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IMPACT OF CLOUD COMPUTING ON INFORMATION TECHNOLOGY

A sustainability perspective

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ABSTRACT

The impact of cloud computing on information technology was examined in this thesis, with a particular emphasis on sustainability. This study looked at the environmental, economic, and social effects of enterprises moving to cloud technology. It integrates environmental science, sustainable development, and IT management through a multidisciplinary approach.

The study evaluates how cloud technology can exacerbate environmental problems or lessen them using actual data and case studies. A thorough grasp of the ecological ramifications is provided by assessments that cover resource optimization, energy usage, and carbon footprint.

In order to demonstrate how cloud computing can encourage innovation, affordability, and efficiency in IT processes, the thesis examines the economic and social elements of the technology. It took into account things like return on investment, spending on capital, and operational costs. Financial evaluations and practical case studies shed light on the financial ramifications of cloud solution adoption for businesses. In addition, the study looks at how cloud computing affects job markets, skill development, and general societal well-being. It also examined the social aspects of cloud computing, such as accessibility and tolerance.

The paper contributes to the continuing discussion on responsible technology adoption by providing a thorough analysis of the effects of cloud computing on information technology and providing enterprises with useful insights to help them align their IT plans with sustainable practices.

Keywords: affect, data, innovation, sustainable, technology

CONTENTS

1 INTRODUCTION

This thesis will explore the indelible effect of cloud computing on Information Technology and study the connection to its possible environmentally-friendly digital shift. It highlights how the right understanding of the impacts of cloud computing on IT operations has a significant role to play in boosting expansions in technology innovation for sustainable environment. Cloud computing is a virtual facility for computer services that has scalability, flexibility, and cost-effective service Naturally, IT operations are not isolated from the impact of the cloud movement when it comes to IT processes. Cloud brings forth a wide range of consequences.

This thesis has a multi-dimensional focus on the environmental aspects of cloud computing, concentrating on the technological advantage of super-efficient cooling systems, centralized architecture, and resource usage level. Cloud services have handy green approach in contrast to the local data centres which are big source of power that eat a lot of electricity. Eco benefits of cloud based systems is the same subject matters that cloud providers emphasize on. Their aim is to reduce their carbon footprint by incorporating eco-friendly infrastructure like combining of computer resources and implementing modern cooling technology.

Meanwhile, the environmental effect of cloud computing via energy efficiency was the remaining key factor studied in the work. It increases resource utilization and a circular economy through virtualization of applications and focuses on reduction of on premise support i.e. hardware maintenance and upgrades. It is analysed as a social and economic aspect of cloud computing. The hosted services at relatively lower rates have made it possible for small and medium enterprises (SMEs) to compete directly in markets dominated by large firms because cloud provides disadvantaged firms with a democratized access to complex computer infrastructure. It is through these inclusive economic strategies that the industry stays ahead of the game and becomes more competitive by breeding innovation. The aim of the research is to result in the overall knowledge of the planet's fares due to cloud computing.

The shift in work, cooperation, and information access is the key area of societal impact of the technology. Policymakers, organizations, and all kinds of people must keep the picture of these cultures transformations in the mind not only because of the fast changing of the work and connectivity landscape but also for other straight reasons. The means of collaborating and working remotely have been made at least easier when workers online and out of office with a broadband connection can access the same information and applications.

Ultimately, by focusing on the sustainability theme, this thesis seeks to demonstrate how cloud computing has been transforming the role of information technology in our world. It observes and concentrates on all social, economic and environmental aspects, from which decision is made on how to keep IT procedures consistent with green practices. This implication will therefore help the politicians, business managers, and IT professionals to understand how to use cloud technology to streamline services for efficient production and security for a future in the digital era.

1.1 Aim and objectives

A sustainable level is what this research has to stop at in order to clarify the effect that cloud computing has on the sector of information technology. Thematically, it presents you with the question of the environmental friendliness of cloud computing virtues and vices, and tough for what the case is, it is highly advantageous through the aspect of carbon emissions reduction and the optimization of IT environment. The impacts of both the economic and the social systems through clouds technologies are in this thesis. Furthermore, the fundamental quality of sharing has been broadened to include leaking in the future that is, the inefficiency of cloud computing.

2 CLOUD COMPUTING

The Cloud, which eliminates the need for consumers to purchase and install storage devices, processing power, or software in order to have internet access to these resources, is the event that fundamentally altered the connection

between IT users and computer data. This principle integrates that the services our customers need will be available at an aberration of their wills; while instead of having them to own or operate the hardware, a shared infrastructure will be available whenever needed. Three primary models are available for cloud computing: SaaS, PaaS and IaaS stand for the three biggest layers of a SaaS platform referred to as SaaS, PaaS and IaaS respectively. Virtual various tools offer consumers the opportunity to dynamically adjust how many resources they use with enumerating the amount they pay only for what they actually consumed. Cloud computing let remote jobs perform at the highest levels, and by means of cost reduction, scalability, flexibility, or accessibility (overall). On the other hand, resource optimum; the number of data centres used will be reduced even if they are kept running for maintenance (Blacharski 2010, 14).

2.1 Cloud services

The cloud servers offer the people available from the online platforms where the customers can use the computing, memory, database and applications from the cloud without any physical infrastructure requirements. This transformation has marked out a completely new trend in the methodology of IT services building leading to the creative use of the influence of globalization in the direction of X4 platforms (scalability, flexibility, affordability, and cooperation) sharing for architecting IT models of the new-generation courses. The technology sector is the realm where the main components, uses, downsides and future vision of cloud services are elaborated (Boutaba 2015, 5-6).

Besides, cloud services are the force behind modern computing as they offer universal flexibility, scalability, affordability, and accessibility to put it succinctly compared to traditional on-premises systems. Cloud services stand for delivering computer resources like servers, storages, databases, networking, software engineering, and analytics through the use of wavers of cloud service providers (CSP). These resources are stored and administered in data centers which provides controlled access to users. We have seen the transition from physical installation to virtualized, demand technologies reshape the area of IT, hence create room for the growth of businesses. One of the most frequently used cloud

service models is Infrastructure as a Service (IaaS), where users pay 'consumption rate' or 'pay-as-you-go' basis for virtualized computer resources at the most cost-efficient and performant level.

In addition, PaaS (Platform as a Service) is a cloud service model fit for implementing programs as it provides the necessary tools, frameworks and infrastructure without requiring the users to do anything. It provides an opportunity for programmer to focus on that of writing code and designing so that of the other things like infrastructure may handle separately. SaaS is a type of software that the customer pays in subscription mode as they don’t have to download and install the programs, maintaining and updating them which is surely a unique type of software delivery through Internet. In the majority of cases, office solutions imply Microsoft 365 productivity suite, CRM platforms, such as Salesforce, and other collaboration applications like Slack and Zoom.

Businesses benefit from cloud services in a variety of ways, including availability, scalability, cost, and flexibility. They are flexible, and they can be scaled up or down rapidly, hence keeping the organization in tune with demand changes. However, there are no new hardware purchases. The cloud platforms, if viewed as a whole, include public, private, and hybrid clouds, and this is what allows companies to create tailor made solutions to cater for demands that are peculiar to each business. Cloud services, a platform available from anyplace with Web connection, enable telecommuting, collaborations, and mobility. The reliable CSPs have already completed the construction of the resource facilities to the powers of duplication and disaster recovery. Cloud providers have spent budgets heavily on security tools to defend users data and other serious security risks including cyber-attacks (Jamsa 2013, 32).

2.2 Comparison between cloud services and on premises services

(Deployment): Each of the cloud vs on premise services feature deployment, management, scalability, security, cost, and flexibility or as you type of issues. On-premises include in-house built and operate the IT infrastructure at the physical site whereas cloud just means it is offered via the internet across the

web by third party service providers. Cloud services are trending for low implementation of local infrastructure that eventually can save time and allow quick deployment, scalability, and flexibility. Before they decide to pick one of the two methods, organizations need to look into their specifics.

(Management): The activity of installing hardware or software requires the skillful IT personnel, such as for installation, updates, bug fixes, backups, checking, and troubleshooting. Organizations need qualified workers to do and have assets to be productive. Cloud services opt to hand over these responsibilities to CSPs thus helping them in the provisioning of infrastructure maintenance, which covers upgrades of software, security protocol, backups as well as escape from disastrous situations and arrangements. The usage of cloud platforms, for example, gives autonomy to the subscriber through self-service webpages, tools for automation, and tracking dashboards, thereby, simplifying administrative functions and hiring of in-house knowledge.

(Scalability): Scale-up is a service that allows businesses to evacuate their resources according to the demand, thus reducing resource wastages and preventing the system from running a single course of action depending on the business needs. Instead of on-premises infrastructure with limited capacity, which would take a long time to install with high costs for procurement and deployment of physical gear, cloud computing enables organizations to be rapidly go online that provides a need for more computing power, storage or network bandwidth.

(Security): Security is vital for both case of an enterprise on-premises and cloud-based services. On premises ones are more sure about the safety that they can do but it has to be monitored that factors are stable and is done properly. CSPs use their own security features upon creation of cloud services. These are encryption of data, intrusion detection system (IDS), firewalls, IAM, and compliance certifications. CSP also includes a range of security measures such as DDoS protection and protected APIs.

