A CASE STUDY ON HYBRID CLOUD APPROACH TO AUTOMATE THE CLOUD SERVICES BASED ON DECISION SUPPORT SYSTEM

Thesis submitted in fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

By

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ABSTRACT

Cloud computing (CC) provides substantial technological benefits and allows businesses, particularly small and medium-sized businesses (SMEs), to save upfront capital investments. This is because of numerous benefits, it delivers pay-as-you-go service plan, on-demand accessibility and service flexibility. The growing usage of cloud services necessitates detailed evaluation techniques in order to select the most appropriate options. Existing research in the literature typically suggest solutions that incorporate a single approach for making such judgments to this goal. As a result, this research presents a complete solution in the shape of ClouDSS, a decision support system that uses several Multi-Criteria Decision Making (MCDM) approaches to optimize cloud service selection decisions. ClouDSS provides a default decision model for assessing the appropriateness of cloud services in terms of organization requirements, which can be adjusted corresponding to enterprise-specific requirements. Following a description of ClouDSS's key components, the used cloud service selection process is detailed in order to emphasize the related tasks, which includes both subjective and objective evaluation techniques. A case study is also used to show the applicability of the suggested system. Cloud computing allows software developers to replace their in-house IT infrastructure with scalable processing and low-cost flexibility. Cloud service provider selection is becoming a significant problem in organizations as the number of cloud providers and services presented grows fast. Multiple factors, such as popularity, geographic location, and deployment style, are used to classify cloud service providers and their supplied services, thus having a reliable technique to choose acceptable cloud suppliers based on decision-maker’s requirements is critical. This research work offers a decision-making assists decision-makers in selecting the best Infrastructure-as-a-Service cloud providers.

ACKNOWLEDGEMENT

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CHAPTER 1

INTRODUCTION

1.1. OVERVIEW

Cloud computing (CC) offers solution where computing resources like hardware, software, networks as well as storage are allocated to users according to need of demand. The key concept behind the development of this form of solution is to provide consumers and businesses with storage and computing facilities. This was a need while encouraging customers to pay only for what they used. The history of cloud computing is dated back to the early 1960s when John McCarthy recommended his idea of 'utility computing' where organizations gave computing power with respect to particular services/applications. Cloud computing is a design to enable easy, demand-based network approach to a distributed pool of configuration-based computing resources (for example, applications, storage, servers, services, and networks). These can be swiftly provisioned as well as provided with minimum administrative/management endeavor or service provider communication. The National Institute of Standards and Technology's (NIST), Information Technology Laboratory identifies that CC is a growing aspect. The definition features of this paradigm are debated in both public and private industries and continued to develop in the coming days.[1]

However, preliminary stages have been considered to construct a globally acknowledged elaboration of cloud computing. It also includes major features and definitions which are deployed differently in service designs. In spite of being reported, these definitions need to be repeated, especially in such type of growing paradigm. The type of cloud technology uses entirely separate ideas against the conventional models given by the service providers. [2]

The previous few years have seen a revolutionary development of cloud computing in Information Technology as well as in public media. It is considered as an outcome of integrated network technology and conventional computing technicality. It is considered in terms of network storage, virtualization, utility computing, grid computing, parallel computing [3][4], distributed computing, load balancing, etc. [5]. Besides, a novel business computing design is also present. Figure 1.1 given below shows the key characteristics of cloud computing.

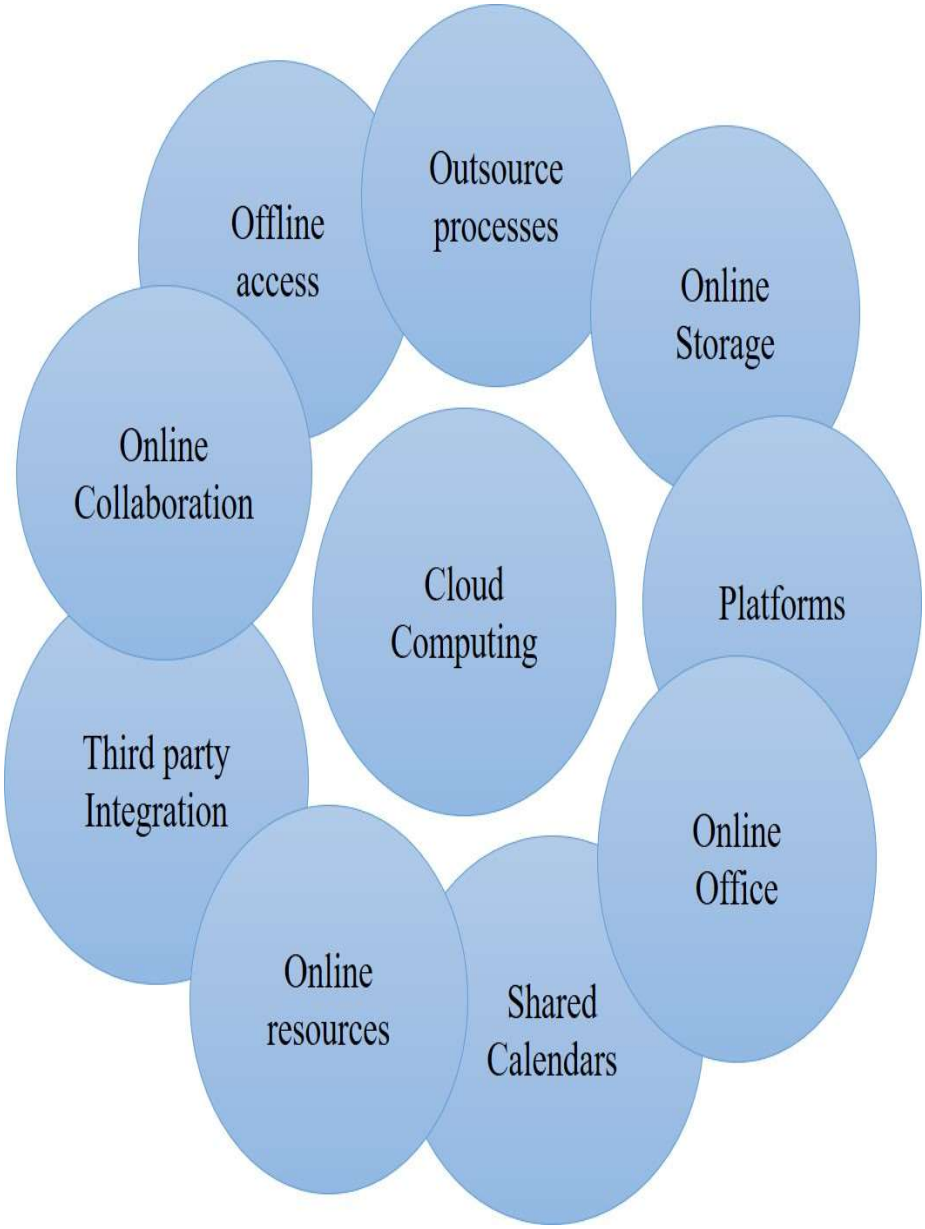

Figure 1.1 Cloud Computing Overview [6]

Maximum organizations need to utilize information-based services in a price-friendly way. The conventional IT services require time and are expensive when it comes to building hardware or developing software, maintaining and managing despite the low server usage. By using cloud computing, the already present IT resources can be essentially virtualized as well as can invite such virtualized resources to a huge inventory of resources [7].

Afterward, it shares the computing jobs to that inventory and allows the application system to get computing ability automatically alongside storage space and software service as per the needs. This resource pool is termed as 'Cloud' and it comprises virtual computing tools [8]. These are maintained as well as regulated by cloud and such resources are broadband

resources, storage servers, and computing servers etc. Through Cloud Computing, all computing resources can be invited to a single place while software can be used for managing the resources without human intervention. It creates space for the first service provider to concentrate on trades and not on the implementation all the time. Overall, it is cost-effective and innovative [9].

Hybrid Cloud is createds by combining both public and private cloud and this is popular among organizations. The benefit of the hybrid cloud covers the safety of a private cloud as well as the open characteristics of a public cloud. For improving the capability of business support as well as the efficacy of Information Technology management, a hybrid cloud computing structure is designed for solving issues with CC like resource integration, migration, resource usage, etc. This structure can help resolve issues and hardships of enterprise datacenter like investment reduction, increasing the speed of application, swiftness in recovering mishaps, amplifying the business continuity, or decreasing the consumption/utilization of both energy and space.

Salesforce.com, Google App Engine, and Amazon Web Services (AWS) are prominent cloud service providers. These enterprises provide choices to the customers in deploying their application across a network of unlimited resource storehouses without much investment and average functional expenses against the real utilization. Through using Cloud services in hosting Web applications, enterprises can be benefitted from elastic service, pay-per-use, as well as resource-abundance.

As a revolutionary technology cloud computing comes with several challenges as well. To solve issues effectively, Cloud is becoming popular although the challenges of the system may become disastrous. Web applications are shifted to Cloud as it involves the complex decision of migrating to the Cloud; It comes with several aspects, starting from issues and expenses to security to service level demands. Besides, the complex aspect of migrating a web application from an enterprise-owned data center to the Cloud technically includes financial things as well because it comprises some important stages. The underlying stages are involved in the migration to a Cloud infrastructural service. These migration-based steps to a PaaS ordering would provide in various aspects. Firstly, an accurate Cloud service, or IaaS ordering, is chosen. It requires a strong decision considering all important variables such as cost, support quality and Service Level Agreement (SLA) level.

The fundamental aspect is data and calculation/estimations about every aspect that elaborates the quality and creating service preferences equivalent. Furthermore, the present Web

application including its platform, i.e. a Web server, is shifted from an organizational data center to the chosen Cloud infrastructure service. So, the Web application, as well as the server, should be transformed into a design that is likely by a Cloud infrastructure service. Usually, an entire web application is grouped as a virtual machine image which comprises of a software stack from software platforms and operating system to the software with the business logic. As it is generally not possible to transform a present web application including its server to a Cloud infrastructure service based Virtual machine image format. A sufficient virtual machine image chosen by the Cloud service provider is selected and personalized. Images already present differ in several ways, like the underlying OS, software within the software stack, or software versions. So, choosing an accurate virtual machine image is a daunting job. Apart from that, selecting an inclusive virtual machine image helps minimize the task to install a software stack on a basic image. Several parts and databases should be migrated in a parallel and complex manner. It needs to implement the stages mentioned above partwise also, interconnections, as well as associations between the parts, should be regarded.

1.2. CLOUD COMPUTING

The growth of cloud technology is one of the revolutions in science and technology and it provides an ample number of scopes to IT industries, healthcare, entertainment and transport, trade, research and so on. Among the computing technologies, Cluster computing, High-Performance Computing, Grid computing and distributed Computing are a few names. Cloud computing is more progressive as it is not confined to resources or services. A few technologies like grid computing are limited based on the type of services it can support, while Cloud is service that is based on demand. Naturally, the latter has been quite revolutionary and is entering deeper into several spheres of IT industries to upgrade and update the structure. The aspiring growth has turned both the developed and developing organizations to shift their attention from unstable and costly infrastructure. Cloud is quite a solution in giving a better result and infrastructure cost-effectively; the whole maintenance is an accountability of the service provider. Like any other service provider, the Cloud Service Provider (CSP) behaves like a mediator to bridge the gap between accessible Cloud resource and client as per the latter's needs and usage. Hence the core of the service is demanding to service, based on cloud resource and service received from the respective cloud. The consumers pay as usage. Storage, security, infrastructural parts, computation resource and many more fall under the resource pool.

The concept of Cloud computing arises from single and obsolete technology integrating with several technologies for better understanding across many applications so that consumers can get advantages. Chellappa et al. (1997) described the Service of Cloud computing in detail. It provides all kinds of services, and these are estimable and chargeable. The periphery of computing, storage, safety and data processing have developed so much after the influx of cloud computing. The realm of data analytics can be highly influenced by the amalgamation of Big Data and CC.

The fundamentals of CC are explored and worked on by Zhang et al. the older computing tools like cluster and grid technologies are the forefathers of Cloud. Maximum computing and distributed resource management services from cloud computing are similar to grid technology. For computation and resource management, the grid has many plus points. This has been utilized for job-scheduling and load balancing for available resources while cloud computing is about applications which are not platform-restricted. Various platforms and services like operating system atmospheres are involved when it comes to providing service-infrastructure.

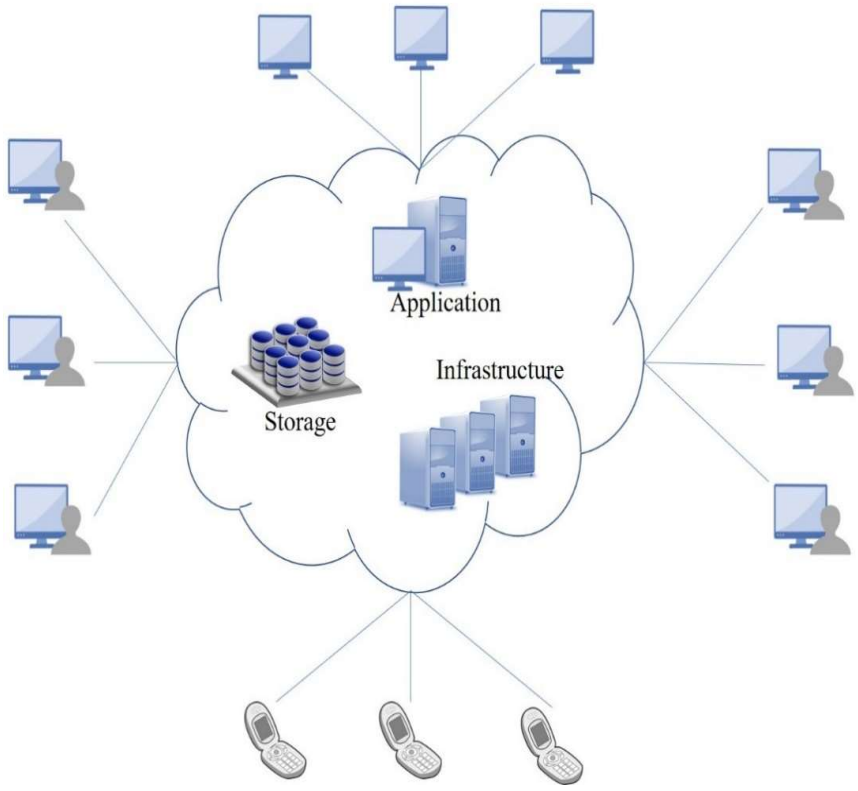

Figure 1.2 Cloud Computing

CC has turned out to be an interesting and popular solution when it comes to providing cheap as well as handy access for externalizing Information Technology resources. More and more companies (for example, research centers and organizations) are benefitted from Cloud

computing for hosting their applications. With the help of virtualization, it is about addressing the similar physical infrastructure with a huge consumer base having various level of requirements by cloud computing [10-13]. Cloud computing is different from its earlier paradigms like Clusters and Grid computing, as it doesn't have application-oriented aspect. Cloud computing is service based, and it fulfills the need for virtualized resources as billable and measurable usage [14][15]. In Figure 1.2, a simple and fundamental cloud computing structure can be seen. This article explores the features, scopes, problems and issues of cloud computing including the bright opportunities of CC in future.

1.2.1. ESSENTIAL CHARACTERISTICS

This part narrates the necessary features that a cloud process. Any cloud is anticipated to have these five features, and these are elaborated in the following [16]. Figure 1.3 represent the simple CC environment.

A. ON-DEMAND SELF-SERVICE

Without requiring human intervention, a customer can randomly provision computing capabilities like: network storage and server time, as necessary with the provider of each service.

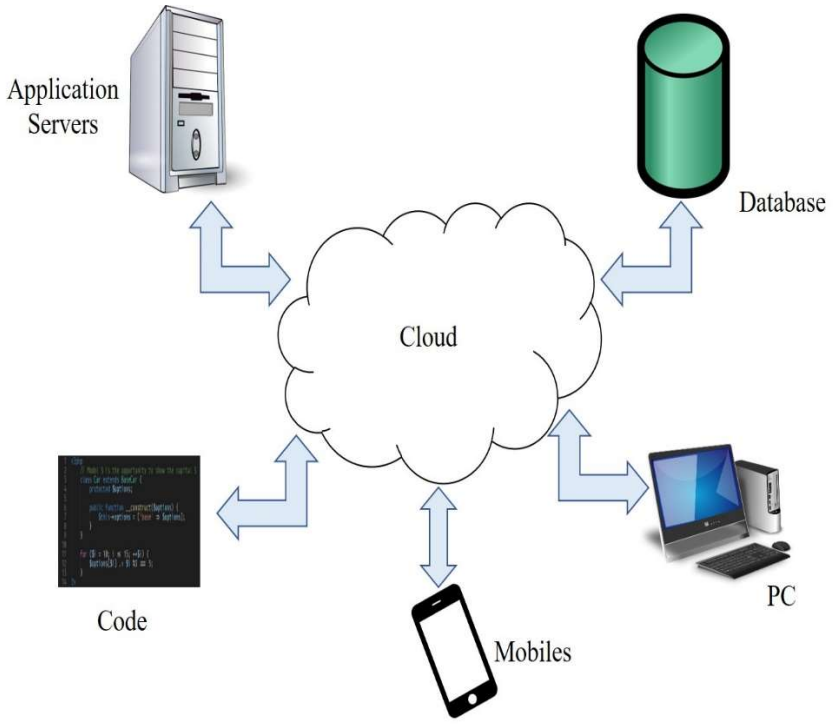

Figure 1.3 Cloud Computing Environment [16]

B. BROAD NETWORK ACCESS

There are capabilities across the network and can be availed across standardized methods that augment the usage by clients' platforms like mobile devices, laptops or personal digital assistants (PDAs).

C. RESOURCE POOLING

The computing resources of providers are used to give services to many customers through a multi-tenant model, with several physical resources and virtual which are reassigned and assigned as per the need of the client. The subscriber usually cannot control or know the accurate location of the given resources although they can be capable to identify the position at a greater standard of abstraction (Such as data center, state, or nation). Virtual machines, network bandwidth, memory, and storage, processing are some of the resources.

D. RAPID ELASTICITY

It is possible to provision capabilities swiftly and with flexibility, and in a few instances automatically as well for scaling out and scaling in purpose. Customers usually can avail unlimited provision which is buyable in any amount at any time.

E. MEASURED SERVICE

Cloud structures can regulate as well as optimize resource utilization by harboring a metering capability at roughly level of abstraction as per the service category (for example, active user accounts, bandwidth, processing, and storage). The utilization of resources can be checked, regulated, reported and thus there lies transparency between the customer and provider of the used service.

1.2.2. TYPES OF CLOUDS

Users can subscribe to various types of clouds on the basis of their requirements. If there is a small business owner of a home user then there is a probability that user's like to use public cloud services [17].

1. **PUBLIC CLOUD –** Any subscriber can access the public cloud with the help of an internet connection and can contact the cloud space.
2. **PRIVATE CLOUD** – It is a type of cloud that is created for a particular group or a certain organization. This space has limited access that can be used just by the specific group.

3. **COMMUNITY CLOUD** – It is a cloud space that is shared by 2 or many companies that have comparable needs from a cloud space.
4. **HYBRID CLOUD** – It is a of a minimum of two clouds where they could be a blend of private, public or even community.

1.3. HYBRID CLOUD COMPUTING ARCHITECTURE BASED ON CLOUD BUS

The design of CC can prevail over a large number of difficulties that can be found in the conventional architecture of the client servers like low performance and poor scalability [18]. It helps to make a better distribution of the computing tasks to the different cluster computers in a rather dynamic manner. It also helps to allocate the resources of hardware and software in a more flexible manner as per the requirements of the application usages. The needs of business development which finally helps to attain better on-demand access and offer a large array of inside and outside IT services [19]. Cloud computing can play a main part in improving the utilization of the server and attain an optimal performance of mass data storage and also computing.

A. ARCHITECTURE MODEL OF HYBRID CLOUD COMPUTING

The system of hybrid CC is based on the local private cloud that is combining with a single or numerous variety of public clouds. The inner structures of both public and private clouds are consistent when in the context of each other. It includes the virtualization layer and infrastructure, the storage centers, the management center, cloud platform layer, the cloud application layer and the cloud bus layer. The virtualization and the infrastructure layer are designed so that it can be incorporated to the underlying hardware resources into a single virtual cloister. It provides a large array of virtual resources to the region of the upper layer. The use of the cloud platform layer is often done to run the web applications and even the services. It is also used for further growth and integrated application through open interfaces. Further, the layer of cloud bus is made of several node buses, a control bus and adapters are fabricated so that it can monitor and can manage the different services of the layer of cloud platform. The application layer of the cloud consists of the PAAS and the SaaS service applications. The center of management is often utilized for user management, task management security management, resource management service quality assurance and also system configuration.

The center of storage is often used for the prices of data processing and it also stores different elements of the cloud environment. Figure 1.4 shows the architecture of hybrid CC.

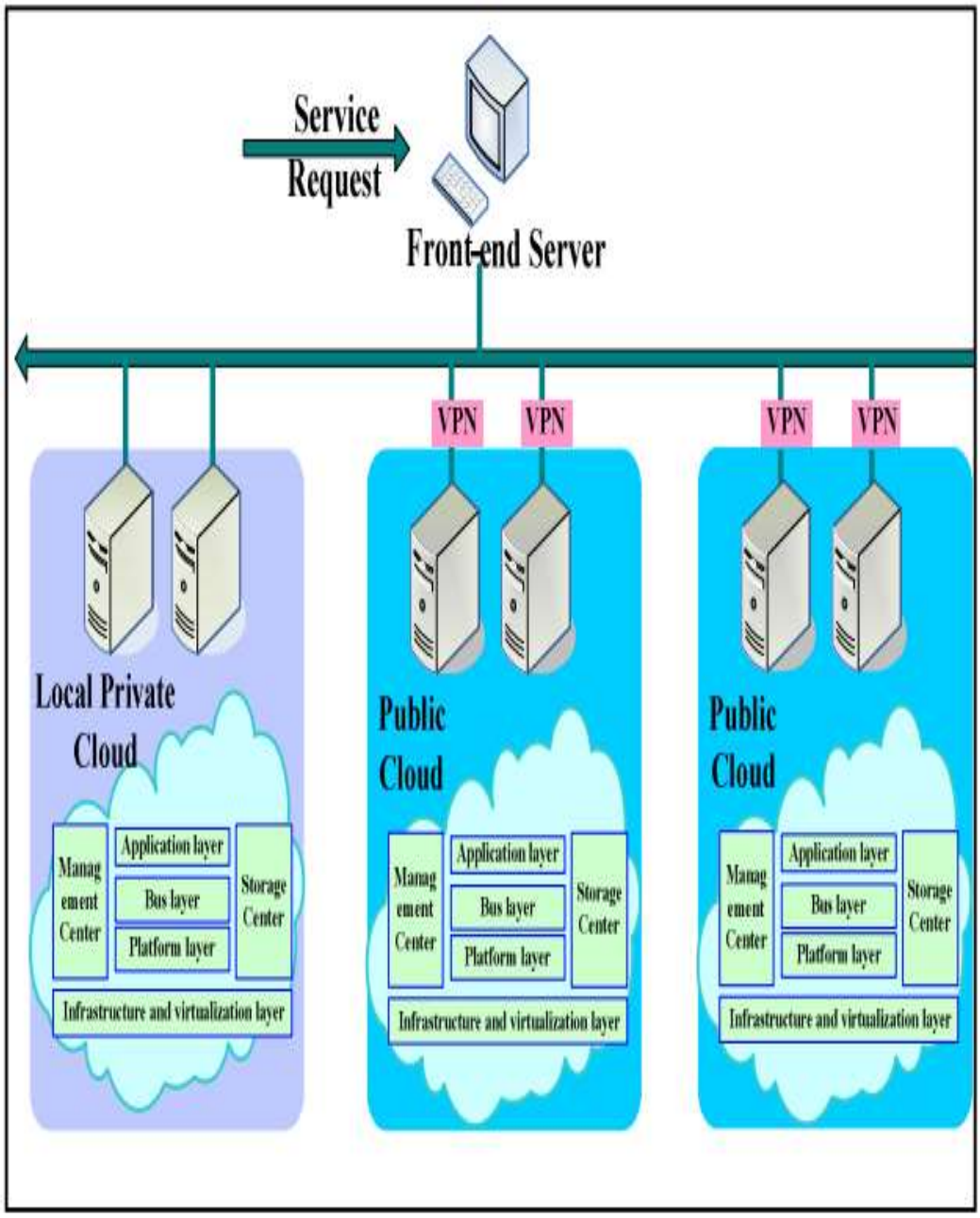

Figure 1.4 Hybrid cloud computing architecture [20]

B. CLOUD INTERNAL STRUCTURE

The internal elements of the public and private cloud are structurally coherent with the suggested hybrid cloud computing architecture. This structure comprises of two centers and four layers. These four layers can contain the virtualization and the bus platform, the infrastructure layer and the application layer along with the platform layer. The two centers

comprise of the storage and the management centers. Figure 1.5 exhibits the details of the structure of the cloud.

C. FUNCTIONAL DESIGN OF CLOUD INTERNAL STRUCTURE

Within the inner structure of the cloud, the virtualization and the infrastructure layer are often separated into a couple of factors: the virtual and the physical layer. The virtual layer comprises of the IaaS solution that makes use of the technology of virtualization so that a large virtual cluster can be built on the resources of the hardware. This provides various kinds of virtual storage, servers, virtual memory etc. Next in line is the physical layer that includes the storage devices, the servers, the network devices etc. The virtualization layer takes the physical resources as a whole single unit. The machinery of virtualization uses by this layer for unified management of the various resources and manages the real time data like load information and performance. In the meantime, it can also lead to auto addition, auto-discovery and auto maintenance of the physical devices and improve the overall scalability. The virtualization layer and the infrastructure can also bring about a self-adaptive, flexible virtual cluster that has a big ability of computing and also an ability of fault tolerance. Apart from offering virtual resources the virtualization layer and infrastructure also offers a set of tools that can be used to manage run and deploy applications. It can also execute the different requests from the applications at all times.

The cloud bus layer happens to be the crucials core component in this model. It has been seen that a majority of the current solutions of cloud computing happens to be rather cumbersome and complicated in their integration information nature. The bus layer is designed so that this situation can be avoided, and information integration can be simplified in the context of the cloud environment.

The bus layer often comprises of three different parts – the core layer, the application adapter layer and the service adapter layer. The adapters are required by the service adapter layer which is used for communication with the service providers. The core layer offers some of the fundamental functions like registration of service, monitoring of services, routing of messages and gain access to authentication. The application adapter layer offers adapters that can be used for communicating with different software applications which include the J2EE and the.NET applications. The bus layer happens to be the core that can be used for the implementation of the data exchange without much of difficulty. It happens to be an independent component of

communication that does not depend on any special language or platform. The bus layer can encode the transmission data for external users to increase security.

As shown in figure 1.5, the application later comprises of three parts – the enterprise applications utilized by the internal users, the enterprise platform utilized by both the external and internal users and the enterprise applications utilized by the external users. The enterprise application that is utilized by the internal users comprises of the ERP, CRM, Recruitment System, OA and the Portal Website. The enterprise application that is used by the external users are comprised of the OA, CRM, and Storage application. MIS etc.

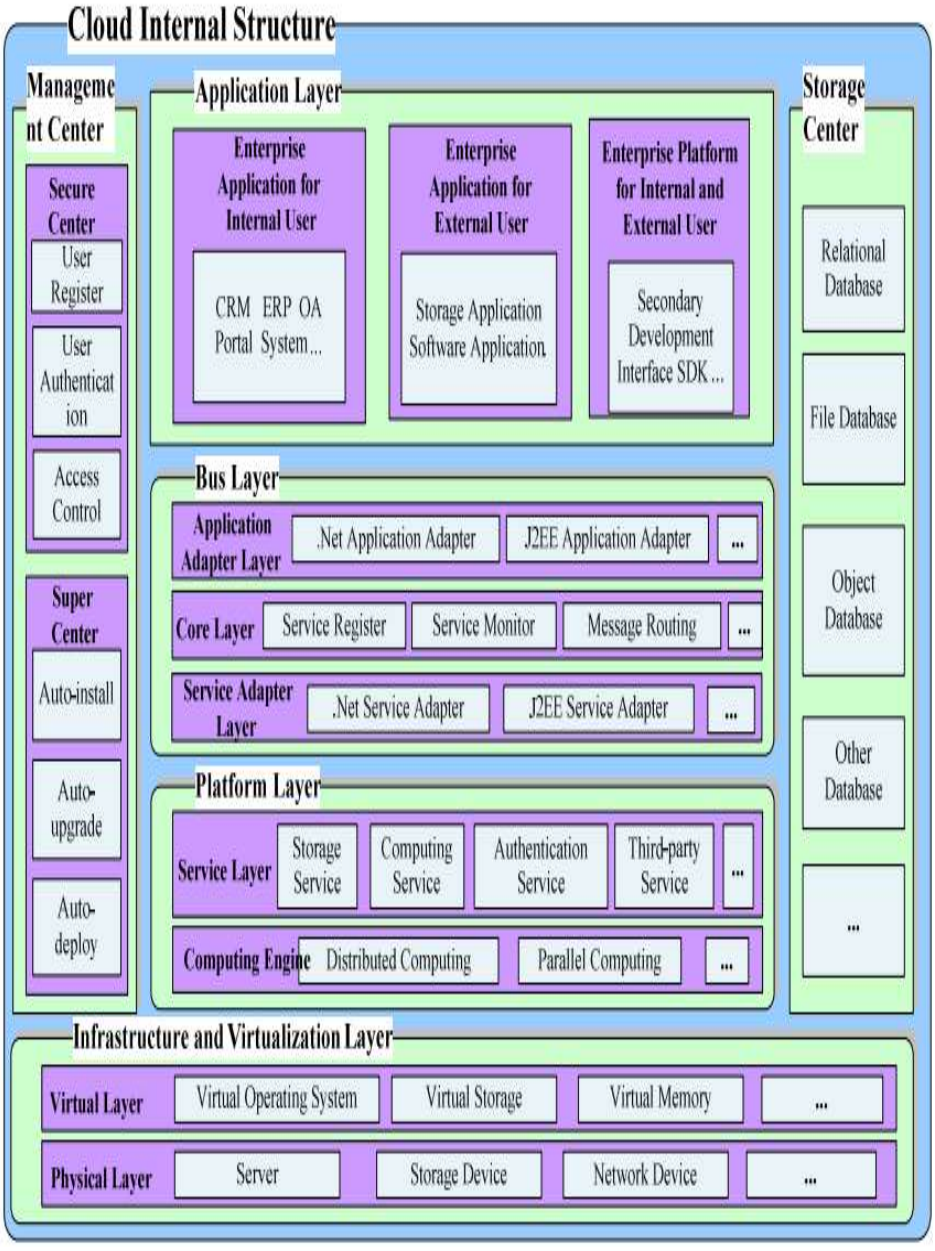

Figure 1.5 Cloud internal structures [20]

The applications are offered to the external users so that interfaces for the purpose of application-specific growth can be provided along with the SDK of the platform for the benefit of the external and the internal application. This is how the interfaces can be easily integrated with the help of Mashup technology.

The management center is divided into two sections: the security center and the supercenter. The aim of creating a supercenter is to make it easy to customize and deploy cloud computing systems, as well as to automate implementation and upgrades. The majority of current cloud storage systems are very difficult to install and deploy, and the management center can help to prevent this. It uses a one-click download to reduce the technological requirements of cloud infrastructure deployment.

1.4. CLOUD SERVICES

A cloud service happens to be any form of service that is provided to the users on their demand or need through internet from the servers of the cloud computing service provider, which is different from getting the services from a company's own servers. The term 'Cloud computing' indicates certain paradigms of computing making use of the virtual private networks or the VPN services. This is a reliable, dynamic and a cost-effective environment with a guarantee of service quality. This is how a number of applications are executed in a dynamic manner that can meet several needs of the user. CC as domain also includes the element of SOA or service-oriented architecture and also virtual applications that happen to be based on both the software and also the hardware. CC as an idea indicates at abstract computation. It does not indicate at any particular system of architecture. These servers in the cloud might be virtual machines or even physical machines. The applications that can be attained out of CC can be quite limitless. The end-users with the help of the services of CC can locate storage capacity, different hardware architecture and network connectivity. This is a technology that aids effective computing with memory processing, centralizing storage and bandwidth without the user coming to know anything.

1.4.1 CLOUD COMPUTING SERVICES

A cloud has the potential to connect with any application or the client (customer) in a wide variety of easy through its own abilities that are referred to as services. The models of these services are the functional designs on the basis of Cloud computing. Three main types of models, services have emerged so far in the world of web.

1.4.2 INFRASTRUCTURE AS A SERVICE (IAAS)

The CC service providers offer virtual and physical computers that have an additional capacity of organizing gadgets. The hypervisors are used for controlling the virtual machines where the machines are sorted in the form of pools and are controlled with the help of operational emotionally supportive networks. The cloud clients are bound to introduce pictures of working frameworks on the virtual machines and their programs of application. IaaS resources such as bandwidth, storage, IP addresses, monitoring services, virtual machines, firewalls and so on can be accessed by the consumer in place of rent.

The consumer is offered the capacity of processing, networks, storage and other software that they wish to run and the OS which they select on the infrastructure of the cloud. The consumer controls the components of networking like the firewall, OS, storage and the deployed applications rather than the cloud infrastructure. The IaaS is a model of provision where a company outsources the various equipment that is utilized to support operations that include servers, storage, hardware and various components of networking. The client typically pays on a per-use basis, IaaS refers to the provisioning of associated software (file system, operating systems, and virtualization technology) as well as hardware (network, server, and storage) as a service.

- **UNDERSTANDING IAAS**

IaaS is a kind of hosting. It includes various elements such as routing services, network access and also storage. The provider of IaaS provides the administrative services, hardware that is required to store applications and also a platform that could be used for running applications. The other elements of storage, memory and scaling bandwidth are also included along with the factor that the vendors compete within themselves on the aspects of pricing and performance. The equipment's is owned by the service providers and they also happen to be responsible for the aspects of maintenance, running and hosing of it. IaaS can be bought on the basis of a contract or on a pay-as-you-go basis.

