**Introduction to Cloud Computing**

Cloud computing is a game changer in computing technology.Cloud computing provides flexibility, scalability,cost-effectiveness, and agility to the business.Cloud computing services such as storage services,networking, analytics,database,and intelligence services using the internet.

Based on the service offering model cloud computing services are classified;Software As a Service (Saas)Infrastructure As a Service (Iaas),Platform As a Service (Paas).

Evaluation of cloud computing started back in the 1990's when the internet started gaining traction.It fuels the idea of remote computing services. Tech companies like salesforce and amazon are early developers of cloud computing technology.Salesforce took advantage of cloud computing technology by launching one of the cloud computing service models back in 1999.

In early 2000s Amazon bought cloud based services by launching Amazon Web Services (AWS).Today amazon web services offers over 200 cloud based technologies services ranging from virtual services ,storage,database,analytics,IoT etc. Followed by AWS, Microsoft and Google entered the global cloud computing market by launching Google Cloud Platforms and Microsoft Azure services.

**Literature Review:**

Following are the Major types of clouds computing based on deployment mode**l**

**Public Cloud:** In the cloud services offered over the internet and computing resources are shared among multiple users

**Private Cloud**: The private cloud services are dedicated to a single organization. It offers more control and privacy over resources.

**Hybrid Cloud:**Multi cloud allows users to combine private and public cloud services.It helps to move data and resources between public and private cloud platforms.

**Multi-Cloud Approach :** Multi cloud approach helps the users and organisation use multiple cloud service providers.It helps to combine the benefit from multiple cloud service providers.

**Type of Cloud service models.**

**IaaS (Infrastructure as a Service):**It Provides virtualized computing resources like servers, storage, and networking. Example: AWS Elastic Computing (EC2).

**PaaS (Platform as a Service):** PaaS provides platforms for developers to build, test, and deploy applications. Example: Google App Engine.

**SaaS (Software as a Service)**: Delivers software applications over the internet. Example: Microsoft 365, Salesforce CRM etc.

**Recent development in Cloud computing**

Cloud computing continues to evolve rapidly, shaping how businesses and individuals leverage technology.

Following are the some recent trends in cloud computing

**Artificial Intelligence and Machine learning (AI & ML):**Cloud providers are increasingly offering AI/ML as a Service, enabling businesses to access advanced analytics, natural language processing, and predictive modeling without extensive infrastructure investment

**Serverless computing:**Serverless computing, also known as Function as a Service (FaaS), is growing in popularity due to its cost-effectiveness and simplicity. It allows developers to focus on writing code without worrying about managing servers.

**Edge computing :** Edge computing is gaining momentum as it processes data closer to the source, reducing latency and improving performance for real-time applications.

**Multi- Hybrid cloud approach**:Companies increasingly adopt multi-cloud strategies, using services from multiple cloud providers to avoid vendor lock-in, and optimize performance.Hybrid cloud approach helps the organisation combine the benefits of public and private cloud. This approach is popular among organisations needing flexibility,control helps to meet strict compliance requirements.

**Benefits of Cloud Computing:**

Cloud computing is the game changer in the technology and business sector. Cloud computing provides many benefits to the business.

**Flexibility and Scalability**

Cloud computing environments provide flexibility to resource allocation such as CPU, Storage,Memory based on organisation’s current requirement. It enables switching workload between environments such as production,development and testing.Scalability in cloud computing refers to the ability to increase or decrease the IT resources such as processing power , storage,memory capacity etc as per need of the organisation without expensive investment

**Cost efficiency and advantage:**

Cloud computing offers flexible pricing options to users. Majority of the cloud computing services operate on a pay as you go model which helps the organisation to manage cost of operation. It eliminates large investment in building and maintaining traditional computing infrastructure.

**Business continuity:**

Cloud computing provides comprehensive backup and retrieval of data and critical IT resources, High Availability(HA),global access and collaboration,continuous monitoring and altering services etc.One of the key feature cloud based services is automated and continuous data backup to geographically dispersed data centers.

**Security**

## Cloud computing offers advanced security for the organisations as compared with traditional on premises system.It includes various security features such as data encryption,multi-factor authentication ,24/7 monitoring and threat detection etc.Cloud platforms are designed to meet stringent security and compliance standards like HIPAA, GDPR,PCI DSS ,ISO 27001 etc.

## **Competitive Edge:**

## Cloud computing provides access to a wide variety of products and services such as big data analysis, Artificial intelligence and Machine learning ,Business Intelligence services.Cloud platforms allow businesses to launch new applications, services, or features quickly without waiting for hardware provisioning or infrastructure setup.

**Challenges faced by companies in the process of cloud adoption.**

Migrating from traditional computing to cloud based computing possesses various challenges.Moving from traditional computing to cloud based technology comes with a wide variety of challenges such as changes in legacy technology and infrastructure, application independency, systems and skill and knowledge of users.