(Cost and Flexibility): The question of cost is amongst the key issues when dealing with cloud services versus an on-premises solution. The deployment of on premise solution requires initial funds along with operating budget, whereas the cloud computing serves to pay as you go or subscribe service prices. Cloud services are able to flex and adapt (self-service portals, APIs, and automated provisioning) and therefore they provide an ease with which these deployments can be done, easily scalable and provides management facilities without the need for manual involvement. They also serve modern hybrid and multi-cloud environments which enable users to easily transfer of workloads, protective solution from disasters, and implement geographic redundancy scheme.

Different deployment approaches, managing responsibilities, scalability options, security models, and cost structures are examined between the public cloud and on-premises models. In on-premises services, there is greater control as the service becomes more customizable and data sovereignty is to be gained but at the same time capital investment is heavier. Cloud services are helpful as they are flexible, scalable, more cost-effective, and of the latest technologies assimilated.

2.3 Cloud computing deployment models

The deployment modes for using and making available cloud computing products and services to other users are referred to as cloud computing deployment models. These models depict that who all are responsible for managing cloud infrastructure, the level of customization and security that it provides, and how it is managed are decided here. Usually, there are four primary models for deploying cloud computing:

2.3.1 Private cloud deployment model

Supposing that private cloud deployment model incorporates private cloud environments, the latter provides the organization more control, customization, and security due to the fact that resources and services are devoted to the organization’s sole use. Following this model, it might be either a third party or a

vendor hired to manage this concept; alternatively, it can be done on site at the company's data center. Upgraded environmental safety and accepted policies, integration and custom applications, and industry-specific resources encompass the main features. A cloud is a cloud, be it public or private. But a subset of users, such as healthcare kingdom, finance and government, have mandatory compliance rules and they have further need of private clouds. The firms may redirect the scenario of the private clouds to their form and its functions, thus tailors their needs according to the workload and applications.

For non-inferiority, resource management could be adjusted by demand in scalability of private clouds assuring any load that can be managed without compromising efficiency. The reason is the fact that the very existence of these components is based on their proper configuration that generally implies their increased performance (the majority of the time it is when the missions are highly critical). However, they may incur initial costs tension and operation costs and lead to higher running costs, respectively. In accordance with a private cloud deployment companies that accept this method need to plan their long-term IT strategy and do not have the financial constraints as critically as their public cloud counterparts. Though private clouds have many reasons to be the preferred option when data security, compliancy, customization and performance control are concerned, they do have few disadvantages which are not seen in public clouds (Rastogi 2021, 54).

2.3.2 Community cloud deployment model

The community cloud service is aimed to bridge common objectives of the enterprises based on the concept of sharing resource pooling and infrastructure. Hence, the industries follow common standards, guarantees on security, and compliance with regulations. The members of the community can join each other and exchange resources while not having close contact. Activeness, common health issues, and taking safety precautions among the residence are the main features. The customizable functionality is the main characteristic of community cloud that can be traced by the resources of the group - the layers like servers,

storages, network, apps, etc. Consequently, exchanging resources, solving common issues, and practicing with each other will be more effective in companies.

Engaging a community cloud can be efficient for cost-sharing, productive backups, enhanced performance, and customized clusters. It provides to the members of community the expenses on the keeping, maintenance, and improvement of security system. Also, it allows companies pool their resources in a more hassle-free way, and enables sharing of information in a safe way and as well as sharing of expertise. For that matter, companies still have permission for creating their environments, so they can adjust the settings and negotiate the policies to figure out everything on their own. It is especially valuable for these is areas where the industry sectors are affected by the common laws and regulations and data security such as healthcare, government, finance, and education (Aggarwal 2013, 172-175).

2.3.3 Public cloud deployment model

The public cloud deployment approach is a type of cloud computing which can be used by individuals or organizations to run virtual machines, software services, under cloud or cloud platforms through a third-party provider. Shared existing infrastructure, insurance, elasticity and scalability, and also easy access are these three factors. Resource efficiency is attained since the cost of resources is driven up by the fact that users only pay for the services that they actually use. Another addition to the Elasticity of public clouds is the ability to surge resources which is a non-investment type that prompts no need of new devices or infrastructure. This model will remain remote jobs and co-working culture.

As far as the matter of management and payments for resources are concerned public cloud infrastructure provide the ability to choose the pay-as-you-go (PAYG) business model. They offer managed services that cover support for technical aspects, the administration of infrastructure, the provision of security, the compliance with standards, and monitoring. They grant flexibility and

internationalization, these defining characteristics ensure efficient data management. (Singh 2023, 154).

2.3.4 Hybrid cloud deployment model

By rendering a blend of the positives of the public and private clouds, the hybrid cloud architecture is an appropriate solution to cloud computing. Through non-customized clouds, it allows businesses to use public clouds for their non-mission critical workloads while customized clouds enable mission-critical operations to be established within the organization so that security and control can be assured. As for the cost savings related to offloading anything sudden onto public cloud services for unstable load and eliminating the need for an ongoing housing maintenance for workloads that are less dynamic, hybrid computing brings along another decisive benefit, that of retaining data residency, privacy, and compliance.

Through the joining of local servers in private clouds with public cloud environments, hybrid clouds are formed and are therefore, one of the solutions for the migration and transfer of workload and data between different types of IT systems. They clone the critical data and do applications to reinstate continuous workflow and recovery strategies from the disasters. With the help of such tools, organizations can get access to a centralized command center for a simplified management, monitoring and optimization. Through this model, businesses can build an infrastructure that can scale, transform and remain stable with the respective control, security and customization attributes of private cloud. This can be achieved by blending the public cloud features such as scalability, affordability, and elasticity (Venkatachalam 2021, 135).

2.4 Cloud providers

Locations as companies with a range of offerings regarding cloud computing that include the hardware and software resources are called cloud providers. As for the online services, they handle and monitor networking, hardware, software, and infrastructure mainly. They open multiple data centers in different locations and

fill them up with networking gadgets, storage devices, and other servers. Different services and capabilities are offered by different kinds of cloud providers:

Public cloud providers: The service providers such as AWS (Amazon Web Services), Microsoft Azure, and GCP (Google Cloud Platform) along with IBM Cloud and OCI (Oracle Cloud Infrastructure) are the examples of the public cloud that collectively provide the internet based cloud computing services to a numerous number of users and businesses. They go beyond compute resources, storage solutions, databases, networking, AI, ML, and IoT technologies. Many other services are available.

Private cloud providers: The enterprise level can use network infrastructure, cloud platform, and computer hardware to create a company-shared and secured private cloud environment for storage, communications, and monitored access either from internal IT department or external third parties. Insights of the solution that is customized to meet the user need proves the case that the aforementioned, OpenStack based, VMware, Dell Technologies Cloud and Nutanix are examples of solutions that aim to meet specific needs and requirements of the organization.

Hybrid cloud providers: Hybrid cloud providers that offer an integrated public and private cloud services let the systems configuration and workload portability to become much more effortless with synchronization and connection of data and a unified experience. They help companies in the transition to the hybrid cloud model by balancing their security, compliance, and performance needs. Some of these solutions include VMware Cloud Foundation, Google Anthos, Azure Arc, and AWS Outposts, to mention just a few.

Multi-cloud providers: Multi-cloud providers are businesses with scope to manage assets from various vendors all at once without even having a choice. This is by creating multi-cloud platforms using various cloud providers to solve the problem. Also, their cloud solutions offer security features; migration facilities for workload; and platforms for cloud management. Each the market players include

CloudCheckr, RightScale and CloudHealth from VMware for example. They guarantee and increase the flexibility, efficiency and cost aspect under the instances of multi-cloud scenarios.

2.5 Challenges and risks of cloud computing

Cloud computing enables massive scalability which result in cost-effectiveness, flexibility, but the risk and security concerns still exist. Cyberattacks, cybercrime and data privacy are growing at the Internet of things. Sensitive data may be exposed by poor access controls on security settings, flatware service and resource corruption. On one hand, users should make sure that the data are safe, sensitive applications and access controls are contained. On the other hand, the cloud providers will be responsible for the security of the infrastructure.

In this regard, exact data protection laws, e.g., GDPR, HIPAA, and PCI DSS, should be implemented by those companies which process and store data in the cloud highways. As a result of data privacy, encryption, and legal obligations that have to be in place, this can be more complicated. Local rules must be understood because the positioning of data centers by cloud providers overseas creates important and international data architecture questions. The businesses tie-up with cloud can be disrupted in their normal operations and specific downtime and revenue which may result due to cloud errors might be witnessed. Thus, availability and reliability epitomize as critical factors in this context. Having them in place is necessary to decrease this risk level. On the other hand, shared resources in a public cloud will possibly be the cause of inaccurate performance such as latency and inerratic response.

However, businesses that heavily depend on just one cloud provider may be susceptible to additional lock-in problems. These events make it hard for these companies to move their workloads or to change their provider. Similarly, human error and software defects cost people and the infrastructure likewise can cause recovery. Effective cost control and the prevention of low-vision costs demands consistent use of cost management. It is mandatory that companies increase the

sophistication level of the security persisted by their cloud services, perform frequent audits, put the data under public eye, set clear compliance rules, draw contingency plans, follow up on performance and economize the expenses, to address this issue. It is imperative that IT teams, security specialists, compliance officers, and cloud providers work together to tackle the constantly changing risks and challenges that come with cloud computing.

