | Score | Rank | Score | Rank | |
| Japan | 84.1 | 1 | 84.8 | 1 | None |
| U.S. | 79.7 | 3 | 82.4 | 2 | +1 |
| Australia | 79.9 | 2 | 80.0 | 6 | -4 |
| Germany | 79.1 | 4 | 82.0 | 3 | +1 |
| Singapore | 78.5 | 5 | 79.5 | 7 | -2 |
| … | … | … | … | … | … |
| China | 51.5 | 19 | 47.9 | 23 | -4 |

(BSA, 2016)

BSA score analysis shows, Japan has improved the IT Readiness and Broadband Deployment area by 0.7 points, due to the implementation of impressive national

broadband networks to retain the first place. U.S. has been able to move up by one level from third place to second place by improving their Cybercrime, Prompting Free Trade and, IT Readiness and Broadband Deployment areas. China has gone down by four levels from the position of 19 to 23 with points declining in the following areas such as Security, Support for Industry-Led Standards & International Harmonization of Rules, Promoting Free Trade; they have only been able to improve IT Readiness, and Broadband Deployment. The Free trade points have drastically decreased due to China's failure on a few Free Trade Agreements (FTA) over the past few years with Australia (Wen, 2014) and South Korea (Schott & Jung, 2016). Figure 15 shows the graphical representation of BSA scorecard data analysis of Japan, U.S. and China[13].

Figure 16: BSA Score Card Japan, U.S. and China (Source: BSA)



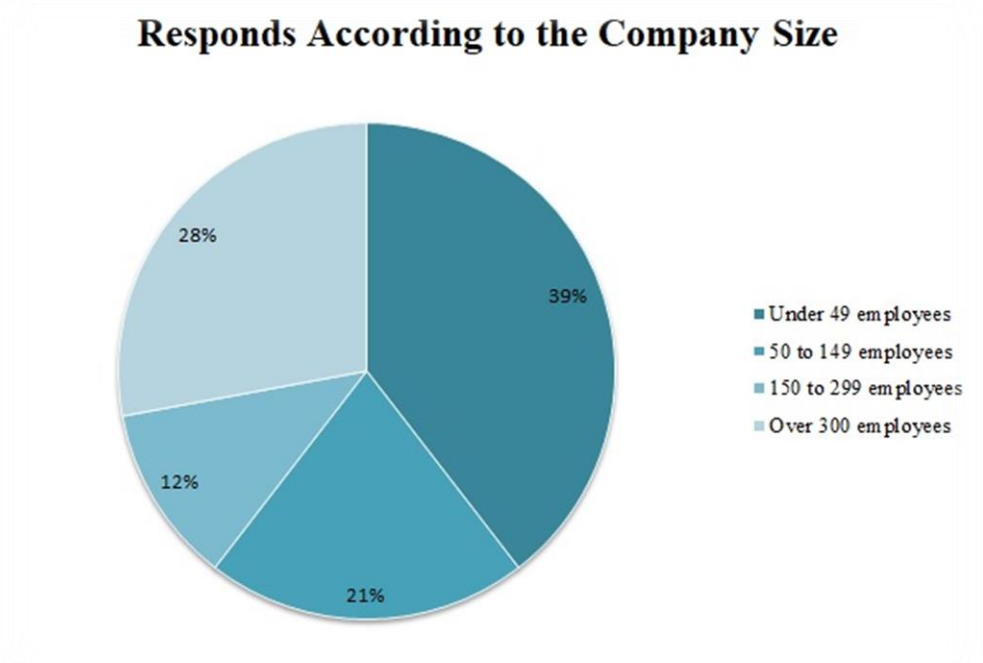

[13] IP Rights and IT Readiness, Broadband Deployment considered as point 10 rage for better understand the graphical representation

# Chapter 5 Results Analysis

## 5.1 Online Survey Analysis

As discussed in chapter 3, the online questionnaire was sent out to the 2560 company email addresses on 14th December 2017. A total of 69 responds have been collected till the end date of the survey which was 28th February 2018. Only 43 complete and accurate responses have been selected for analysis after cleansing the data. Responses have come from various industries, and out of that, computer and business services have contributed the most. According to the company size, 39 percent of respondents are from companies less than 49 employees and second largest responses came from companies with more than 300 employees, which was 28 percent (See Figure 17). These responses have illustrated that most of the startup companies are very much interested to go on cloud computing while large companies have started migrating their IT capabilities to the cloud.