The IaaS offers an environment that could be conducive for the running of virtualized systems in the cloud. Using the techniques of how virtual machines are built for an environment of IaaS, uploaded in the same environment, configured and next how it is deployed in the same environment is used for the creation of the virtual machines on the same premise. Then it is loaded along with the software that is finally used in the running of the cloud. This aspect also

covers the licensed and the custom-built software. When the virtual machine is created then it is uploaded to the provider hosting environment of the IaaS. It's set up here, along with the vendor's IaaS raw stock. After the virtual machine has been installed, it can be implemented and began using some kind of automation that finds available hardware to operate the virtual machine (VM). If the VM is started and running, the Infrastructure as a Service provider should ensure that the VM as a whole remains stable.

- **IAAS PROVIDER AND CONSUMER [21]**

The main functions of a cloud environment comprise the service provider and also the service consumer. The consumer of cloud service requires ensure anywhere, anytime access to the low-cost services that can be adaptable and also much simple to utilize. The major challenge in the context of using a cloud is the discomfort of the customers in the task of service security and the underlying data, service reliability and availability, service management that ensures service quality. This ensures control over policies and access and a proper administration to accommodate flexible pricing designs. It is the service provider who actually runs the service that is given to the final consumers. The one that is created by the creator of cloud services are in requirement of capabilities and tools that offer various services. It also offers various incentive designs so that the consumers and the end-users keep coming back to the services [22]. The service provider requires integrated IT services, the flexibility to add and eliminate resources on-demand, a non-disruptive way to save money, and the ability to charge for use.

- **COMPONENTS AND CHARACTERISTICS OF IAAS INCLUDE**

1. Service of utility computing and model of billing.
2. Administrative and automation tasks.
3. Desktop virtualization
4. Dynamic scaling
5. Services based on policies
6. Connectivity of the internet.

- **BENEFITS OF IAAS SOLUTIONS [23]**

1. Reduction of the costs of the capitals
2. Users pay just for the services they require
3. The users have access to enterprise-level IT infrastructure and resources
4. Users can scale down and up the resources on the basis of their needs at any point in time.

1.4.3 PLATFORM AS A SERVICE (PAAS)

The PaaS is a great way of renting OS, network, storage capacity and hardware through the Internet. The model of service delivery enables a customer to rent the virtualized servers and the other related services for running the current applications and also testing and developing the novel ones. Platform as a Service is an extended part of the Software as a Service or SaaS. This is a model of software distribution in which the hosted software applications are provided to the customers through the Internet. Platform as a Service has a number of benefits that could be enjoyed by the developers. With the PaaS, the OS features can be altered and can be improved and improvised as and when required. This is a technology that allows geographically scattered development teams to operate and function together on different software development projects. Services can be attained from any sources that could be scattered across the world. This is one of the best ways through which the initial and ongoing costs can be reduced to a huge extent. A single vendor could be used instead of multiple facilities of hardware which reduces the overall expenditure and can unite the efforts of program development.

This is a more superior grade of cloud computing. In a PaaS, a cloud service provider provides offers and maintains a run both the computing resources and the software systems. The services of PaaS include the aspects of development, design and hosting of applications. There are other services as well such as collaboration, security, Db integration, web service integration and scaling. Users no longer want to worry about their resources of software and hardware and also the task of hiring experts for the management of the various resources. This is one of the schemes that offer better flexibility of software installation. PaaS also has an advantage in scalability.

It is the distribution of deployment platform and application development as a service to developers through the internet, allowing them to quickly create, launch, and maintain SaaS applications. It also includes devices for implementation and improvement, which are used to create applications. PaaS main feature is a point-and-snap interface that allows non-designers to create web apps. The customer is not required to purchase costly equipment, power, data storage or servers. As a result, scaling down or scaling up in response to application resource demands is challenging.

- **ADVANTAGES**

1. Pay for using the infrastructure.
2. Architecture supporting multitenancy.
3. Offers security and reliability

- **BENEFITS OF PAAS SOLUTIONS**

1. **COMMUNITY –** In a majority of occasions it has been seen that a huge amount of people are required in the making of cloud applications in PaaS environments. This helps to create a strong community that is supportive and can assist the development of a certain team a long way ahead.
2. **NO MORE UPGRADES –** The infrastructure program would not have to be updated or upgraded. Instead, the PaaS vendor is in charge of all program patches, updates, and scheduled repairs. The investment required in the process is also quite low which yet again happens to be an added advantage.
3. **SIMPLIFIED DEPLOYMENT** – The development team can now simply concentrate and focus on the task of cloud application development without any worry about the deployment structure and testing.

1.4.4 SOFTWARE AS A SERVICE (SAAS)

SaaS is a model of software distribution where the applications get hosted by a certain service provider or a vendor. The user sees the SaaS as a network-based programming platform through which the internet is used to provide services that are viewed via a Internet. SaaS has become really important in the current times and is gaining notice in the context of the delivery model which is conducive for the web services and the SOA. SaaS is quite closely related to the application service provider or the ASP and also in the context of demand models of computing software delivery. IDC has identified a couple of different models delivery for SaaS. The first is the hosted application management or the hosted AM. This is a model which has much similarity to the ASP where the provider hosts have commercial software for the end users and provides it through the web. In the model of software on demand, the provider offers access on the basis of customer network for a single copy of applications that are created just for the distribution of SaaS.

Cloud service providers are accountable for managing and running operating systems, application software and other services in this model. The user sees the SaaS paradigm as a network-based programming platform through which the internet is used to provide

services that are viewed via a web browser. Google Docs and Gmail are examples of hosted apps that can be accessed from a variety of platforms such as laptops and smartphones. In contrast to conventional applications, SaaS eliminates the requirement for customers to maintain, update, purchase licenses, install, or run software on their own computers [24]. Scalability, multitenant efficiency, and configurability are among the other benefits [25].

- **ADVANTAGES**

1. SaaS is conducive for accessing a large number of applications
2. With the help of SaaS there is no longer any need to install a certain application
3. This is a technology that can support a number of concurrent users.

- **BENEFITS OF THE SAAS MODEL INCLUDE:**

1. Faster deployment
2. Helps to implement automatic patch management and updates
3. Simple collaboration
4. All users have the same version of software.
5. Accessibility across world

1.4.5 RECOVERY AS A SERVICE (RAAS)

Companies can replace their disaster recovery, archiving, backup, and business continuity tools with a single, streamlined network using Recovery as a Service solution. Companies can restore whole database files, servers (data, configuration, operating system, and applications), and data centers with the help of RaaS providers.

- **BENEFITS OF RAAS SOLUTIONS**

1. Prevent permanent or temporary loss of critical data of any company.
2. Protects from permanent loss of physical infrastructure that can include the IT infrastructure.
3. Cost-effective process through which data can be recovered.
4. Faster recovery and also maintains accuracy.
5. Have more consistency in terms of the type of backup needed (either secondary or primary backup).

Cloud platforms can help businesses save money by increasing productivity and lowering prices. Various cloud systems, enterprise procedures, and fields of specialization may be adopted by different organizations depending on their preferences. Until transitioning to cloud

providers, careful preparation and planning can be used in the case of an IT project. Figure 1.6 depicts the description of service models and some of the companies that offers these services.

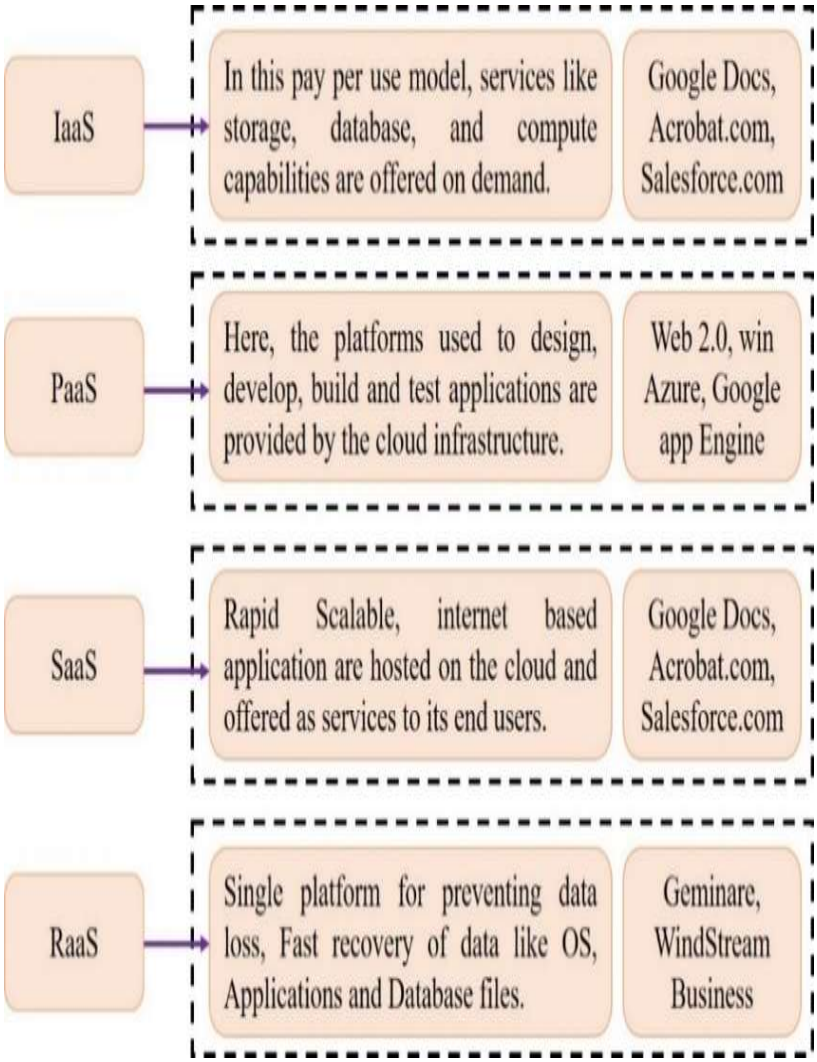

Figure 1.6 RaaS Solutions [26]

1.5. ADVANTAGES OF CLOUD SERVICES [27]

- The widespread usage of cloud machineries in our daily lives, particularly in industry, is frequently linked to instant access to resources utilized by millions for low service fees.
- Developing excellent IT solutions necessitates a wealth of experience, time, financing, and risk-taking. It is a difficult challenge. On the other hand, everyone needs to use IT rather than create it – and now cloud providers make this easy!
- Businesses that use cloud implementations don't have to spend a lot of money on human resources or infrastructure to get their software up and running. They can also select from a variety of options provided by a number of accredited cloud service providers.

Cloud technology is quickly being used by businesses of all sizes and types because it is cost effective and poses minimal danger to the enterprise. Cloud platforms are often created in such a manner that they can be used in a variety of businesses, regardless of their scale, form, or sector. As a result, production costs are spread over a large number of consumers, favorably affecting pricing strategy. As a result, cloud storage costs are relatively modest.

- Another advantage of cloud providers is that they are platform and place independent. Modern cloud networks are made up of complex geo-clusters of servers. As a result, a single piece of data is stored on various cluster nodes across the world and sent to the user as quickly as possible. In comparison to standard device architecture, this system has a higher quality of operation. Furthermore, cloud providers also provide an application programming interface (API), which allows users to extend the capabilities of the service and adapt it to their own requirements. The majority of solutions are Web-based, which means that even older machines can use cloud services.
- Since combinations of mobile personnel, or distributed teams and in-office employees can all work together on common information stored together in the cloud, cloud computing makes teamwork simpler. Employees who benefit the most from the cloud are likely to be remote employees, as Web-based apps enable them to be fully mobile while also completing their tasks.

The above main features of CC are only a little of the numerous benefits that cloud computing provides.

1.5.1 DISADVANTAGES OF CLOUD SERVICES [27]

- Cloud systems have several limitations in addition to their several advantages. The first shortcoming with CC is that it involves an Internet connection to fully use a cloud service. As an outcome, data can't be available at all while customers are unavailable or if the cloud service is disrupted. As a result, whether the operation is terminated or interrupted, there could be additional costs.
- However, some apps, such as Evernote (a note-taking app), have a decent hybrid option, or in-between with phone or desktop software as well as an online service that coordinates data to the cloud. As a result, some programs (such as Gmail) have some basic offline features. Security is a much more serious and difficult-to-resolve problem for cloud storage, both for vendors and for customers.

- The data storage security is defined by the location of storage and data processing. Only because data is collected on its own physical hardware and servers do organizations have complete control of it. Organizations that offer data and service in the cloud have no control of where their processes operate or where their data is processed, so they aren't completely aware of where their methods are operating or where their data is collected. It must have trust in cloud service suppliers to protect their privacy and adhere to the rules. As a result, companies and/or individuals may not be comfortable to store their information, particularly proprietary or confidential data, on someone else's Internet server.
- Before they can access cloud providers, end users must adhere to the privacy rules – it's a "take it or leave it" deal. As a result, if the data is not coded, cloud service givers may have access to it and can inadvertently or intentionally reveal it to third parties or exploit it for illegal purposes. Of course, this raises questions about confidentiality and privacy.
- One of the most serious privacy concerns is that certain social media systems are deliberately geared toward “cyber stalking”. For example, when Facebook recently introduced updates to its default privacy settings for sharing user information with friends. It was also discovered that Facebook would use the microphone on a user's smartphone to record and review music, TV shows, and other content they listen to. This sounds ominous.
- Last year, Google was forced by a European court ruling to enable petitioners to be "forgotten" by its search engine.
- Yahoo recently revised its policies to allow it to refuse customers the right to recommend that their actions not be monitored, claiming that this is a better “personalized experience”.
- Cloud service providers' primary purpose is a benefit, which is dependent on users sharing data and users being ignorant of the degree to which their privacy is violated.
- The majority of cloud service providers' revenue comes from companies who seek to collect as much data as possible on their users because it allows them to not only properly understand but also predict their desires, preferably before they are actively recognized by customers.
- Before anyone switches to the cloud, cloud providers must address these questions of reliability, trust, and confidentiality. Service level agreements (SLAs) or other uniform agreements have some compliance assurance. Cloud applications, on the other hand,

require much more dependable encryption mechanisms, privacy security, and offline usability solutions.

- There are a few options for dealing with privacy concerns in cloud computing. Law and Policy, as well as end users' preferences for data storage, are among the recommendations [28]. Clear and relevant rules describing how each cloud user's data can be processed and used must be developed by cloud service providers. Since encryption is one of the methods for avoiding unauthorized data access, cloud service customers should be able to encode their data while it is stored and handled in the cloud [29].

1.6. APPLICATION OF CLOUD SERVICES IN MARKETING

The marketing world for companies has evolved significantly in today's information ecosystem, due to cloud services. Companies who want to successfully: spread the word about their products and brands, fascinate buyers, connect with them, and eventually maintain them, must respond to the market shifts listed as quickly as possible. Those that may not do that would be left behind.

Any marketing principles are difficult to implement without cloud computing, and they were just concepts before cloud computing.

A. MARKETING AUTOMATION AND LEAD TRACKING

Marketing automation is a technique that allows businesses to cultivate and monitor leads. It includes marketing return on investment (ROI) measurement, customer retention, up-sell and crop sell, lead scoring and lead nurturing, relationship marketing, segmentation, and lead generation.

Marketing automation software, first and foremost, assists businesses in learning more about their customers and leads. Organizations should keep track and extend the profile data of their leads, which includes firmographic and demographic data that can be used to help target and segment the market. Profile data can also contain attitudinal data gathered from various studies and type queries, which can reveal a lot about a lead's intentions and authority. Companies develop a much better understanding of their audience and how information suits their desires by monitoring what was historically unseen – the experiences lead have with the organization's content.

Organizations can extend their business scope until they have a better picture of their leads. They can access more prospects more simply and efficiently through automatic outbound communications, whether in the form of messages, newsletters prompted by web registrations or nuanced automated nurturing campaigns.

Additional lead contact points mean more contacts and a better interpretation of leads, allowing businesses to better prepare them for engagement. The relationship begins with a thorough comprehension of the buyer's requirements, and the customer's journey continues from awareness to analysis to a purchase decision. As a result, through marketing automation systems, every customer phase is meticulously tracked by the IT infrastructure and is then compared to current data to forecast the next step, even further precisely than sales staff. Organizations can also produce content to help address the information needs of their leads at any point of the buying process, as well as monitor their level of interaction.

The primary aim of marketers is to turn visitors into leads, leads into sales chances, and sales opportunities into successful consumers. Using features including reverse IP lookup and real-time website personalization with collaboration scanning, marketing automation tools allow businesses to turn unknown users into eligible leads. These leads are tracked, scored, and converted into revenue opportunities by businesses.

Measuring is at the heart of marketing automation. As businesses use a marketing automation service to send out an email (for example, a newsletter), they may deliver it to more e-mail addresses. In addition, they track how many people have already opened the email in question and/or a particular (offer) connection inside the email. They can also recognize such recipients and keep track of them so that potential marketing efforts can be tailored to them. Companies can also monitor how many leads turn into prospective clients, and then into consumers, which is their main target.

Additionally, before launching an e-mail campaign, several separate copies of the e-mail should be prepared and checked each with a different title, material, and sending day and time. So, as a pilot test, various iterations of e-mail are sent out, feedback is evaluated and assessed, and the most effective scenario is selected and used for the final e-mail campaign.

For example, Mandrill and Mail Chimp services provide comprehensive analytics and influence over received e-mails, and their new mobile-friendly models enable them to target nearly anyone.

Well-known marketing automation cloud systems with very similar collections of solutions complement a broad range of marketing strategies and provide a wide range of application possibilities. They are as follows:

1. **ORACLE ELOQUA –** This includes content development models for marketing activity personalization, lead scoring/analysis, lead segmentation, social media ads, landing pages, and e-mails.
2. **MARKETO –** It also helps with demand generation, prospect relationship building, driving sales, measurement, and optimization.
3. **GOOGLE ANALYTICS –** It provides comprehensive data analytics, reporting, and conversion and sales tracking.
4. **ADOBE MARKETING CLOUD –** Cross-channel strategy management, web experience management, targeting, analytics, and social media monitoring are among the services it provides.

B. INBOUND MARKETING

Marketing automation can be inbound (example, social media marketing) and outbound (example, email marketing).

Some outbound marketing strategies have issues such as increasing blocking machinery (do not call lists in phone marketing, spam filtering in e-mail marketing, etc.), and monitoring return on investment (for TV or print ads) as a consequence, high cost – low yield.

The biggest benefit of inbound marketing is the robust monitoring and measurement capabilities. As previously said, monitoring was previously unseen social networking allowed businesses to get a much broader image of both their opportunities and future buyers, as well as a much richer understanding of their customers' needs, wants, and preferences.

Members to social media are more likely to be available. Users who spend a lot of time online and on social media become really involved in them and feel close to their peers through them. They pay attention to what their online peers have to say about services and products, which increases their interest in those products. Since it has become easier to personalize social network marketing strategies, lower marketing costs, and increase transfers, all as an outcome of expertise gained from extensive user data research, social network marketing campaigns are becoming more effective.

In simple words, inbound marketing is the process of producing content and publishing it on the Internet. Inbound marketing is a tactic that focuses on acquiring consumers or leads while providing original content, allowing prospective customers to come to the brand rather than advertisers competing for their interest. The advantage of inbound marketing is that content readers are involved in the content and actively seek it out, so they become possible buyers and even prospective promoters right away.

Inbound marketing is one of today's most common marketing strategies. Regardless, excellent marketing techniques necessitate certain technical and human knowledge and resources.

It takes a lot of energy and time to produce high-quality content. Furthermore, content marketing necessitates current awareness sharing, an aggressive instructional approach, a broad understanding of product and related topics, and outstanding writing skills. Both of these skills are necessary if advertisers want consumers to trust and value the content, to connect it to the product or business, and to become emotionally invested in the overall concept, so that they can share it with their friends and become brand or product promoters.

Self-published books, social media marketing, questions and answers pages, text or link sharing, podcasting, audio or video materials (tutorials, webinars, streaming video etc.), comment marketing, website activity, blog and tweeting, and so on are all examples of inbound marketing content. Sharing such content is simple with social platforms since they facilitate user engagement.

User experiences are commonly used to assess the effect of the published content. Social media platforms allow users to share content in a variety of ways. It includes targeting the correct demographic, tweets, and interactions, generating descriptive data on users, images, and videos, selecting the appropriate language, arranging post dates and times, reposting and post-editing. End users can select if they want to be delivered content and they have a large range of options to make their social network experience more pleasant. They can select their preferences and how they want to be updated. The frequency and relevance of those alerts and details, so content can be customized, and users can be provided with targeted advertising and ads with the right marketing and analytics skills.

Inbound marketing has been made possible by cloud-hosted platforms such as Facebook, Pinterest, YouTube, and Twitter. By automating content development and delivery, ROI measurement, and lead capture and management, effective inbound marketing tech helps companies simplify their marketing activities.

C. THE ART OF ENGINEERING WHICH MAKES IT ALL WORK SEAMLESSLY

In general, marketing-oriented cloud providers target new clients and encourage them to communicate with the company's content.

Twitter, Facebook, and YouTube are the most common cloud providers. Users can post, comment, and like the content on any of them. Sophisticated algorithms allow for the indexing of video, audio, and graphical content. Which they process the data in specific cloud services to extract all kinds of metadata. It ranges from simple keywords to human faces (Facebook acquired Deep Mind, a small company that developed software that can recognize human faces with greater accuracy than a human being), and then algorithms can identify the content based on the results [30].

Advanced algorithms may also make forecasts for a wider number of individuals, as well as for the whole population. So, well-calibrated advanced prediction algorithms can forecast society sentiment and satisfaction, as well as major global events like protests and strikes, disasters, and even wars, with high precision.

To maximize the amount of analytics, social networks (such as Facebook) build widgets such as "Like," "Share," and "Comment" buttons, which can then be included in other websites. These "buttons" allow tracking of a user's actions around the Internet, in addition to providing a richer user interface and seamless content sharing mechanisms. On the Internet, a person can be detected in a variety of ways. The most popular method is by login, during which a cookie is stored on the user's account. It allows information about the user's activities to be collected and saved each time the user visits pages with Facebook widgets, regardless of which device they are using. Cookies also collect information on which external sites are accessed before and after Facebook sessions, in addition to tracking users' behavior on the site. Sophisticated algorithms then are used to quantify consumer behavioral habits.

Marketers can thoroughly profile customers with all of the data collected, and their experience can be nicely personalized based on all applicable data. One-to-one marketing, also known as personalized marketing, is an intense type of database marketing that results from personalization.

Product distinction used to be the cornerstone of marketing. Marketers attempted to set their offerings apart from those of their competitors. Personalization has altered marketing concepts

by attempting to provide a one-of-a-kind product package for each consumer. As a result, consumers are delivered information that is precisely what they want to see, read, or purchase. Since the majority of people in developing countries already own smartphones, personalization is much easier. For example, Smart phones transfer their location information to cloud providers while transmitting audio or video files, and new marketing campaigns are focused on proximity services, so customers get push alerts based on their actual location. For advertisers, smartphones reflect a massive opportunity and a significant benefit. Almost all information can be collected and classified using tech tools like HP Autonomy's HAVEn, resulting in unimaginable rich meaning for a particular consumer. Since these tools evaluate and interpret "big data," advertisers may learn more from consumers than they are conscious of giving them a significant edge in sales.

It is now possible to predict customer desires and target web ads and information to a single user due to "algorithms" and big data. Furthermore, utilities that enable users to personalize their smartphones and make it easy to automate activities across multiple apps are bringing ever more levels of features to mobile devices. These services can adopt new technologies like augmented reality (AR), and the possibilities for further growth and deployment can be limitless. For eg, with augmented reality, all data streamed directly from the cloud and viewed on next-generation gadgets based on the user's position.

1.7. HYBRID CLOUD

Hybrid cloud is a type of cloud computing environment that includes the characteristics of private cloud and public cloud. Figure 1.7 shows hybrid cloud setup having public cloud and private cloud. Private Cloud provides resources with high security whereas public cloud provides resources at lower cost. Cost benefits and secured control of resources are the main advantages of hybrid cloud. Unlike federated cloud, hybrid cloud does not possess any cloud exchange for resource allocation; overheads incurred by them are eliminated. In hybrid cloud, when the resource of the private cloud is not sufficient, then it can outsource the resources from external clouds for scheduling the task from users and ensuring the elastic nature of CC.

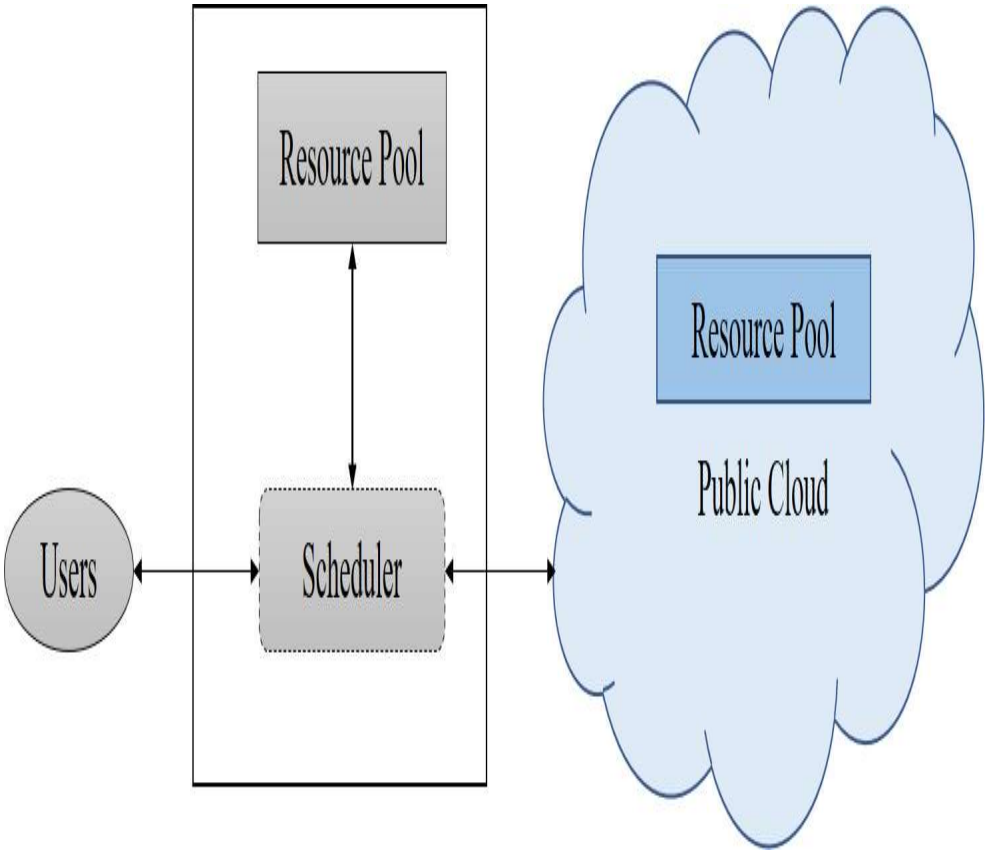

Figure 1.7 Hybrid cloud Framework

A cloud resource allocation structure was simplified [31] to allow for the use of External Clouds (ECs), with the goal of making the Infrastructure as a Service cloud more adaptable. An IaaS cloud, with its innovative nature, contained its own private cloud and outsourced its activities to other vendors known as external clouds when its own resources were insufficient. As every task possess a strict deadline, the resource allocation problem was formulated as Deadline Constrained Task Scheduling (DCTS) one. Particle Swarm Optimization (PSO) algorithm is one of the swarm based intelligent naturally inspired optimization algorithm. The standard PSO merely converges into local optima and does not appear to be robust for the severe problem scenarios. Since the scheduling of tasks to the resources in hybrid cloud is a complex one, an extended version of PSO namely Self adaptive Learning Particle Swarm Optimization (SLPSO) technique was developed. It employs different velocity updating strategies. Even though SLPSO guaranteed added profit with assured Quality-of-Service, it resulted with overhead in the choice of velocity approach.

A hybrid cloud, in the most generic form, is a mix of private and public and clouds. “A hybrid cloud is a mixture of private and public and clouds joined together by either generic or proprietary technologies that allows data and device portability,” according to the National

Institute of Standards and Technology (NIST). That may be a hybrid between an internal private cloud and one or more public cloud providers or a private cloud operated on third-party premises and one or more public cloud providers. Trend Micro, a cloud protection firm, recently published a study that found that public cloud providers fall short of meeting the IT and business needs of certain businesses. Hybrid clouds should be thought of as a transitional stage as businesses plan to transfer the majority of their workloads to public clouds. In recent years, public clouds have become increasingly common. The public cloud makes almost immediate resource provision and quick scaling without the need to manage a data center. Amazon's EC2, a subsidiary of Amazon, has made a significant contribution to the advancement of public cloud and is regarded as one of the first public cloud solutions. However, not only is the cloud ecosystem rising quickly but so is the number of critiques. Public clouds have inherent risks, not only in terms of data protection and safety, but also in terms of other issues (like interoperability, cost, vendor lock-in, and availability). The use of both public and private distribution models, and integrating them into a hybrid cloud, is an obvious but not trivial approach to these problems [32].

1.8. DECISION-MAKING MODEL FOR ADOPTING A CLOUD COMPUTING SYSTEM

Many businesses are undergoing digital transformation as they combine traditional services and operations with digital transformation initiatives and technologies, not just to ensure their survival but also to grow profitably in the fourth industrial revolution (i.e., social media solutions, big data analytics and cloud, IoT, drones and robots, and AI) [33]. Since its inception in 2006, cloud computing services have grown significantly. The basic service at the beginning was Infrastructure as a Service, which offered physical computing power such as network, servers, and storage. However, PaaS, which offers a programming platform for developers, has grown to be a major part of cloud services. And SaaS has made up a considerable portion of cloud providers. Furthermore, hybrid IT has been used in the evaluation of an IT infrastructure model. According to Internet Data Center in South Korea [34], IT spending has increased at a rate of 4.5 times since 2009. It is expected to increase at a rate of more than 6 times until 2020, bringing overall public cloud computing spending from $67 billion in 2015 to $162 billion in 2020.

Since 2011, communication service providers like SK Telecommunication (SKT) and Korea Telecommunication (KT) have started cloud computing services for businesses with services

aimed at established individual users in the Korean cloud computing industry. In addition, in 2012, the South Korean government unveiled G-Cloud [35][36], a cloud computing facility for government agencies. To improve the economy, the South Korean government enacted the Cloud Development Act in 2015 [37][38], urging policy reforms to become a leading cloud computing nation by 2021. Since 2015, global cloud service providers have established data centers in South Korea and have focused on cloud storage services. Firms also gained a gradual appreciation of the value of cloud infrastructure implementation. As a result of these developments, and cloud infrastructure is now considered a common necessity consideration for any digital transformation initiative. According to research conducted by the International Data Group (IDG) [39], the cloud has been growing in popularity due to benefits like efficiency, agility, and flexibility. Over the last few years, four out of ten South Korean businesses have introduced cloud computing, with 53.1 percent of conglomerates in Korea having already done so.

This model gives hierarchical decision structure model focused on the underlying decision factors of cloud computing adoption, with decision attributes, areas, and factors. The paradigm can help with cloud infrastructure service adoption and system management decision prioritization. Modern market systems on the other hand, have undergone accelerated transformations as a result of disruption models involving an emerging technology. In addition, the evolution of open-source technologies, AI, and GPU computing are creating a significant shift in the cloud computing region.

1.8.1 CLOUD COMPUTING SERVICES IN THE IT INDUSTRY

Since 2000, the use of cloud computing, AI, big data analytics, social media and platforms has exploded [40]. These drastic developments have resulted in a series of technologies that have been dubbed the "digital revolution" [41]. The fourth industrial revolution is described as “a convergence of technology that blurs the boundaries between the biological, physical, and digital spheres.” In this climate, in 2006 [42], service providers such as Amazon and Google introduced cloud computing services on the market with the advantages of low maintenance and low cost. Cloud computing is a collection of internet-based distributed computing, hardware, virtualization, and automation technologies that allow on-demand self-service, such as fast auto-scaling and auto-provisioning [43]. Cloud infrastructure is a new concept for a computing usage model [44] focused on agreed-upon service level agreements (SLAs) between the demander and the service provider. Cloud computing has sparked a lot of

interest and study in the IT industry [45] because of its fast rise, ubiquitous existence, and pervasive capacity.

The cloud infrastructure concept, according to Weiss [46], was based on legacy architectures and technology such as multiple cloud shapes, SaaS, the data centre, utility grid and distributed computing. Cloud computing, on the other hand, is a convincing concept that encompasses a wide range of computing models. Between 2008 and 2012, advanced academic reviews in cloud computing were released, which clarified operational and conceptual solutions [47]. Cloud storage, for example, is described by Armbrust et al. [48] as "the application of services provided over the internet with the hardware and system software for the services stored in data centers." According to Foster et al. [49] Cloud computing is a distributed computing model characterized by managed, dynamic scalability, virtualization, and abstraction services. The National Institute of Standards and Technology (NIST). Mell and Grance [50] have mentioned cloud computing's characteristics, deployment models, and service models stating that "cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources like services, applications, storage, servers, and networks that can be released with a single click." On-demand self-service, strong network connectivity, resource pooling, accelerated elasticity, and calculated service are the five basic characteristics. SaaS, PaaS, and IaaS are the three service models. It may also be one of four deployment models: public, private, community, and hybrid." Customer demand and cloud computing infrastructure control capabilities were used to choose the characteristics. Software as a Service is an application service distributed via cloud infrastructure that is centrally provided and metered on a subscription basis, according to the cloud computing service model. PaaS provides programming systems and application stacks with software environments. It runs technical solutions on a CC infrastructure [51] without the need for a developer to supply the cloud computing environment with software and hardware. IaaS, on the other hand, offers computer hardware such as storage, networks, and virtual machines, as well as system software such as operating systems [52]. A wide range of cloud storage platforms has been available in recent years.