3 CLOUD COMPUTING AND SUSTAINABILITY

To take into account the environmental issues, an alluring alternative for sustainable and green computing is cloud computing. By bringing together the whole of computer resources on wide scale that provide the best usage and therefore, the lowest energy bills and high efficiency. Such a pay-as-you-go model ensures the businesses to run their computing operations in a dynamic way where the carbon emission is significantly reduced by removing the overprovisioning. Moreover, cloud suppliers aim at implementing the environmental goals through investing in the advanced technologies which include the development of the hardware systems that use significantly less energy while running on renewable energy resources. It serves the purpose of inter-operability, collaboration, teamwork, and remote work to a prograde extent thereby lessening the amount of infrastructure and time for business travels. The environmental consequences therefore of those electrical devices must be considered so that together with the refrigeration equipment and data centres everything is included (Rivera 2017, 45).

3.1 Sustainability in information technology

To define sustainability in IT, this is for an idea where all resources tend to be used efficiently without causing any negative impact on the environment and thereby build the sustainability of the system. It all boils down to lower energy consumption, decreasing electronic waste and rising up the share of renewable sources of energy. Apart from urban area, it is capable of creating a rural development, fair labor standards, social, economic and information technology

being in the community. The main objective lies in the enterprise development of sustainable and transparent digital space (Violino 2022).

Energy or energy economy, clean energetics, the Management of electronic waste in the proper way and the environmental protection practices are the main topics of the sustainable information technology. Through intensive IT CO2 emissions reduction measures like server virtualization, energy-efficient equipment, and so on, they may really achieve the goal of lowering the IT carbon footprint. The mentioned end servers with the carbon-less IT infrastructure are the owners of solar, wind and hydro electrical energy. It is necessary to dispose electronic wastes in an environmentally friendly and healthy way with the view of diminishing pollution and keeping from the health risk. In relation to this, we can start and the implementation of projects that will cover the aspects of recycling and restoring of worn down pieces of equipment. In order to reach energy efficiency within less emissions they used the attitude of reduce energy HVAC and lighting system, working from home and other things to telecommunication systems as well (Dastbaz 2015, 223-225).

Not only the DEI improves in the IT sphere as human resources are being recruited but it also gains the another side of IT tendency such as possibility, advancement and fairness which do not have certain limits. Such an execution would allow people to implant the feeling of excitement and awaken their imagination in the students with minds always willing to discover and to indulge in experience which are new and thrilling. Security and fair sourcing should be the two key areas that should enhance confidence that these commodities do not violate any human rights laws, or labor regulation (the laws that govern laborer's activities). The second factor is digital equity among everyone from low-income communities get an affordable, accessible and trust training and skills to get participated in the economy digital The extraordinary invention of human computers has dehumanized and requalified the performance with friendliness and social responsibility.

Furthermore, Green IT has other aspects, too, which include maximizing the life span of a device, having low discount rate, and TCO's [total ownership costs] can be reduced by changing the paradigm of the ownership of IT resources. Being on the other side the pollution grows as well as the culture that is bound not only by the reuse of waste materials but decreasing harmful waste at the same time. Green innovations strive to find and explore solutions to short run and long-term social and environmental problems while at the same time creating new job opportunities for people and raising the level of competitiveness of businesses by applying climate smart technologies and climate-friendly business development. These implacable three aspects form up a no separable model, made of the following: economic dimension, social issues, and environmental sustainability. The power of IT as a good actor as well as the one that is able to create and hold the world environmentally sound and sustainable is attributed neither to the responsibility that is only for the government players, consumers, and industry players, rather, all these factors should support one another. (Tomlinson 2012, 63).

3.2 Environmental impact of cloud computing

Cloud computing has been found to be a provider of this diversity in benefits such as flexibility, cost-effectiveness, and the ease of handling the data. In close relation to this is ecology. In addition, it is reported that it also influences the environment. Cloud data usage is power-hungry and complicates atmospheric pollution mainly through oil extraction and usage. Besides that, it leads to global warming. Recourses are exhausted and carbon emissions are also released by means of data centers establishments and maintenance as well as by their work. In addition to the environmental problems, the management of the electrically generated waste, which comes from outdated devices, is also an important issue. For instance, in areas that experience having droughts and water scarcity, these facilities use water in refrigeration units which ultimately leads to water consumption and at the same time stressing local resources. Water consumption in data centers accounts for a significant percentage of their power use; hence water management is necessary to diminish this impact and instill sustainable practices in the cloud computing world. Electronic waste management especially

that related with big data processing and massive data storage is increasingly being identified as an urgent problem. In order that the e-waste containing hazardous elements may not end in leading to users getting health problems and dumping the environment, user friendly take-back systems or recycling should be introduced with policies governing their usage and disposal.

Such actions on the part of cloud computing providers are executed by means of help ecological policies, renewable energy etc. Hence they are forced to care for the environment and create sustainable technologies in our world. So-called approaches perform on hardware component to virtualize single physical server where multiple virtual machines can be hosted. Leading figures, such as virtualization technologies, have already proven to be secure for performance of multitude of virtual machines housed inside a single physical server as a whole. The same technology that highly passive can also fight the energy crisis. As a result, you will receive less of the same service while the pay goes down. Saving energy and making more use of renewables is the key to companies to build data centers that are very much fueled by green-powered assets. The beginning of the campaign directs the promotion of a more sustainable e-waste disposal pattern through means such as organized waste recreation. To mention, you can reinvent the use of already available items; utilization of waste and hosting servers near places with abundance of water is just but an example (Smith 2013, 41-52).

3.2.1 Energy usage and effectiveness

In manufacturing, logistics and technology industries, it is energy efficiency and usage which are the most vital because they play a significant role in the level of both operating expenses and environmental sustainability. Energy use includes the applications of energy to equipment, tasks, or infrastructure; while the production of data, the manufacturing of raw materials, and the buildup of data centers are the energy-consuming industries. The implementation of both energy savings and high productivity is the purpose of energy effectiveness, referred to energy efficiency. Taking actions that lower the waste, improve resource use, and

cut energy consumption such as adopting green technologies, recycling, and creative energy utilization are all necessary to enhance energy efficiency.

Besides, boosting energy efficiency is of importance since it leads to less cost, firstly, and on the other hand, an eco-friendly environment is created for saving resources. When these gases and pollutants are released lower, it aids in the alleviation of climate change, as well depletion of resources. The transition to greener energy provides a chance for sectors to support each other, reach more consumers and unite with the governmental authorities who regulate it (Porto 2015, 135-138).

3.2.2 Evaluation of carbon footprint

The most effective way to do this, (I believe), is to take the steps to calculate one's carbon footprint, which is the first and foremost step on the road to environmentally responsible living. Sources, electricity, and the total cycle which includes also the supply chain are all included in the counting of the overall amount of the greenhouse gas emissions by the company. The Greenhouse Gas Protocol and ISO 14064 are a couple of the numerous methods used for the recording and analysis of environmental data across economic activities. In order to make assessments reliable, accuracy of data collection and analysis is vital.

Emissions assessment of companies allows them to establish mitigation measures in place to prevent greenhouse gas emissions. These plans are able to consider such options as investments in carbon offset projects, branded products and services with a focus on sustainability, streamlining supply chains, switching to renewables, and implementing energy-saving technology. Among the challenges that this on-going process operates is to reduce its regulations and viewing this on a regular basis. To point out, a vegan diet does the same with regard to carbon footprint evaluation (Muthu 2014, 158).

3.2.3 Techniques for resource optimization

Efficiency enhancement, discard minimization, and success in sustainability is largely due to a satisfactory resource reconciliation plan. One of the primary strategies that can be done is using net inventory in the production process, that is, storages of raw materials and components at the lowest level as possible that can be shipped to customers on-time which also leads to the reduction of the excessive stocks and expenses. Water conservation is obligatory these days; up to date use of energy is required in minimizing the level of energy utility bills. The main things that can be applied in order to raise the efficiency of the business are data forecasting, which lies at the origins of prudent management of energy resources; just-in-time inventory; and the number of economic orders are some of the methods.

In order to increase company's productivity with reduced waste of the environment resources, the following strategies are needed, such as 'lean manufacturing', 'supply chain' optimization, 'waste management', and implementation of technology. The production managers can figure out the bottlenecks of their process by involving themselves with the application of the Kaizen and the 5S methodology, and by using the Value Stream Mapping approach. Effectively, if you succeed to run an establishment more efficiently through implementation of new technology and improved management of waste, then it becomes another way of improving the efficiency of operations. Perspectives for the long-term optimization processes are connected to a long-term observation and data, which in turn trigger new ideas (Xiong 2014, 68-72).

3.3 Economic implications of cloud adoption

The cloud computing implementation is responsible for considerable change in the economies, industries, and companies in the global community. It not only modifies how business works but also brings benefits such as creation of job, efficient performance, growth in the economy, cost savings, and innovation (Rodríguez 2018, 15).

Cost Savings and Efficiency: Organizations get a lot of financial advantages in terms of lower maintenance, improved operation performance, and reduced capital expenditure with the assumption of cloud computing services. Companies can make possible to streamline the processes, overhaul the computer systems, and shift their attention to the business strategy through cloud computing. The carrying-out, updates and security that cloud vendors offer additionally lowers total expenses.

Business Agility and Innovation: A shorter period of time to market for new notions and products as well as supporting the agile development methods that accelerate succession of the development iterations, collaboration and continuous improvement that eventually lead to creative solutions and quick response to market, are two ways through which cloud computing bolster competitiveness (Sahana 2019, 36).