Following are key challenges faced by organisation during the process of cloud

**Security and privacy**

Security and privacy is one biggest concern for business. During the process of cloud adoption enterprises data and IT systems are vulnerable to various security threats and breaches.misconfigurations, weak access controls etc. A strong security and private protocol must be established before starting in the process.

**Compliance and governance.**

Businesses in industries like healthcare,finance,public transportation,defence are subject to stringent data protection laws and standards like GDPR, HIPAA. Business in regulated industries must ensure that cloud providers meet these regulations can be complex.

**Cost Management**

Companies may face unexpected costs due to scaling, redundant resources, or failure to shut down unused instances.Cloud providers often have intricate pricing structures that make predicting costs difficult.

**Data migration challenges**

Migrating large volumes of data can be expensive and time-consuming, especially when moving across regions.Data migration can lead to downtime, impacting operations and revenue.

**Skill and knowledge gap**

Organizations unfamiliar with cloud best practices might face inefficiencies, security risks, or compliance violations.Successful cloud migration requires skilled professionals such as cloud architects, DevOps engineers,developers etc.Many companies lack the in-house expertise required to effectively adopt and manage cloud computing.

**Vendor lock-in**

Once all the system and data is moved with one particular cloud service provider, the company's operation is bound to that particular service provider.The cost of changing cloud infrastructure can be expensive and time consuming, this makes business overly dependent on the particular cloud service.

**Strategies for Overcoming Challenges**

Cloud adoption can be challenging, but adopting the right strategies and leveraging emerging technologies can help organizations address these challenges effectively. Below are actionable proposals organized by common barriers:

Security is a major challenge faced by organisations while implementing cloud computing .Adopting industry standard security measures like zero trust security, data encryption,regular security audit , and use of robust Identity and Access Management (IAM) tools helps to reduce security and privacy concerns in cloud computing.

Another challenge faced in cloud adoption is governance and compliances barriers

majority of cloud service providers offer various compliance tools like Amazon control tower or azure policy etc to enforce policies and standards across the organization

Cost Management is another challenge in cloud computing.Today cloud service providers offer various tools to monitor and manage the cost .Use of these tools like AWS Cost Explorer, Azure Cost Management helps the organisation to monitor and control expenses.

Data migration is another concern in the process of cloud technology implementation.By adopting hybrid approaches like starting with non- critical data and resources helps to minimise the risk of data loss and disruption.

The shortage of required skill and talent requirements is another challenge in cloud computing. Universities and education institutions are offering various training and education programs in cloud computing. Apart from these cloud service providers also like AWS ,Azure ,GCP etc. offer certification programs to cover up the talent and skill gap in cloud computing.

Vendor locked -in is one the challenges in cloud computing.Adoption of practice like distributing workload across multiple cloud service providers helps to reduce over dependence on one CSP and avoid vendor lock -in.

**Impact on Business**:

Following are case studies highlighting successful cloud adoption and its transformative effects on business operations.

**Netflix And Amazon Web Services**

Netflix Revolutionised the entertainment industry by successful utilisation of cloud technology.

Netflix was the one first company to utilise Amazon Web Services cloud platforms.By growing number of streaming services netflix quickly realised that by adopting cloud based model can help them to scale up their operations without significant investment in building infrastructure.

As the largest streaming service provider it required enormous amounts of data storage. Amazon Web Service’s well developed cloud infrastructure helps Netflix to deliver a secure and scalable solution to its streaming operation.

AWS offer wide variety of services to support operation need of netflix which include

Computing power through Amazon Elastic cloud (EC2),Amazon load balancer for balancing load across multiple data centres, Amazon Relational Database services for database instances, Amazon storage service for data storage.Netflix uses Amazon Content Delivery Network (CDN) for bandwidth capability etc.

**Conclusion and Future OutlooK**:

Cloud computing has rapidly evolved into a cornerstone of modern business operations, enabling organizations to innovate, scale, and compete in today’s fast-paced digital world.

Recent trends like multi-cloud and hybrid cloud strategies are helping businesses avoid vendor lock-in while ensuring flexibility and resilience. Edge computing is revolutionizing real-time data processing by bringing computation closer to the source, while the integration of AI and machine learning into cloud platforms empowers organizations with advanced analytics, automation, and predictive insights. Sustainability has also emerged as a priority, with cloud providers adopting green computing practices to reduce carbon footprints and energy consumption.

Cloud-native technologies such as containerization and Kubernetes are reshaping application development by enhancing scalability and resilience, while serverless computing simplifies infrastructure management for developers. Industry-specific cloud solutions are addressing compliance and operational needs in sectors like healthcare, finance, and retail, further expanding the cloud’s impact.

While cloud adoption offers unparalleled opportunities, businesses must address challenges like cost management, security, and interoperability to unlock its full potential.

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