1.8.2 CLOUD COMPUTING ADOPTION AND INFLUENCE FACTORS

Industry leaders, governments, and research institutes have recently raced to implement a cloud computing infrastructure to solve rising computation and storage problems. Cloud infrastructure was also projected as an inevitable future management mechanism for businesses

operating in the latest technological growth environment [53]. The cloud computing adoption [54] approaches examined and addressed the feasibility and strategic orientation of cloud adoption, as well as problems and concerns such as integration, security, and performance, and cloud interoperability solutions [55]. Many researchers have looked at the successes and failures of cloud computing adoption. The most common study topics have been determinants and success factors of cloud computing adoption [56-58]. Cloud-deployment success factors were investigated [59] and discovered a connection between cloud-deployment efficiency, managerial capability, trust, and technological competence. Low et al. [60] identified environmental, technical, and operational backgrounds to better explain cloud adoption decision components. Another best-fitting model was considered in [61] for implementing cloud services in a business. A measurement metric was created in [62] that combines information quality, system efficiency, and net benefits to assess cloud system performance.

The TOE (technology, organization, and environment) system was used to verify Low et al. [63] underlying model for cloud computing adoption. After that, it established a relationship between the moderating influences of IT governing mechanisms and examined these relationships in depth.

Alshamaila et al. [64] sought to investigate and establish a cloud computing adoption model for medium and small businesses. For cloud adoption, a TAM (Technology Acceptance Model)-TOE system [65] and a goal-oriented approach [66] were developed. The strategy included requirements for engineering steps, goal categories, and cloud adoption steps. A toolkit was developed for decision-makers to use in order to define threats and organize appropriate techniques and methods. The case studies identified the direct impacts of CC on the organization across a broad variety of operations, including multinational organizations, in a recent analysis of cloud adoption from a national perspective and for medium and small enterprises.

Two points were discovered as a result of the suggested approach: To begin, numerous cloud computing adoption variables may be classified as environmental, technical, and operational. The second goal was to get a better understanding of how cloud computing is being used in various industries. For example, Géczy et al. [67] suggested a paradigm of three major dimensions: cloud computing adoption issues aligned with current corporate process models, management and regulation of organizational data and resources, and legal aspects. Low et al. discovered that the technical context's “relative benefit”, the corporate context's “top

management support” and “firm scale”, and the environmental context's “economic burden” and “trading partner pressure” all had statistically important effects on cloud computing adoption in the high-tech industry. They also realized that "complexity," "compatibility," and "application readiness" were not considered major considerations. Bahsoon and Zardari used a goal-oriented approach to offer structured advice that was based on organizations weighing the benefits and costs of CC adoption. It emphasized the importance of setting objectives. A cloud deployment paradigm was suggested [68] that focused on resource-based philosophy that stressed organization-specific resources such as “application support infrastructure contextual resource " and " technological infrastructure”. Khajeh-Hosseini et al. [69] created a cost modelling technique to highlight that “cost” is one of the influencing factors for cloud computing system adoption.

1.9. DECISION SUPPORT FOR CLOUD SERVICE SELECTION [70]

It is well known fact that migrating an application to the Cloud necessitates making a lot of decisions on how the application can be refactored for the Cloud. In this context, the Sot A's emphasis on performance prediction and cost estimation, only provides partial support for these goals. It addresses those issues by providing an outline of the principles which is needed to incorporate a decision support system to support device migration to the Cloud. This holistic view defines, our vision on what constitutes a full solution for stakeholders and application developers who are deciding whether or not to move their application to the cloud.

More precisely, two categories of principles have been identified: decisions that must be taken (and therefore are the system's focus) and activities that must be completed in order to facilitate these decisions and as a result, influence their outcome.

Each of these decisions has an indirect or direct impact on the others, as shown in Fig. 1.9 by the transparent arrows. For example, choosing the right elasticity approach is pointless until the Cloud service provider backs it up. The decision on which service delivery model has to be used is a part of the service provider selection process. As a consequence, it has a significant impact on both the distribution methods for the application and how multi-tenancy can be applied.

The following tasks are often listed, in addition to the decisions and their relationships.

1.9.1 WORKLOAD PROFILING

Estimating or defining the application's estimated workload profile is used for both other tasks (cost analysis and performance estimation) and as a guidance for any decision about how to allocate the application.

1.9.2 COMPLIANCE ASSURANCE

Ensuring compliance with regulations regarding, for example, personal data protection has a direct impact on both the provider's selection (especially in terms of data service location) and how the application is delivered, as personal data may need to be stored on-premises.

1.9.3 IDENTIFICATION OF SECURITY CONCERNS

The selection of a suitable service provider that meets these protection constraints is guided by defining which data and communications are vital to be secure. Delivering the program in a multitenant environment creates additional data separation restrictions that must be considered for this role.

1.9.4 IDENTIFICATION OF ACCEPTABLE QOS LEVELS

Appropriate thresholds for Quality-of-Service characteristics including service provider availability can be assumed based on current and expected SLAs. This role also guides the concept of an effective elasticity approach to ensure the cloud selection process, in addition to service provider selection.

1.9.5 SERVICES

The CSP is questioned on the purposes for which data is used, the encryption mechanisms used, the access control mechanisms used, the location of the servers to be used. Whether there is any more outsourcing sharing of information with other organizations and the mechanisms. Based on this information in place that the CSP has for enforcing the organization's requirements down the chain.

1.9.6 USE CASE FOR DECISION SUPPORT

A use case is a system research technique for identifying, clarifying, and organizing system specifications. The expression "system" refers to something that is being operated or developed, such as service Web site and mail-order product sales. A basic notation for modeling real-world structures and processes, use case diagrams are used in UML (Unified Modeling Language).

Some examples of system goals are planning overall specifications, validating a hardware specification, evaluating and debugging a software product in progress, developing an online support reference, or executing a consumer-service-oriented role. Item ordering, inventory updating, payment collection, and customer relations are examples of use cases in a retail sales environment.

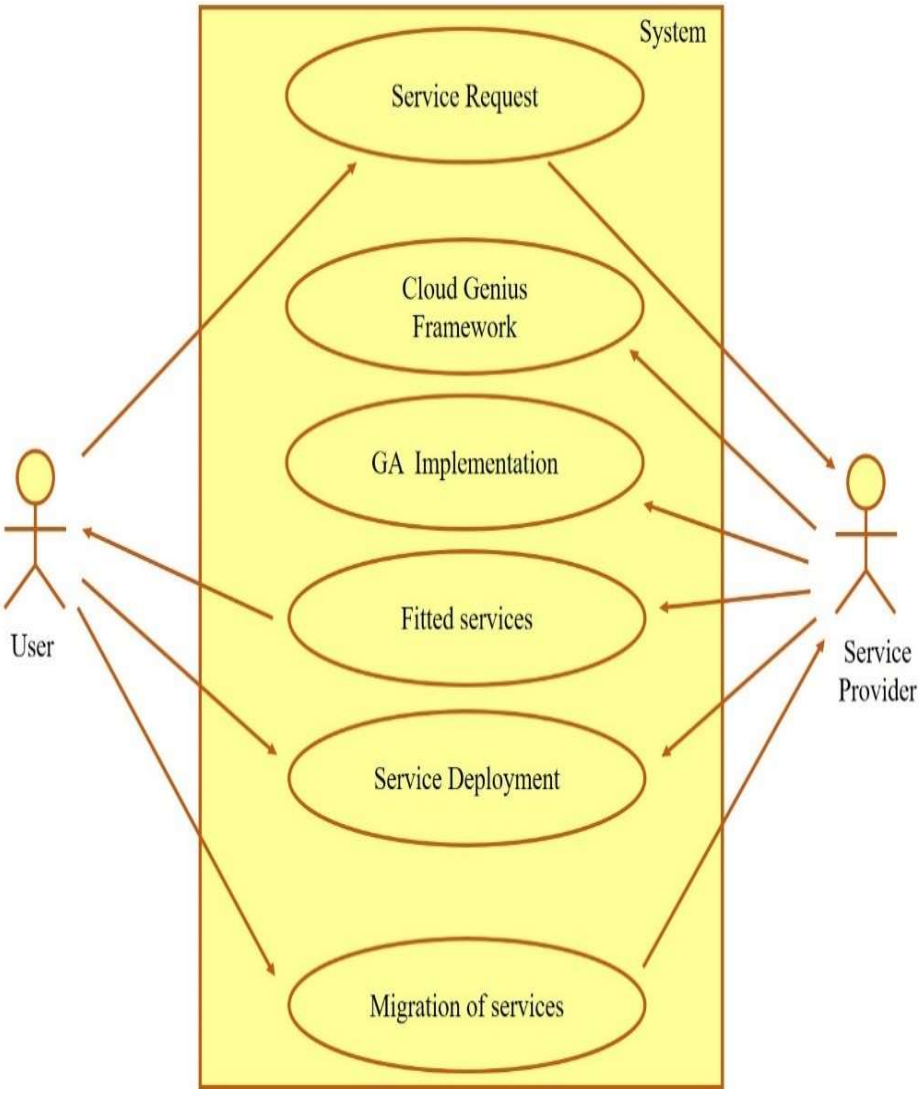

Figure 1.8 Use case for Decision Support [70]

Various TC representatives have submitted use cases, but each has been addressed using an agreed-upon "Use Case Template" for ease of usage and contrast. Identity is used in the cloud computing. It is easier to transition a configuration through cloud infrastructures if it is an accepted standard. This method of transfer is advantageous because it allows subscribers to seamlessly switch applications from different cloud deployment models and platform services without losing their identities. This group includes a list of one or more cloud employment or service models listed in the use cases.

1.10 DECISION SUPPORT SYSTEM FOR ADOPTION OF CLOUD-BASED SERVICES

Traditional IT aligns resources in the applications to meet their corporate objectives. Each program has its own data storage and infrastructure. Recovery solutions and Dedicated backup are also utilized to secure data and guarantee the integrity of company activities. Cloud Computing (CC), as an alternative, has newly emerged as a model that allows users to scale their computing resource consumption without worrying about over- or under-provisioning. Utility Computing, Service-oriented Architecture (based on loosely interconnected autonomous services), and Virtualization (the separation of physical hardware into one or more virtual devices) are examples of technology that have evolved and have been adopted by CC (which charges the user based on the usage instead of a fixed rate). The increased economies of scale, flexibility, business agility, and the pay-as-you-go model, are all major advantages of cloud-based services. However, there are some drawbacks in terms of vendor lock in, privacy risk and security. Public Cloud, Hybrid Cloud, Private Cloud and Community Model are the four deployment models offered by Cloud computing [70]. Today, Cloud computing can be distributed as XaaS (Anything-as-a-Service) and contains the basic service models of SaaS, PaaS, and IaaS. These can be generalized to include Business-as-a-Service, Communication-as-a-Service, or Database-as-a-Service, Network-as-a-Service [72]. Due to the numerous choices available, an organization must decide on the subsequent aspects [73]:

- **SELECTION OF DEPLOYMENT MODEL:** Every model has benefits and drawbacks, so many factors must be believed before making a decision.
- **SELECTION OF SERVICE MODEL:** Each service model has a set of specifications that must be met by both the CSP and the company that uses the solution. In the case of PaaS, Cloud Service Provider (CSP) provides all software and hardware on which programs run, while in IaaS, CSP provides a VM. Organization is accountable for the middleware and operating system. As a result, the choice of which service model to use is dependent on a variety of factors.
- **SELECTION OF APPROPRIATE SERVICE PACKAGE:** In addition, there is a wide range of capabilities offered by CSP providers in a variety of packages. These packages may have a variety of advantages and disadvantages. Some CSPs, for example, can provide low-cost services but fail to provide backups or redundant data storage in multiple locations. This means that the variables driving the decision may be mutually incompatible and

interdependent. As a result, the company must make a trade-off and choose the option that best meets its needs.

Due to the increased number of choices and selections that must be made, an industrial-strength automated Decision Support System would have to make trade-off decisions that require a rigorous assessment of alternate alternatives. As a result, the following study issues must be addressed:

- How does such an approach evaluate multiple options with respect to contradictory and interdependent requirements?
- How can a quantified trade-off-based strategy be recognized?

The TrAdeCIS approach was created to solve the issue of decision making when implementing Cloud-based services in an enterprise. TrAdeCIS automates the decision-making process, and the document assesses its validity and applicability not only in the case of CC, but also in the use of any emerging technology in an enterprise.

1.10.1 BENEFITS OF DECISION SUPPORT APPLICATIONS IN THE CLOUD

CC is a distributed computing architecture which shares services across a network. Applications and Data like the decision support systems (DSS) and business intelligence systems are the resources. Four main cloud architectures (Irvine 2012) are – 1) a private cloud, 2) hosted private cloud, 3) public cloud, and 4) mixed cloud. Cloud-based applications can be accessed by a mobile application, desktop application, and web browser.

A cloud can help businesses that use mobile apps, have so many locations, or have a lot of data. According to Irvine (2012), a private cloud is infrastructure that is "hosted and operated on-premises by the customer, typically behind a firewall, with access to cloud resources restricted to that client or a known group of users." The biggest difference for a hosted private cloud is that the infrastructure is "hosted off-premises and operated by a cloud service provider, but only one customer has access to cloud resources." A cloud service supplier hosts and manages a public external cloud to which many clients have access. Finally, with both private and public elements, a hybrid cloud has a more dynamic architecture. CC is the same as the electric grid which shares computing power, resulting in cost savings.

CC is defined by the National Institute of Standards and Technology as "...convenient, on-demand network access to a distributed pool of configurable computing resources (e.g., services, storage, networks, and servers) that can be rapidly provisioned and released with

minimal management effort or service provider involvement." IaaS, PaaS, and SaaS are examples of cloud delivery models. An organization can rent the servers or both software and servers, which include decision support system. The amount of cloud-based decision-making apps are growing. One example is IBM and Aetna subsidiary Active Health Management's cloud-based clinical decision support system. The software "analyses patient data contained in electronic medical records (EMRs) and administrative data structures that provides alerts to doctors on care progress, medication reactions, and best practices".
For the 2012 Roland-Garros (French Open) tennis tournament, IBM created a global private cloud. "The French Open was able to meet increasing tennis fan demand for real-time data, statistics, scores, and videos accessible via the mobile phones, tablets such as the iPad", and Web due to IBM cloud technology.

A well-designed redundancy-based cloud can be dependable, stable, and ideal for business applications. Utilizing the cloud to provide decision support saves money on both capital and operating costs (Irvine, 2002). According to Jackson (2011) "Proper implementation offers considerable savings, improved IT facilities, and a higher degree of efficiency". Agility, app and device compatibility, and position independence are also stated advantages. The below are some of the advantages:

1. Expertise: Cloud providers and employees become an integral part of a company's IT capability.
2. Scalable: Capacity can be expanded and contracted to satisfy requirements. It is available on a variety of devices.
3. Greater reliability: A decision support system is more likely to perform where and when it is required.
4. Accessibility: Available anytime and anywhere.
5. Agility: New decision support applications can be created and deployed more quickly.
6. Decrease capital expenses: Outsource technology & support.
7. It is well suitable for dispersed company processes.
8. More secure: Safeguards that are well implemented make a device less vulnerable to cyber and physical attacks.
9. Reduce IT and IT-dependent activities' direct and indirect operating costs. Just pay for what you use.

"If cloud computing is to meet its potential, there has to be a good understanding of the different problems involved, both from the viewpoints of the vendors and the users of the technology," Marston et al. (2011) write in a recent analysis and assessment.

Managers must realize that the "internet" refers to software and hardware that is stored on a network rather than on a local server or in the facilities of their company. The cloud is a global platform for servers and Software that user access over the Internet.

CHAPTER 2

LITERATURE REVIEW

2.1. OVERVIEW

A literature review of related works in the form of study papers, review papers, documents, and other forms are used to achieve a deeper understanding of the topic. Most businesses are already moving to a Cloud Computing environment to manage their customers' on-demand requirements. Instead of purchasing new services, the companies loan them. Allocating Virtual Machines based on cloud users' needs is a difficult yet critical task in CC, especially in Infrastructure as a Service. The resources must be managed as the need for Virtual Machines increases or decreases in order to achieve optimum resource efficiency. This chapter offers a comprehensive review of the different resource utilization methods utilized in traditional Cloud and Mobile Cloud Computing environments.

Tarousi (2019) [74] Using cloud computing technology for the development of decision support system of a cohesive proposal for helping the decision makers in natural disasters are the primary aim of this article. This proposal is about the natural disasters which can be seen in Europe on often basis. Decision support system in cloud-based platform is the enhanced set of information processing tools which offers the opportunity to give out significant outcomes to make decisions for the urgent requirements of children and families.

Yoo (2018) [75] Using huge chunk of information, artificial intelligence along with new information and communication technologies resulted in the natural developments and enhancements in business competitiveness. Cloud services for a long time have been considered to have specific system needs for a business company and they were signified through various CC architecture layers such as platform, infrastructure or software. With the entire setting of IT services experiencing consecutive fluctuations, companies are forced to have second thoughts about their business models where they may implement a CC system that might lead to business accomplishments and developments. Talking about a decision-making model to implement a CC system, the paper here evaluates significant factors in an orderly pattern of decision areas: technology, organization, and environment along with the 7 factors and 23 features, depending on the fundamental decision factors of cloud computing implementation through AHP and Delphi Analysis. Along with this, the study here goes deep into comparative evaluation among

demanders and suppliers of CC. As a result, the research recommends some significant elements to adopt a CC system which are: best executive assistance, competitive burden, and compatibility. Compatibility and competitive burden were the elements which were highly prioritized for demanders while associated benefit and highest executive assistance were highly prioritized elements for providers.

Siamak (2018) [76] through cloud computing, software manufacturing organizations can replace internal IT infrastructure and can be acquainted with the improved computing and flexibly decreased price. Cloud service supplier variety is rising to be a significant contest for the industries with the increase in negotiations of cloud sellers and services. Use of different factors such as their appreciation, topographical area, and deployment type can consider the cloud service suppliers and the services offered, therefore, it seems to be necessary going with a strong approach for selecting the cloud salespersons needed, related to the needs of decision-makers. Here, a decision assistance method is shown that would prerequisite the decision-makers to choose most fitting infrastructure-as-a-service cloud supplier.

Maciel (2018) [77] Cloud computing provides the services through the internet. It is influenced by the old technologies such as collection, grid computing and peer-to-peer. These are carried out by nearly all the enterprises now. The corporations for example Amazon, Google, Microsoft, and Facebook have experienced significant supplies in CC providing the services which have improved stages of dependability. Accurate and effective calculation of cloud-based organization is essential in making sure of business strength and constant communal services. The article here presents a technique of selecting the cloud computing infrastructures which goes hand in hand with dependability and price which coordinates with business and consumer needs. Stochastic methods are used to determine the dependability-related values for various cloud substructures. A Multiple-Criteria Decision-Making (MCDM) factor is used to rank biggest cloud infrastructures where consumer service conditions such as stoppage, price, and dependability are considered. Practicality of this technique is determined through a case study.

Myneni (2017) [78] Primary focus is the effective and user-based data hosting service for the hybrid cloud. There is a forthcoming transaction policy which is cost effective and is accessible to the users. The outline here smartly integrates information to cloud with efficient cost and high accessibility which leads to the evidence of information morality where client looks at the accuracy of his information. Significant cloud storage sellers in the research here, from India,

are taken into consideration and factors such as cost of storage, storage space, outward bandwidth and the sort of transition mode are considered as well. Intelligent hybrid cloud data hosting framework, on the basis of accessible awareness of the factors of current cloud service providers of our country, guarantees the consumers about low cost and high access with the transition mode. There is an assurance of insignificant ability from the consumer's part which is useful for the consumers themselves.

Suthar, Krunal et al. (2017) [79] Cloud computing can say to be the phenomenon which is used nowadays for the large-scale organizations or for the people with the requirement of varying network services which have minimum costs. Information of people can be seen on public cloud on often basis, and it can be accessed by anyone. It leads to a few problems which are the counterparts of adaptable services of cloud suppliers, which somewhere resemble the confidentiality, integrity, availability, authorization, etc. There are many alternatives recently which can be accessed to secure the information and among them, the most proper techniques would be making use of encryption. It leads to increasing chances of performing encryption and decoding process for all the inquiries. Along with this, it is a proper practice to consider the users where the user information is transferred on Cloud premises and they do not have the authority over this information. They must keep in mind the security of the important information of user on Cloud server. For abandoning the weight of Cloud server for enough security of user information, there is the recommendation of integrating the two techniques which is, user information may be jumbled up if it needs security for the records or archive and the DaaS service of Cloud getting authenticated with the use of jumbling techniques. By making use of these methods, it is safe to state that the recommended plans provide sufficient security for unknown access and saves privacy when data can be accessed on Cloud servers. Offering the proper respectability verifying device is also a consideration along with better access control factor, group sharing system, etc. that would decrease the weight and increase trust within the Client and Service providers.

Gholami and Laure (2016) [80] presented the reconsideration for protection and confidentiality of the information, keeping in mind the cloud reference design. Here, different arrangements were shown in the work, such as, approval, confirmation, personality, access management, faithfulness, privacy, convenience for the security problems in the cloud.

Sangwan and Singh (2016) [81] talked about cloud computing and various kinds of cloud. There are economic, technological, non-operational factors which should be discussed through

clouds which are presented in this paper. Research of cloud computing service models-Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS) can be seen in the work as well. There are numerous security problems which are presented too in the end of the study.

Garg et al. (2016) [82] recommended active data integrity auditing protocol to decrease calculation and communication costs in cloud computing. There can be improvements in secure transmission among cloud operators and cloud providers with the help of this technique.

Piechotta et al. (2016) [83] discussed the protected active association ecosystem for the cloud computing. In this method, the work comprised of development of increasing cloud space which leads to improvements of secure transmission. With the growth in virtual cloud space, there is also growth in element space for cloud storage.

Andreas et al. (2016) [84] described SCM to be the combination of significant business procedures from end user via real suppliers supplying the products, services and information which increases the customer value and other shareholders. There is also the need of a demand-placed inter and intra corporate information supply, therefore, it is an important duty to select, convert and use the proper information technology solutions. It is where the Cloud computing commences and rises up to be an innovative method.

Glass et al. (2016) [85] talked about reliable routing and path reliability for the mobile systems. The approach here would be helpful to identify the path for the purpose of securing the information routing between source and destination where the routing and communication operating costs are decreased. Cloud computing first started when ARPANET was introduced so the people can reap the advantages from the incomes in various instant regions. Sultan et al (2014) [86] mentioned Cloud Computing to be a model of offering variety of information technology services through the help of Internet or a networked IT environment.

Hashmi et al. (2016) [87] mentioned the various benefits of the CC though the security problems are enough to hinder the users from adopting it. There are many users who can share similar physical resources through multi-tenancy and virtualization which can result into cloud specific threats. Different legal problems can occur associated with the user information an application due to geographical degree of cloud computing. There is restricted administrative authority for owner organization due to the managing identity and accessing control coming from a digital resource of the company with unique types in the cloud computing. Security threats falling under sharing, virtualization and public cloud are discussed deeply and the

methods are put forth as a countermeasure. Security service scope is emphasized particularly in current evaluation which is provided through developed methods.

Wei et al. (2016) [88] presented vigorous multi-copies testing method for the small cloud users. The information which is messed because of third-party access can be retrieved through this method. Security problems such as replay attack and forgery are possibly decreased too with the use of this method.

Zhang et al. (2016) [89] put forth the multi-replication information control protocol that had dynamic base to aid cloud customers. It is useful for decreasing the security problems in which security proof and validation are there. The multi-replication helps in decreasing control and routing operating costs.

Omar et al. (2016) [90] presented reliable and dependable credential chain protocol meant for mobile ad hoc systems for decreasing communication operating costs which is entirely on the basis of web of trust model.

Derbeko et al. (2016) [91] privacy and security characteristics in MapReduce on Clouds: A study, Computer Science Evaluation defined the security aspects for Cloud System against various attacks in real time Cloud environment. The computation is provided for MapReduce environment with public and private Cloud specification. The confidentiality, data computation, integrity analysis and correctness of outcome are investigated by the authors. The requirement, characterization and challenges of MapReduce system for data security are discussed by the authors. The privacy and security control with master process are defined to achieve higher security aspects for Cloud System. Various security methods, including authorization, authentication and access control observations are also provided by the authors.

Aruna and Aramudhan (2016) [92] recommended the improvement of QoS and positioning the cloud maintenance suppliers in merged cloud atmosphere where the Cloud Broker Manager (CBM) was presented for categorizing the operators as SLA and non-SLA supporters through FCBM and sCBM (Secondary CBM). FCBM calls upon distinguished service modules. sCBM operates as choosing, grading and selecting ideal cloud provider. Markov process model is put forth to choose the corresponding cloud providers.

Talal et al. (2016) [93] gave his thoughts on trust management, considering it to be among the most difficult problems in adopting and growth of cloud computing. Assuring the access to trust management service is also an important obstacle because of the dynamic kind of cloud

environments. Authors came up with a reputation-based trust management context which offers numerous functionalities for providing Trust as a Service (TaaS), that comprises i) a new protocol for proving the reliability of trust responses and maintaining the privacy of users, ii) an adaptive and vigorous reliability model to calculate the reliability of trust responses for protecting cloud services from hackers and making comparisons in reliability of cloud services, and iii) accessibility model for managing the access of decentralized execution of trust management service. Feedback of customers is a beneficial source for evaluation of reliability of cloud services.

Kumar (2016) [94] CC is the contemporary computing method that categorizes hardware and software resources as the virtualized services in which consumers do not have the burden of disturbing the reduced-phase system management specifics. Transferring the web applications to Cloud services and integrating with cloud services in leading computing infrastructures is quite important as it leads to modern competition in which there is the need of inventing the examples and practices at the stages of mechanical, conventional, legal, controlling and communal. Selecting the ideal and properly suitable combination of software pictures is a significant problem in mapping web applications for the virtualized Cloud services.

Lively and dependable computation of various skills of Cloud Service Suppliers (CSP) have a big part to play in selecting the kind of CSP to use in the upcoming time, mostly as a cloud service delivery which develops deep into delicate and restricted places. The study presents an important technique here. There is a method allocated in which the framework is gathered related to CSPs that is logged into rule-reliant system. The choices here are outcomes of preciseness of CSPs comprising of the study of privacy and protection risk along with the recommended situations to keep in mind while transferring the agreements and SLAs.

Kayalvizhi and Anitha (2016) [95] CC means to the allocation of computing resources with reduced management efforts. Biggest issue in transfer of multi-component originality applications to Clouds is selection of ideal mixture of VM pictures and cloud infrastructure services. There is the requirement of relocation method for guaranteeing that QoS requirements are met but fulfilling the contrasting selection standards such as price and quantity. Biggest problem in planning the software applications of the cloud services is to select the excellent and intimate software instruments so there can be cost-operative method followed. While selecting the instruments for transferring to cloud, software engineers must keep in mind the various factors compound needs through various kinds of factors of the systems. Therefore, there is the

need of an approach to detect the machineries which should be transferred without actually moving them. There is the recommendation of a technique which can be used in cross-decision-making approach, on the basis of various kinds of quantifiable factors in pricing of cloud suppliers. The formation of links through the various factors of scheme is kept in mind in obtainable method. Therefore, a planned price determining operation is used to choose the ideal immigration contexts. PSO algorithm is also kept in mind so it can help to determine the precise values for selecting ideal cloud service approach for the purpose of removing the complications in web application schemes.

Zheng et al. (2015) [96] suggested an approach for controlling data access and evaluation of trust through the attribute-based encryption and proxy methods. There was the development of a framework to ensure Cloud data by carrying out various algorithms. It is possible to secure cloud services automatically because the cryptographic keys are produced on trust model. The information stored cryptographically can lead to various issues because other common applications may have to access the information.

Mazhar et al. (2015) [97] Protection in CC: Prospects and Questions consists of the outcome of research which is because of security problems on the basis of collective, realistic and open environment of cloud computing model. Literature of study offers counter measures for security problems. There is the evaluation of the methods in this paper which put attention of extent of security services offered through methods reconsidered. Author mentions that the work gathered would be extremely useful for future investigators for making comparisons and evaluating the merits and demerits of the study. Researching the method has offered various means of emphasizing the problems which would encourage study community and experts to put attention on this topic.

Brandenburger et al. (2015) [98] Authentication of Reliability and uniformity for Cloud Object Storage (VICOS) model is produced for cloud storage data pattern in cloud computing. The protocol mostly emphasizes accuracy, reliability and accessibility. With the help of VICOS, a group of commonly believing clients can recognize the information reliability along with the breaches in stability for a cloud object storage service. It focuses on the services where numerous clients can work together on stored information distantly on a service which is not behaving well. Through VICOS, there is stability of fork linear, that would favor wait free client semantics for majority of the procedures and reduces the communication and calculation operating costs in comparison with current protocols.

Fonseca et al. (2015) [99] presented cloud security in next-to-next generation SDN-based solutions. Zhao et al (2010) [100] conducted a work on the basis of reducing extent of search outcomes of a user's file which can be decrypted in a given set, using ABE and CP-ABE. There is reduction in the data disclosure and complications in searching is reduced among various user cryptographic cloud storage environment. Along with this, looking for an all-keyword index in cloud storage for matching it with mentioned keywords and decrypting them is impossible to perform. System which is stated here can just search for the information which can be decrypted through the user and is more efficient.

Preethi et al. (2015) [101] recommended a technique to securely transmit the information in cloud computing. This method usages keyword search on the basis of binary criterion which are multiple synonym-based search query and rank keyword search. Multiple rank keyword search is applied to obtain ideal outcomes while synonym-based search queries would use synonyms of a word to reclaim the documents.

Chen et al. (2014) [102] talked regarding Top-N files keyword search in CC for solving safety problems in cloud computing, data encryption instead of outsourcing procedure can be relied upon to safeguard the delicate information.

Jadhav et al. (2015) [103] security maintenance free reviewing method was presented for secure information gather in cloud computing despite of the increase in period. Privacy was secured in which information was stored in cloud using most ideal algorithm AES.

Zhan et al. (2015) [104] Recognizing and arranging the proper resources for fitting workloads from time to time for increasing the efficiency of usage of resources is the primary aim of autonomic cloud computing. Resources must be minimum fort the workload, so a certain level of service quality is maintained, or workload completion time is reduced. Gathering the information involves the issues related to reliability that can lead to various threats to the existing information. Consequently, this is crucial to maintain the system reliability.

Mingming et al. (2015) [105] have recommended the cloud service searching system using a focused crawler. In this research work, the authors have applied the URL analysis policy along with a previously available method. The authors have also done the URL analysis algorithm which depends entirely on the link clustering and semantic content principle on the cloud platform. In this URL analysis algorithm, all the similar type of cloud services are consolidated successfully. However, the consolidation was a time-consuming process, with no alteration in the cloud user. Here Downloaded URL is grouped on the clustering principle with respect to a

virtual machine. The Heritrix algorithm is compared by Best First Searches algorithm & Shark Searches algorithms.

Bhargava et al. (2015) [106] have recommended the Multi-Agent System (MAS) which mainly concentrates on the value conciliation cycle among cloud operators and suppliers and has been planned to affluence the problems faced by cloud customer & cloud vendors and to attach the complete latent of cloud computing. The prototype was centered purely on cooperation and collaboration between participating representatives and is operated manually. The agent communication and collaboration is stored in a central data base. There is no unique database for the agents involved. Hence synchronization issues are raised when all the agents communicate at the central database. The knowledge stored in a centralized was some time modified by an agent without notifying other agents. Without this notification, the agent has to maintain the old database and not a modified and revised database. Hence the cloud user does not have the ability to know the latest cloud service on the list.

Narducci et al. (2015) [107] have recommended a discovery of web link by means of the cross language matching technique for e-government services. This system was implemented on the Linked Open Data (LOD) cloud system. The large e-system has been more transparent on the government as well as common public. This method has provided the best public services and used for economic growth of the country & many social values. Nevertheless, the data opening process should adopt various standards and regulations of open format. These systems have to exploit the best practices collected from various countries and cities.

Bellini et al. (2020) [108] have made a proposal for indexing and searching service on a social media, which contains rich information contents and has a variety of services. This research work had shown the indexing of variety of cloud service on the social media and effective search and retrieval of the particular content on the rich set of information. The contents of the social networks are in multilingual in different formats. However, the system required different kinds of querying and complex mining process to retrieve the service from database because those contain unformatted information on the same database.

Ioannis et al. (2015) [109] addressed a novel approach for selecting cloud services based on personal preferences. It provides optimization as a brokerage service by using a multi-criteria decision-making strategy. The ambiguous AHP methodology is used to address the issue of provider rating and enables multi-objective evaluation of cloud resources. This system captures

and processes customer views and desires in a more expressive and cohesive manner than conventional service rating approaches.

Pablo et al. (2015) [110] had developed the framework for cloud service composition and cloud service discovery in an integrated fashion. In these frameworks all the cloud service ae composed in fine grained method. The composition of cloud service from various cloud service provider are based purely on the graph generation. This discovery system contained the relevant cloud services for the cloud user requirement.

Dingzheng Liu et al. (2015) [111] have suggested the agent assisted cloud computing for cloud service searching in a central controlled fashion. This study allows the cloud user to autonomously choose the cloud service provider from multiple numbers of cloud vendors. It does also select the extremely appropriate cloud service user by million numbers of customers. The selection process could be done by examining the central database maintained by these systems. The cloud provider frequently contacts the participating agent to know about the cloud user's request. This kind of request is successful sometimes, and not in some situation, when a few agents have not replied to queries raised by cloud provider and cloud users.

Teng (2014) [112] A limited models were offered for an improved understanding of PaaS. The Internet mammoth Amazon is well known for giving the EC webpage to citizens. It leases the structure platform that initially operated for them. Users could select the operating structure and middleware publicly by this service presents software and hardware platform. Through 2006, Amazon EC forced this service addicted to showcase use. The distinguished IT financier Google has gathered countless datacenter around the globe and is renowned for its internet searcher just as new kinds of promotion. Google bought modest computers and ground-breaking middleware in adding to their very personal advancements made the best dominant datacenter global and high execution parallel computing cluster.