Global Reach and Accessibility: New markets can be entered and conquered by companies with the use of cloud adoption, which provides scalable infrastructure, data storage, and applications. Such services are available from any location on the globe regardless if the connection is available through an Internet. This technology enables remote working too, and it reduces the costs, it is easy to employ highly skilled professionals from around the world, and the workers are highly motivated and therefore they are very productive.

Data Analytics and Insights: Accompanied by cloud platforms' high-quality analytics and data processing features, businesses can amass data, go through it, complete a comprehensive examination to reveal important insights, thus spurring businesses' decision making and an edge in the marketplace. This is where the sophisticated machine learning and analytics tools of early stage cloud platforms come in to save the situations. Job Creation and Skills Development: In a cloud driven scenario cloud related positions like data analytics, cloud architecture, cybersecurity and management can rise from where the skill based and employment can have developed. Efficient utilized of cloud technologies not

only by individuals but also by organizations ensures the cloud certificates and trainings.

Competitive Landscape: Now, the move to the cloud has turned established corporate business models upside down, even creating a lot of new market entries. However, some of the business that comes out to be victorious through forms of cloud-based technologies can gain competitive advantages like cost-efficiency, agility, product innovation, and customer experience. These factors help in the market leadership and growth in the field of business expansion (Williams 2012, 51).

3.4 Social dimensions of cloud computing

Cloud computing revolution fosters in us a new attitude to technology, which is looked at differently or interpreted in a new way, and leads us to the topics of security and education, occupation, opportunities, and team work. Unlike the case before the digital era, it now serves as a base for developing innovative ideas and concepts. In addition, it is one of the foundations of creation, use, learning and communication and interaction. Social media include many major social issues including education, employment, living in community, and teamwork among others.

Accessibility and Inclusivity: The swift expansion of cloud computing in different software capabilities for the poor users who need no capital to install machines and develop their programs has been the greatest boost to the software packages and applications coupling usage ease. Most probably, this act will shape inclusion as it has the possibility of giving every one of the group regardless of whether it is big or small business, start-ups or large firms, and chance to be part of the process.

Collaboration and Connectivity: Above all, the apps driven by cloud technology which are simple examples of the teamwork, project management software, document sharing, video conferencing, and cloud storage are changing the types of communication that is usual by global teams unlike before. First of all,

nowadays they substantially help productivity as widespread as an idea sharing and international communication increase the globalization of the workplaces to the level that it happens all over the countries and the world.

Education and Learning: This period also marks the rise of web-based learning platforms, cloud-based learning platforms and applications for learning that are learner-centered so as to give easy to access, scalable solutions for the existing and the new emerging needs. It enables teachers to conduct academic activities instead of random, purposeless talks which are difficult to be meaningful while there exist many communication routes that last 24 hours and grant many training chances to the learners.

Employment and Workforce Dynamics: Now it is the turn of the cloud technologies to take the lead position, some new specialties have emerged such as cloud architects and engineers, data analysts, and cyber-security specialists. To this end, they did not only issue and authorize pieces of currency but also turned the market into something more energetic. One of the current society's novel occurrences is its influence on the labor force exactly for a very short period of time in the case of cloud computing and telecommuting. And consequently the jobs would need to stay under the cloud instead of the assignment to the workshops that are of the same level (Gonzalez 2022, 123-127).

Privacy and Data Security: Even though cloud computing is a powerful technology that comes with many advantages, the security and privacy of data remain very important issues to deal with. To build up the plausibility of security leaks, the use of strong security protocols must be ensured in these remote servers. For user data protection and accountability mechanisms like GDPR and data privacy laws, organizations are put into effect.

Digital Divide and Technological Literacy: Cloud computing now has gained in prominence, but, however, there is still insufficient grasp of the internet connection, digital skill, and technology application among distinct social classes.

The "digital divide" is the one such problem. Addressing it through disclosure on the works of infrastructural construction, literacy efforts, digital inclusion and affordable technology is an approach that should be taken along.

Environmental Sustainability: The integration of the social dimensions with the environment has become very evident, as the providers establish environmentally friendly end storages, production renewal energy sources, and environmental innovations that help to lower carbon emissions and adhere to the ethical business conduct principles that correlate with the social expectations (Arai 2021, 78-83).

4 METHODOLOGY

An established protocol or methodology that is the methodical guide to the collection, analysis, and interpretation of data in research projects is what research projects employ. It is a guarantee for validity and reliability, and can be quantum surveys or case studies, experimental design, quantitative or qualitative research, or else the governor of all. The decision regarding the use of a particular technique is explicitly based on the questions and objectives of the research and therefore ministers as a system that guides the investigators in gathering and analysis of the data. People are more willing to believe results, if the approach and the whole process is evident. This hence makes the study much understandable for others to get to know by repeating, which in turn broadens knowledge (Sreekumar 2023).

4.1 Demography

Demographic analysis gives reliable and specific data. I selected 15 persons of all ages and genders to participate in the survey. A Google form was created for the survey, and the link was emailed to each participant via email. From March 28 to March 30, 2024, the Google form link was available for them to submit their feedback. Males submitted 80% of the responses, while females contributed 20%. The majority of participants were young people aged 18 to 35

(73.3% between 18 and 28, 20% between 29 and 35, and 6.7% between 36 and 45).

The first question was about the option which prompted them to learn more about cloud computing technology. More than half of the people chose personal experience, which was nearly 53.3 percent, and the remaining 46.6 percent chose reviewers as their opinion.

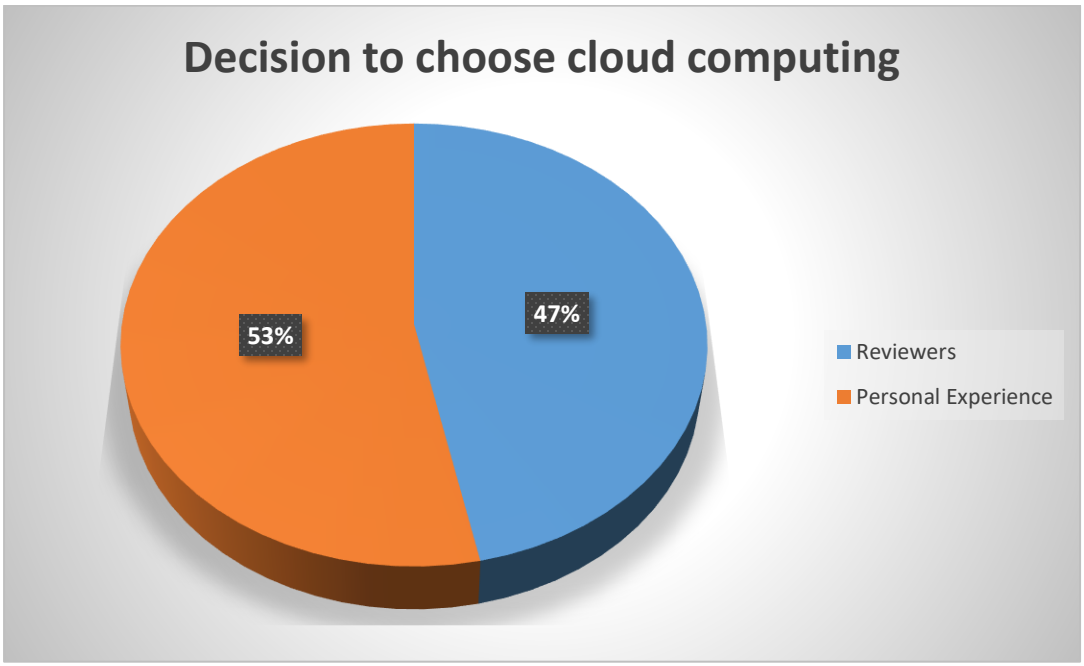

FIGURE 1. Decision to choose cloud computing

The second question was about their personal experience with cloud computing, where 66.7% of users were pleased with cloud computing and offered their view as satisfied, and the rest of the few (33.3) gave feedback of average on this subject.

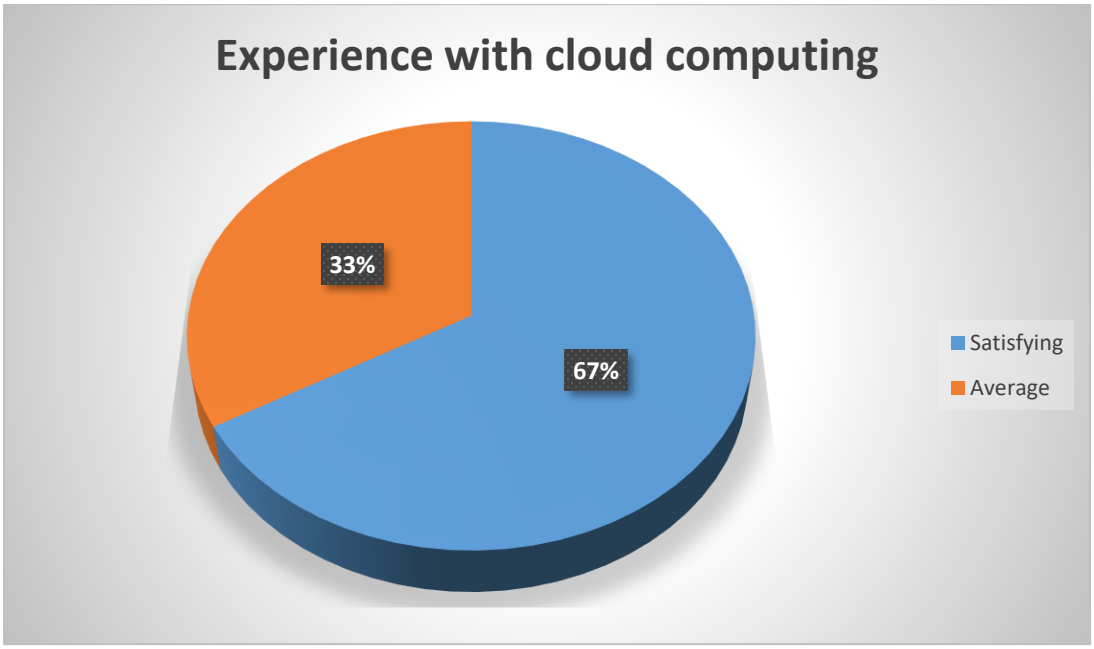

FIGURE 2. Experience with cloud computing.