Figure 17: Response According to the Company Size (Total Responds=43)



According to the awareness and usage of the cloud, currently, every organization knows what is cloud computing but with different levels of understanding (See Figure 18) while 61 percent of respondents are already using the cloud, 23 percent are planning to use it in the future (See Figure 19).

Figure 18: What level you know about cloud computing? (Total Responds = 43)

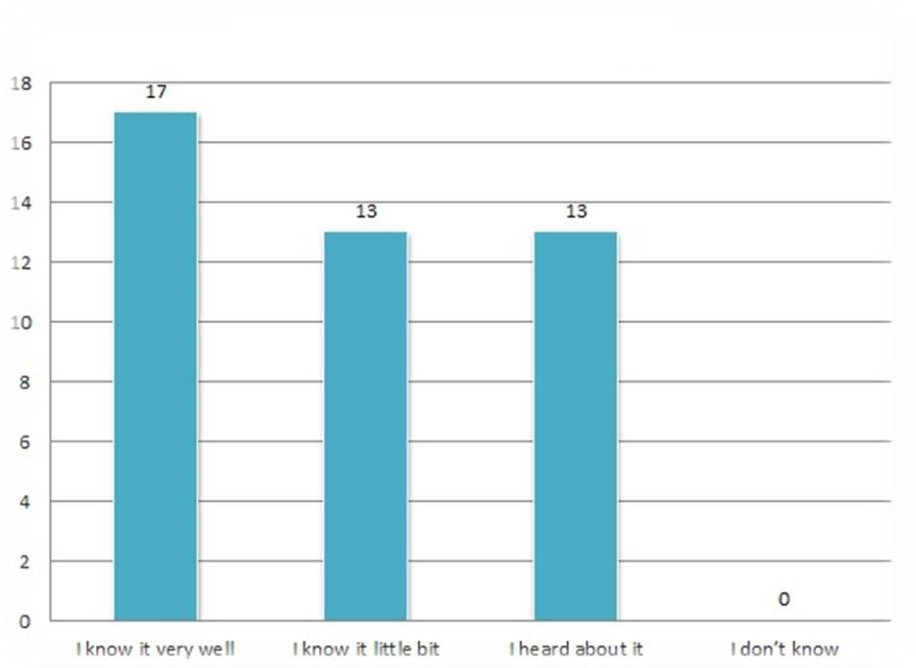
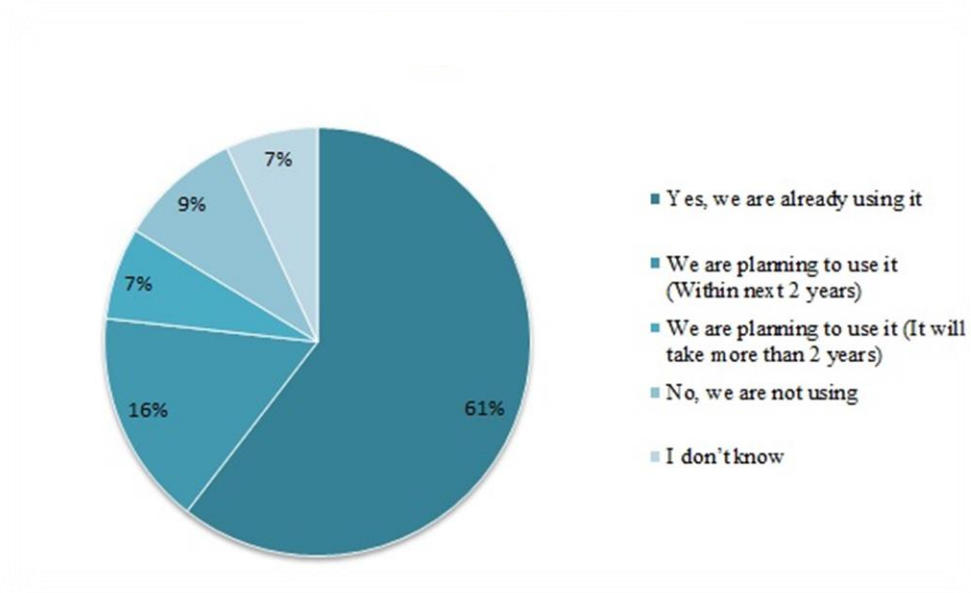



Figure 19: Usage of Cloud (Total Responds = 43)



Cloud category wise analysis shows that most of the organizations use SaaS model which is 43 percent (23 Responds) and IaaS model which is 30 percent (16 Responds) while 24 percent (13 Responds) of respondents had no idea of the category used by their organization (See Figure 20). Cloud deployment model results show, that 41 percent (19 Responds) responded with "I don't know" and 35 percent (16 Responds) responded with using public cloud while 15 percent (7 Responds) responses to use private cloud and finally, 9 percent (4 Responds) responded to use hybrid cloud (See Figure 21). No responses were found for community cloud. These two results show that every organization has the awareness of the cloud but still, they have lack of understanding of the cloud category and deployment models.