Prabhu (2014) [113] In the case of cloud data storage, consumers want a service provider that can send them the right answer based on their request, but they don't want the service provider to know the genuine content, especially when it appears to dealing with scrambled data. As a result, a watchword search with secure privacy that makes use of PEKS has been developed. In the case where B sends an email to A, the outsider uses the trapdoor provided by A to see whether a certain term appears in the email without regard for the content. This strategy takes into consideration a service provider that is interested in content decoding and search but cannot

read the whole simple content, which aids in relieving strain on user information handling whilst protecting privacy.

Liu (2014) [114] besides, the component of the "Cloud" is extendable to satisfy the necessities of a growing amount of requests and customers. Service on request is an additional basic component of the "Cloud". It is a colossal collection of assets which clients could buy depend on their requirements. The allegations are equivalent to tap water, power and gas. What's more, due to the extraordinary variation to non-critical failure strategy comprising of modest hubs in the "Cloud", the programmed control of the "Cloud" brings down the price of information focus administration significantly; The all-inclusiveness and shared trait of it increment the accessibility of assets generously; The office of the "Cloud" normally situates in the zone where it is loaded with electrical assets, which prompts the diminishing of vitality charge. Hence, the cost exhibition is amazingly elevated. In this way, clients can totally appreciate the ideal services of the "Cloud" giving bit respect to high degree of consumption and extensive expanse of computing.

Harfoushi et al. (2014) [115] introduced the security as one of the fundamental difficulties of Cloud Computing model that makes various associations hesitant to receive cloud technology notwithstanding a few focal points like productivity, adaptability, versatility and capital decrease. In their work, they said that to improve the security affirmation, measures ought to be taken towards guaranteeing high degree of privacy, respectability, confirmation and trust.

Zameer et al. (2014) [116] have developed a cloud service search engine for a cross language. This system uses the Drupal methodologies to implement all components required by discovery methodology. Most of the mobile applications are implementing this technique these days. The issue identified in this system is focus more on platform independence, but it is tedious process. This technique has also created the indexing problem because of cross language.

Goettelmann et al. (2014) [117] presented the combining security risk management into cloud business process management, an integrated approach to business process management and security risk management is presented in the perspective of the cloud. Before implementing the cloud, they defined the possibilities of various actors, the process models they operate on and the risk-management tactics to protect commercial processes. The detailed methodology classifies the methods that can be utilized to mitigate the security risk of the cloud that takes into account the cloud broker and threatens business processes. Please give us an example of our motivation. Their cards have various limits to face in future research.

Alabool et al. (2014) [118] explain in "Normal Believe Standards for IaaS Cloud Analysis and Resolution", the assessment of the IaaS cloud's measure of confidence remains an issue. This understanding aspires to analyses and assess universal belief norms (CTC) from context-based belief and context-based cloud, and then to prepare, address, and aggregate a balanced philosophical mannequin of CTC. The primary goals of the CTC model are to: (a) provide Cloud Service Requesters (CSRs) for a CTC with which to assess the level of confidence that can be placed in an IaaS cloud; and (b) provide guidance to Cloud Service Providers (CSPs) about what to build into their fresh, widely available, and reliant IaaS cloud in order to meet trust supplies. A scientific assessment of context-based beliefs and context-based cloud is offered in order to take action. The findings revealed that there was a core collection of belief values, similar to Integrity and fame, that had been overlooked in the current cloud study.

Hassan et al. (2014) [119] in "Evaluation of Cloud Computing Efficiency, Scalability, Availability and Protection" describes that cloud processing implies that a marriage of endless wide assortment of PCs through a contact channel like web. This is the method for distributed computing they use to send, obtain and store data on web. Cloud work offers them a chance of parallel computing by means of using a noteworthy amount of advanced machines. Presently productivity, versatility, supply and security could characterize the enormous dangers in distributed computing. This highlights the issues of protection, accessibility and adaptability. And also set up model based on distributed computing-based framework that is extra secure and more accessible Also, a couple of elements which stressed for expanding the extreme productivity of distributed computing can even be expressed.

Sabetzadeh et al. (2014) [120] in the research work "Improving Talents Great by way of a Semantic Oriented Framework for a Social Talents Cloud", authors describe the concept that presents a meta-commentary over an integrated cloud ecosystem, which has been generally restricted toward program/software, platform and infrastructure. This tries to provide another perspective of cloud background in a holistic vision of its broader utility and constitution by knowledge administration window. This may occasionally envisage a deeper insight into how cloud has a built-in ecology that increases satisfaction of potential customer for potential offerings. Focal point is on cloud integrity as an ecosystem that may tries to demonstrate value addition and implications of such ecosystem for advancement of the offerings in the system.

Fitzek et al. (2014) [121] in the publication "Implementation and Performance Analysis of Disbursed Cloud Storage Resolutions Expending Random Linear Community Coding",

recommends the use of dispensed clouds connected using linear network and coding by storing in this cloud, so as to decrease the storage and visitors are charged following dynamic strategy. It discusses about addition of a new storage or removing the existing storage space in clouds on the fly when optimum utilization of resources is achieved. The authors initiate a lot of community coding strategies that exchange-off reliability, storage and visitor ‘s charges, and approach complexity counting using probabilistic recoding for cloud regeneration. The authors examine the strategies with additional procedures centered across the boundary of replication of data and Reed Solomon codes. They have developed a simulator to carry out an intensive piece evaluation of a number of methods that rely on special procedure settings, including finite fields, community/storage stipulations, space for memory applied per cloud, inadequate network apply, and incomplete reanalyzing capabilities. Not like usual coding approaches, their approaches don't require them to retrieve whole ordinary know how among intention to store significant amount of information. According to this paper numerical outcome show an excessive resilience over a significant amount of renewal cycles in comparison with different techniques of data storage.

Abbdal et al. (2014) [122] demonstrate how cloud computing allows consumers to outsource their information to the cloud remotely, relieving them of the burdens of local storage and security. Customers may not have access to or control over the results. This property introduces a slew of additional security concerns, such as unknown individuals and the accuracy of saved records. It concentrate on the challenge of guaranteeing the confidentiality of data processed in the cloud. They recommend a solution that combines biometric and cryptography techniques in an efficient manner in order for data owners to harvest confidence in the cloud. As effective explanations, they award productive and stable honesty based on the XOR operation and iris function extraction. This work gives the cloud user increased trust in detecting any modified blocks. Furthermore, their suggested scheme makes use of the user's iris points to make the user feel at ease and incorporates information in a way that makes it difficult for some within or outside individual to take or compromise it. Their system is especially successful and provably relaxed, according to extensive safety and performance assessment.

Hazarika et al. (2014) [123] in "The Mobile-Cloud Computing (MCC) Roadblocks", describe cloud processing as a best investment notion and earlier to currently a lengthy time this counsel has detonated directly into a fundamental area in IT organization. Ventures, regardless of measurement, have each embraced cloud or wanting to attempt cloud. In most recent

Smartphone look into, cell science is a high caliber run well with to influence cloud work, the later characteristically managing the limits of the previous. With cloud work, abilities and related refinement can even be offloaded to cloud and the prepared comprehension would likewise be utilized by means of cell contraptions. This sort of coordinated effort is appropriately called as cell cloud work. To make the portable cloud biological system to work flawlessly is an immense undertaking without anyone else. Receiving cloud infers putting industry essential capacities and sensitive information out to a 3rd party cloud merchant, which has most basic safety consequences. With telephone devices, the danger can be more appropriate than any time in recent memory. This sort of paper talks about the fairly a significant number of cell cloud challenges that cause capacities detours for mobile phone cloud coordinated effort.

Goel (2014) [124] presented Cloud computing vulnerability: DDoS, which is one of the main security threats and IDS as a solution model, all resources are in the same position, making the cloud computing atmosphere vulnerable to DDoS attackers Researchers are a permanent and complete solution to these attacks. DDoS attacks are one of the biggest and greatest risks to the availability of CC services. Organizations that exist online are affected by these attacks. Everyone can easily find the DDoS attack tool and there are no real technical solutions that can entirely contest the DDoS attack on the cloud computing environment, so need appropriate strategies, plans, functions, and resources. Prevent attacks.

Sen and Madria (2014) [125] presented in the research work, "off-line Risk Assessment of Cloud Service Provider" stated an offline risk evaluation structure to assess the security of various cloud service providers (CSPs) based on the threats in applications transferred to the cloud platform. This allows the organization to better understand application security on the cloud platform generally assess the security of the CSP. This structure helps in development and identifies vulnerabilities related to the application. Next, evaluate the security of another usable CSP against the application security constraints. When the highly appropriate CSP is discovered, the structure performs a compromise analysis of cost merit to define the optimal cloud transition plan. The migration to the Cloud platform is to identify the components of the application that are advantageous both in terms of costs and security.

Nithyabharathi et al. (2014) [126] AES data encryption was reported to be more scientifically capable as it has a more cryptographic procedure, but its primary focus lies in the key length. The time required to crack an encryption approach is directly proportional to the key length

which is used to ensure the transmission. AES permits the user to choose one out of a different type of bits from 128-bit, 192-bit or 256-bit key, producing it relatively powerful than the 56-bit key of Data Encryption Standard (DES).

Strizhov (2014) [127] The availability verification is done for the storage space as highly sufficient space should be available in order to store enormous amount of data. If the availability of storage space is sufficient, then the users can faithfully upload their data through their respective cloud servers. The use of multi cloud environment facilitates more storage space, but sometimes the availability of space is not enough. The availability verification process is required for checking the storage space of the cloud storage system. Here the space available is checked before getting data as input, thus loss of data due to space shortage is avoided. If storage space is not available, then a message is generated to notify the no available space and the data to be sent is blocked.

Reddy et al. (2014) [128] in their publication "Cloud-Based Cyber Physical Systems: Design Challenges and Security Needs", describe cyber-physical system. According to the authors this system is a combination of computational factors that may have interaction among humans by means of several modes. The security entails the malicious efforts through way of adversaries that disrupts and fails capabilities of program and involves infrastructure, companies, and movement ‘s social existence. As a result, they mentioned reputation of protection in cloud of cyber-physical techniques. Also, they offered challenges forward to the layout and advancement of longer-term engineering method with new protection capabilities. Third, they introduced security constraints in Hadoop distributed file system. On grounds that trust-founded packet move in sensor network is among the fundamental security difficulty infrastructure security, they provided a believer-headquartered plan utilizing Sporas formula [129] and provided replications to believe of a consecutive node earlier than relocating packets.

Pecchia et al. (2014) [130] in the publication "Filtering Protection Signals for the Evaluation of a Production SaaS Cloud", describe protection indicators that are gathered under the real workload stipulations that represents a goldmine of understanding that preserve confidentiality and integrity of a commercial cloud. However, the amount of runtime indicators overwhelms the operation teams, but makes forensics extremely tough and time taking. In this author investigates the use of unique textual content allowance programs to purify the traditional volume of 2,000 signals/day produced by the use of security understanding and event administration software in a created SaaS Cloud. For that reason, a filtering process centered

on the log is created. The author developed a scheme named Entropy to pinpoint the critical expertise throughout around the quantity of regular documented indicators.

Abolfazli et al. (2014) [131] in "Cloud-based Augmentation for Cell Instruments: Inspiration, Categorizations, and Open Encounters", describe Cloud-established Mobile Augmentation (CMA) strategies that have received awesome input not only from academia, but also from industry. CMA is one of the cell augmentation models based upon latest technologies that make the use of resource intensive clouds to broaden the scope, enhance, and optimize the computing capabilities of cellular gadgets that are aiming the execution of useful resource intensive mobile functionality. For this study, researchers make the use of various cloud computing resources that includes far away clouds and nearest mobile nodes, to fulfill the requirement of more than a few computing resources for a single cellular customer.

Firdhous et al. (2014), [132] testing is critical in deciding if a SLA has been broken and, as a result, determining the penalty provision that can be invoked as a result. From a regulatory standpoint, surveillance tends to be a requirement for contract compliance. SLA-based certification is a series of 'consequences' for failing to meet the agreed-upon SLOs. According to Rana et al. (2008) and Clark et al. (2010) [133], service clients place a high value on the monitoring infrastructure offered by service providers. Monitoring enables a transparent and streamlined SLA compliance system to be implemented in real time and without unnecessary delay (that is, once an SLA violation is recorded, the agreed sanction can be automatically triggered). Monitoring often makes more conventional enforcement possible. In this scenario, whether the vendor or customer appeals the applied automatic penalty, it would use surveillance evidence to support the case. It is also critical to track all measurements of legal significance and to provide the parties with the ability to retrieve those statistics in a format that can be used as proof. Violations are found either by internet surveillance or through post-facto auditing of the programmed implementation.

Huang et al. (2014) [134] recommended a chaos control algorithm to solve cloud service composition problem. The various kinds of cloud services are evaluated on their QoS basis. The algorithm achieves good results within reasonable time compared with other optimization methods.

Jula et al. (2015) [135] stated an efficient algorithm to find optimal composition sequence by dividing the service providers into recommended, less recommended and highly recommended.

The classification of service providers is centered on service time of atomic services and through an increase in a number of iterations avoids the fast decisions.

Fan et al. (2013) [136] have projected a framework to compose SaaS services by projecting the details of service component relation. To improve the composition process, the reliability and transaction parameters are considered while modeling composition sequence. To select user required service from the available candidate service, the enforcement algorithm and reliable composition techniques are applied. To enhance the reliability of a service composition, the redundancy mechanism, and petri nets modeling is used in the composition process. The recommended framework performs well regarding scalability and efficiency.

Gutierrez-Garcia and Sim, (2013) [137] recommended an agent-based method to meet user requirements by monitoring cloud users and providers catalogs. The stated method composes different services across cross platform according to changes in user requirements. However, the stated method consumes more time to compose services than other agent-based mechanisms.

Karim et al. (2013) [138] modeled a layered architecture to evaluate and rank both IaaS and SaaS services. Established on the client needs, the AHP model weights the criteria to evaluate the alternative cloud services. The model is good in evaluating the composition of IaaS and SaaS services, by performing matching of user QoS and composite service QoS. They recommended a dual standards evaluation system for cloud computing (MC2) to select and rank cloud infrastructure services. The analytical networking process (ANP) is adopted to evaluate the QoS of a service regarding benefits, cost, risk and opportunities.

Zheng et al. (2013) [139] recommended a predication-based cloud service selection. The Kendal rank correlation coefficient (KRCC) is used to find the similarity between trained users and current user. They stated cloud rank1 and cloud rank2 algorithms which are based on greedy methods. The stated method achieves good results when compared with several ranking and rating based collaborative filtering approaches.

Paudel et al. (2013) [140] in "Safety Standards Taxonomy for Cloud Applications in Critical Infrastructure IT" describe the development of utilizing the cloud soon attain the feature of principal infrastructure in information technology. Due to the lack of critical taxonomies and no standard catalogs, it is very difficult for application progress teams who work on the infrastructure and cloud area to adopt the correct and best software for the requirement they are

dealing with. The work presented by author, motivates the investigation of the applicability of program protection specifications and tools for cloud infrastructure to be used in IT.

Nix et al. (2013) [141] in “Toward a Real-Time Cloud Auditing Paradigm”, the authors describe the quantity of computing finished within the cloud is largely growing. The decentralized nature of the cloud, nevertheless, makes it complicated for individuals to make certain that the computation is being carried out appropriately. Consequently, the notion of "cloud auditing" has seemed. As applications within the cloud end up extra sensitive, the necessity for auditing techniques to provide speedy analysis and fast responses also raises. Computer finding out algorithms may also be employed for the needs of offering audit information. Few of these algorithms may also be achieved in a web-based fashion. Based upon this work, they examine one such online computer studying algorithm, and describe the way it may be employed in a dispensed computing environment.

Chang (2013) [142] Further, US are the largest CC providers like Salesforce.com and Amazon. But this improved use of CC services makes the US companies to confront through subsequent stage disputes as they endure by lower IT performance (Compuware). Utilizing numerous particular local services and processing citizen’s request, Hybrid Cloud computing adapters are functioning efficiently in US countries. Furthermore, Hybrid Cloud computing system is created as the federal, state, and local US governments are associated to each other (Marston et al. 2011) [143].

In GBR and in the USA the private sectors that are owning CC services cooperate with the government, whereas in South Korea and China, the governments fund administrative structures for delivering own CC-services. This dependence on multiple factors should be further studied, by special focus on the uni-loop and bi-loop probabilities of learning along with required amount of actions for the individual governments. Generally, interrelations and disputes along with reasons which influence for certain regions may be a preferable field for future prospect.

Jeong (2013) [144] In case of enough available space in cloud then the data block, with signature which is in the form of tag is received and stored for future use. If the available space is not enough then data of not enough space is sent to the cloud server which would allocate space needed for uploading. Data owner would upload the data that is encrypted and signed, which would reach cloud server only after challenge for a response from cloud server provider. Cloud service provider handles all sorts of services inside a cloud environment. According to

(Jeong et al. 2013) [145] cloud computing has 4 major ideas which are; service orientated designs/thin clients, delivery models for cc, deployment and virtualization techniques. As per (Dhar et al. 2012) [146] “Virtualization covers the physical features of a cloud computing platform through clients which develops a virtual computer ecosystem that shows another abstract processing platform such as a valid operating system, a server, a high-capacity storage device or network resources”.

Huang (2013) [147] The cloud computing market of China was still in its inception stage because the appropriate quantity of vendors remained low which resulted in only a few adopting companies. In addition to that, many companies have met the raising requirement for organizational IT process within their sector having very less IT capabilities because the staff ratio per company of any IT industry was in an alarming number when compared to Europe or United States (Xiao et al. 2011) [148] including all factors, the Chinese government, in order to gain from the mentioned opportunities recognized a well-known cloud service platform.

Lee (2013) [149] In South Korea, to create a well-operational SaaS market system (NISA) it was made a must by the government of south-Korea with strict rules and SaaS quality assessing certification. But neither did foster remarkable progress.

Lee et al. 2013 [150] discovered that South Korea has transitioned from a policy-led economy to a consumer-driven market, in which costs have been dramatically reduced and rapid rollout probabilities have the greatest effect for companies to adopt SaaS. It accomplish that widespread protection apprehensions remain a significant impediment to catching up with mature CC markets.

Popa et al (2013) [151] the system gave flexibility to the user for finding a number of multiple documents that one can access say n, with various types of encryption keys. One search token was given to server by the user instead of giving n tokens. The user has to supply a certain public data and a word token to find it. The system server with the help of this information evaluates the token for several keys and adjusts function to obtain all the information that matches the word even if their encryption keys are varying. Only one single user and the multiple key criteria were assumed in this work.

Silva et al. (2013) [152] Security threat in the cloud computing model: domain and proposal of security threats in cloud computing. "They would help researchers who want to develop work in this field and those who want to state solutions to some of the problems, therefore, the systematic mapping has calculated 661 publications on topics and confirms that it is the most

explored in the literature. This threat is not only accompanied by a fairly complete grouping but is also strongly harassed by the fact that it reflects the transparency problems of cloud providers and compliance issues in cloud services These problems are the most persistent theme in the cloud computing era.

Garg and Sharma (2013) [153] presented, for mobile cloud computing, the cloud computing idea states that there is a huge opportunity for users to use services on demand. The need for mobility in cloud computing has created mobile cloud computing. MCC would expand the possibilities of access services appropriately. A few years later, many mobile users are required to use cloud computing on mobile devices. Due to the limitations of mobile devices, mobile cloud computing has so much trouble. Security is a big challenge for mobile cloud computing.

Lee et al. (2013) [154] suggested three case studies that use different features of the architecture to solve the problems of the next generation sensor data management platform. This design is currently applied by component convergence and pauses. Also looking forward to reporting on the lessons gained from these case studies until they're done. This serves as a framework for data exchange and serves as a medium for more study to promote wider interdisciplinary research in the light of the realization of the smart city idea.

Madhusudan et al. (2013) [155] Cloud protection, according to a review, encompasses all of the older and well-known problems, such as network and other infrastructure flaws, authorization, user control, and privacy. It also involves issues arising from the adoption of emerging technology to include sufficient infrastructure (mostly virtualized), applications, and auxiliary tools for cloud development. These issues are divided into three categories: hypervisor bugs, physical position of data and legal implications, and lack of data control, confidentiality, and even decision-making. Since the cloud lacks specifications, an effort to move to a new provider is immediately affected by the absence of standards for protocols and formats after transferring data from local systems to cloud processes. Even if migration is driven by genuine factors such as non-fulfillment of service level agreements and service provider outages, migration from one cloud to another is dangerous. As a result, the first option must be cautiously considered, as SLAs are not perfect and service outages occur at the same rate as infrastructure sharing, multi-tenancy, and scalability, both of which are not fail-safe. After that, potential migrations of resources between clouds would be cost intensive.

Selvakumar et al. (2013) [156] define a cloud storage mechanism that allows users to interact with information without fear of losing assets. In the current method, data is processed in the

cloud utilizing complex information operations of computing, requiring the user to create a copy for more upgrading and data loss checking. It is intentional to create an efficient disbursed storage auditing process that surpasses the limits of coping with data loss. In this article, a partitioning solution for data storage is introduced, which eliminates the need for a geographic duplicate at the user's end by using the partitioning process. This procedure guarantees a high level of cloud storage integrity, better error localization, and easy detection of errant servers. To do this, a faraway knowledge honesty testing recommendation is used to boost cloud storage performance. The knowledge in the cloud is diverse in nature. As a consequence, the aim of this project is to offer knowledge to retailers in a smaller space with less time and computational expense.

Wei et al. (2013) [157] projected a protocol used for auditing of data security in the cloud and given the name Sec Cloud that discourages privacy cheating and secure the computation. According to the author it is the latest approach that jointly considers both the issues, first issue being the issue of security in data storage, and another is computation auditing of security in the cloud. Researchers have provided the concepts for both these security issues and stated the protocol named Sec Cloud that they use to achieve the respective goal. They recommend that, in order to improve the protocol's efficiency, separate users' requests should be addressed simultaneously by batch authentication. SecHDFS, another protocol suggested by the author, was found to be accurate and productive for achieving stable cloud storage after comprehensive protection review and performance simulation.

Zhifeng et al. (2013) [158] "Protection and Privacy in Cloud Computing" discusses about cloud architecture, its characteristics and the security issues. The various security attributes it discusses include confidentiality, integrity. The authors make the discussion on cloud confidentiality and integrity with respect to the threats and strategy used for its defense. The authors discuss various approaches used for data integrity that includes PDP, POR, Scalable PDP, Dynamis PDP and HAIL. In this publication author discusses about cloud accountability and cloud privacy. It gives a very good view on various approaches of privacy enforcement that includes information centric security, trusted computing and cryptographic protocols.

Schiffman et al. (2013) [159] developed the Cloud Verifier, a tool that cloud vendors may use to offer cloud verification services in IaaS clouds. The cloud verifier is a cloud-based autonomous service that can be used to resolve a cloud administrator's credibility requirements for cloud components. The authors of this study summarized a proof of cloud verifier for the

Open Stack open-source cloud infrastructure and illustrated some testing options that consumers may use to ensure that their instances are in a safe state. The authors use this method on two of Amazon's EC2 cloud's most common application instances. According to the authors' study, instances have marginal overhead as a consequence of testing carried out on more than 20,000 concurrent customers.

Pitropakis et al. (2013) [160] explain how cloud storage is gradually replacing traditional IT infrastructures. Nonetheless, one of the problems that have arisen as a result of the revolution is the system's upkeep and an inadequate degree of protection for the infrastructure. According to the authors, a range of researchers are operating in the field of cloud security and privacy protection, offering a variety of solutions to address risks to cloud infrastructures.

Yongzhi et al. (2013) [161] Integrity Assurance Framework for Huge Knowledge Analytics and Management Purposes" concluded that gigantic information examination and potential administration of this data is turning into an alluring subject with the latest technologies used for distributed computing and gigantic information figuring model equivalent to MapReduce. In any case, enormous scale reception of MapReduce applications on open mists is prevented by method for the deficiency of change to the working together online machines conveyed on the overall population cloud. In this, they extend the present half and half cloud MapReduce engineering to more than one open environment.

Built up on such system, they stated Integrity MR, a trustworthiness affirmation structure for huge data administration and investigation applications. They find the result trustworthiness due to the checking of frameworks at various substitutable programming layers that includes the MapReduce wander and the capacities layer. The author concludes this paper with the strategy at both layers in view of Apache Hadoop, MapReduce and Pig Latin, to be included in an arrangement of trials within vogue tremendous information investigation and government purposes, for example - Indian Mahout and Pig on business open mists (Amazon EC2 and Microsoft Azure). The exploratory result of the endeavor layer strategy demonstrates high trust worthiness (98% with a credit limit of 5) with non-immaterial proficiency overhead (18% to 43%) additional running measure of time in examination with ordinary MapReduce. The test effects of the application covering approach indicates higher proficiency contrasted with the starting layer approach.

Kumar Garg et al. (2013) [162] suggested a structure and mechanism for assessing the consistency of Cloud resources and prioritizing them. The Cloud Service Measurement Index

Consortium (CSMIC) has defined core performance indicators that are integrated into the Service Measurement Index (SMI) and used to evaluate cloud resources in this context. This Cloud service measurements are used to compare various Cloud providers based on customer needs. Analytical Hierarchical Process (AHP)-based rating system for categorizing value attributes by assigning weights to attribute interdependence. Figueira et al. (2005) [163] used Multiple Attribute Utility Theory (MAUT) and Outranking processes [164].

Garg et al. (2013) [165] recommended a framework and a mechanism which measure the prioritize Cloud services and quality. In this context, the Cloud Service Measurement Index Consortium (CSMIC) has identified key performance metrics that are combined in the form of the Service Measurement Index (SMI) and used to evaluation of cloud services. These metrics of Cloud services are comparing with several Cloud providers related to user requirements. Analytical Hierarchical Process (AHP) based ranking mechanism to categorize the performance attributes by assigning weights to interdependence between the attributes. Multiple Attribute Utility Theory (MAUT) and Outranking methods used Figueira et al (2005) [166].

Kang and KwangMong (2013) [167] have suggested a revised cloud service searching tool which can integrate the neat portal's scheme for displaying the cloud service provider list. In this research work, the authors have used the ontology principle to catalog and search all the cloud services. All the cloud services are indexed in the catalogue. The cloud services are defined semantically by the relationship between each other. The displayed cloud service has some identical in some aspect but this system failed to adapt the revised cloud service to the existing catalog because the customer has frequent needs for the modern innovative cloud service for this work. These specify the similarity among various cloud services using the reasoning method and similarity analysis techniques. These cloud portals face the similarity indexing problem while interacting with different cloud services. The cloud portal does not function a same occasion, particularly when a new kind of cloud service added. It seems that to avoid and reduce the indexing problem is very difficult since new technique are needed.

Jaeyong and Mong (2013) [168] have recommended a cloud service search engine for choosing relevant cloud service by means of ontology's techniques. In these approaches the authors have made semantic definition of the relationship between clouds services. This enables cataloging and efficient indexing of all the relevant cloud services. It enables quick finding the required services. This system provides a good response time for accessing the suitable service in a database. The authors had designed two kinds of ontology. In the first, the cloud concept

alone was indexed but in the second two set of cloud service concepts was arranged. This facilitated the cloud user to determine the similarity among the multiple numbers of cloud services, especially Software as Services. There are three levels of cloud reasoning strategy implemented for consolidating and classifying the cloud service in an agent-based system. The first similarity module is concept; the second is object property, the last is data type property. The entire system is referred to as cloudle method. Based on the experimental result, the author clearly specifies the successful rate and response time for retrieving the suitable cloud service. The cloud services are selection includes software services, server-based services and storage-based services. This kind of cloud services has made supplies to the customer in a self-service method. The system is well suited for providing the on-demand cloud service.

Zibin et al. (2013) [169] QoS projection for collaborative web services using Neighborhood Integrated Matrix Factorization' Quality-of-service (QoS) forecast method for network services based on service customers' previous web service use experiences. The term "quality of operation" (QoS) is commonly used to define the nonfunctional aspects of web services.

Arpita Gopal and Netra Patil (2010) [170] Service providers normally advertise QoS values measured at the server-side (e.g., price, reputation, etc.) as being similar for certain users, while QoS values measured at the client-side are typically advertised as being different for various users (e.g., response-time, throughput, availability, etc.). For interactive and customized web service QoS value projection, a neighborhood-integrated matrix factorization (NIMF) technique is utilized.

Vidhyashree et al. (2012) [171] presented a Cloud Broker Service (CBS) architecture that allows for the dynamic selection of IaaS service providers based on QoS specifications, cost, and credibility. Centered on the Service Measurement Index (SMI) and the company's credibility, the stated CBS framework offers a rating method that compares the services provided by different IaaS service providers such as Amazon EC2, Rackspace, and others for various Quality of Service criteria. The Service Measurement Index, suggested by CSMIC to define the different measurement indexes that are relevant for assessing a cloud service, allows for the identification of the correct service provider that can meet the user's needs.

Changji et al. (2012) [172] in "Enforcing a Personal Health Record Cloud Platform using Ciphertext-Policy Attribute-Based Encryption", the authors describe Work on designing and imposing software centric, private wellbeing report cloud platform headquartered based on

open-supply Indivo X procedure. They undertake cipher textual content-policy attribute founded encoding to deliver privacy safeguard and fine-grained access control.

Francis (2012) [173] in "Reliability of Cloud Computing in Quantum Chemistry Calculations" [174], describes cloud computing is not good only for computer, but it is useful for emerging science to scientific group in various style of disciplines. Authors give its significance in chemistry connected fields like bioinformatics, pharmaceutical chemistry and even in chemical industry and justifies its role is massive with a very good reward. With the use of cloud in the study of various branches of theoretical chemistry including Quantum Chemistry, Molecular Modeling, Theoretical Chemical Kinetics, Molecular Dynamics, and Chemoinformatic that make the use of complex computations, requires large computational cost. Based upon the studies in this paper, the extent of effectiveness of cloud computing in such varies, that is in case of research it is effective, but from the perspective of industrial vendors it is unreliable. This concludes that using cloud computing give great benefits in theoretical chemistry in the area of quantum chemistry calculations by the use of payment according to unsafe, safety and accessibility. In this publication comparison is made with few leading business cloud providers and confidential clouds.

Salman and Baset (2012) [175] considers a number of public cloud service providers that include the most popular cloud provider named Amazon, Rackspace, Microsoft windows azure and Storm on Demand, check their SLA and conclude the impact of SLA on the services provided by this service provider. For this it includes a number of parameters. It concludes with the results that from cloud providers which they surveyed, no one offer any performance guarantees for computation of services and ask customer to detect violation of SLA that means it is the responsibility of the customer to raise the issue of SLA violation and prove it from the services used.

Kwang (2012) [176] has projected an efficient agent involved paradigm for developing software tool & test beds for a cloud service organization. In this research work, the author illustrates the function of the cooperative agent for problem solving technique to automate the cloud services consolidation. The author has pointed out how large complex synchronized cooperation had been solved on a cloud platform. The author has also constructed a software agent for developing a cloud service search engine. The author has also specified a cloud negotiation mechanism which can simply discuss the procedure for cloud resource negotiations, but there has been no discussion on the Quality of Service or simply (QoS) & Negotiation

agents for various time slots. The issue identified from that work figurers out the cloud services as being tedious

Deyan and Hong (2012) [177] concluded that privacy protection and data security problems in CC are major challenges that must be addressed as quickly as possible due to the availability of different models focused on services and rollout, as well as critical features in cloud computing. According to the author's observations, protection and privacy matters occur at all levels of SPI distribution models and at all points of the data development cycle in the cloud. Privacy security, which involves shielding sensitive details, is a significant problem in data exchange. Since they include the storing of employee records, including credit card details, including health care services with all data relating to health, the key networks that need privacy security are ecommerce and health-related programs.

Controlling knowledge flow and revealing the role of the individual who can access the information through the Internet has become a major concern. These questions include which sensitive details may be retained or read by third parties without permission, as well as whether third parties may trace which websites an individual visit. Another issue is whether web pages that the consumer visits gather, store, and potentially exchange personal details regarding their visitors. The strong isolation of confidential staff data from non-sensitive data, followed by encryption of sensitive elements at various stages of the data lifecycle, is the secret to privacy security in the cloud.

Gibson et al. (2012) [178] in "Benefits and Challenges of Three Cloud Computing Service Models", authors describe Cloud can even be characterized as the utilization of previous or present figuring equipment and virtualization connected sciences to make a common structure that considers web arranged cost presented offerings. The three dominating administration models are framework, stage, and programming as a transporter. IaaS is regularly laid out as model using web servers, stockpiling, and virtualization permitting utility like decisions for clients. Defense is an enormous situation inside IaaS, since the excitement of the cloud supplier made do with top on the foundation and related layers. PaaS merchants exhibit passage to APIs, programming dialects and advance middleware which empowers supporters of increment custom limits without including or arranging the advance environment.

SaaS gives subscribed customers passage to programming or administrations which they think reside inside the cloud and no more available on the customer's devices. Recognizing the cloud deployment model is huge bonus in picking, if cloud administrations or web facilitator are a

reasonable industry determination. Distributed computing offers many favorable circumstances to organizations. It has empowered joint effort between groups and workgroups and has beat challenges which have blessing through venture decisions. All things considered, the shield, protection, and uprightness of the cloud are of high essentialness and there are a few difficulties that exist.

Wentao (2012) [179] in its research study ―Research on CC Security Problem and Strategy combines a number of cloud concepts including the capabilities of cloud such as scalability, platform independent, elasticity, low cost of using and reliability of overall system. This paper includes a number of security issues related to CC system. According to the research paper, a lot of research is going on in cloud computing at the level of industries, in result, CC is moving at very fast pace of development and shows a great and prosperous potential. According to author cloud computing is an integral part of many domains related to management of information and services, so, the data privacy issue becomes more prominent than the traditional network because the data in the cloud computing environment is largely dependent on the network and remotely accessible server. This paper discusses many customers who do not trust the privacy and security of CC and were reluctant to move their data into the cloud platform from their own system. These problems related to security become the bottleneck in the development and progress of cloud computing.