The third question inquired how frequently they had used cloud computing. The response broke into three segments, where most of them (46.7%) assured to use cloud computing often, the ones who were unfamiliar with the concept (33.3%) offered a negative answer, and the remaining number of them (20%) claimed that they rarely use cloud computing.

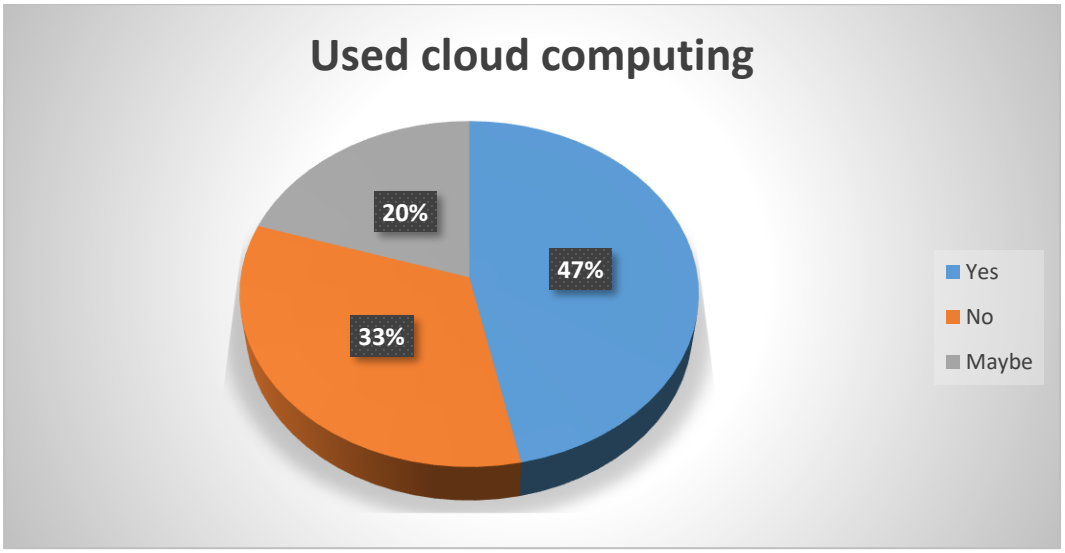

FIGURE 3. Used cloud computing.

The next inquiry sought information how familiar the users were with cloud computing technology. Most users (66.7%) were very familiar with this cloud computing technology, whereas the remaining users (33.3%) were extremely unfamiliar with it.

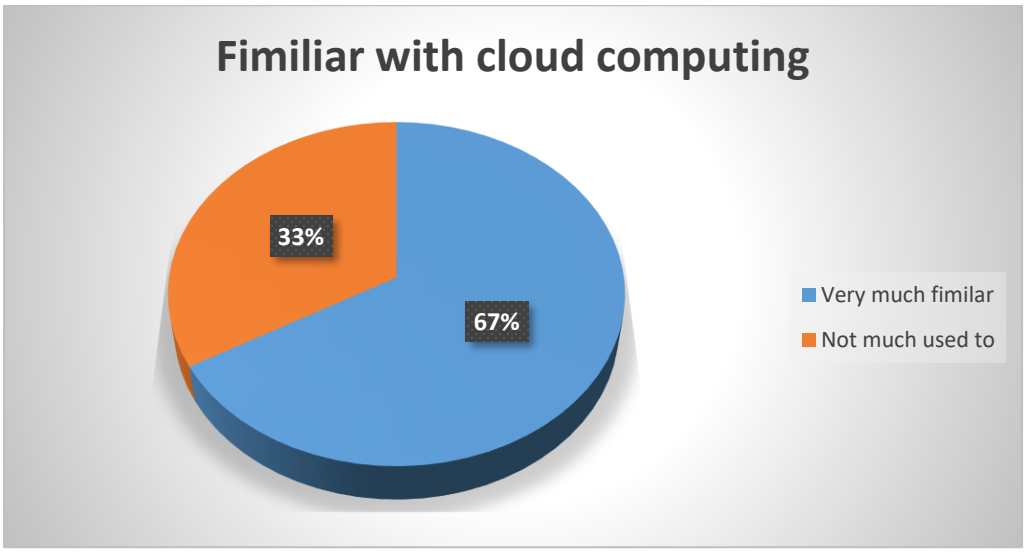

FIGURE 4. Familiar with cloud computing.

The next question inquired if they have implemented cloud computing solutions in their workplace. The results were extremely surprising; the majority of users (60%) failed to get cloud computing solutions in their job sector, whereas only about 40% were successful in adopting cloud computing solutions in their job sector.

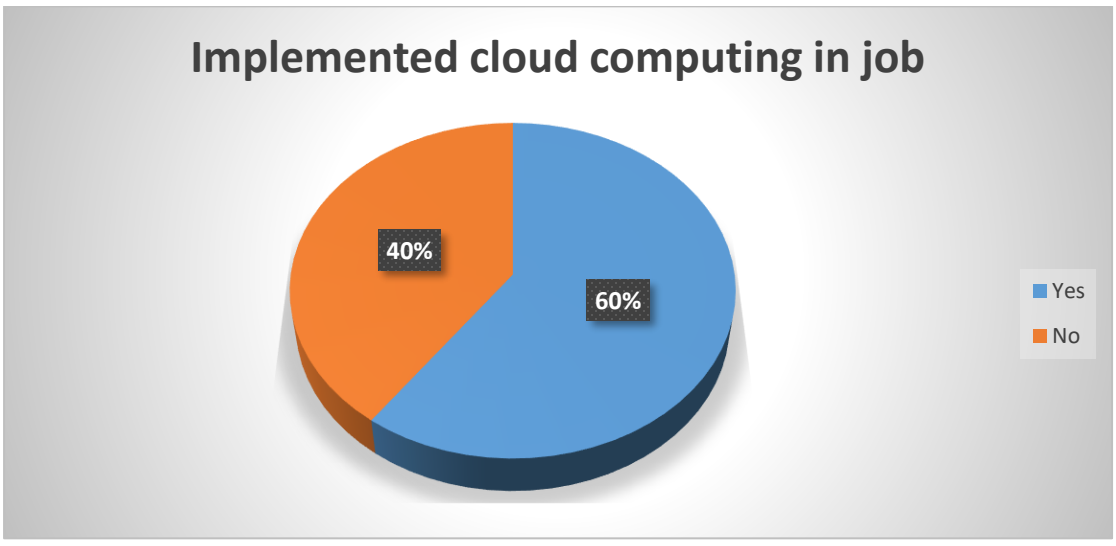

FIGURE 5. Implemented cloud computing in job.

The following questions were answered to learn about the principal motivations to use cloud computing in their organizations, and it turned out that majority of them (73.3%) use cloud computing because it is more suitable to use, and the rest of them (26.7%) use it for its simplicity.

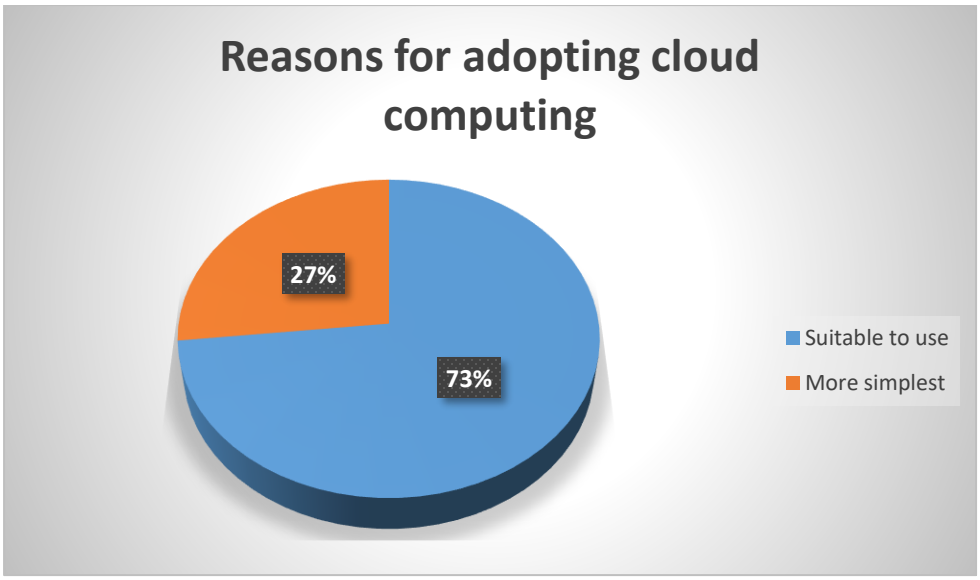

FIGURE 6. Reasons for adopting cloud computing.