Figure 20: Category wise Cloud Computing Usage (Total Responds = 43)

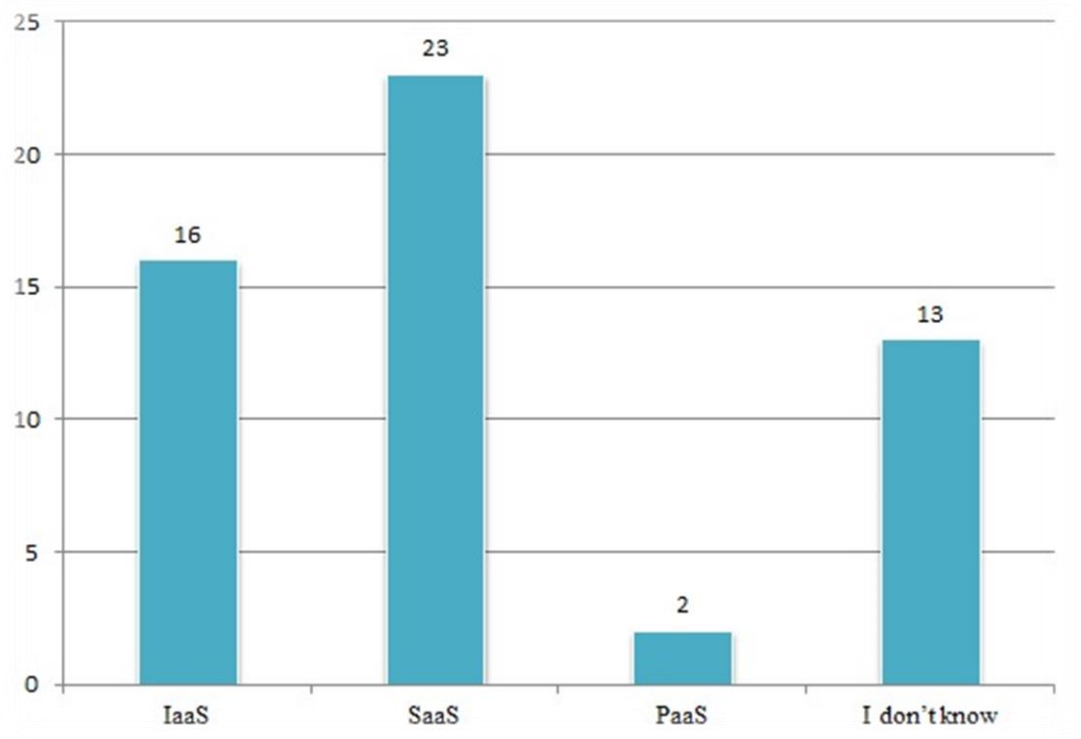


Figure 21: Cloud Deployment Models (Total Responds = 43)

