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Chapter 3: Leveraging Amazon Web Services, Microsoft Azure, and Google Cloud platform for cross-industry digital innovation

3.1. Introduction

Cloud computing is emerging as a model that has the potential to revolutionize IT delivery and consumption in a similar way to how the Internet changed the business landscape by transforming communications, commerce, and the creation and management of information. Nevertheless, organizations are beginning to invest in cloud-based information and communication systems to address the inadequacies of several workforce changes and business requirement developments. Motivation for cloud investment may be driven by a variety of different factors both internally and externally, and the current concerns and factors driving cloud investment at an organizational level a few years ago need to be revisited and reconsidered for the most part. Organizations are increasingly interested in PaaS (platform-as-a-service). Business process modeling and simulation are important tasks when building and implementing BPM (business process management) frameworks for cloud-based platforms. However, academic research on cloud-based BPM is still limited, while these platforms are becoming a preferred way of business expenditure. Furthermore, considering the relevance of this issue, it is surprising not to find more published research on the business, organizational or managerial implications of cloud technology. BPM+ is seen as the whole view of the future BPM landscape by many vendors, consulting firms, and BPM experts, and cloud-based platforms are regarded to play an important role in evolving enterprise applications according to BPM+ approaches. However, research on a systematic understanding of this issue is still scarce. A few perspectives are in the field of information systems, including the traditional stage framework on BPM evolution.

Preliminary explorations have addressed privacy issues related to SaaS (software-as-a-service) BPM solutions. Hence, this study is aimed through scholarly research into emerging paradigms of cloud computing and BPM and the implications on business innovation in organizations.Emerging new digital platforms and ecosystems are resetting the competitive landscape. While there are some emerging competitors like NASDAIx, A-share listed platforms, and emerging new power platform firms, the tech giants are still the dominant players in the digital platform space. Investments for platform services are huge despite the COVID-19. Efforts on innovation-based strategy and business model are underway. However, platforms encounter huge threats and pain points by growing, with overwhelming competition from new niches and complex regulatory scrutiny.

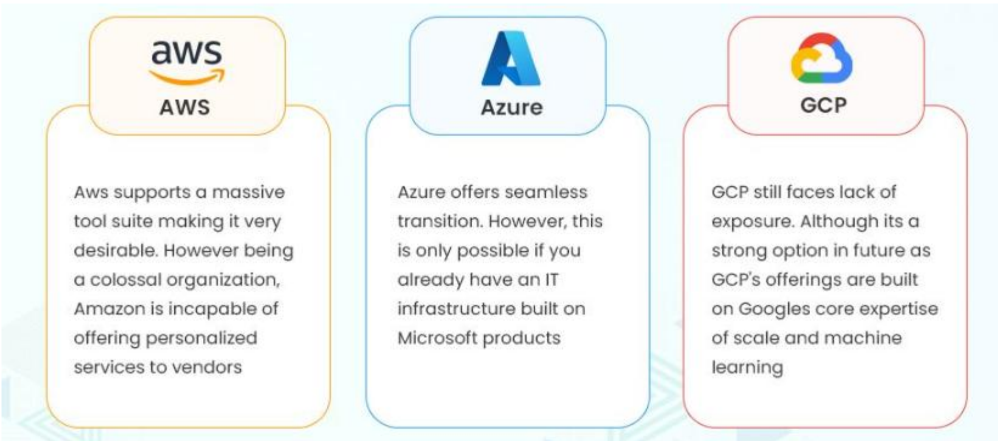

Fig 3.1: AWS Vs Azure Vs GCP

3.1.1. Background and Significance

Digital platforms will reshape the future. Platforms establish ecosystems that extend user networks and amplify interactions for innovation and business value creation. While the concept of the platform has long been recognized in academia, it is only now being fully realized. The "Cloud" is being increasingly recognized as the major dominant Internet evolution platform, alongside ubiquitous, social networking Web, mobile, data and the Internet of Things (IOT). The cloud platform is a key enabler of the vast "industrial Internet" to emerge. With the rapid advancement of the cloud platforms, Internet giants enter the enhanced services space with e-commerce, finance, health care, logistics, education and tourism. They also offer "5-6" public cloud services to handle big data analysis, medical images storage and remote treatment. As a big piece of business, the cloud platforms play a sizable role in China's economy and social development.

3.2. Overview of Cloud Computing

Cloud Computing refers to both the applications delivered as services over the Internet and the hardware and systems software in the data centers that provide those services. The services have long been referred to as Software as a Service (SaaS). When a Cloud is made available in a pay-as-you-go manner to the general public, we call it a Public Cloud; the service being sold is Utility Computing. We use the term Private Cloud to refer to internal datacenters of a business or other organization, not made available to the general public. Thus, Cloud Computing is the sum of SaaS and Utility Computing, but does not include Private Clouds. From a hardware point of view, three aspects are new in Cloud Computing: 1. The illusion of infinite computing resources available on demand, thereby eliminating the need for Cloud Computing users to plan far ahead for provisioning. 2. The elimination of an up-front commitment by Cloud users, thereby allowing companies to start small and increase hardware resources only when there is an increase in their needs. 3. The ability to rent resources and release them as needed. We argue that the construction and operation of extremely large-scale, commodity-computer data centers at low cost locations was the key necessary enabler of Cloud Computing. Any application needs a model of computation, a model of storage, and a model of communication.