The follow-up question was regarding the primary challenges encountered with the adoption of cloud computing. Security issues were obvious to majority of users (66.7%), while the rest of them (33.3%) perceived migration complexity as their main obstacle.

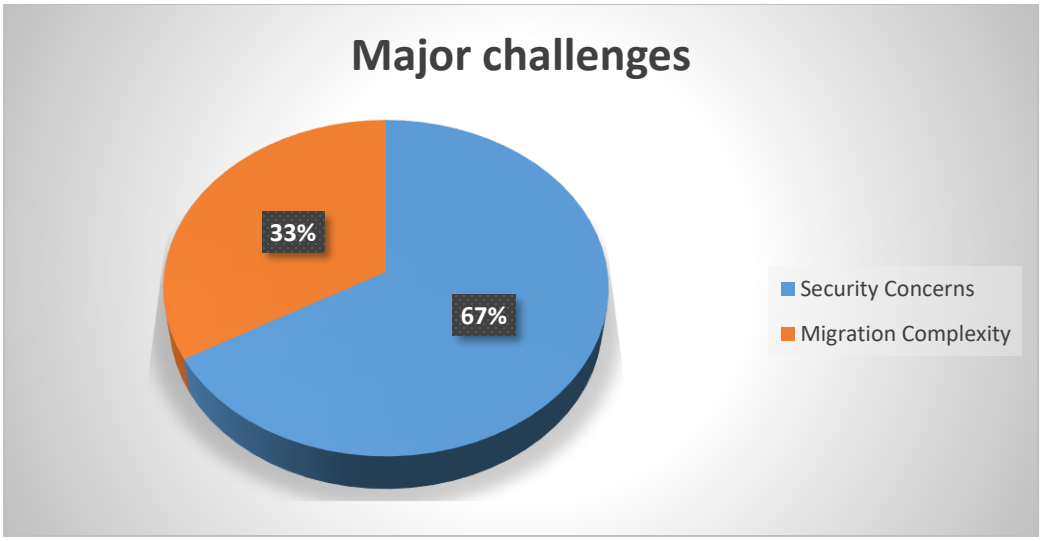

FIGURE 7. Major challenges.

The next question was about how much they are concerned about data security and privacy when using cloud services. Majority of them (86.7%) are very much concern about data security and very few of them (13.3%) never get the opportunity of concern.

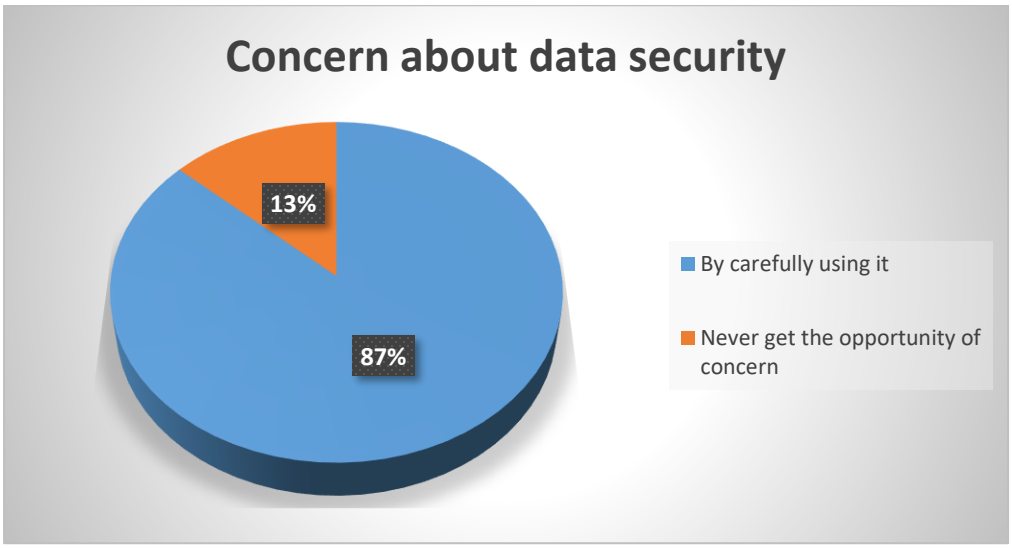

FIGURE 8. Concern about data security.

The next question was about the benefits that customers have personally encountered when using cloud computing services. Cost reductions received 60% of the votes in this question, while the remaining 40% chose scalability as their personal benefits.

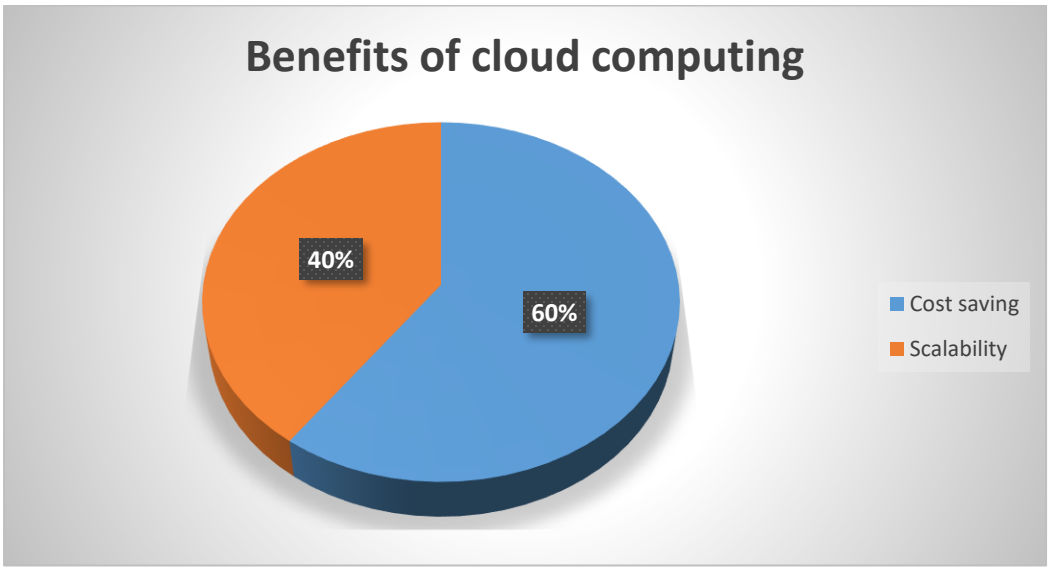

FIGURE 9. Benefits of cloud computing.

The next inquiry was about how cloud computing improved users' abilities to manage and access digital resources. The majority of users (60%) chose accessibility, whereas the remaining 40% chose flexibility instead of accessibility.

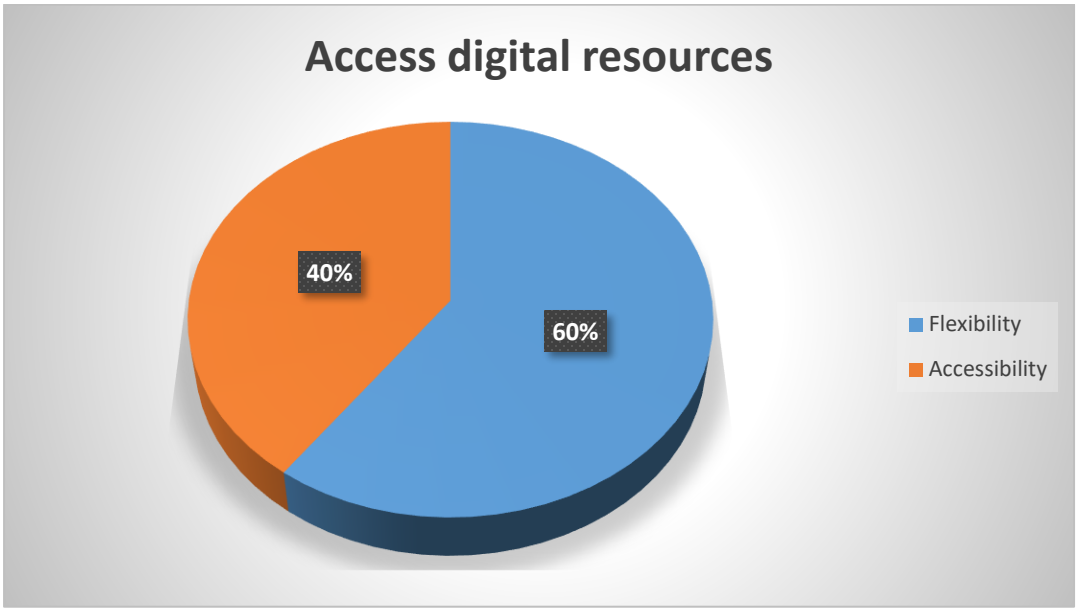

FIGURE 10. Access digital resources.

Participants were then asked if they experienced any substantial costs connected with shifting to cloud services for personal usage. The majority of respondents (40%) witnessed the financial implications, but it felt reasonable to them; 33.3% did not see any cost consequences, and the remaining 26.7% were unsure about it.