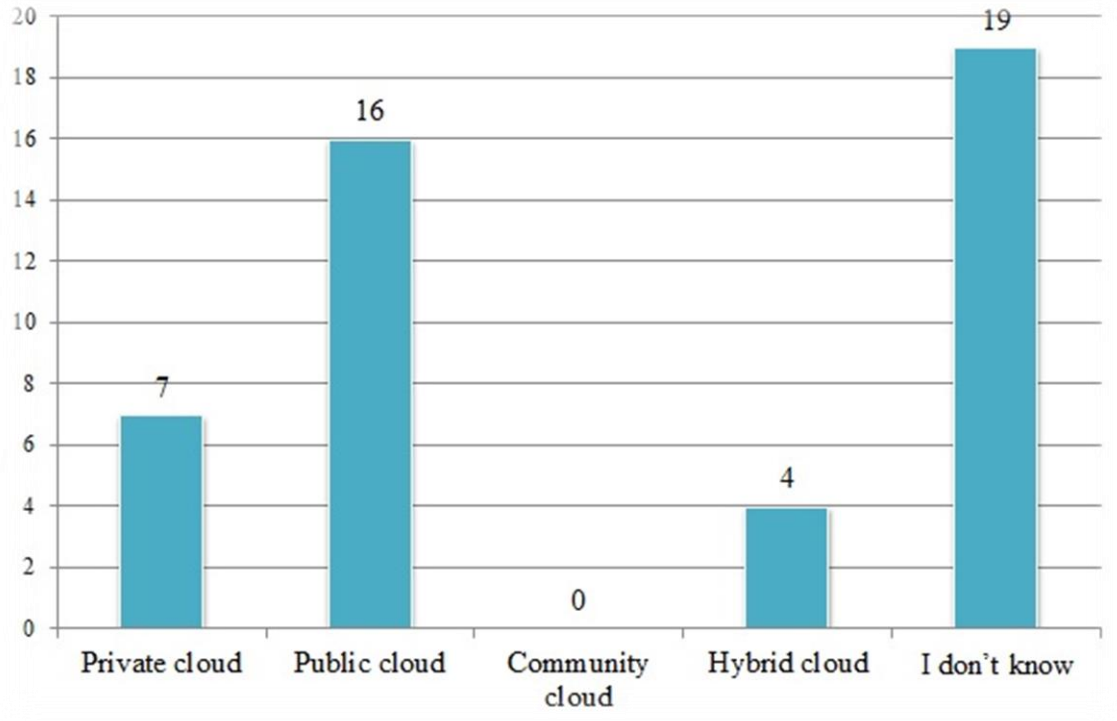
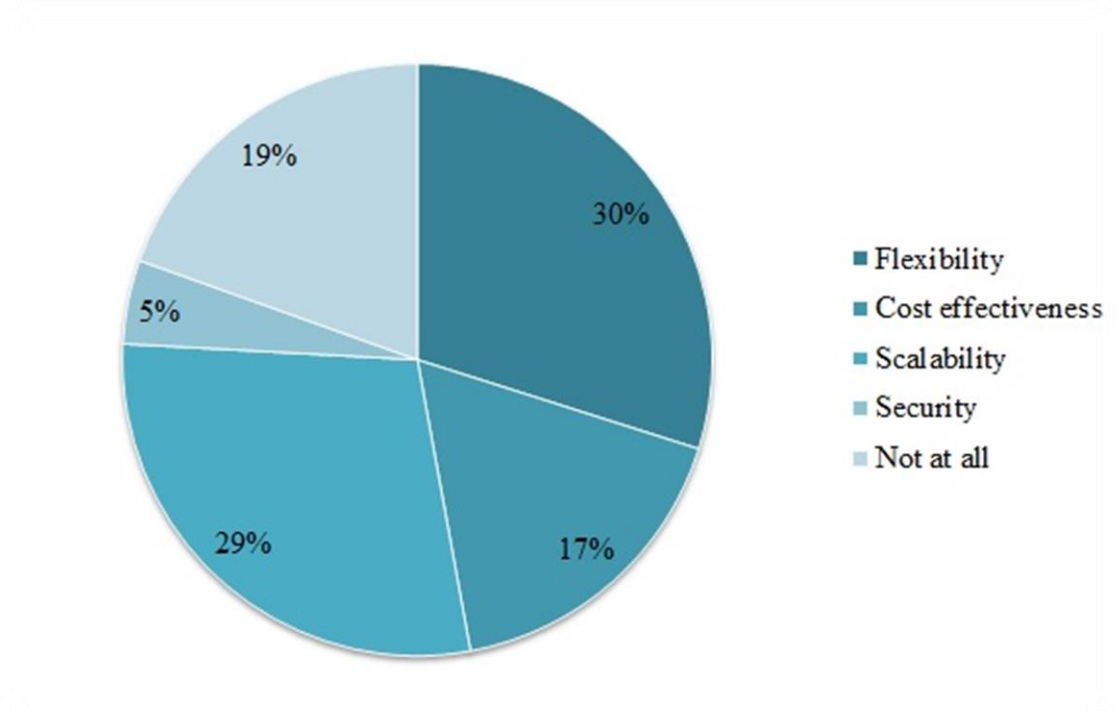
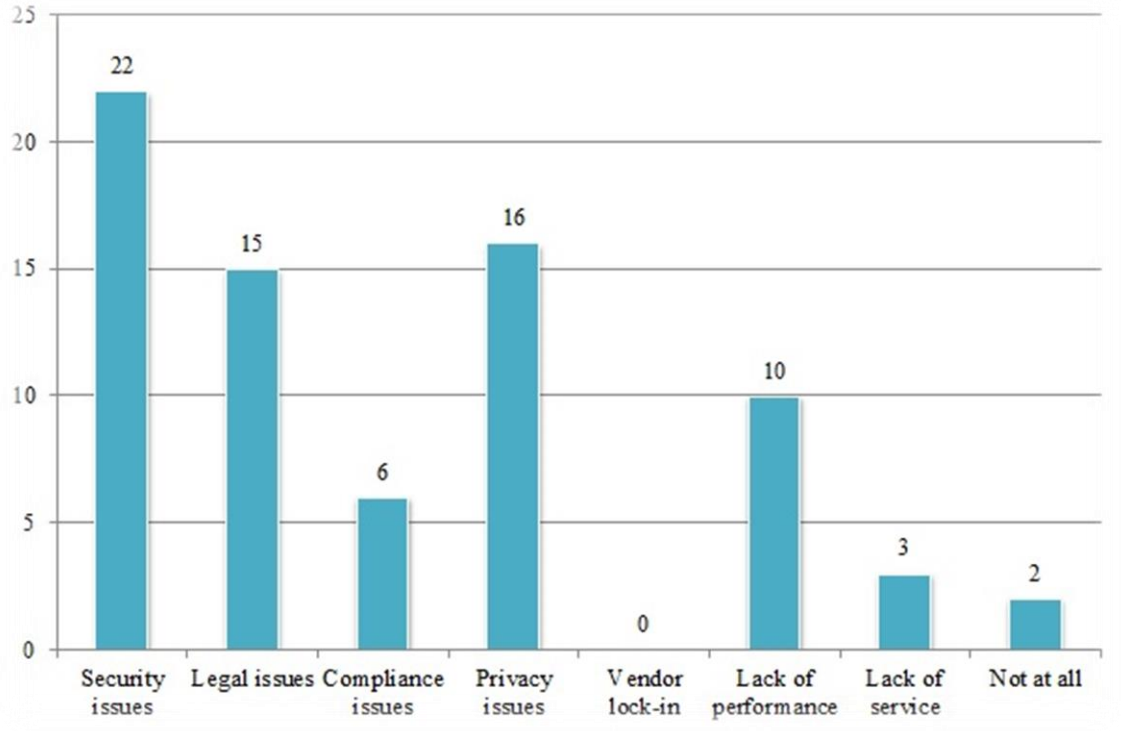