Kumbhare et al. (2012) [180] in the research work "Cryptonite": A Cozy and Performant Information Repository on Public Clouds", describe that in future cloud storage has to grow immensely, due to the requirement of retaining synchronized copies of documents and to share these documents with the proper coordination of various collaborators. Nevertheless, there highlighted situation concerning security of cloud hosted data as a result of shared infrastructure-based model and an implicit trust in participating service providers. Emerging requirement of ease in order of storage space and sharing for domains like clever power grids, which deal among touchy customer data, require persistence and availability of cloud storage all the time possibly, however among patron-controlled security and encryption, low key administration overhead, minimal efficiency expenditures.

Cryptonite is a secure repository of storage available on Cloud that addresses these problems by a strongbox mannequin for shared key administration. The author describes Cryptonite as a service for computing device customer that discuss efficiency and optimum utilization of resources and furnish an empirical evaluation of upgrades. Their experiments indicates that

Cryptonite customers reap a forty percent development in folder add bandwidth over plaintext storage utilizing Azure Storage consumer API regardless of brought protection profit, even as their file download efficiency is five times better than the baseline for data of size 100MB.

Sean et al. (2015) [181] provide the details of some key characteristics of the cloud computing technologies and explain the three essential services named Software as a service, Platform as a service, Infrastructure as a service of the CC system that defines the cloud computing technology and their delivery model. In this author have identified and explained the underlying technology of virtualization that makes cloud computing possible. It investigated and discussed a number of challenges that cloud now computing technologies is facing a day. Based upon their research they give the future direction of cloud computing technologies along with various applications that may use the cloud and trends, it follows. It gives a brief outlook of the direction in which the technology would proceed into the future and how.

Jain (2012) [182] is a study entitled "Security Problems and Solutions in Cloud Computing", both cloud service providers and customers need to confirm that the cloud is sufficiently secure from all external threats there is mutual understanding among the client and the cloud facility benefactor because it states that there is. The biggest gap between cloud security and cloud security analysis theory makes it the truth that there is no very important variation between actual cloud security and virtual machine security. Research should focus on these gaps and differences and their removal.

Poolsappasit et al. (2011) [183] Tradeoff analysis of cost benefits is being implemented in the Cloud-Adoption Strategies module, as described in the article "Dynamic Security Risk Management Using Bayesian Attack Graphs" (2012) [184]. This helps clients understand the best cloud migration strategy for their applications. They would conduct a tradeoff analysis of cost-effectiveness by adopting this work.

Singh et al. (2012) [185] stated "Security issues occur with cloud computing and its solutions". This white paper shows how in cloud computing various security issues arise, how to securely protect data from unauthorized users when transferring data from the cloud to data and provides security to private data with the server. Public-key cryptography, digital signing, and network design, this document protects your private data and allows you to transfer data from one cloud to another to change your cloud service providers.

Priyanka et al. (2012) [186] the experimental result with respect to the text files used reported that the AES Algorithm uses minimum encryption and the Rivest-Shamir-Adleman (RSA) uses

highest encoding time. It is also concluded that the decryption of AES algorithm was more effective than other algorithms. From the simulation result that was obtained it was evaluated that the AES algorithm was more efficient than DES and RSA encryption algorithm, where the Data Encryption Standard is a symmetric key algorithm for the encryption of electronic data that has been fed to the cloud. Even-though, recently this protocol was considered insecure, and it was extremely influential in the development of modern methods of cryptography. In the meantime, the publication of a National Security Agency (NSA) approved encryption protocol, resulted in its quick international adoption and a worldwide academic scrutiny.

Cegielski (2012) [187] On the opposite, the CC provider sector in Central Europe is well-established. However, when it comes to computer confidentiality, European businesses are more risk averse than their counterparts in the United States and China. The EU's additional data security legislation would improve CC efficiency, which is particularly important for SMEs. According to cross-sectional studies conducted inside German firms (Benlian et al. 2011) [188], protection threats were the most influential element in CC adoption, accompanied by success and economic risks. They focus on costs as the most important SaaS incentive driver, led by competitive stability and efficiency enhancements.

According to the report, there is little discrepancy between the existing expertise of European organizations and the existing state of knowledge in the science literature. In comparison to the cost-driven underdeveloped CC economies, the CC impact indicators of US businesses are more granular, considering factors such as business process sophistication, capacity to work, ability to co-sustain, and organizational culture. Furthermore, observational surveys inside US-based organizations assigned values to the CC significance for inter-organizational SC performance (Cegielski et al. 2012) [189].

Chun (2014) [190] In the security guidance report CSA define three different types of cloud based upon the services they provide, that are IaaS, PaaS and SaaS. IaaS provides computer infrastructure that include processor for processing any application, storage space for raw data and networking to customers such as Amazon EC2. PaaS provides computing platform that assist in development, testing and deployment of an application with the hardware and software that is available to the developer at very low cost and simply relieved of purchasing and managing the hardware and software, for example Google App Engine. This includes support for all the processes that are required for development, testing and deployment of applications that work over the Internet. SaaS is a cloud model where everything required for the working

of the application that include the software and its related data are stored in the remote system with the feature of cloud and accessed using Internet by users via browsers. This research started with the basic of cloud computing that may be considered as a special type of distributed system.

Singh et al. (2012) [191] developed cloud ecosystem enablement, cloud management and infrastructure, service-orientation, cloud core on provisioning and subscription, compostable cloud offerings, cloud information architecture and management: an integrated co-innovation and co-production framework based on seven principles to get cloud vendors, cloud partners, and cloud clients to collaborate. Wang asserted that CC has made significant strides in recent years and that its development is likely to remain.

Chang et al. (2012) [192] the selection of services is done by maximizing or minimizing one or several criteria on constraints by applying optimization techniques. Chang et al., (2012) [193] recommended a model to select cloud storage from a number of available storage services. The projected model is based on dynamic programming and by formulating the cost measurements and objective function. The constraints for selecting cloud storage are data durability, and the budget should be within the user preferences. The storage services are selected by considering the maximum durability and a minimal number of failures.

He et al. (2012) [194] specifically projected an integer programming and greedy algorithm for SaaS service selection; the algorithm is named as multi-tenant SaaS optimizer (MSS optimizer). The skyline operator is used to generate non-dominated solutions. The nondominated solution is given as input for the MSS optimizer to enhance the efficiency and to find near optimal solution. Skyline and greedy algorithms are capable of management a large number of candidate services.

Alba María et al. (2012) [195] addressed the topic of confidence. Trust can be categorized into two types: soft trust (non-security-oriented) and hard trust (security-oriented). Hard trust covers sections and operations such as authenticity, encoding, and process reliability. Fame is an example of soft confidence, which is a component of online trust and may be the most valued commodity of a business, as Singh S et al. in (2012) investigated [196].A company's name is liked because of its credibility and confidence. It would struggle and be destroyed if it cannot effectively function in areas such as confidence and privacy.

Simons et al. (2012) [197] applied dynamic programming to solve both static and dynamic service composition and to assure quality to improve revenue. The crucial service parameters

that are considered while composing services are idle time, execution cost and availability. The selection of services depends on deadlines, whether to select highest or lowest price services for fulfilling the composition sequence.

Monsef et al. (2011) [198] Persistent social-based faith in a hardware or software device or system is an indication of confidence in technological-based trust, since it guarantees the component's or system's execution and activity. Since it is necessary to know who is vouching for what as well as what they are vouching for, there are ties between social-based confidence and technological-based trust via the deliberate mechanism; therefore, social-based trust should always be regarded. Mechanisms to provide complex technological-based trust must be utilized in conjunction with social and technological mechanisms to provide permanent trust when evaluating cloud infrastructure provision. If software processes contain knowledge on how data is processed, retrieved, and exchanged in the cloud, the information can only be trusted if trusted institutions Philipp (2011) vouch for the method of delivering and evaluating the data. These organizations may be customer associations, auditors, protection analysts, regulators, organizations with a demonstrated track record, existing CSPs, and so on, depending on the background.

Firdhous et al. (2011) [199] focused on topics of availability and backup once more. In the cloud, ensuring proper compatibility and backup is difficult. When data is stored securely in the cloud, companies must provide a contingency plan in place to restore in the event of a malfunction. However, cloud providers who want to ensure the resilience of their infrastructure can depend on continuous backups. This is a major protection problem since these backups can be performed without the customer's active, informed consent, potentially exposing the consumer to serious attacks by an insider or external intruder.

Rimal et al. (2011) [200] there are many problems with the cloud. Protection, affordability, scalability, service level agreements, interoperability, data transfer, data governance, the trusty pyramid, user-centric safety, openness, legal and political problems, business service management, and so on are some of them.

Dillion et al. (2010) [201] identified ten critical general denominators that promote the utility of CC: automatic, elasticity, data protection, scalability, accuracy, durability, ease of management, energy consumption, ease of data access, and latency in their analysis.

Xiao et al. (2011) [202] Cloud Computing is the evolving technology that has created a great impact in the field of Information and Communication Technology. In China, the management

is unwilling to invest extraordinary amounts in IT wares since the financing channels for small and medium sized entities are quite limited. To improve the use of the newest IT without capital expenditure by using the rental model of CC and offer transparency throughout SC processes as in particular the Chinese logistics infrastructure suffers from a low level (Li et al. 2009) [203]. The scholars from China have highlighted that the important information safety has risen in cloud computing because the logistic industries have been affected due to very less security level. cloud computing can allow a high functioning advanced intersection traffic control system which can take the traffic problems mainly in metropolitan areas of China, it was perfectly described through prototyping by Li et al. (2015) [204].

Agrawal et al. (2011) [205] made an encryption for numeric data that can preserve the order and also permits queries related to comparison conditions. Even in that scheme the encryption is provided for the plain text by which the cipher text can follows a distribution of the target given by user. In the bucketization process of searching the encrypted databases, an attribute domain is divided into a set of buckets where each of them is identified by using a tag. These tags or buckets are maintained in the form of an index and mainly used by the server in order to process the queries.

Jose (2011) [206] presented in the work, "Implementing data security in cloud computing" suggests a classic scheme that combines the cloud computing scheme with cluster load balancing, SSL over as and safe sitting. This model includes some important security services, verification of counts, confidentiality and consistency offered in the organization of cloud computing. Now costs are greatly reduced, and maintenance costs are reduced. The data is protected with SSL. AES-based encryption, server grouping and server load balancing. The levels are divided according to the security rules. Active attacks detected on cloud computing resources are controlled by force. Dictionary attacks are analyzed and private efficiently by creating server redirection using the server load balancing method.

Joshi and Moudgil (2011) [207] presented in the study "Secure cloud storage" means that storage is a protocol that runs between the client and the server and that the server can test the client that the server has not tampered with that data. Before storing the data, encoding should be done. From the starting point, you want to test data integrity, but to test storage protocol with the server. An important advantage of displaying storage is that they are multi-faceted; the amount of information exchanged between clients and servers is very small, regardless of the size of the data. Proof of storage can be verified privately or publicly. The personally verifiable

memory test only allows the customer (that is, the part that encrypted the file) to validate the integrity of the data. With the test of open, verifiable memory, in any other way, anyone with the client's public key can verify the integrity of the data.

Forell et al. (2011) [208] presented in the study "Cloud management: challenges and opportunities" says cloud is a new paradigm with different management activities. These involve scales, multiple levels of abstraction, association and dynamism. This white paper also illustrated these aspects and principles based on distributed management, sustainability and federation. There are still some unresolved issues in cloud management, a rich area for further research to make the future of CC a success.

Tanimoto et al. (2011) [209] in this study, "Risk Management of Security Problems in Cloud Computing" was announced. In this document, they used risk breakdown structure for the security problems of cloud computing and method of risk matrix. Furthermore, they have developed the measures individually to meet the risks extracted. In some way, the cloud service provider should be capable to remove the unclear concern of the user from the measures.

Almorsy et al. (2011) [210] Framework for Cloud Computing Security Management This stated a cloud infrastructure protection monitoring system focused on cooperation. To fit with the cloud infrastructure paradigm, this architecture implements the NISTFISMA norm alignment. To manage the protection of the cloud provider, they used existing security automation software such as CPE, CWE, CVE, CAPEC, and so on (SMP). They validated our architecture by designing and securing multitenant SaaS applications with two distinct tenants.

Mahmood (2011) [211] highlights a number of issues related to data security in the cloud. Author discusses some environment-based issues that are based upon the location of data and its transmission from one location to another. The issues related to location are important due to the legal boundaries, due to which end user wants that data must reside in its country. Due to the policies, regulations and legislations of different countries involved in data creation, usage and storage, transition of data from one country to another may lead to these legal risks. Another major issue is related to availability of data — the unavailability of data leads to unavailability of the service or application outages, outcome of this can be loss of customer, and in turn revenue and loyalty. This research paper discusses one more security issue is that is data security in mobility, which means when the data mobility is high, the risks related to its security are more, in particular, when the data is transmitted from one country to another country and both the countries are governed by different regulatory framework.

Ding zheng Liu et al. (2011) [212] have suggested a novel cloud service discovery system with the help of a central controlled Agent-based Cloud Computing System. In this research work, the authors have tried to achieve a cloud service searching mechanism by means of multiple agents; these multiple agents are involved in independent cloud resource allocation and cloud resource management techniques.

Kertesz et al. (2011) [213] introduced an SLA-based service virtualization architecture based on 3 major components: a met negotiator responsible for agreement negotiations, a meta-broker for choosing the appropriate implementation environment, and an automatic service deployed for service virtualization. They model an entirely decentralized component that sits on top of each conventional broker in order to achieve cloud interoperability, dubbed the Inter-cloud meta broker.

Toosi et al. (2011) [214] addressed a Cloud federation that requires underutilized services to lend a portion of their infrastructure to other federation participants, typically at a lower cost, in order to prevent using non-storable computing resources. Both situations result in increased benefit and elasticity for suppliers. In the event of a resource deficit, the vendor terminates low-bid VM requests and substitutes them with higher-bidding VM requests or on-demand requests. As a result, bidding at a higher price reduces the probability of the supplier terminating the VM. This solution fails to meet the consumer's requirements depending on pricing, and the user does not find the best service provider for the available expense inside the customer.

Kumar et al. (2011) [215] provide a talented, infrastructure as a service approach to assign the resources for the kind of real-time responsibilities. Real time responsibilities need to be finished in before to the specified time period, Cloud computing offers an assortment of the resources having types of resources at various speed and cost. Furthermore, in cloud computing, distributions of the resources might be enhanced as per the necessities. This type of approach is termed as elasticity and it holds a prominent modification of available multi- processor mission distributions. The writer’s distillate on the issue of resource distribution for an array of real time responsibilities and also the financial charges are decreased. The writers even familiarize polynomial-time answer for the well-organized distribution of the available resources.

Kossmann et al. (2010) [216] Cloud computing holds extended profits in order for the disposition of information-intensive applications. They expose that the system especially is utilized to decrease charge having a pay-as-you-go commercial approach. The assignment

phase is enhanced, depending on the amount phase of the server. The writer concentrated on the business processing, like read and modify workload phase together with OLAP. Furthermore, the extensive goal is on operative cloud 33 calculating appearance for database applications and the statement consists of outcomes of a comprehensive assessment. As an outcome cost phase and performance of the service varies suggestively, depending on the workload.

Jiyin et al. (2010) [217] in cloud computing, calculative resources are provided for remote customers in the edifice of tenancies. They even industrialized an implemented reserve distribution approach having preemptable errands in cloud network. For the cloud customer, the work directs appeal to various cloud services, concurrently in assistance of the cloud substructure. In regard to this circumstance, the system requires similar dispensation in the cloud system to enhance its recital. A smearing similar processing in cloud computing is more crucial to operate the distribution of the resources and also to plan the errands operating order. Resource Allocation Apparatus is utilized with pre-executed job implementation cash propagates to increase the bandwidth consumption of the cloud atmosphere.

Goiri et al. (2010) [218] introduce a profit-driven approach to outsourcing and selling unused services. Y.Lee et al. [219] projected a user fulfilment-oriented scheduling algorithm for service requests (2010). As long as QoS is maintained at a certain amount, such an algorithm aims to optimize Cloud providers' benefit by receiving as many service requests as possible. Contracting with other service suppliers was seen in this respect as a way to prevent user demands being rejected. The dilemma of determining how to value commodities and how price affects use is not an easy one to solve. For the infrastructure resources they offer, current public Cloud service providers such as GoGrid, RackSpace and Amazon, typically use fixed price policies.

Taekgyeong and Kwang (2010) [220] have designed an augmented cloud service searching technique based on the ontology principle. In this research work, the authors have designed the Cloud Service Discovery System named as CSDS. In the CSDS, the agents have direct interaction with the ontology database for retrieving the most suitable of cloud service on behalf of the user.

Marshall (2010) [221] concentrates on providing a diverse pool of services. A method for creating an "elastic location" model that can be used by batch schedulers, storage, and web services. They implement various simple strategies for allocating resources, such as “on

demand," which means resources are distributed when a service call or job arrives, "steady stream," which implies constant consumption and hence keeps certain elastic resources operating constantly, regardless of (temporary) task shortages, and "bursts", which are for fluctuating load. They focus on dynamically raising and decreasing the number of resources, however load balancing among the assigned resources is handled by third-party logic.

Metsch et al. (2010) [222] Prototype broker architecture (based on a combination of the core SLA project framework and the Reservoir framework) This permits for on-demand provisioning and easy of virtualized infrastructure resources inside a federated cloud platform, with the core SLA framework acting as an SLA-based broker and the Reservoir sites acting as SLA third party providers.

Buyya et al. (2010) [223] addressed Inter-Domain, a federated cloud storage environment that allows apps to scale through many provider clouds. The aim of their newly launched federation model was to improve cloud providers' provisioning capability in the event of unexpected spikes in workload by borrowing computing and storage resources from other service providers. A service trader, a cloud exchange, and a cloud coordinator are the three key components of the planned architecture. In order to reach the specified QoS goals, a client initiates a cloud broker, while cloud coordinators, serving as a conduit between their external clouds and internal datacenters, publish their services to the federation. Cloud exchange serves as a middleman, putting service providers and consumers together. It combines infrastructure requests from service brokers and compares them to accessible services published by cloud coordinators. The architecture is still a study vision, and it would be developed in conjunction with the cloud bus project. The simulation findings, on the other hand, revealed that the federation solution improves user device efficiency significantly.

Kevin Hamlen (2010 [224] to complete the literature survey for this research, knowledge of private cloud, public cloud, hybrid cloud and some of the security issue are collected from above reviews. The security issues in cloud include storage security, middleware security, network security and application security that is due to the life cycle of data in cloud. In case of hybrid cloud, they try to solve the problem of security at the level of data by taking some public cloud and implementing some private cloud and deploying some application at the level of their integration - hybrid cloud.

Subashini et al (2010) [225] elaborate its finding as cloud computing is a way using which the capacity of computing can be increased exponentially or the capabilities can be added

dynamically that is too without any investment in infrastructure, or training of existing personnel, or purchasing licenses of any existing software. So, the conclusion is cloud computing can extend Information Technology ‘s (IT) existing capabilities with least of efforts. In the last one and a half decade, CC has grown from being a promising business concept being used by the organization internally for its own use to one of the quickest growing domains of the IT industry where this resource can be provided as the services to outside world on pay per use basis. Despite various hypes surrounding the enterprise customers and cloud are interested to deploy their business in the cloud due to the benefits it provides to the enterprise. Security is the major issues which is behaving as a bottleneck in the growth of cloud computing. Another issue is related to problems with data protection and privacy that continue to plague the market.

Hanqian Wu et al. (2010) [226] discusses on network security for virtual machines and for the study researchers select the open-source project, Xen, and use this hypervisor as the platform for the specified research. According to this publication authors analyze the network security problems that exists in virtual machines, introduce a novel virtual network model which can control the intercommunication among multiple virtual machine instances running on the hypervisor with better security. From the aspect of security, one major challenge in the designing of a cloud computing platform is that of interconnectivity between multiple virtual machine instances. As in case users who are granted super user access to their provisioned virtual machine, without proper care or by mistake, can possibly monitor any of the virtual machine or access the underlying network interfaces.

Dimitrios Zissis et al. (2010) [227] Addressing Cloud Computing Security Issues discusses the basic of cloud computing, deployment architecture of cloud and a number of security issues, with the ability to address the susceptibilities in context to cloud that are familiar in traditional infrastructure and its dynamic characteristics that are able to deter the efficiency of traditional counter measures. The researchers identified a number of design principles that are generic in nature in context to the cloud environment which have its base from the necessity to control relevant exposures and threats related to computing. For this the researcher adopted information systems and software engineering approaches of designing. According to the finding combination of PKI, LDAP and SSO can counter most of these attacks that were countered while working. The threats specified in this publication were related to the issue of data integrity, data confidentiality, authenticity of user and availability of data and its communications. Researcher provided the solution by presenting a service which is accessible

to all its associated entities, which reaches a security mesh through federations, within that the essential trust is maintained.

Gowrigolla et al. (2010) [228] describe how cloud computing is lengthy and complex dreamed vision of computing as a value. According to the author, information owners can remotely contain their knowledge in cloud to travel in on-demand high excellent applications services from a mutual pool of configurable computing resources. While information outsourcing relieves data owners of the burden of neighborhood information storage space and the renovation of its system, it also eliminates the physical control of storage dependability protection, which regularly has been anticipated through each project participants among excessive provider-degree necessities. This paper gives a quick foreword to Cloud computing privacy hindrance being addressed is then offered, by describing some of the distinctive factors to be regarded when data enters the Cloud. Eventually, a knowledge defense method with community auditing system is printed with the intention to deal with a number of those explanations, with the aid of providing a mechanism to enable for information to be encrypted in Cloud without loss of accessibility and performance for authorized events.

This system is not forever a substitute for traditional privacy and protection measures for information, however as an alternative an improvement which allows users (once more, at either the man or woman or manufacturer level) a greater measure of self-assurance within adoption of revolutionary, rate-saving Cloud computing technology.

Annapureddy (2010) [229] Security Challenges in Hybrid Cloud Infrastructures concluded that future of cloud computing is hybrid cloud, hybrid model is not a fixed model; it is the customized model that is designed according to the requirements of the enterprise. It allows the organization to place some data within the secure local network and the remaining in the unsecure network using public cloud. Most of the organization places secure data in their private cloud and the less secure data in public cloud. But there are few possible threats from outside attackers to the valuable enterprise‘s data as the path is there to the private data. According to the solution provided by the author it can be concluded that to secure their private cloud some companies have worked upon the solutions like creating a secure tunnel between enterprise cloud and public cloud, encoding the data and storage it in cloud and setting up firewall with elementary ACL rules.

Lombardi and Pietro (2010) [230] presented in study, "Secure virtualization for cloud computing is a new cloud-based advanced architecture (ACPS) that can monitor the reliability

of tourists and middleware and can protect against most attack classes, but service users and Sources of service, ACPS is designed for various cloud applications, prepared in advance, able to respond closely to the beginning of security, inform the level of organization of security of such occurrences Moreover, the planned construction is fully applied to the current open source solution, the efficiency of the guard and the results of the presentation are silent and analyzed. The outcomes demonstrates that the intentional method is effective and presents a slight penalization of presentation.

Avetisyan et al. (2010) [231] presented in the study Open Cirrus states that Cirrus is used by numerous exploration projects on parts such as interaction, sustainability, exascale calculation, archiving, service procedures, security, etc. As a result, some of these schemes, to the basic hardware or to the schema software, inform the operator of the physical machine. This is a change to a distinctive cloud that allows users to use only virtual machines. Many management tools/services are required to support the storage of physically equivalent properties. In the rest of the text, they describe some of these services in a specific node booking scheme, cloud sustainability console, scalable monitoring.

Zhou et al. (2010) [232] stated in the work, Cloud computing privacy and security: questionnaire, users of cloud schemes and cloud services strongly protect the issues of security and privacy. They are experiencing security and privacy concerns from the amount of CC sources in this study. However, these concerns are not accepted. Why you need to change the performance of five goals (availability, confidentiality, data integrity, control, review) and confidentiality to learn new relationships between users and sources in the cloud context, the cloud need to set up an additional security plan in advance by setting. The secret of success in cloud computing is that certain security and privacy issues would be suspended.

Damiani et al. (2010) [233] the fundamental task is to create a keyed hash for all the keywords that are present and also to store the information encapsulated in the cipher text. This hash value can help the server to search the keywords by matching.

Cao et al. (2011) [234] introduced an elegant method to perform queries on encrypted information and also give a safe index for speeding up the two-step mapping. (Goh 2003) [235] protocol permits to look into an encrypted data that has utilized a safer index which is based on a bloom filter that consists of a low storage overhead. Introduced a new approach to index the encrypt in such a way that it allows effective access to the data.

Ang Li et al. (2010) [236] work with various public cloud providers, based upon their studies develop CloudCmp, which is a system that work on the systematic comparison in performance and charge of cloud givers. Based upon the metrics that is based on the effect on the performance of customer applications, CloudCmp measures the various parameters offered from a cloud including persistent storage, networking services and elastic computing. CloudCmp tries to guarantee fairness, representativeness, and compliance of these measures while work under the limits of measurement cost. Relating CloudCmp to various popular cloud providers that together account for majority of the cloud customers today, researcher concluded that their offered services vary based upon the costs and performance, so it give them a platform that help in selection of the best of provider according to the requirement. From these representative cloud applications as the case studies, they show that CloudCmp can guide customers in picking the best performing supplier for their respective application.

Li et al. (2010) [237] recommended a cloud service comparison framework called "cloudcmp". Before accessing the services, the service provider would be selected by evaluating the generic services such as storage, elastic services, SLA, etc. The evaluation results help in acquiring the user service request is satisfied or not, and also the performance of user application is predicated when it is deployed on service provider platform.

Marian Mihailescu et al. (2010) [238] spoke about competitive resource prices on Federated clouds. Users buy various categories of services from one or more resource suppliers utilizing a fixed price system in cloud computing. Pricing is used to handle logical consumers in a strategic-proof dynamic pricing system stated for allocating services on federated clouds. Depending on the application background, a reasonable consumer may reflect a person, a community, or an entity. Users in federated clouds request several types of services from various providers. Unlike fixed pricing, which requires users to manually aggregate services from various suppliers, flexible pricing does not require users to do so.

Ahmed et al. (2010) [239] investigated cloud storage protection issues with the aim of identifying and establishing a stable channel of contact between a single knowledge user and the cloud service provider (CSP). This diagram illustrates the existing state of protection in the application as a service (PaaS), and infrastructure as a service (IaaS) industry and software as a service (SaaS).

Krishna Reddy et al. (2011) [240] concentrated on CC and concerns of security in order to promote collaboration across internet-connected realms. Data maintenance is a major protection concern in the cloud**.**

Subashini et al. (2010) [241] presented the results of a study on security concerns in cloud infrastructure application distribution models. A complex protection architecture with various approaches has been provided to improve the protection of knowledge in the cloud world. The author has developed the idea of cloud protection, which is built on real-world security frameworks in which the level of security required is linked to the value of an organization's assets and money, and each organization prioritizes its preferred security based on the importance of the data. Sachdeva is a character in the film Sachdeva (2011). Risk–Based Security Testing in CC Environments was introduced by Philipp Zech et al K (2011) [242]. As a result of the authors' analysis of the number of threats and their danger, a modern approach for dealing with security issues and threats in cloud environments has been created.

Khaled et al. (2010) [243] Cloud service providers, in particular, must protect the virtual world that allows them to administer software for multiple customers and deliver individual services for each client. Identity management, data leakage (caused by numerous tenants sharing physical resources), virtual machine (VM) privacy, access control, continuous client-data authentication, and the prevention of cross-VM side-channel attacks are all important security concerns in the sense of virtualization. Cloud-specific protection issues are being addressed by vendors and testing communities. Claim-based access management, a security assertion markup language, a federated identity and security token service methods were suggested to maintain consistency and authenticity, as well as to fix gain access to control in a cloud-enabled environment.

Han et al. (2009) [244] recommended a recommended system for cloud service selection. The cloud services are evaluated according to the virtual machine performance, and it also considers network QoS parameters. The cloud service performance varies based on which virtual machine platform it is running. The virtual machine parameters perform a crucial role in the performance of cloud services. The stated method is successfully in meeting user requirements, and it minimizes the number of SLA violations. The summary of optimization methods applied to solve cloud service selection problem.

Weinhardt et al. (2009) [245] discuss the evolution of cloud computing from grid computing. Based upon their research, authors discuss upon the business model framework. In this paper

authors discuss the various model used for deployment of cloud. It gives a number of organizations that are using different models for their different business applications.

Armbruster et al. (2009) [246] cite the 2008 failure of The Linkup, an online database administration, as a very bad example of a CC storage provider going out of business. To soften the blow of such troubles, the Cloud Security Alliance (2009) recommends that cloud computing clients consider providing an exchange region that can perform the functions before provided by the CC administration provider. This region may be at the client's own data centre or at some CC management benefactor facility.

Viega (2009) [247] clients should hold up their own reinforcements in addition to those taken by the cloud storage administration provider, but it is usually less difficult with IaaS than with PaaS or SaaS.

Reese (2009) [248] Cloud computing is a technology where one server or a set of servers make the computing at one place for other servers that are located somewhere else that are connected using the Internet. According to Reese, cloud is a space where one can use any technology remotely, without any installation at its machine, and it may never pay for this in case it do not use this technology. The cloud can be assumed as a very big distributed system, which host a number of services and provide these services to each and every user across the world using Internet. These services are used for hosting a number of applications at various data centers consisting of appropriate hardware and system software.

Liu (2009) [249] the term Hybrid Cloud is utilized for at least two clouds make hybrids cloud, which has just one of its sort substances yet have the option to be encompassed mutually, when it offers the benefit of different use models. By using "hybrid cloud" basic design, organizations and people would be smart to get degrees of mistake broadmindedness joint with locally moment ease of use with no propensity on internet connectivity's. Hybrid cloud auxiliary design requires both on-premises capital and off-site off the beaten path server-based cloud communications are required. Hybrid clouds don’t have the versatility, safety and certainty of in-house applications. Hybrid cloud is given the flexibility of in-house applications with the duty broadmindedness and adaptability of cloud-based services.

Buyyaa et al. (2009) [250] imagined CC as the fifth utility with the headway of Information and Communications Technology. To deliver this vision they stated a cloud engineering to incorporate computational hazard management and customer driven service management to

accomplish Service Level Agreement situated asset allotment. They showed the storage cloud as a contextual analysis for high execution content delivery.

Mell and Grance (2009) [251] portrayed the CC Environment as a model that gives helpful approach to a common pool of configurable computing assets (e.g., networks, servers, storage, applications, and services) on request that can be discharged and provisioned with minimal management exertion or service supplier cooperation utilizing pay-per-use plot. They condensed the basic highlights of cloud into five key qualities: on-request self-service, wide network gets to, asset pooling, quick flexibility and estimated service. They examined the virtualization technology used to make Virtual Machines in Cloud Computing Environment which is a software implementation of a computing environment above which a working framework (OS) or program might be introduced and run.

Catteddu and Hogben (2009) [252] on request cloning of virtual machines is supported by IaaS (Infrastructure as a Service), thus if a security break happens, the customer can take a picture of a live virtual machine for disconnected scientific examination. This can help in less personal time for investigation. Moreover, with storage on top, various clones can be made and examination is presented in parallel to lessen examination time. This gives advantage in improving the export investigation of security occurrences and expanding the likelihood of following assailants. CC likewise gives cost-powerful storage to logs thus, offering exhaustive logging.

Shi and Sim (2008) [253] have suggested for making a simultaneous negotiation and coordination, cooperation among provider agent, broker agent and customer agent within the stimulated time period. In this work, the authors have fulfilled the different requirements of the cloud service user for a reasonable price. The system is most suited for making commitments among different cloud service vendors and cloud service consumers. The regression-based system had connected different levels of vendor with multiple number cloud users across the globe. If the requested cloud service is not available on the particular vendor, immediately that the cloud vendor may immediately contact another service vendor to fulfill the customer's request without any delay.

Lijun Mei et al. (2008) [254] A Tale of Clouds: Paradigm Comparisons and Some Thoughts on Research Issues provided a qualitative comparison of a number of computing that include cloud computing, pervasive computing and service computing. They concluded their research with the framework positions of the cloud computing on the basic model of computer

architecture, including 3 different features: input-output, calculation and storage. The author presented a comparison for all of the three features that can be summarized as: (i) the input-output feature of computer architecture resembles with that of service computing in cloud computing. (ii) The storage aspect of computer architecture is very close to that of pervasive computing than that of service computing in cloud computing. (iii) The calculation features of these paradigms are same. So, based on their comparison, authors give a number of research issues that include a number of pluggable computing resources to cloud applications, transparency in access of data, adaptive nature of applications in cloud environment, and automatic quantification of application quality in cloud.

Kartalopoulos (2008) [255] next in the process is to learn some security issues in public cloud and private cloud and later check them in the hybrid cloud. Prior to the understanding of security issue in cloud computing, they need to understand the security issue in networked system. According to the research on network security while developing the secure network, following are the points to be considered: Access, Confidentiality, Authentication, Integrity and Non-repudiation.

Balding (2008) [256] Craig Balding is a framework/database overseer subsequent to moving on from college with a Systems Analysis degree in 1994. Author has ISC (Information Systems Security) affirmation. The author is additionally ISACA for example Guaranteed Information Security Auditor and Chartered IT Professional. Thinning up top (2008) grants seven technical security benefits for endeavors some of them are prompt advantages while others may land with time and have a few conditions connected. Cloud offers significant security advantages to little and medium endeavors as the vast majority of them endure with constrained or non-presence in-house assets and spending plans.

Vogels (2008) [257] in traditional frameworks, framework asset usage is low, evaluated at 15–20 percent for data focuses; dissimilar appraisals are lower. There are many explanations behind low usage as administrators generally in purchase for close to top and future burdens and along these lines don't develop the entire limit constantly. While to benefit in this issue Cloud Computing smoothest impacts crosswise over many customers and today may achieve 40 % usage.