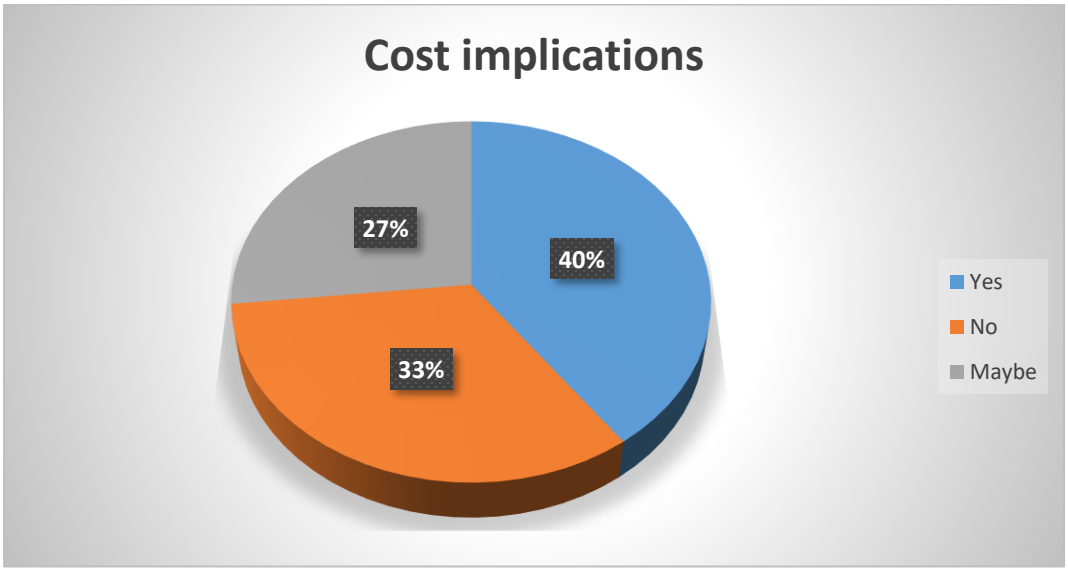

FIGURE 11. Cost implications.

The users were then asked what were the main benefits they had gained from adopting cloud computing services. The majority of people (53.3%) chose disaster recovery as their main benefit, while the remaining 46.7% chose cost efficiency.

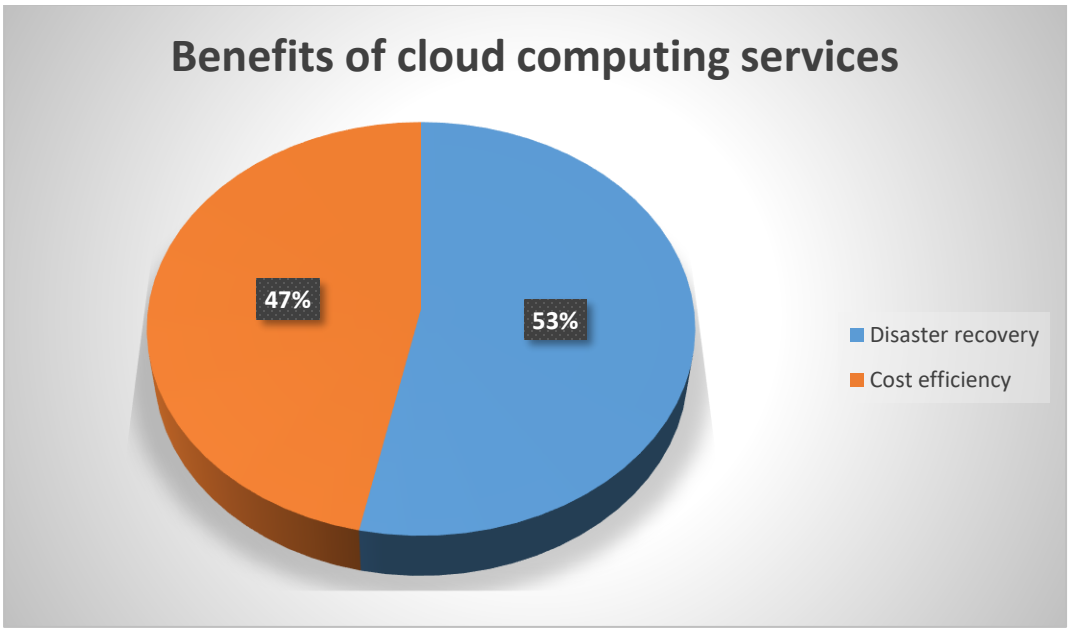

FIGURE 12. Benefits of cloud computing services.

The next question was posed to the users: how has cloud computing changed the scalability and flexibility of IT resources? Around 60% of the users chose the choice Global reach, while the remaining 40% went with the option Elasticity.

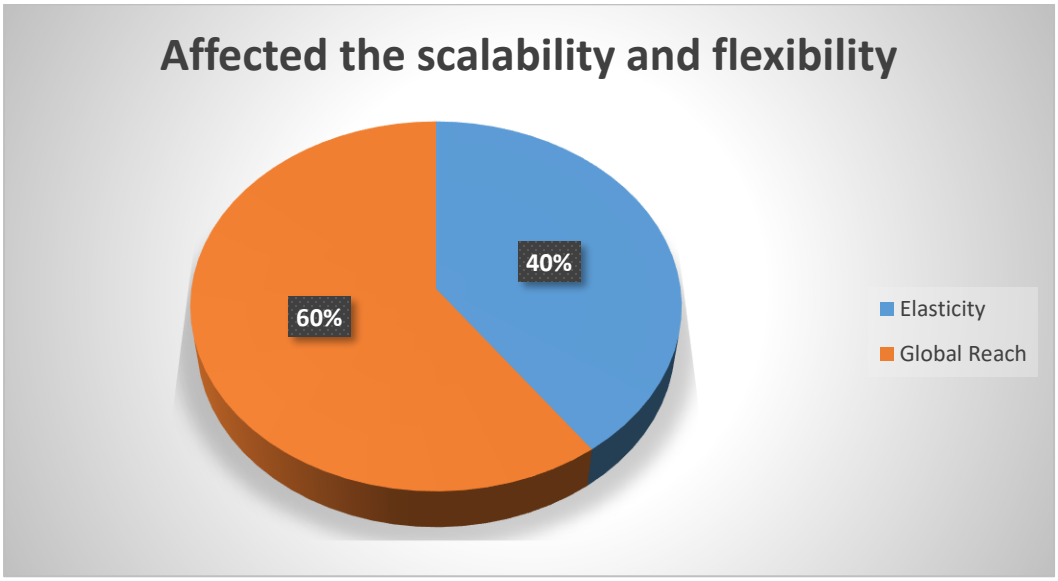

FIGURE 13. Affected the scalability and flexibility.

The second question was posed to the users: how do they rate the dependability and uptime of cloud services against traditional IT infrastructure? Almost three-quarters (73.3%) of consumers opted for monitoring and advice, while the remaining 26.7% chose geographic redundancy.

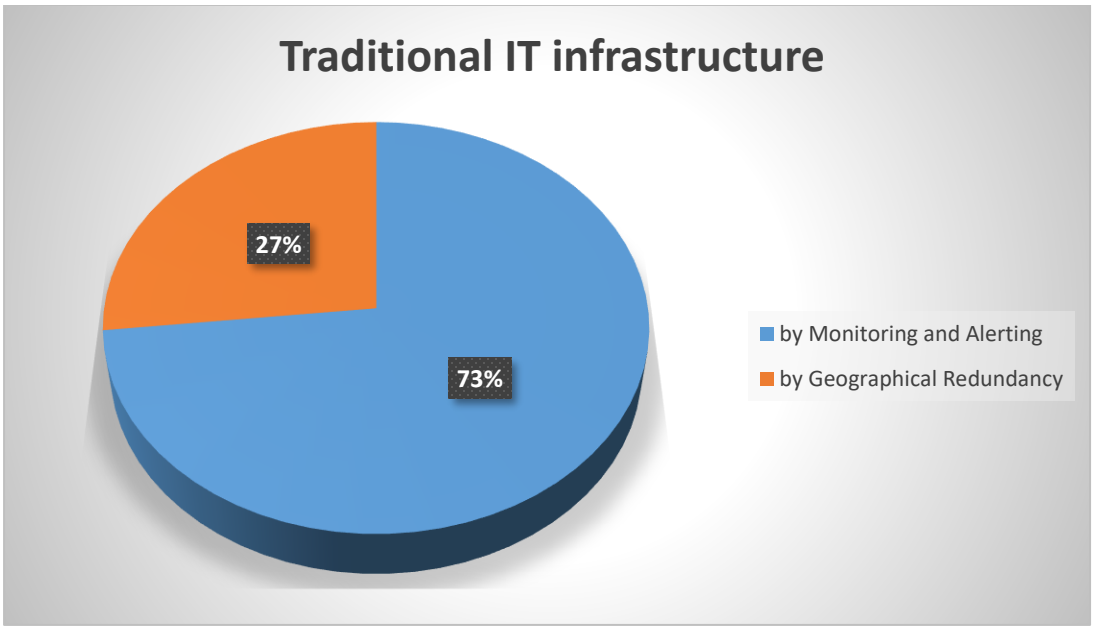

FIGURE 14. Traditional IT infrastructure.

Another question was posed to users: how has cloud computing impacted the speed and efficiency of IT operations in their personal experience? Four out of five persons (80%) responded to the data visualizing tools, with the remaining 20% stating that they did not find it efficient.