Figure 22: Cloud Computing Benefits (Total Responds = 43)



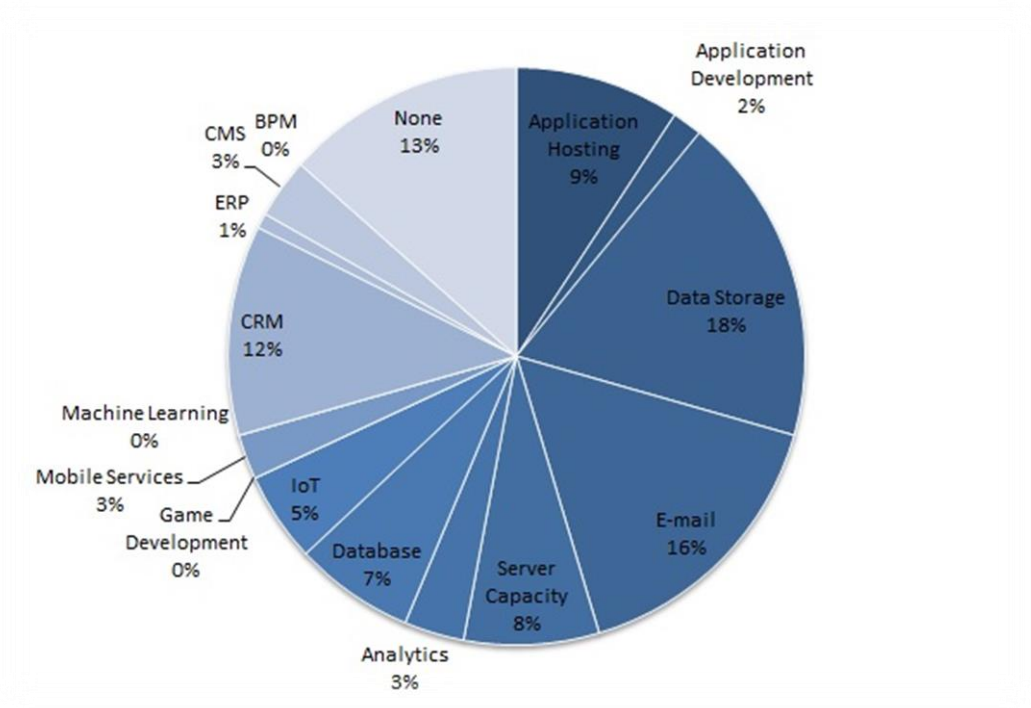
Cloud benefits (See Figure 22) analysis shows that flexibility and scalability have more response rather than cost-effectiveness which was 30 percent (26 Responds), 29 percent (25 Responds) and 17 percent (15 Responds) respectively. Cloud security is still in the top concerns list in many organizations according to the survey results. 22 out of 43 respondents are highlighted their most concern areas of the cloud adoption is security vulnerability while 16 respondents have selected the privacy issues. Legal and lack of performance problems are the next most concerned areas of the organizations according to survey results (See Figure 23).