Youseff et al. (2008) [258] Amazon cloud has embraced the layered valuing model in which the cloud services are obtainable in a few levels and each level gives fixed computing details (for example memory portion, CPU type, speed and so forth.) and SLA (Service Level

Agreement) at a specific value for each unit time. Perunit estimating is for the most part utilized with data move and memory utilization. GoGrid Cloud contribution utilizes the fundamental memory portion, where they indicate "Smash/hour" as application unit for their framework. This strategy is more adaptable than layered evaluating as it enables users to reallocate the memory area based on their needs. Finally, for the most part, the membership-based approach is used for SaaS. This model lets the users to foresee their occasional costs of using CC.

Jon Brodkin (2008) [259] the hybrid cloud is collected of at least 2 cloud types, which are bound by a standard or exclusive technology which makes data empowers and application convenience e.g., cloud blasting for load-adjusting among clouds. The hybrid cloud shows a large number of the advantages and disadvantages of its partners.

Vouk (2008) [260] the central reason of cloud computing is to re-appropriate likewise should be possible by it and IT infrastructure can from an inside (on location) managed network activity to an outer network activity. In light of this is, four kinds of clouds (public, private, network, and hybrid) would direct unique security and implementation contemplations. With outside cloud services, the DOD should fastidiously investigate the degree of security could be made with a private cloud, the DOD would be managed, and police security likewise can utilize it for its very own information frameworks. The accompanying talks about cloud dangers and countermeasures comparative with every one of the ten areas. For the reasons for this exploration, the examination of dangers and suggestions/countermeasures can be applied to both interior (private) and outside (public) cloud implementations.

Hall and Liedtka (2007) [261] Cloud storage can increase the likelihood of unauthorized access to sensitive data. First, international policymakers might be involved: there may be heightened threats as a result of government monitoring of data collected in the cloud, as the data could be stored in places where it was not previously. In such cases, governments in the countries where the data is collected or held may have legal privileges to access the data, although users may not be told. Second, there is an inherent possibility of unintended entry, much as there is for other programming models. Data leakage from cloud machines may be caused by rogue CSP workers, data hackers breaking into service providers' machines, or also even users with the same business where there is no isolation of different customers' data in a cloud server that they share. In general, cloud storage is more vulnerable to harmful activity than cloud computing since data can be stored in the cloud for extended periods of time,

increasing the exposure time. On the other side, the use of encryption in cloud computing has further promise.

A Tweney and Crane (2007),[262] another big problem for CC is ensuring that the user has control over the lifecycle of their data, especially deletion; more precisely, this risk is highly dependent on the cloud service model being used. One or more virtual machines are built utilizing Infrastructure as a Service (IaaS) or Platform as a Service (PaaS) in order for a programmed to operate inside them; once the mission is completed, the virtual machines and disc space are allocated. However, the media is not cleaned, because if it isn't, the prior user's data may be recoverable from the next user. Users have no idea what happens to the actual volume that supports their virtual storage because space is virtualized. The consumer is one of the consumers of a multi-tenant platform created by the CSP, and the customer's data is processed in the cloud, ready to be accessed the next time the customer logs in, using the Software as a Service (SaaS) method. Only towards the close of the data's lifecycle, or whether the client wants to move service providers, the data be erased**.**

Jfisang et al. (2007) [263] Reputation is related with successful execution of commitments. Basically, trust is between client and service provider, but the reputation is the comprehensive opinion of a community concerning that service. Generally, a service that has great reputation evaluated by several users in that community with past experience with the same service. Reputation based trust are extensively utilized in e-commerce and P2P networks. The reputation of cloud services or cloud service suppliers creates healthy contact with cloud users. Therefore, cloud givers try to develop and sustain higher reputation. Organically, reputation-based trust enters into the vision of making trust judgment in federated cloud architecture.

Pearson et al. (2005) [264] addressed privacy concerns in the public cloud. Privacy is a basic human privilege that includes the right to be alone. In the commercial, user sense, privacy includes the security and proper usage of customers' personal details, as well as satisfying customers' preferences of its use. For organizations, privacy includes the implementation of rules, regulations, guidelines, and procedures for managing individuals' Personally Identifiable Information (PII). When it comes to cloud privacy threats, the following stand out: loss of access discretion, possible unlicensed secondary use, data fragmentation, cross-border data flow, and complex provisioning. Illegal Secondary Use According to CSA (2010), there is a possibility that the data could be used for unauthorized purposes. It is part of the traditional

cloud storage business model for the service provider to earn money from approved secondary uses of users' data.

Bellard (2005) [265] presented a QEMU, a fast and portable, dynamic machine translator which supports full system emulation where Linux process compiled for one CPU can run on other CPU also. Bolte et al. (2010) [272] integrated a libvirt, a stable interface with remote hypervisor management facilities for VMware ESX and Microsoft Hyper-V, for virtual machine management problem in open-source management environment and strongly simplifies the long-term maintenance through libvirt's prominent API.

Boneh et al. (2004) [266] Bucketization process is comparatively less in performance overhead and also allows more complicated queries like range and comparison queries and thereby exposes a lot of information regarding the encrypted data. Most of the encrypted search methods that were mentioned above search the encrypted data depending on the secret keys

Warren Smith and Chaumin (2004) [267] published the research report by the name An Execution Service for Grid Computing covers the detail for migration from distributed to grid computing. According to this report, next step to the distributed computing was grid computing, where the researchers work on different concept using which the distributed system can be provided to the user as a single system. In this the idea was to work upon the resources that are available in the underutilized system and can be provided to the outside (remote) user. It includes the work on different concepts based on the uses of processing power, uses of memory (primary and secondary) and securing them.

Nguyen and Jennings (2004) [268] have developed a system to manage the agent commitment for the multilevel simultaneous negotiations among the provider and customer agent. The broker agent acts as a facilitator between the service Provider and cloud service user. In this work all the activities are automated since they do not require any manual interference for making negotiation. In this multilevel concurrent cloud service negotiation, all the agents actively participate in the bargaining activity, supporting the cloud user for finding the appropriate cloud service provider and simultaneously helping the cloud provider to know about active cloud service user based on the previous purchase history. This work is most suitable for bilateral negotiation among agents. The following problem identified in this method, is that unfortunately, partial agreements are made between provide agent and cloud user agents due to insufficient knowledge of each

Deshpande et al. (2004) [269] recommended Item based Recommendation algorithms which can find out similarities between different items to be advised from another combination of items. There are different items involved in this algorithm. Firstly, a method is used to find out the similarities between a set of items and set of recommended items. The aim of Top – N recommendation method was to separate the items bought by a single user neighbor-based recommendation system, this algorithm is a way faster and its shows results with far better accuracy and quality.

Ho et al. (2004) [270] planned an Orthogonal Simulated Annealing (OSA) algorithm along with Efficient Generation Mechanism (EGM) for explaining large floor planning problems. Systematic reasoning technique makes next move of OSA based on OED. Swap operation is adjusted to cooperate with EGM for efficient results.

Nguyen and Jennings (2003) [271] have developed an agent based heuristic system to manage the simultaneous negotiation process within certain duration. This work was well suited for a better negotiation among all the agent's software in a quick manner. In this research work there are three kind of agent's involved for making a successful negotiation. The agreement between the cloud user agent with a broker agent or intermediate agent. In this scenario, the client agent worked on behalf of the cloud users. These agents collect the various requirements. Based on which broker agent immediately contacts s the provider agent. The provider agent has been working on behalf of the cloud service vendor. Now a negotiation occurs between the broker and the provider agent the requested service is available on the database and the negotiation is called successful and the cloud services are distributed to the end user instantly.

Haowen et al. (2020) [272] The purpose of this research is to create model concepts for a Hybrid Intelligence decision support system (HI-DSS) that incorporates human and computer intelligence capabilities. To create a prototype artefact and a collection of design concepts, we used a design science analysis methodology. Our research adds to previous work on decision support for business models, the use of complementary abilities of humans and machines in decision-making, and support mechanisms for highly uncertain decision-making issues by including prescriptive information for HI-DSS.

Sheng et al. (2020) [273] If additive manufacturing (AM) becomes more advanced, a reliable and efficient method for identifying parts that are suitable for AM, as well as gaining insight into the value it may bring to a product, is needed. Prior approaches are organically established

and heavily reliant on prior knowledge, making them ineffective in terms of objectivity and transferability.

CHAPTER 3

RESEARCH METHODOLOGY

This chapter gives an overview of the framework proposed “Ranking based Cloud Services Selection Decision Support System”. A hybrid cloud method to automate the cloud services based on decision support system are projected in this work. All the phases of this proposed work with their methods will be discussed in this chapter.

3.1. REQUIREMENTS FOR DECISION SUPPORT SYSTEM

When migrating an application to the Cloud, a lot of decisions must be made about how the program can be refactored for the Cloud, how it can scale, and so on. In this respect, performance prediction and cost analysis can only help to a limited extent. It addresses these issues by providing an outline of the principles needed to create a decision support system to facilitate application migration to the cloud. This theoretical perspective outlines our idea for what comprises a full solution for stakeholders and application developers who are deciding whether or not to transfer their application to the cloud.

More precisely, two sorts of ideas have been recognized: decisions that must be made (and hence are the system's emphasis) and activities that must be completed in order to support all decisions and, as a result, impact their result [275].

3.2. BACKGROUND STUDY

CC is a novel processing paradigm that delivers hardware and software resources as virtualized services, removing the problem of caring about low-level system administration concerns from users. It's not easy to migrate Web applications to Cloud services and to integrate Cloud services into current computer infrastructures. It creates original issues that frequently necessitate paradigm and practise innovation at each levels: cultural, legal, technical, regulatory and social. The most difficult aspect of translating Web applications to virtualized Cloud services is determining the optimum and most compatible software image combination. Particularly when cloud service supply develops further into more sensitive and regulated areas, a consistent and clear assessment of the numerous capabilities of cloud service providers (CSPs) becomes a key component in determining which CSPs to utilize in the future. This chapter provided a useful method in this regard. This chapter explains how to automate cloud services using a hybrid cloud strategy based on a decision support system.

For real-time supervisory control of industrial automation systems, a cloud based DSS is recommended. For real-time decision making, the knowledge and ASM base are moved from PLCs to the cloud. Self-healing is one of the self-management characteristics enabled by integrating FTA systems into the cloud based DSS. The IEC 61499 standard is utilized as the fault modelling language to integrate the fault tree with the PLC control logic. The FTA, in conjunction with the ASM, makes the necessary configuration modifications to keep the system running. To boost the speed of the cloud-based DSS and meet real-time necessities for time-critical industrial applications, parallel faster-than-real-time simulations are used. The cloud based DSS with a water processing station is installed on a local server as well as on the public cloud. The suggested DSS employing the local cloud can provide real-time supervisory control for both process control systems and manufacturing, according to the self-healing tests [274].

3.3. PROBLEM FORMULATION

In the majority of the works the decision for the selection of the service or any of the available alternatives is based on the predefined parameters and remains constant throughout. As can be noticed every user query for service and alternatives definition varies and there is a need to have dynamic ranking system-based decision system. In the recent work the decision factors are considered along with the iterative ranking of the same and on the basis for ranking alternatives. Majority is defined to which laid for optimum service selection. To establish a ranking of the cloud services for cloud service choice, a comparison of the accessible cloud services based on the variability in their performance over time is required. Because cloud services have so many different properties, any comparison of two clouds must take all of them into account. However, comparing two services is difficult since one cloud service may be superior in some respects while another excels in others. Furthermore, cloud service features may not be similarly significant for meeting specific operator needs over all time periods for that a decision must be taken. In such cases, a decision support system based on a dynamic ranking system is beneficial for ranking and comparation cloud services.

3.4. OBJECTIVES

1) To study and analyze the cloud service adoption over hybrid type of cloud and requirement for decision for decision support system.
2) To adopt a literature for cloud service adoption over hybrid type of cloud.

3) To propose a hybrid technique for automating the service solution over hybrid cloud using decision support.
4) To validate the implementation of the suggested in comparison to the literature techniques.

3.5. BASICS FOR HYBRID TYPE OF CLOUD

Cloud computing is the modern processing paradigm in which software and hardware resources are dedicated as a virtualized service where consumers are free to worry about system management issues. It is non-trivial to migrate web applications to cloud services and to integrate cloud services into current computer systems. The most important challenge in mapping web applications to virtual Cloud services is the selection of the finest and most appropriate mix of software images. Careful and reliable analysis of the different skills of cloud service providers (CSPs) is needed. In particular when a cloud service provider extends into the most sensitive and regulated sectors, it would be a key component in selecting which CSPs should be chosen. This methodology is useful in this regards that it describes the mechanism in which context for CSPs is collected and a rules-based system is introduced for the judgements on the suitability of each CSP are produced. It includes a study of the security and private risk and proposed stipulations for contracts and SLAs to be taken into consideration.

3.6. RESEARCH METHODOLOGY

The proposed system architecture is based on cloud-based decision support system. The work considers a study on hybrid cloud approach to computerize the cloud services based on decision support system. Figure 3.1 shows the completes process flow of methodology.

Step 1: Firstly, User request the service to the cloud supplier then cloud provider will apply to the training dataset.

Step 2: Service request comprises service level agreements. This service level agreements includes cost, service name and validity.

Due to its complexity, the old-style method requires the operator to essentially compose and create a service-oriented architecture that cloud framework for choosing services are brought to the consumer through a third-party entity with the user's assistance in selecting the provider that best happens his service level agreement necessities.

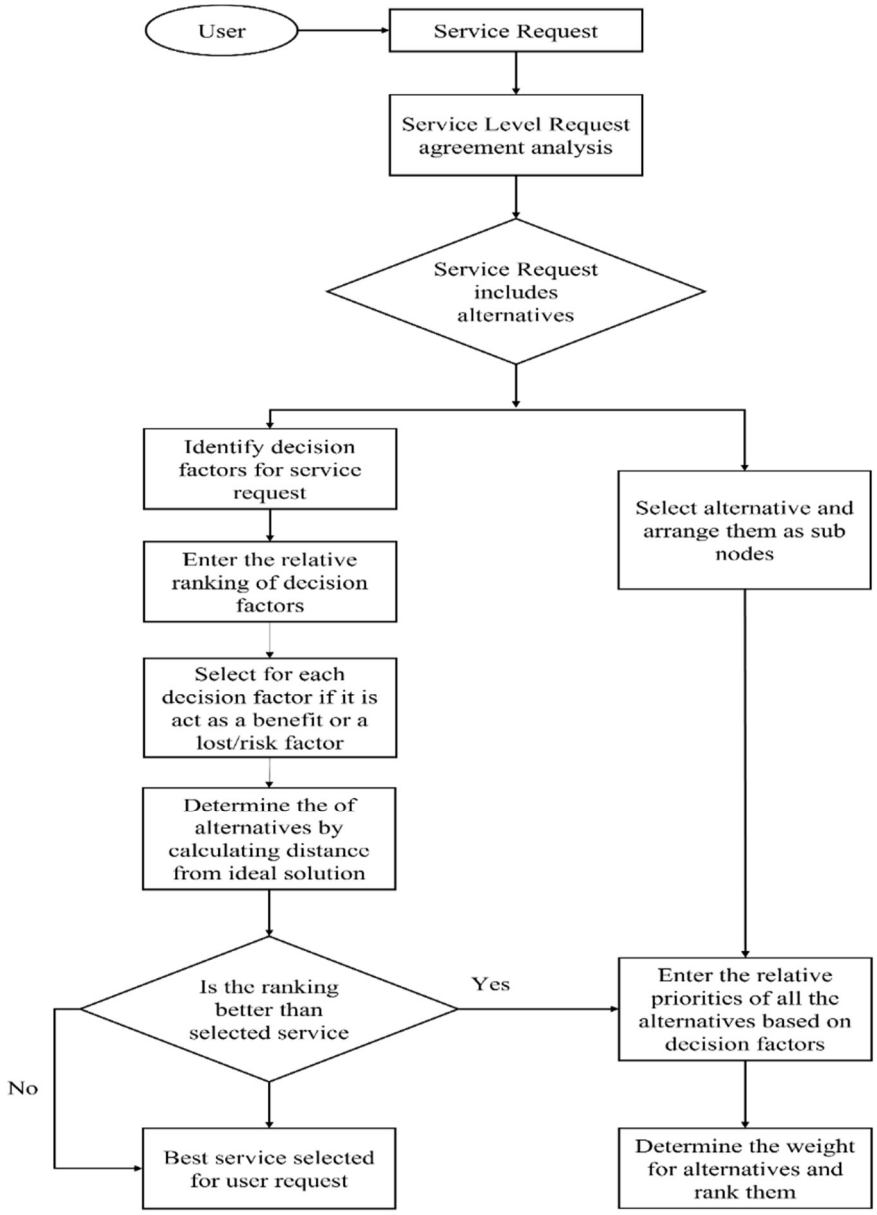

Figure 3.1 Proposed Methodology

Step 3: Next, attributes and key factors for choosing on cloud computing adoption derived for service request. In the procedure of deriving key factors and alternatives for CC adoption, AHP analysis was utilized to appear at the decision-making process. The decision-making model was related to the variables defined by AHP analysis.

AHP analysis, which uses hierarchical analysis to solve decision-making difficulties, is the best option. This study utilized this approach as a methodology for making decisions and prioritising processes, and the experience, knowledge, and intuition of evaluators were identified by a _pairwise comparison of components that make up the decision-making order.

Step 4: Analysed the ranking of alternatives and factors by calculating distance from the ideal. It shows composite weights and priorities for factors, decision areas and attributes for adopting a CC system from a broad viewpoint, involving providers and demanders, and it shows composite weights and priorities for decision factors, areas, and characteristics for adopting a cloud computing system.

Step 5: If the ranking of alternatives is not better than selected service then the best service is selected for the user request. All the identified factors were believed as options for the factors and attributes in the proposed model. Those factors were placed appropriately by nature into factors and attributes in the work. Each attribute and factor are determined to determine their suitability for adopting a CC system.

Step 6: If the ranking is better than the selected service then enters the relative priorities of all the alternatives based on decision factors. Each attribute and Each factor are decided after computing the various weights due to pairwise comparisons then a vector of priorities was significances based on decision factors. Next, determine the weights of the factors and contributions for alternatives and then rank them.

In this work, considered the cloud service choice problem and proposed a dynamic ranking-based decision system. A service selection decision is taken based on raking of alternatives and each decision are combined to get the whole optimal service. Then linked the outcomes obtained using this method with those obtained by current approaches and noticed that, due to the variations in service performance outcomes from the dynamic nature of the cloud environment, the compared methodologies don’t run to the choice of the similar service.

CHAPTER 4

IMPLEMENTATION RESULTS AND DISCUSSION

4.1. OVERVIEW

Cloud computing (CC) is a cost-effective, user-friendly, and on-demand computing service based on the Internet that has emerged as a critical component in real-time decision-making processes. It provides scalability to any user from anywhere in the world to share, view, and analyze the data. The cloud computing architecture is used to build the decision support system (DSS). Cloud-based decision support system increases accessibility, decreases deployment and processing times, lowers costs, and improves communication and collaboration among decision-makers.

The previous chapters started from the introduction of the domain area and covers different aspects like cloud computing services and its types. The previous chapters provide a detailed description of various literature works carried in the field of decision support system. This chapter provides the experimental outcome of the proposed method. The proposed work is based on a cloud-based decision support system that uses parallel AHP (Analytic Hierarchy Process) analysis to assess all cloud services that is related to client preferences before collecting the findings to establish the overall rank of all cloud service alternatives. AHP analysis offers the best alternative through hierarchical analysis on decision-making process. In this work user selects different cloud providers then user selects some decision factors which are further evaluated for selected CSP (cloud service provider) to see whether it act as a benefit or loss/risk factor. Additionally, these results recommend the nine cloud service providers such as google, amazon, oracle, digital ocean etc. on the basis of their raking and weights. Then after comparing ranking of each cloud service provider, it is concluded that CSP which is ranked as 1 is selected as the best CSP among other cloud providers and CSP which is ranked as 2 is selected as the second-best cloud provider. This method helps the cloud service user to choose the finest likely accessible service corresponding to the needs.

4.2. IMPLEMENTATION AND RESULT

Result 1

In Figure 4.1, firstly user request for the service of cloud provider. In this result user enter his credentials to continue the process. Here, user enter his username “Gautambhata1” and

password “Password:” then request for his desired cloud provider. After that service level agreements are determined for deciding cloud service provider. The given table 4.1 shows the list of cloud service providers among which implementation is done.

Table 4.1 Cloud service provider

Cloud Service Providers	Logo
Amazon	
Alibaba	
Dell	
Digital Ocean	
Google	
IBM	
Microsoft	
Oracle	
Salesforce	

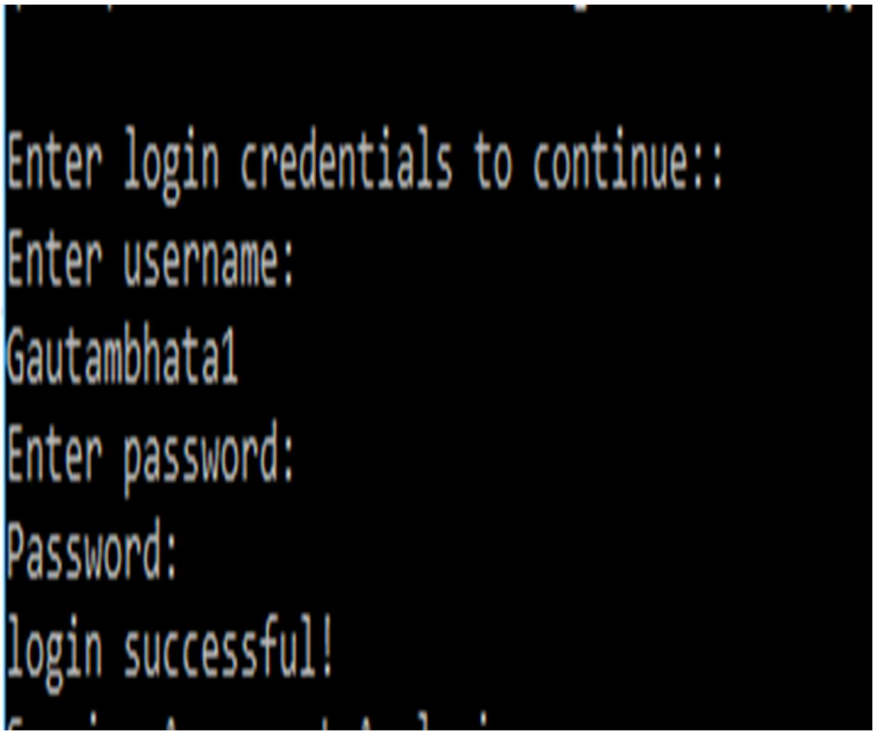

Figure 4.1 Login process

Result 2: Table 4.2 depicts the service level agreements of different cloud providers, it includes cost, validity, and service name such as SaaS (software as a service), IaaS (infrastructure as a service), and PaaS (platform as a service). Here, 1 indicates that what services are provides by CSP and 0 indicates that what services are not provided by it. For example, if user select the service from Alibaba cloud provider, then it provides the services as only SaaS and PaaS as they are indicated by 1 and IaaS is indicated as 0 so, Alibaba does not provide the service as IaaS.

Table 4.2 Service level agreements

	Google	**Amazon**	**Microsoft**	**Alibaba**	**Salesforce**	**Dell**	**IBM**	**Digital ocean**	**Oracle**
Cost	3250	2356	1036	900	800	1200	1300	100	1800
Validity	1	1	1	1	1	1	1	1	1
SaaS	1	1	1	1	0	1	1	1	1
IaaS	1	1	1	0	0	1	1	0	1
PaaS	1	1	1	1	1	1	1	1	1

Figure 4.2 shows the service agreement analysis of Microsoft cloud provider. In this result the cost of services provided by Microsoft cloud provider is 1036 $ which provides the services as the SaaS, PaaS, IaaS, and the validity period of these services is 1 month. Next user selects “yes” or “no” according to the user requirement that user wants to see more recommendations of cloud providers or not.

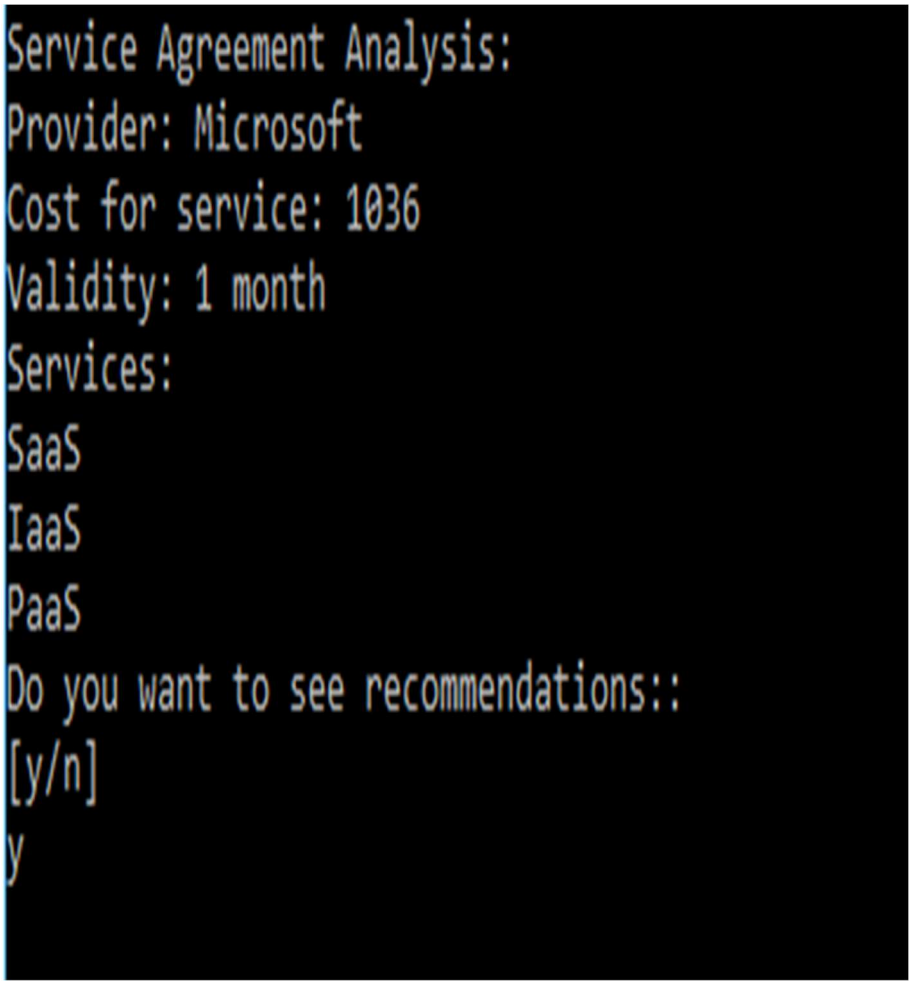

Figure 4.2 Service agreement analysis

Result 3: If user wants to see more recommendations, then user must have to selects some important decision factors or attributes for service request. In figure 4.3 user selects the five decision factors such as cost_benefit, commitment, relative_pos, law_policy, and availability. Table 3 depicts all decision factors of individual cloud provider with their respective weights.

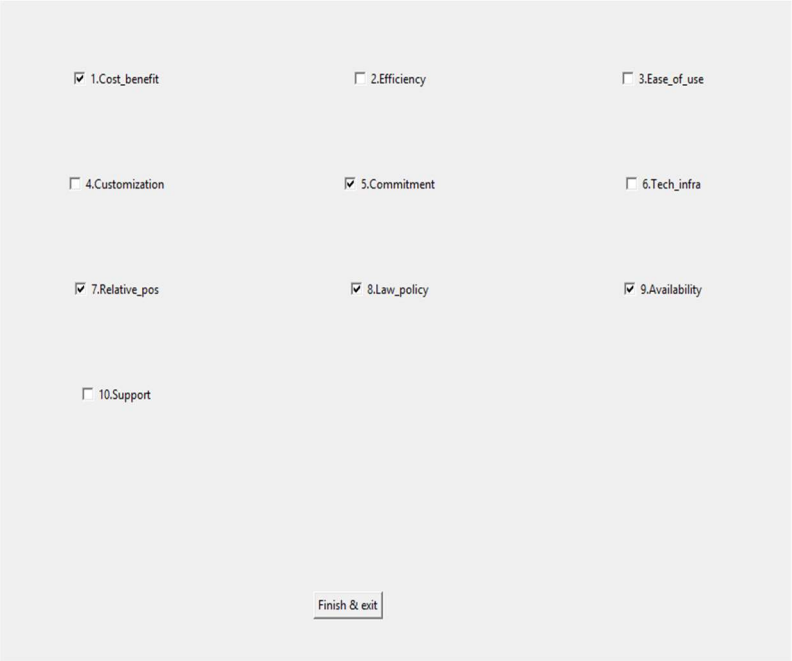

Figure 4.3 Selecting decision factors

Table 4.3 Decision Factors with their weights

	Google	Amazon	Microsoft	Alibaba	Salesforce	Dell	IBM	Digital_Ocean	Oracle
Cost_benefit	0.7106156	0.803187664	0.458612224	0.172770914	0.307690812	0.046721314	0.165189904	0.855281069	0.687635069
Efficiency	0.907792967	0.05802187	0.76066677	0.558332851	0.587203692	0.087311032	0.829592834	0.866062882	0.998582895
Ease_of_use	0.796643859	0.862608498	0.956262479	0.75826692	0.928846801	0.393494415	0.671232631	0.26376782	0.265483994
Customization	0.231400318	0.487698483	0.034158382	0.762684091	0.207243329	0.596974184	0.694307406	0.144568945	0.130924306
Commitment	0.004558112	0.645558924	0.445243353	0.133866401	0.691025617	0.351707882	0.908092965	0.767078917	0.251766213
Tech_infra	0.537929459	0.915300285	0.594742782	0.139884617	0.324876985	0.745057386	0.249876206	0.709492276	0.652549349
Relative_pos	0.208590192	0.158579821	0.62769655	0.15506228	0.643634177	0.510468769	0.519027781	0.988429685	0.804351187
Law_policy	0.57654057	0.762933457	0.718774094	0.609063727	0.534291944	0.635604287	0.402440913	0.154420347	0.961024947
Availability	0.889219085	0.684065695	0.477498324	0.334518202	0.814452834	0.441556265	0.429176512	0.788200857	0.881223094
Support	0.742370623	0.646120408	0.344174966	0.524456599	0.342262304	0.158893706	0.773062282	0.379500081	0.066683533

Figure 4.1 to 4.13 shows the performance analysis of decision factors in form of bar graph for different cloud providers. Figure 4 shows that the digital_ocean has the highest cost_benefit and dell has least cost_benefit factor.

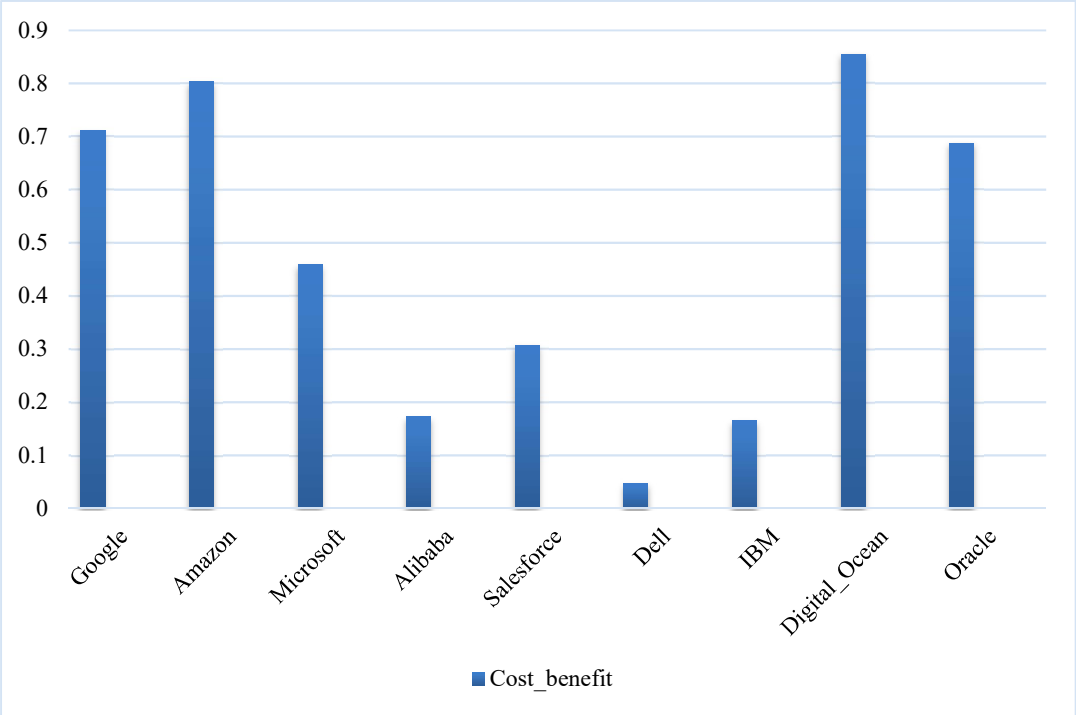

Figure 4.4 Comparison graph of Cost_benefit between different CSPs

Figure 4.5 shows that the Oracle has the highest efficiency and amazon has least efficiency value.