Throughout its history, the Internet evolved from a static network few could manage to a complex and dynamic environment of worldwide scope. In the early 1990s the introduction of the World Wide Web removed many of the barriers to entry of the Internet. Technical hurdles that prevented practically anyone from using the Internet disappeared; only legal and commercial barriers remained. In the late 1990s the World Wide Web ushered a new phase of the Internet. Suddenly large amounts of information previously unavailable were at everyone’s fingertips. New businesses saw unprecedented opportunities and new business models blossomed. At the same time this environment became a battleground between municipalities, states, and nations, each competing for businesses, deposits, and jobs. Today the Internet is a frantic battleground where competing businesses engage in a war of attrition, and occasionally, disappear forever, and whole economies can rise and fall overnight as investors chase the latest ideas and fads. This dynamic and volatile environment is impossible to predict, and consequently difficult to manage.

3.2.1. Research design

The aim of this paper is to investigate how cloud platforms can be leveraged to address cross-industry digital innovation. Understanding how cloud-based digital platforms spur innovation in other markets is critical since a platform in one sector may spread to others. Therefore, a contextualized research design, including in-depth qualitative interviews with cloud intermediary platform providers and industry platform representatives in finance, agriculture, and energy, was developed and applied. A case study protocol was created, starting from the overarching research question and sub-questions and then detailing the methods. The inclusion and exclusion criteria were listed, and the interviews were structured from broad (a.-b.) to targeted (c.-g.) concepts. Digital platforms and the cloud were defined as required at the beginning of the interview to set the frame for the first few questions.

Research steps were laid out in an iterative process with the data analysis conducted in-between interviews to optimize time and data integrity. The collection ended when theoretical saturation regarding platform-market pairs was reached, within the limits of cloud/industry and context knowledge ensuring results relevance. Five platforms were found that had already been launched or were in advanced development stages. The mechanisms behind the different levels of intermediary platform success differed. The results and implications of that analysis are described in detail elsewhere. Preliminary analyses uncovered that the motivations and ways of developing a platform differed based on the actors involved. The collection and analysis were grounded in case-oriented, nuanced, and contextually rich qualitative research [ref?]. Case selection for platforms was therefore not made based on platform-related attributes or measurable variables. Rather, purposive sampling was based on theoretical tenets: target successful cloud platforms in different industries based on the credibility of the knowledge and the contextual comparability [ref?].

3.3. Amazon Web Services: Features and Capabilities

This section provides an overview of the AWS deployment and a description of selected features. The AWS deployment provides a cloud-computing platform for the centers. The platform consists of secure information storage, computational resources, and analytic algorithms. The storage service provides an object storage solution that enables the storage of an unlimited number of information objects. Each object can be up to a terabyte in size and can have an unlimited size for associated metadata. Objects are accessible via a web-based REST API. The computation service provides a flexible, scalable platform for rapid and secure provisioning of resources to support the development and execution of analytic jobs. The analysis suite consists of data and information analytic resources, aggregate behavior discovery and visualization algorithms, statistical and machine learning prediction algorithms and analysis results visualization tools. A description of the selected platform features and capabilities of the AWS platform is provided in the following subsections.

Elastic block storage, in conjunction with the compute service, provides the storage for EC2 instances. Storage is allocated in volumes that can be attached and persisted independently of the EC2 instances. Volumes can be snapshot to create backups and can be easily replicated in separate regions for disaster recovery. Elastic IP addresses enable the assignment of fixed public addresses to instances, even if they're recreated in a different availability zone. Since private IP addresses can be only reused in the same virtual private cloud, those public addresses can provide a link to the instance once released for repurposing. Instances can also be set up using a web based console, command line interface, or SDK as part of automated scripts. CloudFormation provides resource management tools that can create and tear down complete VPC installations with multiple instances, load balancers and RDS configurations, based on template definitions.

Fig 3.2: Amazon Web Services Features and Capabilities

3.3.1. Core Services

Cloud platforms are rapidly becoming indispensable service network infrastructures and have combined with digitalization to usher in an era of unprecedented change stimulated by the rapid digitization of society and the delivery of new services in 'cloud' ecosystems (Datategy, 2024; Ambilio et al., 2025; Hashed Analytic et al., 2025). However, utilizing the platforms effectively to stimulate significant disruptive innovation is still a perplexing and under-investigated area, as recent literature has focused on a limited range of industries mainly on users and network effects rather than more broadly applicable strategies for stimulating platform innovation. Based on a framework developed from a systematic view of cloud platforms, ten foundational strategies for cloud platforms in their more advanced stages are proposed. The methods utilized in this study are also reported, including a systematic literature review of cloud services, the conceptual framework built based on a levels-of-innovation framework augmented by the service-dominant logic of cloud platforms, and the analysis of illustrative cases based on qualitative content analysis.