Figure 23: Critical Concern Areas of Cloud (Total Responds = 43)




Cloud service usage analysis shows, most respondents selected the Data storage and E-mail services which were 22 (18 percent) and 19 (16 percent) respectively while 14 (12 percent) and 11 (9 percent) responded for use of CRM and Application hosting purposes respectively. Rest of the usage type services are from the Server Capacity, IoT, Database, and Analytics area (See Figure 24).

Figure 24: Cloud Computing Services Usage (Total Responds = 43)




It can be seen that most of the Japanese organizations have started following the cloud journey but still they lack a considerable amount of deep understanding about the cloud benefits, usage, and deployment models.

## 5.2 Previous Studies Analysis

According to the JETRO San Francisco, ICT related market forecast in Japan as follows,

Table 11: ICT Market Forecast Japan

| | 2014 ($ Billions) | 2015 ($ Billions) | 2020 ($ Billions) |
|---|---|---|---|
| Smart Payment (50.2% *) | 542 | 582 | 874 |
| B2C E-Commerce (74.3*) | 128 | 144 | 251 |
| Online Advertising (38.1*) | 7.8 | 8.4 | 11.6 |
| Social Gaming (6.5%*) | 7.4 | 7.7 | 8.2 |
| IT Security (32.7%*)** | 5.2 | 5.5 | 7.3 |
| M2M[14] (217.3%*) | 3.5 | 5.2 | 16.5 |

[14] Machine-to-Machine

| | | | |
|---|---|---|---|
| Digital Publications (50.0%*) | 2.2 | 2.6 | 3.9 |
| Video on Demand (33.3%*) | 1.3 | 1.5 | 2.0 |

Source: (Abe, 2015) ($=100Yen)

*Expected Growth %: From 2014 to 2020
**Enterprise IT Security Market

M2M/IoT market has been forecasted to grow by 200% in 2020 according to the above table. M2M basically deals with AI related work and connected devices in the form of IoT. Japan's IoT market is expected to evolve using cloud-based data processing architecture with organizational IoT data getting shared for strategic collaboration. (Abe, 2015). But according to the Nomura Research Institute (NRI), survey shows that IoT security architecture has many issues due to the variety of IoT devices which have different Central Processing Unit (CPU) capabilities, memory capabilities etc. This issue has been growing at a critical level as the IoT device usage increases.

Cloud data center market in Japan started to grow rapidly after the devastating earthquake and tsunami in 2011. This incident was an eye opener for small to large organizations to think about securing business continuity when natural disasters impact on their businesses. In addition, Japan has a very large market with a stable government along with ICT infrastructure facility which promotes the global expansion of Japanese businesses. There are many Japanese companies such as NTT data, Softbank, Fujitsu etc. providing the data center facilities to the domestic market and expanding towards global market to compete with cloud giants such as AWS, Google, Microsoft and IBM. According to the NRI survey[15] of Japanese organizations Big Data analysis shows that 53.8% (Abe, 2015) responds with "No Action" related to the Big Data while only 7.3%

[15] 810 Total survey responses

fully utilize Big Data and the rest are somewhere in between. The following factors have been noted such as lack of data scientists, leadership for Big Data projects, lack of investments and restricted privacy laws for challenging areas to improve Big Data journey in Japan. Also, Japan mainly focuses on security measures related to data privacy and is expected to expand the IT security market from $4.9 billion in 2013 to $7 billion in 2020 with the growth of 33% (Abe, 2015). IT security market segregated into two parts including IT Security Tools (Tools include hardware appliances and on premise software solutions) and IT Security Services (Services include cloud solutions and outsourced security brokers).

According to the IDC, Cloud IT infrastructure revenue has been growing fastest in Japan at 42.3% year over year in 4Q2016. IDC survey results show that private cloud market size is larger than the public cloud market in Japan with the forecast of $18.6 billion and $5.3 billion respectively in 2019 (Abe, 2015). The following chapter will discuss in detail analysis of what should Japanese organizations focus on to develop their cloud strategy according to the survey results and previous studies.