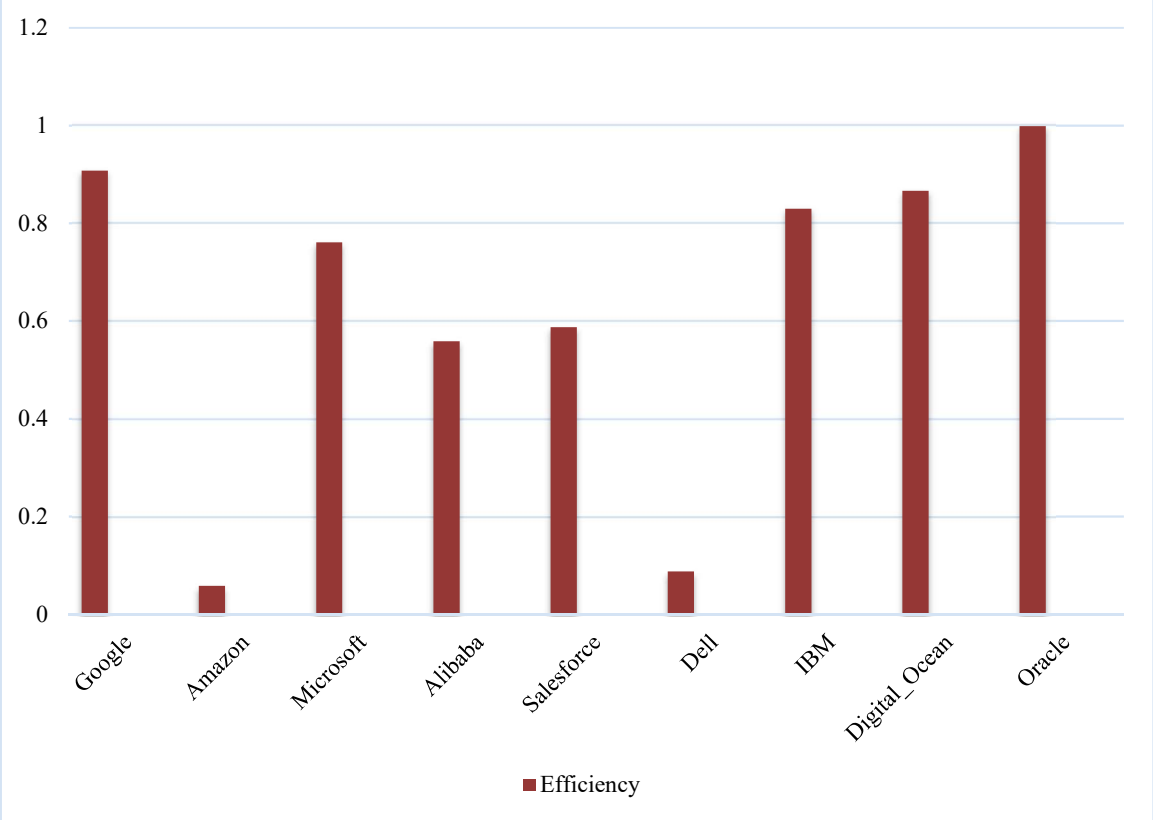

Figure 4.5 Comparison graph of Efficiency between different CSPs

Figure 4.6 shows that the Microsoft has the highest ease_of_use and digital_ocean has least ease_of_use.

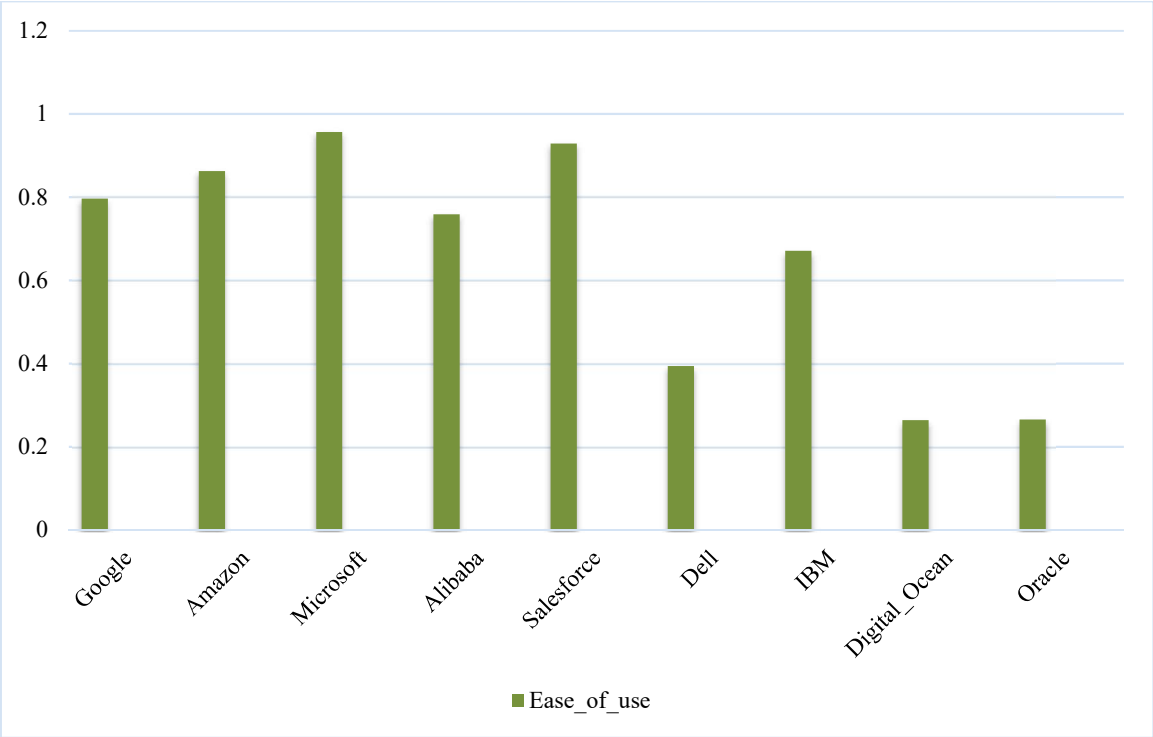

Figure 4.6 Comparison graph of Ease_of_use between different CSPs

Figure 4.7 shows that the Alibaba has the highest customization value and Microsoft has least customization value.

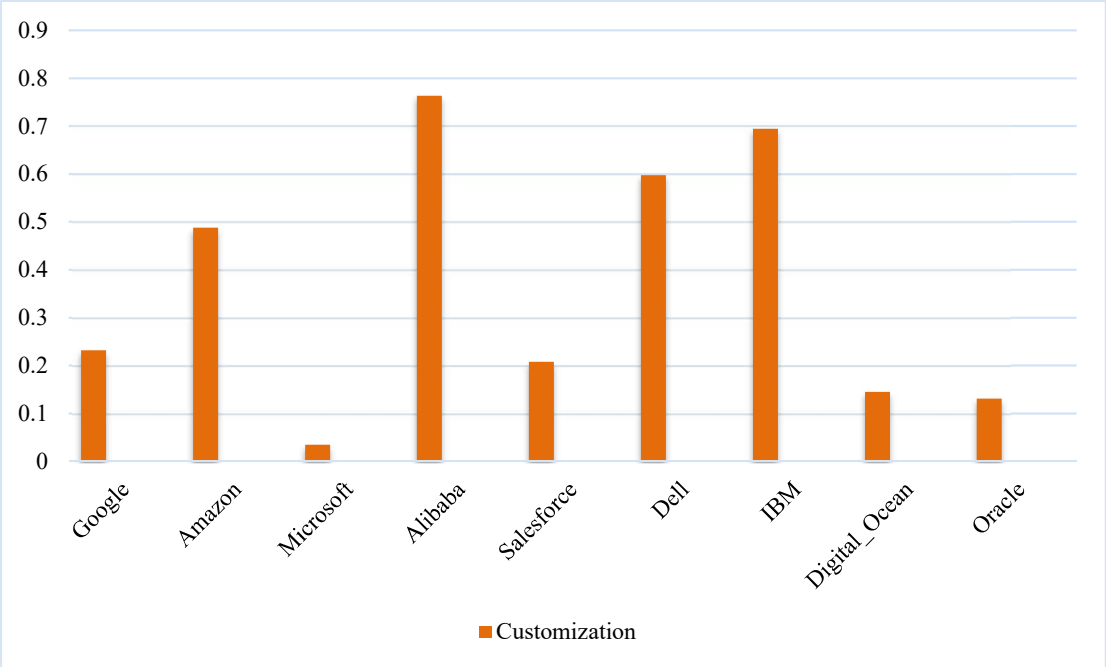

Figure 4.7 Comparison graph of Customization between different CSPs

Figure 4.8 shows that the IBM has the highest commitment value and Google has least commitment value

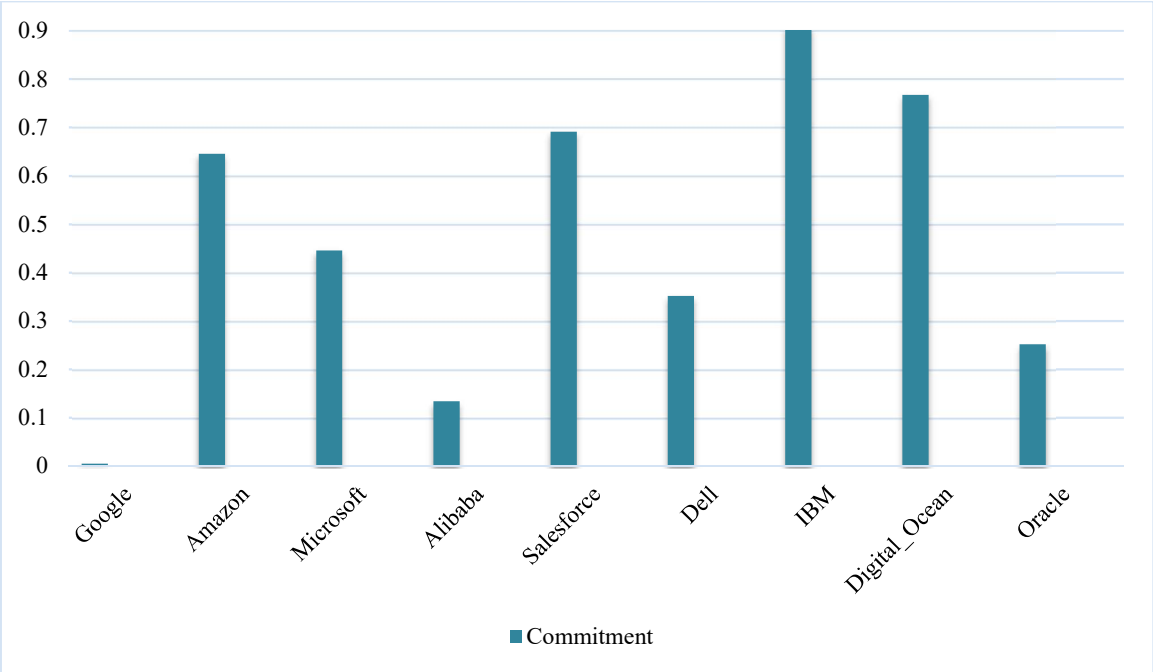

Figure 4.8 Comparison graph of Commitment between different CSPs

Figure 4.9 shows that the Amazon has the highest technological infrastructure value and Alibaba has least technological infrastructure.

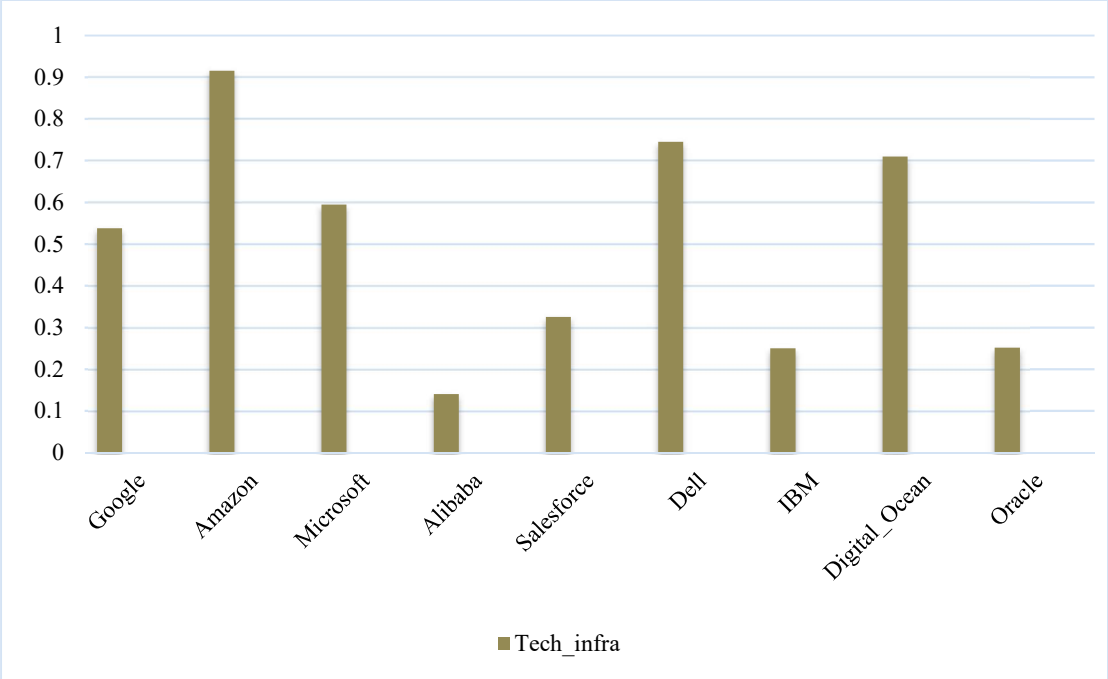

Figure 4.9 Comparison graph of technological infrastructure between different CSPs

Figure 4.10 shows that the digital_ocean has the highest relative position in market and Alibaba has least relative position in the market.

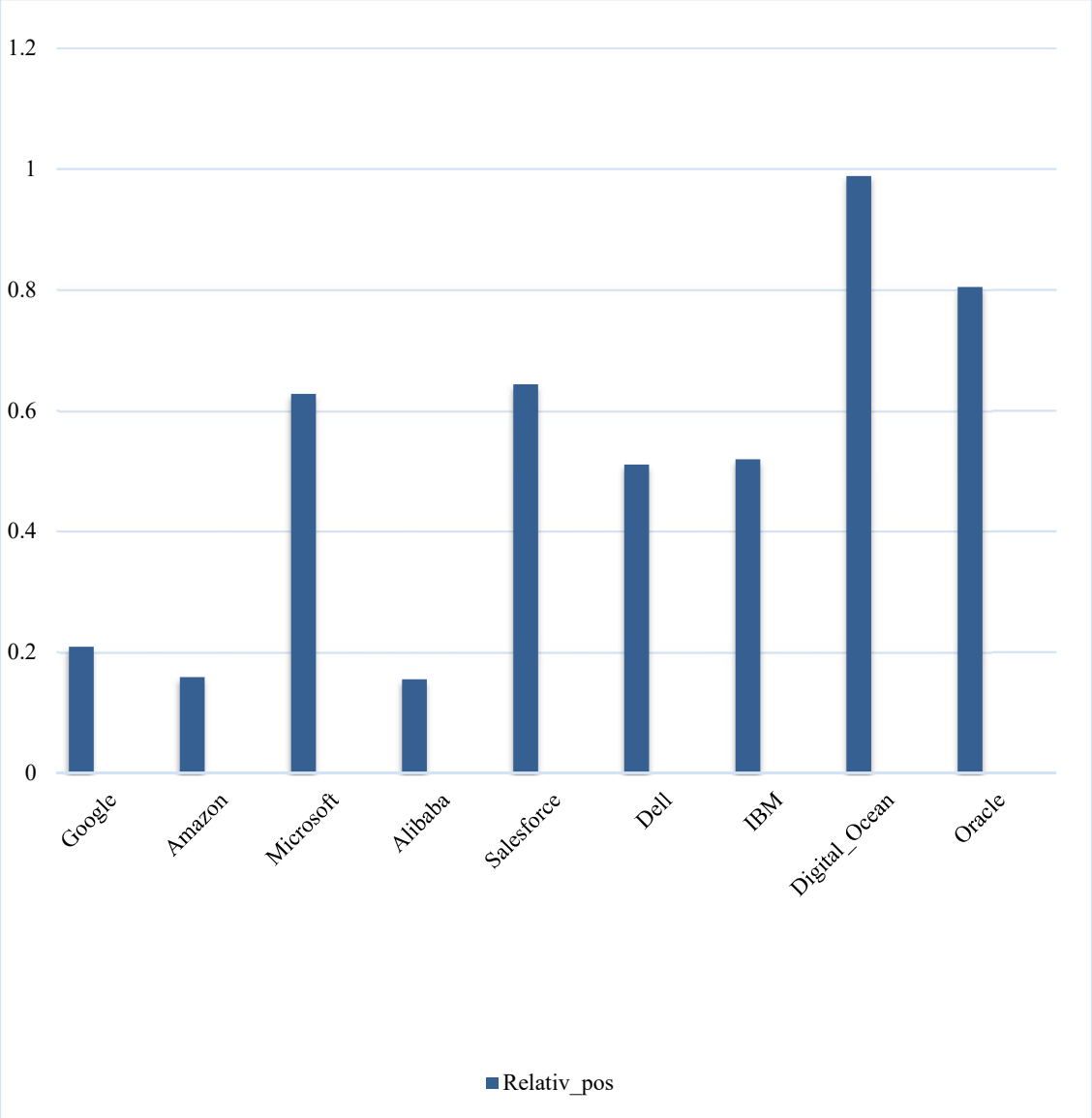

Figure 4.10 Comparison graph of Relative position between different CSPs

Figure 4.11 shows that the oracle has the highest law_policy and digital_ocean has least law policy.

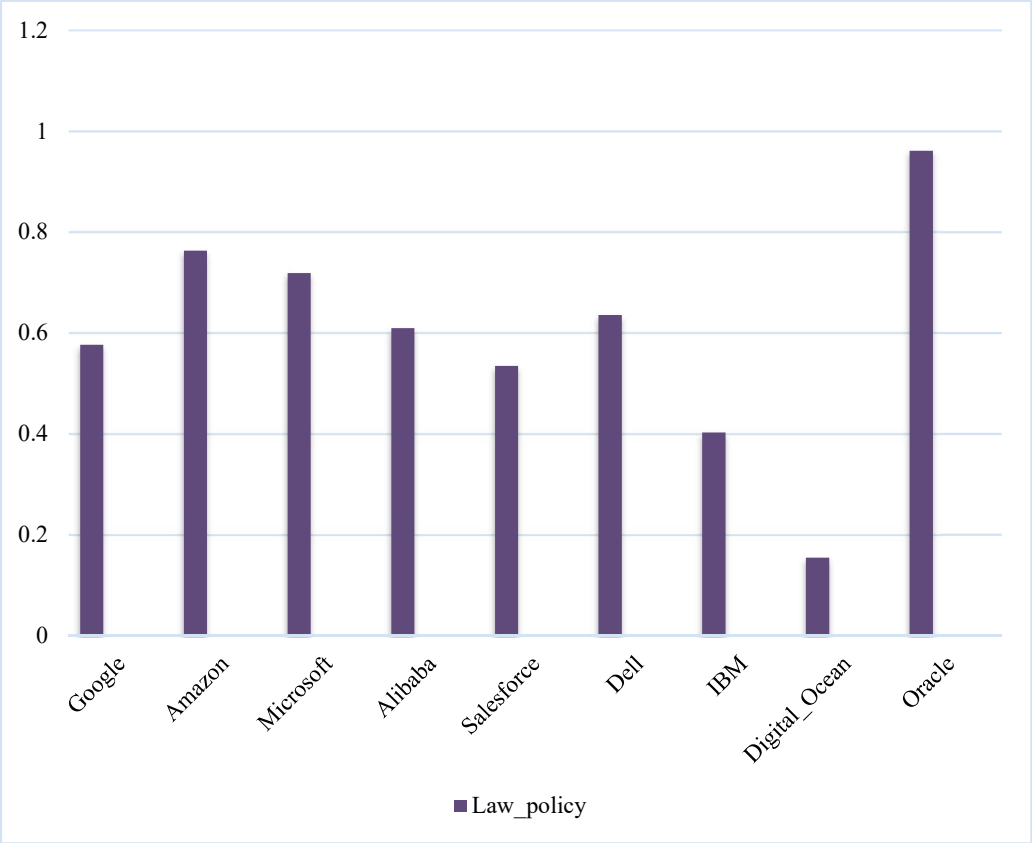

Figure 4.11 Comparison graph of Law_policy between different CSPs

Figure 4.12 shows that the google has the highest availability and Alibaba has least customization.

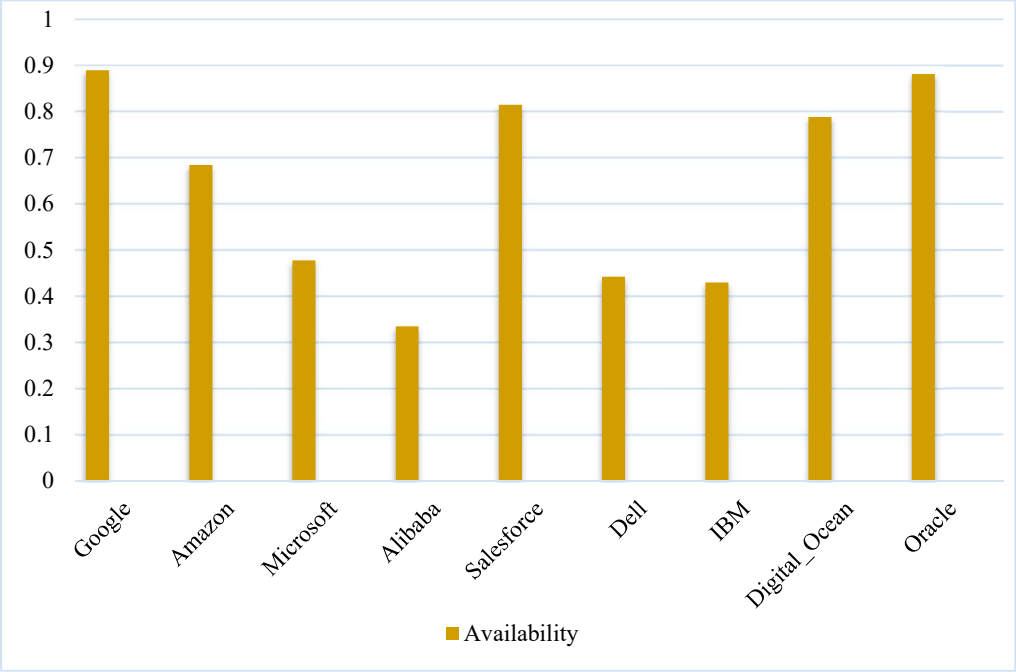

Figure 4.12 Comparison graph of availability between different CSPs

Figure 4.13 shows that the IBM has the highest support value and oracle has least support value.

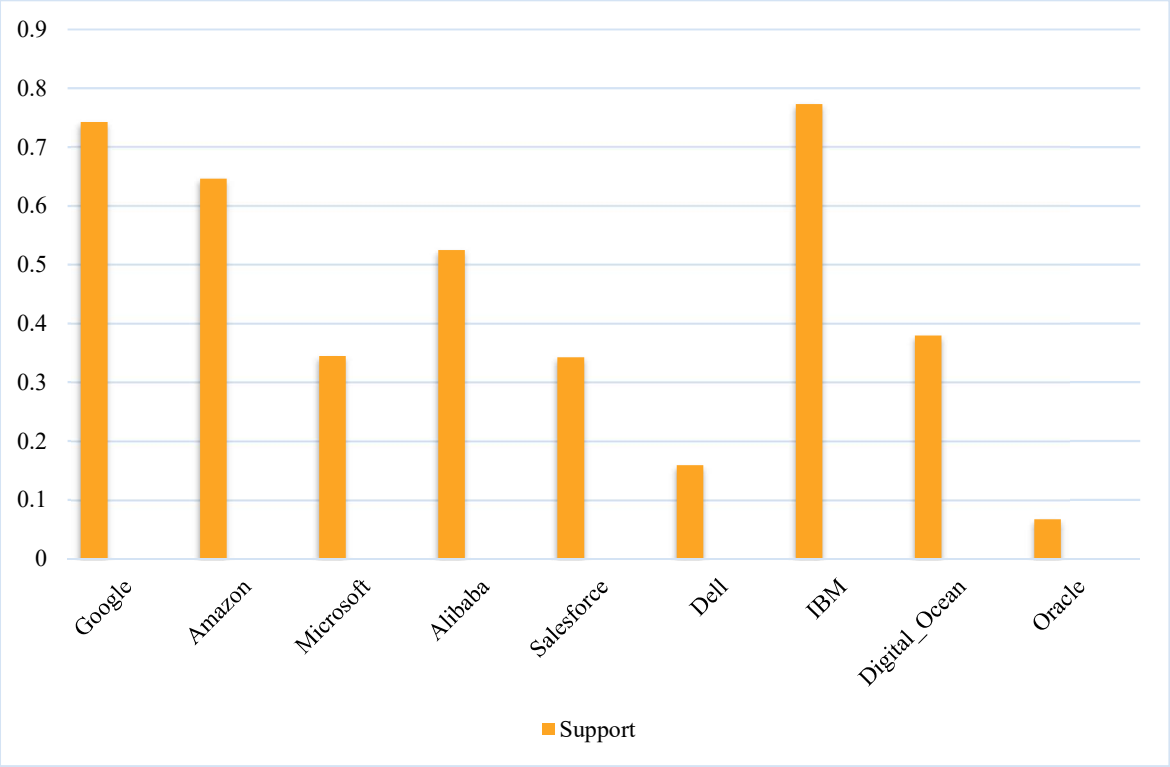

Figure 4.13 Comparison graph of Support between different CSPs

Result 4: Then all the identified factors are evaluated for selected cloud provider (Microsoft) to see whether it act as a benefit or loss/risk factor. In Figure 4.14, the selected cost benefit and availability factor of Microsoft cloud provider is act as a beneficial whereas the commitment, law policy, and relative position of the provider in market is risky. In addition, it analyzed the ranking of other alternatives. This result shows the analysis of nine cloud providers with their weights and priorities for adopting a best cloud service provider (CSP). Next, all the alternatives are ranked on the basis of their weights and CSP values. In this result, digital_ocean is selected as the best cloud service provider as the ranking of this provider is 1. The second-best cloud service provider is amazon whose ranking is 2.

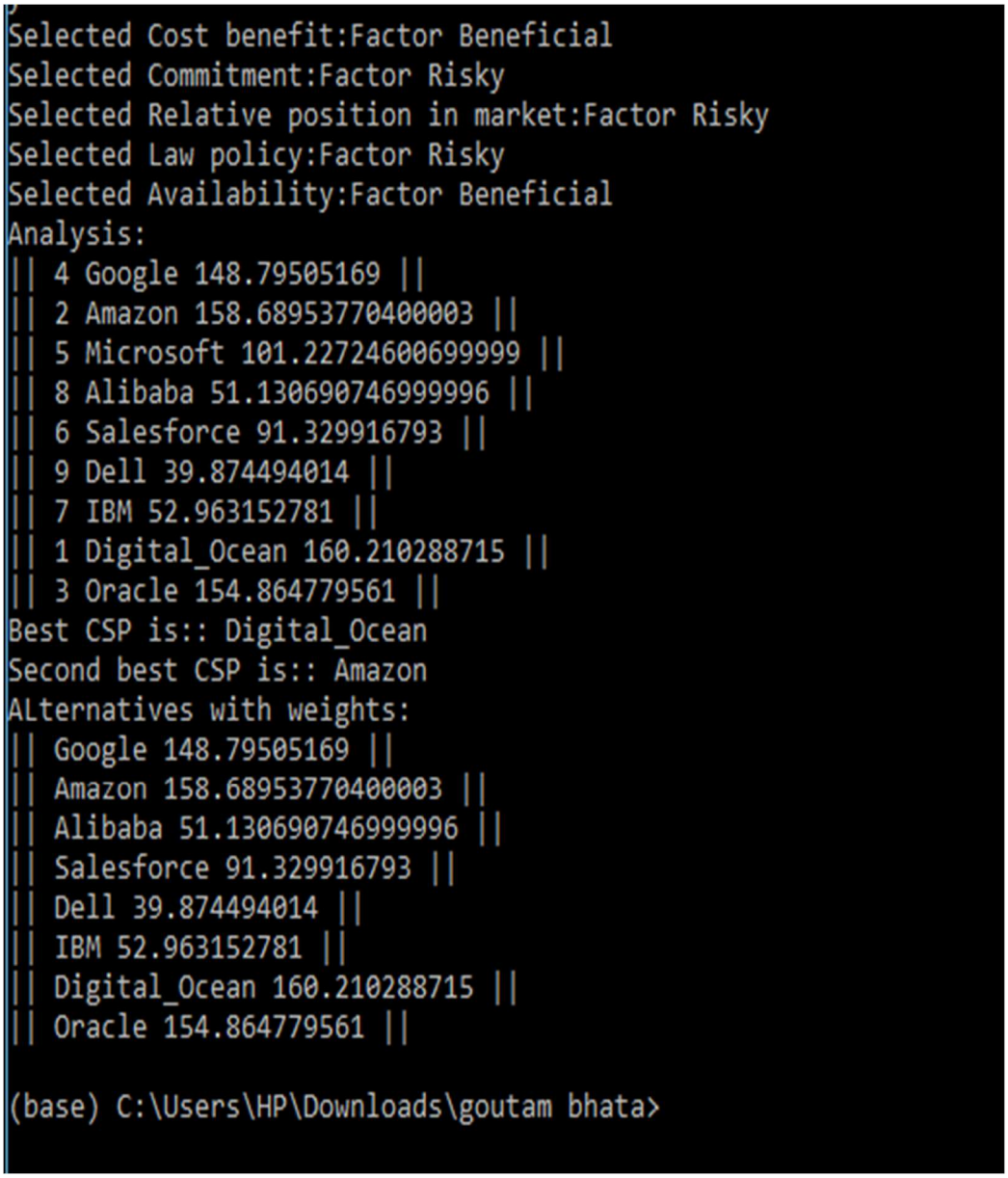

Figure 4.14 Selecting best CSP based on ranking and weight

Result 5: In Figure 4.15, user request for the service from google cloud provider after successful login procedure. Then it provides some service level agreements for google cloud provider such as its cost, validity, and services offer by google. Google provides the SaaS, PaaS, and IaaS to the user whose validity is for 1 month and the cost of these services is 3250 $. After that it shows some more recommendation based on decision factors such as cost benefit, efficiency, ease of use, customization, commitment, technological infrastructure, position in market, law policy, availability, and support. These factors are evaluated for selected cloud provider (google) to see whether it act as a benefit or loss/risk factor. After analyzing all these factors, this result shows the list of recommended cloud providers based on their ranking and weight. As the result shows that the google cloud provider is ranked as 1 so, google is selected

as the best cloud provider, and digital_ocean is selected as the second-best cloud provider with ranking 2.

```
Enter login credentials to continue::
Enter username:
Gautambhata1
Enter password:
Password:
login successful!
Service Agreement Analysis:
Provider: Google
Cost for service: 3250
Validity: 1 month
Services:
SaaS
IaaS
PaaS
Do you want to see recommendations::
[y/n]
y
Selected Cost benefit:Factor Beneficial
Selected Efficiency::Factor Beneficial
Selected Ease of use:Factor Beneficial
Selected Customization:Factor Beneficial
Selected Commitment:Factor Risky
Selected Technological infrastructure:Factor Beneficial
Selected Relative position in market:Factor Risky
Selected Law policy:Factor Risky
Selected Availability:Factor Beneficial
Selected Support:Factor Beneficial
Analysis:
|| 1 Google 384.131362624 ||
|| 4 Amazon 294.574729543 ||
|| 6 Microsoft 282.032843072 ||
|| 8 Alibaba 236.13420056099997 ||
|| 7 Salesforce 250.22655610899997 ||
|| 9 Dell 121.94520075899999 ||
|| 5 IBM 290.65566139 ||
|| 2 Digital_Ocean 338.25705185 ||
|| 3 Oracle 322.574177884 ||
Best CSP is:: Google
Second best CSP is:: Digital_Ocean
Best service selected: Google
```

Figure 4.15 Service agreement analysis for google cloud provider

Result 6: In Figure 4.16, user request for the service from Alibaba cloud provider. Then it provides some service level agreements for Alibaba cloud provider same as in google and Microsoft. Alibaba provides the SaaS, and PaaS to the user whose validity is for 1 month and the cost of these services is 950 $. After that it shows some more recommendation based on decision factors such as cost benefit, ease of use, commitment, technological infrastructure, law policy, and availability. These factors are evaluated for selected cloud provider (Alibaba) to see

whether it act as a benefit or loss/risk factor. After analyzing all these factors, this result shows the list of recommended cloud providers based on their ranking and weight. As the result shows that the amazon cloud provider is ranked as 1 so, amazon is selected as the best cloud provider, and google is selected as the second-best cloud provider with ranking 2.