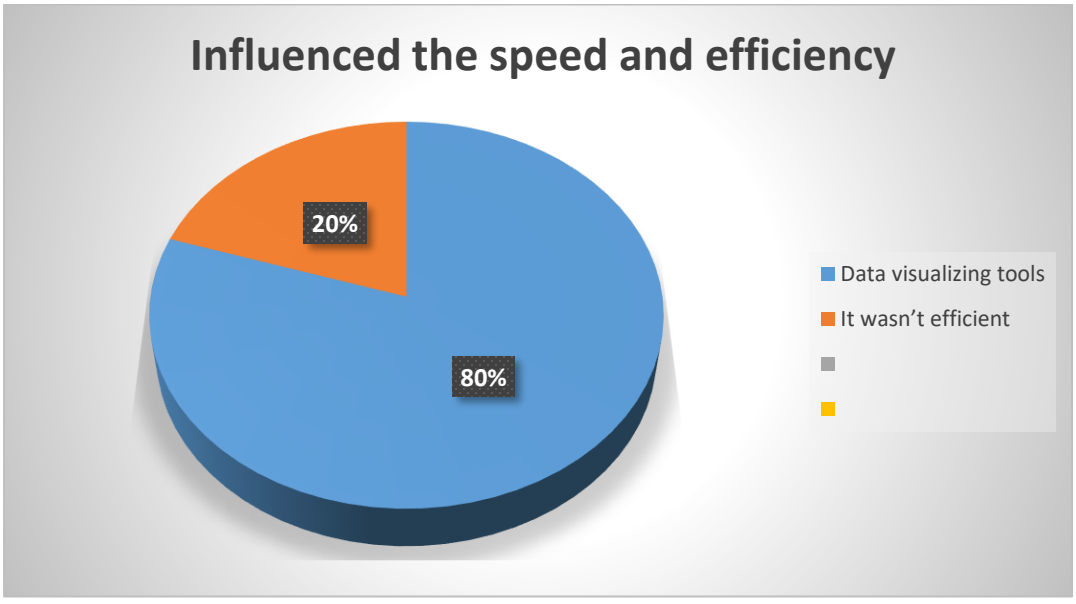

FIGURE 15. Influenced the speed and efficiency.

4.2 Summary of the results

The research surveyed the respondents about their personal comments about the experience of hailing from the cloud computing technology, with 53.3 percent story of their personal experience behind the primary reason for learning more in depth. Nevertheless, most of the participants were content with this service, 46.7% to be exact, that use it as their primary source of computing. The largest number of them were into the cloud computing technology, 66.7% declared being very familiar and 33.3% indicated being extremely unfamiliar.

In the bulk number of cases, participants did not apply the working principle of cloud in their office, with 60% from them abandoning the venture. However, with cloud computing became more popular in organizations, advantages were many more. Convenience (73.3%) and simplicity (26.7%) were named as the main reasons for choosing this. Security problems constituted the primary concern of 66.7% of users, whereas 33.3% indicated that migration program complexity posed the great barrier. The data security and privacy overtook the interests of 86.7 percent of the users.

The cost CSRs and scalability CSRs the customers experienced were 60% and 40% respectively when they relied on cloud computing services. Accessibility was the most picked option by 60% of respondents appearing on the neutral scale, whereas flexibility was the most picked option by 40%. A total of 40% respondents considered cloud services as affordable financially in the perspective of the shift. They stated disaster recovery to be their predominant benefit and 46.7 % considered efficiency as the biggest advantage.

Supply of IT resource scalability and flexibility also served as an advantage for cloud computing. Reliability and availability of cloud services form the basis of consumer preferences with 73.3% and 26.7% of their choices to geographic redundancy. The results of IT operations use of data and visualization tools were overwhelmingly positive 80% participants. Thus, the survey indicates that accommodation of the wishes and needs of the cloud users and their experience of technology for cloud computing can be more vital. Nonetheless, organizations

can now benefit from these problems, which can help businesses and outfits increase their overall effectiveness and productivity.

5 CONCLUSION

This thesis examined the greenness of cloud computing in IT environment focusing on ecological, economic as well as social consequences. It took on a challenging task of looking into already existing literature, using cases as a tool to unveil an influence IT has on loyal sustainable practices of customers. The study defined that cloud computing has one of the most important environmental advantages reducing of energy consumption and carbon emissions in the long-term by the means of traditional centralized IT infrastructure. Another way how cloud providers can diminish greenhouse gas emissions is via virtualization, resource sharing and power-efficient data centre administration, which addresses the global environmental issues. Through this study the cloud computing role as an incentive for sustainable IT procedures is stressed.

Users' experiences, in that regard, are a true measure for learning of the technology. The research proved that more than half of the respondents explained that it was of the significant importance they would perfectly understand this technology because it was the personal encounter. Nevertheless, there was a little step from just using to preferring, and the majority still put the cloud computing usage as their option, with a content of 46.7 %. An astonishing number of learners (67%) have been demonstrated a clear grasp of cloud technologies in their course, whereas others (33%) considered them difficult and complex. Statistically speaking most of them, which is 60%, only mentioned the working principle on which they became stuck and could not continue because they had a general knowledge of cloud technology. The questionnaire had revealed that the convenience and simplicity are the two principal advantages that came with cloud implementation among the respondents (73.3% and 26.7%). People’s major apprehension of 66.7% was the difficult paperwork required which involved security issues while forcing 33.3% into not enrolling. The key issue about which data protection and privacy 86.7% of users were selecting answers.

The hidden cost and a scaling factor - that negatively affected 60% and 40% of self-users respectively - were crystal clear.

Also, cloud computing is a green and logical solution for businesses due to its pay-as-you-go implementation and scalability. It allows businesses to adjust their computing services to their needs, saving capital expenditure and promoting flexibility. This approach also encourages organizations to respond quickly to market changes and customer demands. Cloud computing promotes a circular economy by reducing waste, ensuring efficient use of IT resources, and promoting resource-sharing and product/material reuse. Additionally, cloud collaboration, remote working, and easy access promote work-life balance and diversity, contributing to ecological and sustainability development. Remote work reduces carbon emissions, improves productivity, and improves worker welfare, ultimately improving the employee-to-employer relationship. Overall, cloud computing promotes a more sustainable and efficient business environment.

However, cloud computing faces challenges such as privacy issues, data breaches, and digital divides, which impact the environment. Decision-makers, companies, and technology suppliers must determine the rules and standards for the right cloud systems application. Sustainability is a long-term process that balances ecological impact and economic development levels. The social effect of cloud computing is crucial, as it helps pass problems caused by cloud services onto artificial intelligence, enabling AI advancements in the traditional IT realm. However, the nature of cloud computing remains hidden, and more efforts in advanced research and international outreach are needed to achieve full success. The success of cloud computing can help overcome these barriers and advance artificial intelligence in the IT realm.

Cloud processing service has radically changed the IT because it developed a new business model that still refers to the term “the cloud” as a dark disk provided that allowed small businesses to access the latest technology platforms at significantly lower initial costs and compete with bigger established entities. In addition to this, automation has achieved well optimization of currently-existing IT systems. They can now operate faster, change the models of production flexibly

and enormously afford increased productivity as well as solutions to their clients' problems. In addition to that, a construction of a cloud computing-based foundation of the organization allows everyone to be in it and to focus on the common purpose together without any boundaries and improves the ways of sharing the experience. When woven together, the integrated segments like businesses, communities and societal level can be taken as a futuristic and advanced concept.

Cloud computing has substantially revolutionized education by enabling access to materials, collaboration, and immersive experiences, hence improving educational quality and preparing students for the digital age. The future of cloud computing in information technology seems bright, with advances in AI and machine learning enabling predictive analytics, automation, and personalized experiences. Edge computing and Internet of Things integration will broaden the reach of cloud services by enabling real-time data processing and decision-making at network edges. This convergence will transform areas such as healthcare, transportation, and smart cities, hence boosting quality of life. Adopting cloud computing and staying current on future developments is critical for fostering innovation in the digital age.

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LIST OF FIGURES

1. What motivated you to explore cloud computing technology?

    - Reviewers
    - Personal experiences

2. How was your experience with cloud computing?

    - Satisfying
    - Average

3. How do you address concerns about data security and privacy when using cloud services?

    - By carefully using it
    - Never get opportunity of any concern

4. What benefits have you personally experienced from using cloud computing services?

    - Cost saving
    - Scalability

5. In what ways has cloud computing enhanced your ability to manage and access digital resources?

    - Flexibility
    - Accessibility

6. Have you noticed any significant cost implications associated with migrating to cloud services for your personal use?

    - Yes
    - No

7. Do you use cloud computing in your day to day life?

    - Yes
    - No

8. How familiar are you with cloud computing technology?

    - Very Much familiar
    - Not that much used to

9. Have you adopted cloud computing solutions in your job sector?

- Yes
- No

10. What are the primary reasons for adopting cloud computing in your organization?

    - Suitable to use
    - More simplest

11. What are the major challenges faced during the adoption of cloud computing?

    - Security Concerns
    - Migration Complexity

12. What are the key benefits experienced from using cloud computing services?

    - Disaster recovery
    - Cost efficiency

13. How has cloud computing affected the scalability and flexibility of IT resources?

    - Elasticity
    - Global Reach

14. How do you assess the reliability and uptime of cloud services compared to traditional IT infrastructure?

    - Monitoring and Alerting
    - Geographical Redundancy

15. How has cloud computing influenced the speed and efficiency of IT operations in your personal experience?

    - Data visualizing tools
    - It wasn't efficient

Survey google form link:

https://docs.google.com/forms/d/1DMMmKQa8WIFMbvXBk227TovNWG6cPVKChwg7Sg7kT7A/edit#responses