# Chapter 6 Conclusion

In this chapter analysis of the data is carried out to find outcomes to the research questions. The primary data obtained through online survey was used along with the previously published secondary data for analysis. The online survey shows that almost all the organizations have awareness of cloud computing concepts but still have a problem of understanding the technical way of correctly applying it to relevant business requirements. As reactions to questions regards to cloud deployment models[16] and cloud computing categories[17] numerous respondents reacted with "I Don't Know", which implies that respondents know about the cloud computing at first glance however they do not have in-depth technical knowledge of the cloud. Another factor to be highlighted is that most organizations still have a problem with trust in the cloud. Privacy and security issues also are major factors that negatively affect to the cloud migration.

Previous research and publications show that the Government has initiated the cloud journey in Japan. University of Tokyo Open Data Center (UTODC) project is one of the initial stage projects that is open for the Big Data analysis in private sector as well as public sector. This project illustrates that Japan's public sector with Big Data is worth more than ¥700 billion and this being available for the private sector for free which in turn provides the transparency of the public-sector activities giving more options to the private sector to enhance their activities according to the data. Another initiative is the national ID and data sharing roll out (My Number) project that link the entire individual's transaction data for analysis while improving privacy laws through the Act on the Protection of Personal Information (APPI) paved the way for the individuals to

[16] Which cloud deployment model you using in your organization?
[17] Which category of cloud computing you are using?

drive the integrated information platforms. But Japan's aging population might impact negatively for the usage of information technology as a country to boost their IT literacy in future.

Considering the overall factors after the analysis shows, as a country, Japan is driving towards a very bright future cloud adoption through enhancing security, awareness, and training as well as expanding the cloud market to the global level through acquiring global businesses such as NTT communication acquisition of RagingWire Data Centers, Inc, in U.S. and partnering with global giants such as SoftBank with Alibaba for Alibaba Cloud. On the other hand government initiatives made the path clear for the cloud journey of Japan by establishing rules and regulations like IoT council for improving IoT infrastructure and security and establishing UTODC for integrated information systems.

# Chapter 7 Limitations and Further Study

Cloud computing is a very interesting technology to discuss and this paper focuses on Japan and its adoption to cloud. The main reason for selecting Japan is for its high tech-savvy market and it will be interesting to see how this market interacts with cloud computing. One of the main limitations of this study was the language barrier. There are many articles and websites provide information but all were written in the Japanese language. Due to the time constraint and the cost factor, it was very difficult to get an interpreter (with a high level of technical knowledge) to translate these documentations. For further studies, it is better to have a combined study of online survey and face to face interview with ICT executives of selected few companies as well as casuals like students from Schools and, Universities to get an idea as to what the next generation thinks about the cloud. Furthermore, retired executives would also provide great feedback to get an idea of how the aging population sees the future of the cloud technology usage of organizations in Japan.

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# Appendix

1. In which industry do you work?
   あなたはどの業界で働いていますか？

   Accounting　会計
   Advertising　広告
   Automotive Industry　自動車産業
   Agriculture・Forestry・Fishing　農業・林業・漁業
   Biotechnology　バイオテクノロジー
   Business Services (Hotels, Lodging Places)　ビジネスサービス（ホテル、宿泊施設）
   Computers (Hardware, Desktop Software)　コンピュータ（ハードウェア、デスクトップソフトウェア）
   Communications　コミュニケーション
   Construction・Home Improvement　建設・住宅改善
   Consulting　コンサルティング
   Computer Software　コンピューターソフトウェア
   Education　教育
   Engineering・Architecture　エンジニアリング・アーキテクチャ
   Entertainment・Recreation　エンターテイメント・レクリエーション
   Finance・Banking・Insurance　ファイナンス・銀行業務・保険
   Food Service　食品サービス
   Government・Military　政府・軍隊
   Healthcare・Medical　ヘルスケア・医療
   Internet　インターネット
   Legal　法的
   Manufacturing　製造業
   Marketing and Marketing Research　マーケティングおよびマーケティングリサーチ
   Media・Printing・Publishing　メディア・印刷・出版
   Mining　鉱業
   Non-Profit　非営利
   Pharmaceutical・Chemical　医薬品・化成品
   Real Estate　不動産業者
   Retail　小売業
   Telecommunications　電気通信会社
   Utilities　ユーティリティー
   Wholesale　卸売業
   Transportation・Distribution　交通・物流
   Business・Professional Services　ビジネス・プロフェッショナルサービス
   Other　その他