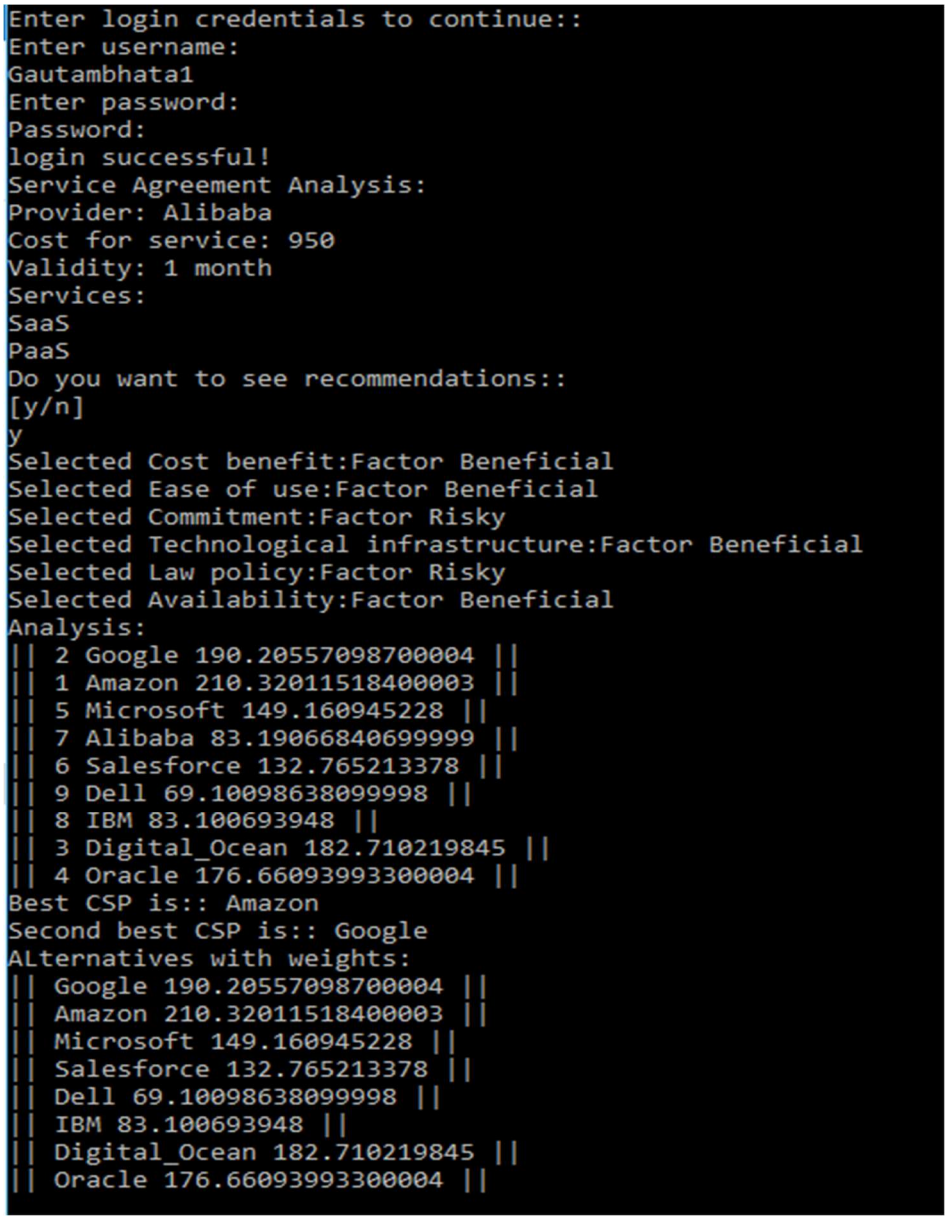

Figure 4.16 Service agreement analysis for Alibaba cloud provider

Result 7: In Figure 4.17, user request for the service from IBM cloud provider after successful login procedure. Then it provides some service level agreements for IBM cloud provider such as its cost, validity, and services offer by it. IBM provides the SaaS, PaaS, and IaaS to the user whose validity is for 1 month and the cost of these services is 1300$. After that it shows some more recommendation based on decision factors such as cost benefit, efficiency, ease of use,

customization, commitment, and availability. These factors are evaluated for selected cloud provider (IBM) to see whether it act as a benefit or loss/risk factor. After analyzing all these factors, this result shows the list of recommended cloud providers based on their ranking and weight. As the result shows that the google cloud provider is ranked as 1 so, google is selected as the best cloud provider, and digital_ocean is selected as the second-best cloud provider with ranking 2.

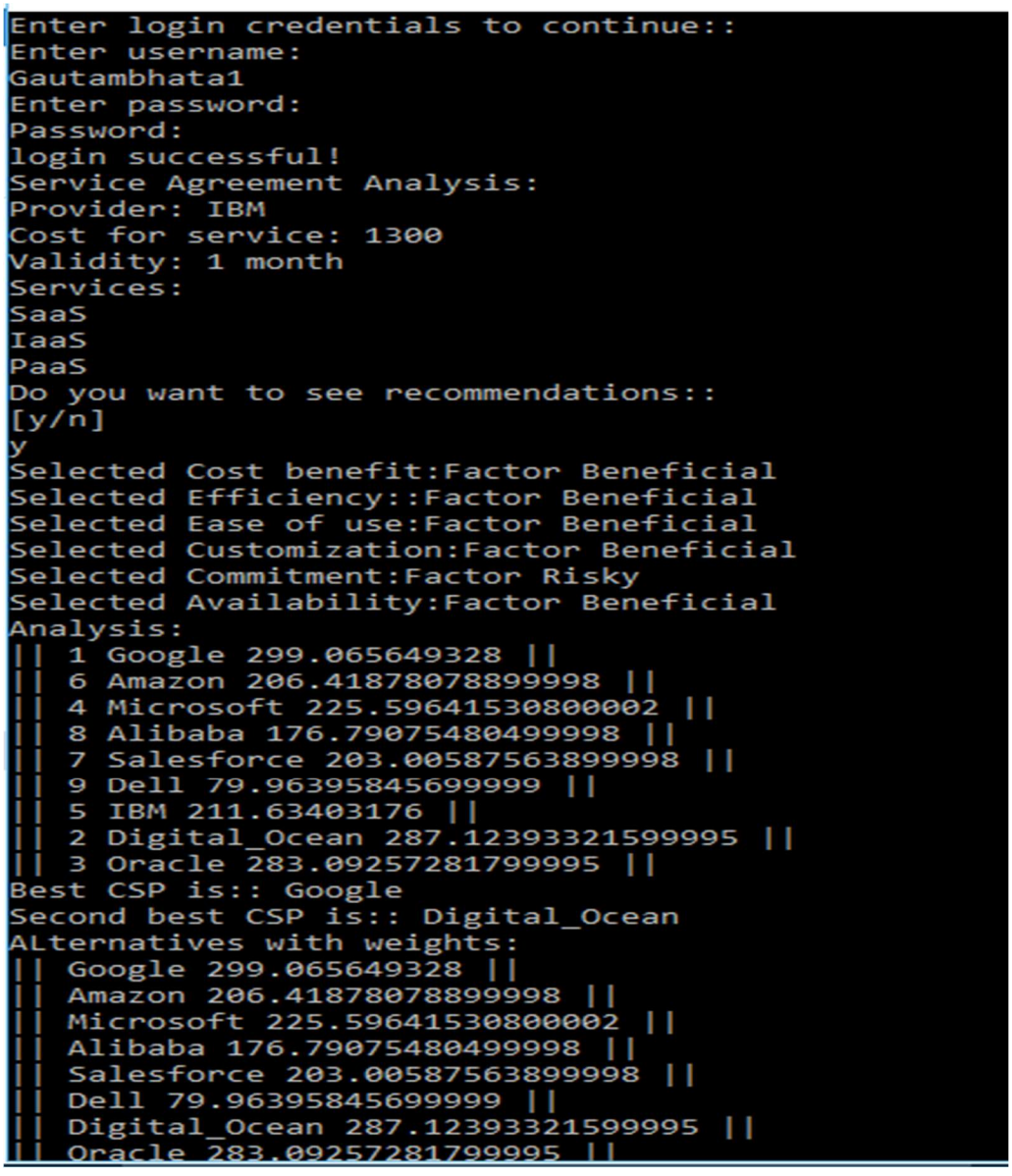

Figure 4.17 Service agreement analysis for IBM cloud provider

Result 8: In Figure 4.18, user request for the service from amazon cloud provider after successful login procedure. Then it provides some service level agreements for amazon cloud provider such as its cost, validity, and services offer by it. Amazon provides the SaaS, PaaS, and IaaS to the user whose validity is for 1 month and the cost of these services is 2356 $. After

that it shows some more recommendation based on decision factors such as cost benefit, law policy, and availability. These factors are evaluated for selected cloud provider (IBM) to see whether it act as a benefit or loss/risk factor. After analyzing all these factors, this result shows the list of recommended cloud providers based on their ranking and weight. As the result shows that the amazon cloud provider is ranked as 1 so, amazon is selected as the best cloud provider, and digital_ocean is preferred as the second-best cloud provider with ranking 2.

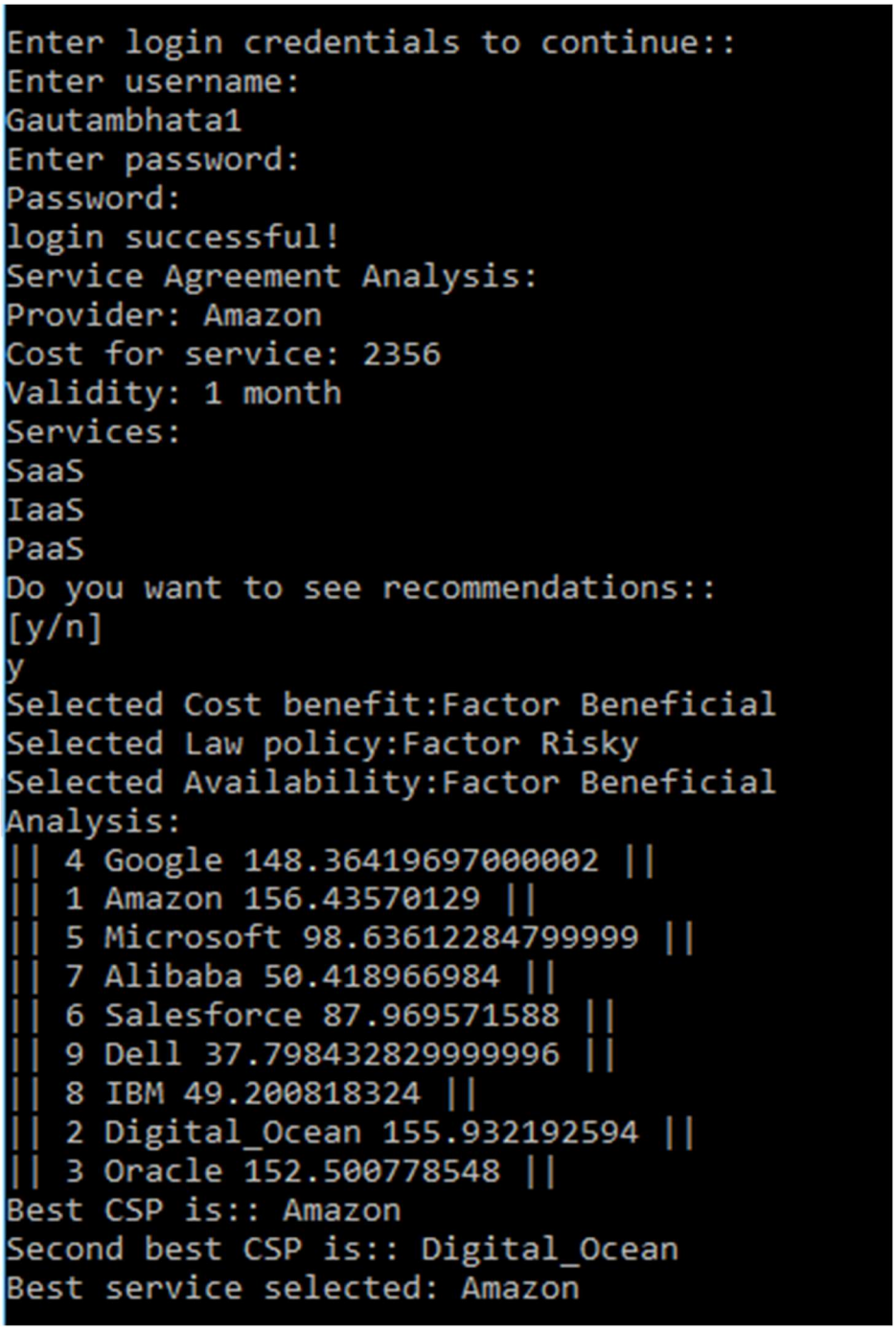

Figure 4.18 Service agreement analysis for amazon cloud provider

Result 9: In Figure 4.19, user request for the service from salesforce cloud provider after successful login procedure. Then it provides some service level agreements for salesforce cloud provider such as its cost, validity, and services offer by it. Salesforce provides only PaaS to the user whose validity is for 1 month and the cost of these services is 800 $. After that it shows some more recommendation based on decision factors such as ease of use, commitment, technological infrastructure, and position in market. These factors are evaluated for selected cloud provider (salesforce) to see whether it act as a benefit or loss/risk factor. After analyzing all these factors, this result shows the list of recommended cloud providers based on their ranking and weight. As the result shows that the amazon cloud provider is ranked as 1 so, amazon is selected as the best cloud provider, and Microsoft is selected as the second-best cloud provider with ranking 2.

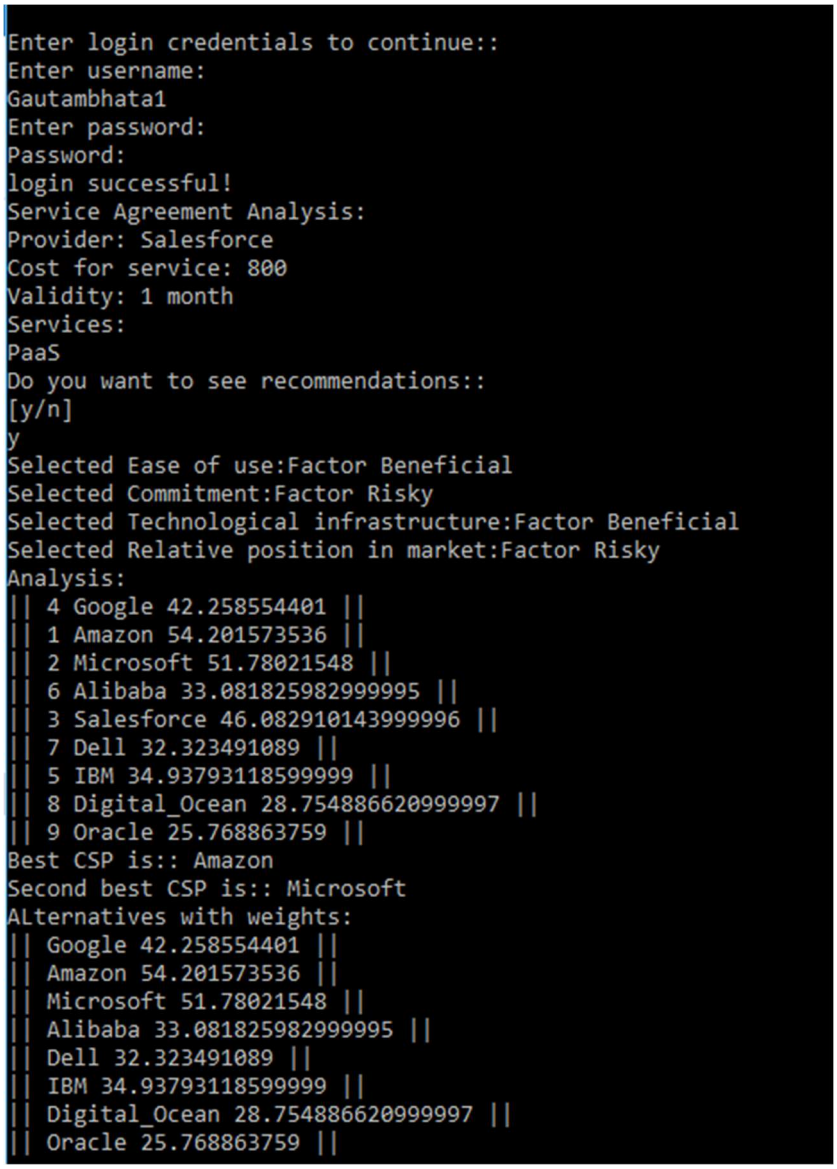

Figure 4.19 Service agreement analysis for salesforce cloud provider

Result 10: In Figure 4.20, user request for the service from digital_ocean cloud provider after successful login procedure. Then it provides some service level agreements for digital_ocean cloud provider such as its cost, validity, and services offer by it. Digital_Ocean provides the SaaS, and PaaS to the user whose validity is for 1 month and the cost of these services is 1000 $. After that it shows some more recommendation based on decision factors such as cost benefit, ease of use, availability, and support. These factors are evaluated for selected cloud provider (digital_ocean) to see whether it act as a benefit or loss/risk factor. After analyzing all these factors, this result shows the list of recommended cloud providers based on their ranking and weight. As the result shows that the google cloud provider is ranked as 1 so, google is selected

as the best amazon and cloud provider is selected as the second-best cloud provider with ranking 2.

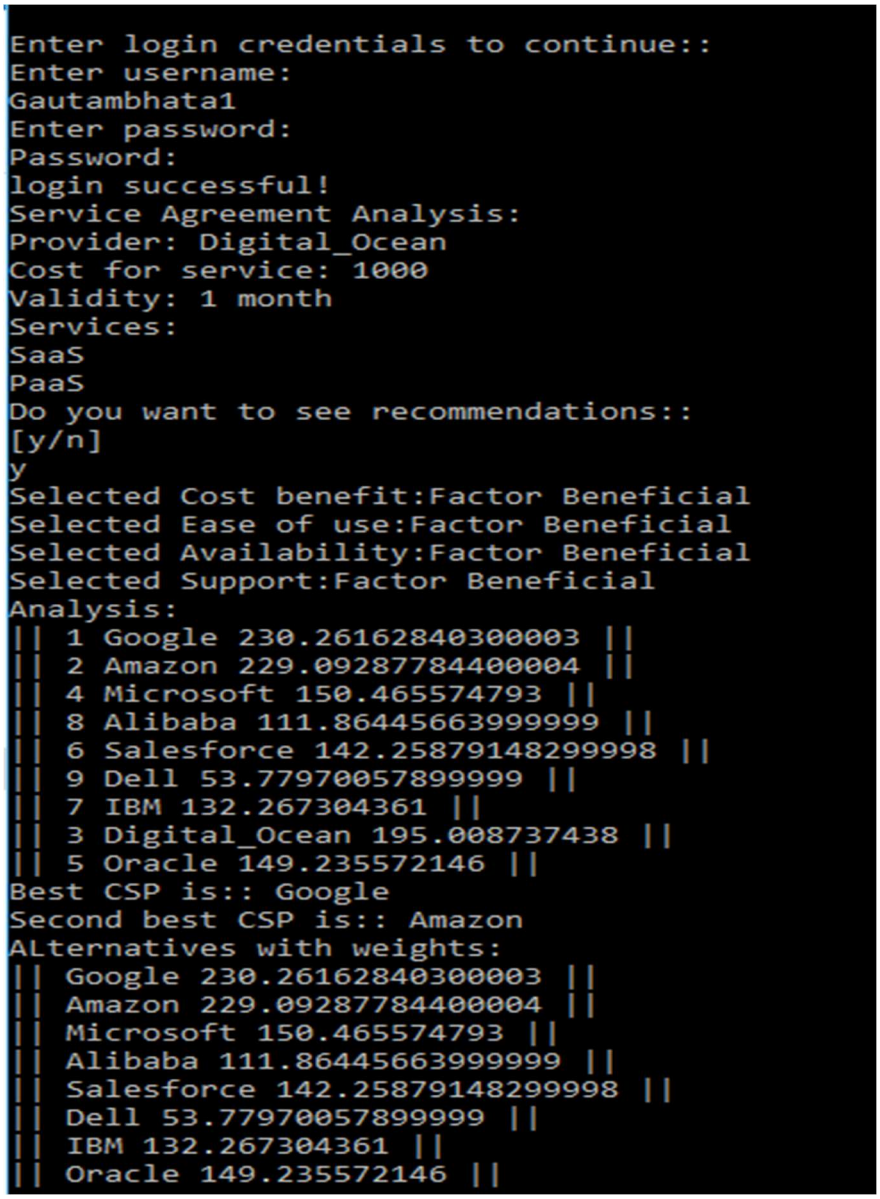

Figure 4.20 Service agreement analysis for digital_ocean cloud provider

Result 11: In Figure 4.21, user request for the service from Dell cloud provider after successful login procedure. Then it provides some service level agreements for dell cloud provider such as its cost, validity, and services offer by it. Dell provides the SaaS, PaaS, and IaaS to the user whose validity is for 1 month and the cost of these services is 1200 $. After that it shows some more recommendation based on decision factors such as commitment, position in market, law policy, and availability. These factors are evaluated for selected cloud provider (Dell) to see whether it act as a benefit or loss/risk factor. After analyzing all these factors, this result shows the list of recommended cloud providers based on their ranking and weight. As the result shows

that the oracle cloud provider is ranked as 1 so, oracle is selected as the best cloud provider, and google is chosen as the second-best cloud provider with ranking 2.

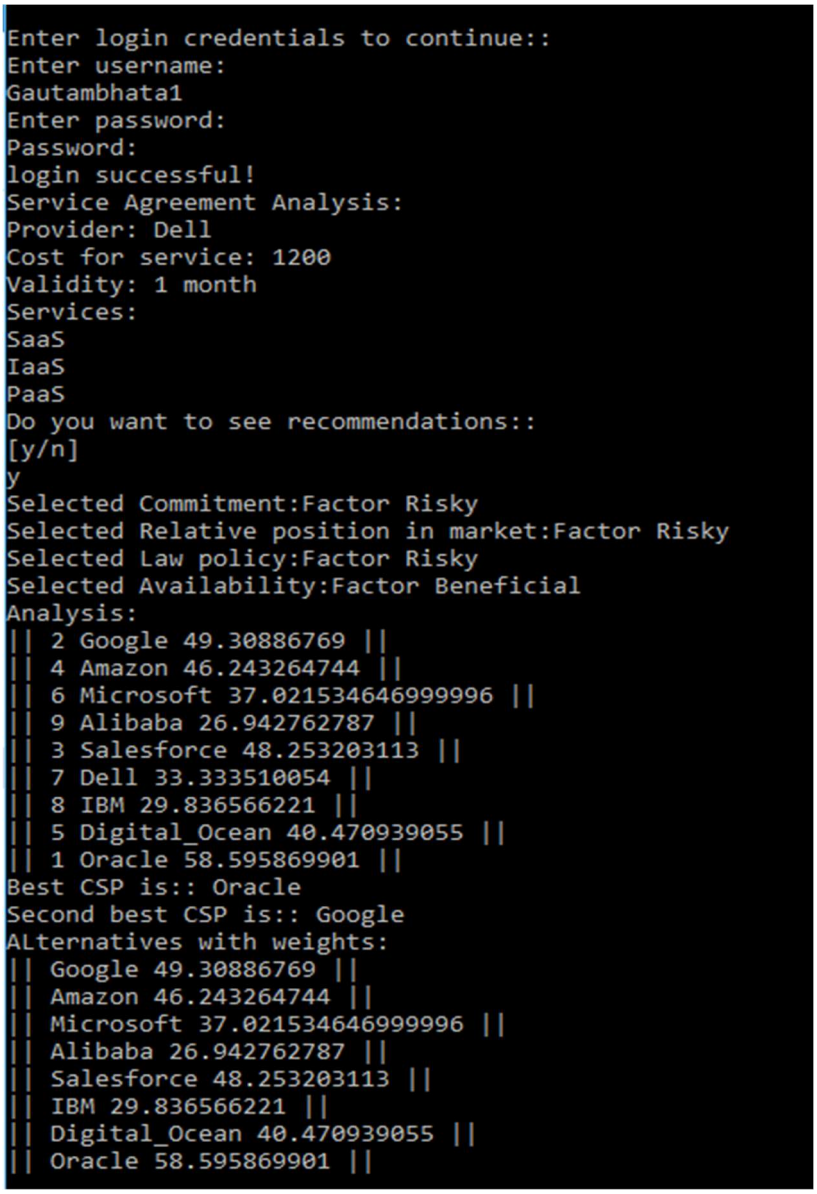

Figure 4.21 Service agreement analysis for dell cloud provider

Result 12: In Figure 4.22, user request for the service from oracle cloud provider after successful login procedure. Then it provides some service level agreements for oracle cloud provider such as its cost, validity, and services offer by it. Oracle provides the SaaS, PaaS, and IaaS to the user whose validity is for 1 month and the cost of these services is 1800 $. After that it shows some more recommendation based on decision factors such as customization, law policy, availability, and support. These factors are evaluated for selected cloud provider (Oracle) to see whether it act as a benefit or loss/risk factor. After analyzing all these factors, this result shows the list of recommended cloud suppliers based on their ranking and weight.

As the result shows that the IBM cloud provider is ranked as 1 so, IBM is selected as the best cloud provider, and google is chosen as the second-best cloud provider with ranking 2.

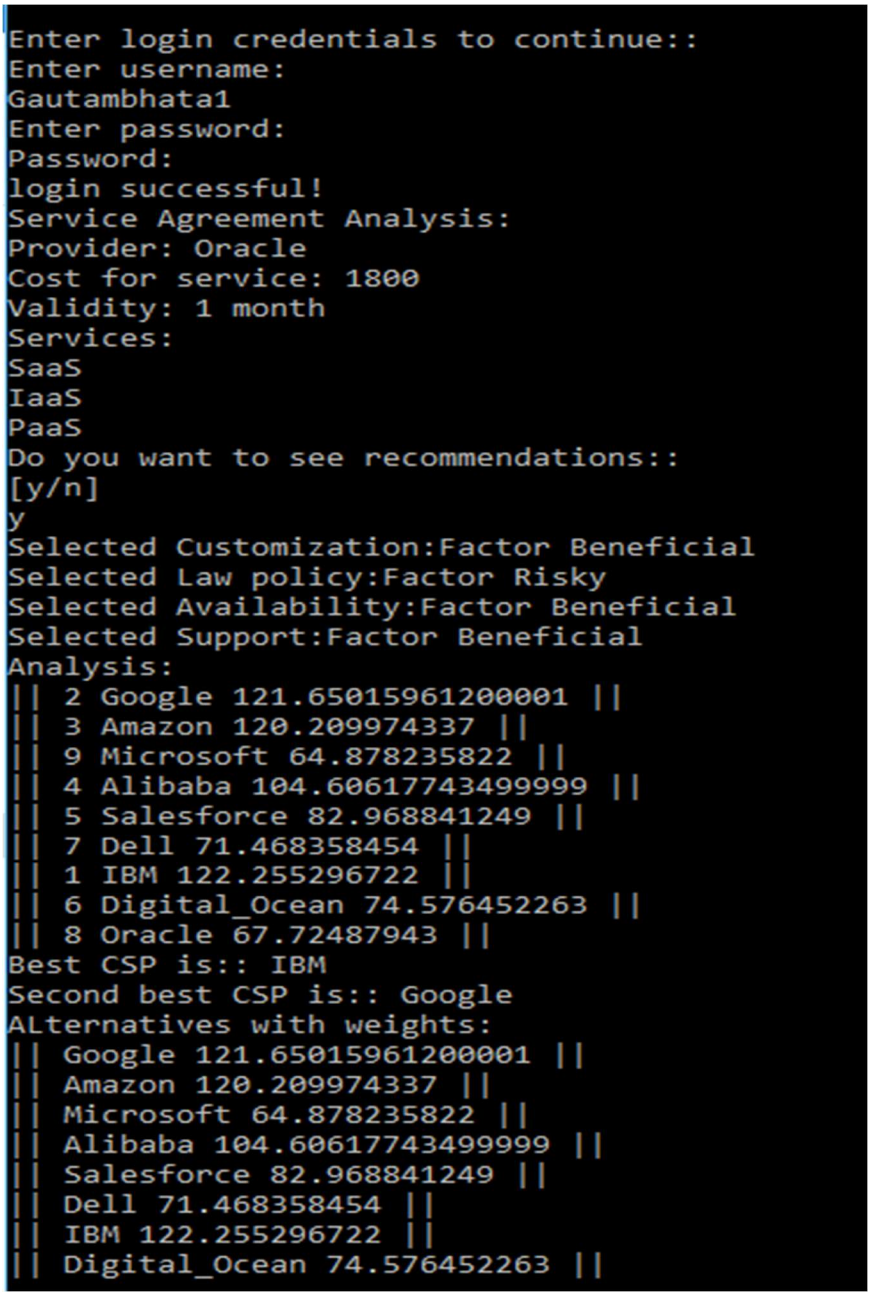

Figure 4.22 Service agreement analysis for oracle cloud provider

CHAPTER 5

CONCLUSION AND FUTURE SCOPE

5.1. CONCLUSION

This complete work has provided the state of the recent developments in the area of Ranking based Cloud Services Selection Decision Support System and also the defined objectives are well formulized using the research methodologies drawn.

In general word, cloud computing is accessing and storing applications or data over the Internet rather than on computer's hard disk. CC is a name that states to the usage of shared computing resources as an alternative to have programmes run on local servers. Cloud computing combines many computing services and servers to provide their total capacity accessible on-demand, pay-per-cycle basis CC, like many other technology services, has provided several advantages. For example, it enabled the storage of enormous amounts of data and the provision of different services. Furthermore, by sharing valuable resources across numerous users, cloud computing lowered the cost of services and tackled the issue of limited resources. The platform must be secure in order to guarantee resource performance and dependability.

Cloud computing provides the three models based on service such as: software-as-a-service (SaaS), and infrastructure-as-a-service (IaaS) and platform-as-a-service (PaaS). Access management responsibilities in services, such as policy controls, are prioritized under the SaaS model. For example, a user is only permitted to access specific data from programmes. However, several end users profit from a single instance of the service. SaaS is now offered by companies such as Dropbox, Microsoft Office 365, Google, and others. PaaS refers to the usage of the development environment layer as a service, from which other top-level services are developed. Customers can develop their private projects that operate on the provider's infrastructure in the PaaS model. In reality, PaaS combines application servers and operating systems, such as the LAMP platform (PHP, MySQL, Apache, and Linux), Microsoft Azure, and Google App Engine. It's worth emphasizing that data security is one of the major objectives of the PaaS model. This is especially true when it comes to storage as a service. This model has ability to encode data though storing it on a third-party infrastructure, and it should be conscious of controlling problems that might affect data accessibility in various countries. IaaS offers storage and compute capabilities as consistent services via the network.

Cloud service providers (CSP) host cloud services in their data centers and offer users (cloud customers) a subscription charge to gain access to and utilize them (pay-per-use). Cloud services have become extremely essential to customers, particularly companies and corporations; as a result, suppliers are competing to offer services with a variety of performance and features qualities. As a result, asymmetric services with a variety of forms and characteristics have been established.

Users of cloud computing have a variety of applications with varying QoS needs. On the other hand, there are a variety of cloud service companies that provide services with varying levels of quality. Finding the best cloud service that meets client needs with specified Quality of Service (QoS) qualities has become a problem for cloud clients as the amount of cloud providers and available cloud services has grown. Cloud-based DSS is a method of solving the challenge of determining the most appropriate service or collection of services for a given set of criteria. The ranking of cloud service providers in this system evaluates various services supplied by multiple cloud providers based on service quality in order to choose the top CSP.

To assessing the appropriateness of cloud services in relation to business demands, cloud-based decision support system (DSS) provides a default decision model that can be adjusted corresponding to enterprise-specific necessities. DSS is refers to “Computer-based information systems that give interactive information assistance to managers during the decision-making process”. The Cloud-based DSS lowers costs, increases accessibility, improves communication and collaboration among decision-makers, and shortens processing and deployment times.

This thesis discussed the various types of deployment models and cloud services. This work proposed a ranking based cloud service selection decision support system. This work considers a study on hybrid cloud method to automate the cloud services related to decision support system. Suggested method recommends the best cloud service providers based on their ranking and weights. In order to choose the finest cloud service provider, user firstly request for the service from cloud provider then enter his username and password to continue the process. If username and password are correctly matched then it shows some service level agreements such as cost, validity, and type of services of request cloud provider otherwise, system shows the error message that username and password are not correctly matched.

In this proposed work, a Service Level Agreement (SLA) has been formed among the cloud service provider and the cloud service user. This is when the communication among these 2 parties begins. When the agreement is successful, the user's cloud service is provided to the

client for usage during the contact time. If the discussion falls during the agreement, both parties will search for a new supplier or customer for their transaction. Response time, access time, performance, quality, precise delivery time, and pricing are all comprised in the SLA. Clients' technical and functional necessities are included in this SLA.

After that if user wants to see more recommendation for best cloud service provider, then user select some decision factors on which best cloud service providers are recommended. These decision factors are cost benefit, efficiency, law policy, availability, commitment, ease of use and so on. After analyzing all these factors, system recommend the list of best cloud service provides based on their raking and weights. This proposed work recommends the nine cloud service providers such as google, amazon, Microsoft, dell, Alibaba, digital ocean, oracle, salesforce. Based on their ranking and weights, digital ocean is selected as the best CSP, and amazon is selected as the second-best CSP. The results shows that the suggested cloud service selection DSS is efficient of choosing the best cloud service supplier related to the weights.

This work benefits both the cloud end operator and cloud supplier. The user has the option of selecting the highest-rated CSP. This cloud-based ranking system is in place to ensure fair competition among cloud service suppliers. The major goal of this study is to offer a cloud-based decision support system that is both effective and efficient for selecting the best cloud service providers. This proposed work presents a cloud service identification approach designed specifically for cloud consumers instead of a manual search in the world of the web.

5.2. FUTURE WORK

The following is a list of future work: collect additional pre**f**erence data from consumers in terms of technological and functional requirements, more in-depth cloud service negotiations with several service providers, and to produce a top-ranked list. A cross-language search engine can be deployed (Internationalization) in a cloud environment, a more efficient testbed for automotive test processes can make successful searches. Cloud service finding is a work in progress, and the cloud service identification technique is currently being improved.

Future work can include optimizing the CSP ranking procedure based on customer recommendations, reviews, requirements, and comments as well as maintaining user’s past information in database for future recommendation. By utilizing a strong cloud-based decision support system, this study effort has been enhanced by offering efficient cloud services to users and improving storage and user interaction.

Future work can include putting together the most compact package of cloud services within a specific price range for immediate fulfilment of client requests, as well as planning to manage consumer willingness and demands. Because the demands of the customer may vary over time. The following actions could be taken to put the plan into action: The first stage is to gather user requirements that are well-defined. The requirements are securely recorded in a database. Following that, a security strategy is implemented to protect against several attacks. The user requests are now compared to the provider database that already exists. It can be listed out if the required relevant cloud service is available. Aside from this cloud service searching approach, future study effort could also incorporate the crucial capability of delivering warning messages. The introduction of the newest cloud service to the registered cloud consumer are indicated by this alert message. This alert message feature can encourage the cloud service user's purchasing and selling activities. The client can choose the best CSP depending on their willingness. The user can also give comments on cloud services that they have already utilized. The user's future expectations and requirements are included in this feedback. The agent-based system can collect the cloud user's preferences based on the analysis and also notify the desired cloud service provider.

CHAPTER 6

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