2. What is your job title?
あなたの役職は何ですか？

Senior Managing Director 上級管理役
Managing Director 取締役社長
Director ディレクター
Deputy Director 副局長
General Manager ゼネラルマネージャー
Branch Manager 支店長
Auditor審査員
Senior (Corporate) Advisor シニア（コーポレート）アドバイザー
Presidential Secretariat 大統領事務局
Advisor 顧問
Deputy General Manager 副総裁
Plant Managerエ場長
Manager マネージャー
Deputy Manager 副マネージャー
Assistant Manager 課長補佐
Section Chief 課長
Chief Investigator 主任研究員
Supervisor スーパーバイザ
Secretary 秘書
Receptionist 受付
Clerical Staffs 事務職
Company Employee 会社従業員
(Immediate) Boss （即時）ボス
(Immediate) Subordinate （即時）従属
(Immediate) Senior （即時）シニア
(Immediate) Junior （イミディエイト）ジュニア
N/A N / A

3. How big is your organization?
あなたの組織はどれくらいの大きさですか？

Under 49 employees 49 人未満の従業員
49 to 149 employees 社員 49〜149 人
150 to 299 employees 150-299 人の従業員
Over 300 employees 300 人以上の従業員

4. What level do you know about cloud computing?
クラウドコンピューティングについてどれくらい知っていますか？

I know it very well 私は非常によく知っている
I know it little bit 私はしばらくそれを知っている
I heard about it 私はそれについて聞いた
I don't know 私は知らない

5. Is your organization currently using or planning to use cloud computing?
あなたの組織は現在クラウドコンピューティングを使用していますか、それを使用する予定ですか？

Yes, we are already using it はい、私はすでにそれを使用しています
We are planning to use it (Within next 2 years) 私たちはそれを（今後 2 年以内に）使用する予定です。
We are planning to use it (It will take more than 2 years) 我々はそれを使用する（それは 2 年以上かかる）
No, we are not using いいえ、私たちはそれを使用していません
I don't know 私は知らない

6. Which category of cloud computing are you using? (Choose all applicable)
クラウドコンピューティングのどのカテゴリを使用していますか？（該当するものをすべて選択してください）

IaaS - Infrastructure as a Service (Servers, Compute...etc) IaaS - サービスとしてのインフラストラクチャ（サーバー、計算など...）
SaaS - Software as a Service (Office 365, Database...etc) SaaS - サービスとしてのソフトウェア（Office 365、データベース...など）
PaaS - Platform as a Service (Various development platforms) PaaS - サービスとしてのプラットフォーム（さまざまな開発プラットフォーム）
I don't know 知りません

7. What are the benefits you gain from using cloud computing? (Choose all applicable)
クラウドコンピューティングの利点は何ですか？（該当するものをすべて選択してください）

Flexibility 柔軟性
Cost-effectiveness 費用対効果
Scalability スケーラビリティ
Security セキュリティ
Not at all ちっとも

8. What are the critical concern area for using cloud computing? (Choose all applicable)
クラウドコンピューティングを使用する際の重大な懸念は何ですか？（該当するものをすべて選択してください）

Security issues セキュリティ上の問題
Legal issues 法的問題
Compliance issues コンプライアンスの問題
Privacy issues プライバシーに関する問題
Vendor lock-in ベンダーロックイン
Lack of performance パフォーマンスの欠如
Lack of service サービスの欠如
Not at all ちっとも

9. Please rate the below-given statement?
"Cloud computing is going to be the next IT model for any company"
以下の声明を評価してください。
「クラウドコンピューティングは、あらゆる企業にとって次の IT モデルとなるでしょう」

Strongly agree私は強く同意する。
Agree 同意する
Neutral中性
Disagree 同意しない
Strongly Disagree 強く同意しない

10. Which Cloud Computing services is your organization using?
あなたの組織はどのクラウドコンピューティングサービスを使用しますか？

Application hosting アプリケーションホスティング
Application development アプリケーション開発
Data Storage データストレージ
E-mail services 電子メールサービス
Server Capacity サーバー容量
Analytics アナリティクス
Database データベース
IoT
Game Development ゲーム開発
Mobile Services モバイルサービス
Machine Learning 機械学習
CRM (Customer Relationship Management) （顧客関係管理）
ERP (Enterprise Resource Planning)（企業リソース計画）
CMS (Content Management System) （コンテンツ管理システム）/DMS (Document Management System) (文書管理システム）
BI (Business Intelligence)（ビジネスインテリジェンス）
BPM (Business Process Management)（ビジネスプロセス管理）