Speedy service innovation supported via cloud computing platforms and infrastructure is one of the cornerstones of business transformations in the digital economy. Cloud computing has driven digital innovation by providing the speed, scale, knowledge, and insights customers and suppliers require to maintain competitiveness (performance). As the traditional value-creation processes, operations, and business models have become obsolete, the controlled scale of operations is no longer sufficient and horizontal cooperation driven by cost and resource efficiencies is not enough. The collaborative, participative, and co-creative structures and relationships in various innovative processes shape new opportunities to utilize and monetize created value, such as user-created new services and customer communities.

3.4. Microsoft Azure: Features and Capabilities

The platform Microsoft Azure was first announced in 2008 under the name Windows Azure Platform, and subsequently launched in 2010 under the name Windows Azure. Microsoft Azure is an IaaS and PaaS service offered by Microsoft for building, deploying and managing applications and services hosted in Microsoft's advanced cloud data centers. Azure supports any operating system, language or tool. This means being able to work with any Windows or Linux OS, as well as such well-known and widely-used databases or tools as SQL Server, Oracle, C#, Java, etc. We do not have to worry about the technology stack of the application we are going to implement. This means being able to work with the full ecosystem of Windows and Linux; therefore, any application and service can be created that runs on any device with any operating system. Within that environment, the greatest libraries that will be used in this project are those of Azure Diagnostics. They were created for the monitoring of cloud services and in particular, the data employed by these services, the Performance Counters. To do so, the test system will be needed along with its dynamically-created performance counters that will then be consumed by Azure Diagnostics.

Windows offers a way to protect important information by automatically backing it up in a storage service. Backups are created by the Windows Azure Backup service, then transmitted to the storage endpoint and finally stored there encrypted. There is an initial interest in using this service since Microsoft has developed a convenient and security-oriented tool. In addition, there is no need to build a tool that has a similar but limited functionality. Studies show that there is no service-oriented architecture within Azure's Backup service as there is in the SQL Server Backup service. Therefore, it would have to be built from scratch and consume all the available time. There are, however, some advantages and disadvantages to consider.

3.4.1. Core Services

Cloud platforms (CSPs) provide a core service comprising the IT infrastructure domain highlighted by public or hybrid utility computing, which consists of the provision for the right consumer of the right quantity and quality of IT resources at the right time and the right (low) price on the basis of a pay-per-use model. In order to do so, CSPs acquire physical capacity such as servers, networks and data center facilities, and rental of IT systems from other domains in the (cloud) on-premise model. These IT resources need to be provisioned automatically by deployment on the cloud infrastructure supposed to be fully virtualized, which is not a trivial matter. This involves the mapping of virtual workloads on physical resources, taking into account the infrastructure topology and the load on resource components to avoid bottlenecks. The capacity management service ensures that at all times, sufficient free resources are available on the cloud infrastructure to comply with the demands for the core service. This involves the monitoring of resource components and virtual workloads, as well as timely actions to allocate or release resource components on behalf of the core service.

Finally, the security service domain includes security-related services that are offered as part of the cloud service provider's offerings. Cloud or IT system security comprises two aspects (2 A's): Availability and the confidentiality, integrity and authenticity of data. Cloud service providers offer a level of security against unauthorized access, hacking or denial of service attacks. They implement, for example, firewalls, encryption, intrusion detection systems and other measures, which makes it difficult for hackers and causes them to seek another target. Most security-related services are aimed at enforcing privacy rules and preventing unwanted service disruptions. The design, implementation and governance services described are important services to a cloud consumer during the consumption of a cloud service. They can be particularly important when the cloud consumer wants to move systems to a public cloud and wants to make sure that any critical systems will be able to consume the public cloud service as designed beforehand during the development stage.

3.5. Google Cloud Platform: Features and Capabilities

The Google Cloud Platform (GCP) provides a full set of services for cloud computing, including resource orchestration and meta-cloud services, which can support many users in high-performance computing and big data analysis applications. The providers of the services may be academic, commercial or vice-versa. Its distinctive features include the following two aspects: The supporting infrastructure and the used technology. It employs two main infrastructure technologies to build GCP. One is a full virtualization technique with a hypervisor, which is used in commercial cloud computing systems. The other is a lightweight container-based virtualization scheme with the same interfaces as the deployed full virtualization instances. It is designed for building large-scale data analysis systems to process one-time or repeated data. GCP has been successfully adopted in the analysis computing of particle physics experiments, high energy physics science, and global environmental modeling. An overview of the infrastructure and technologies used in GCP is given and discussed in.

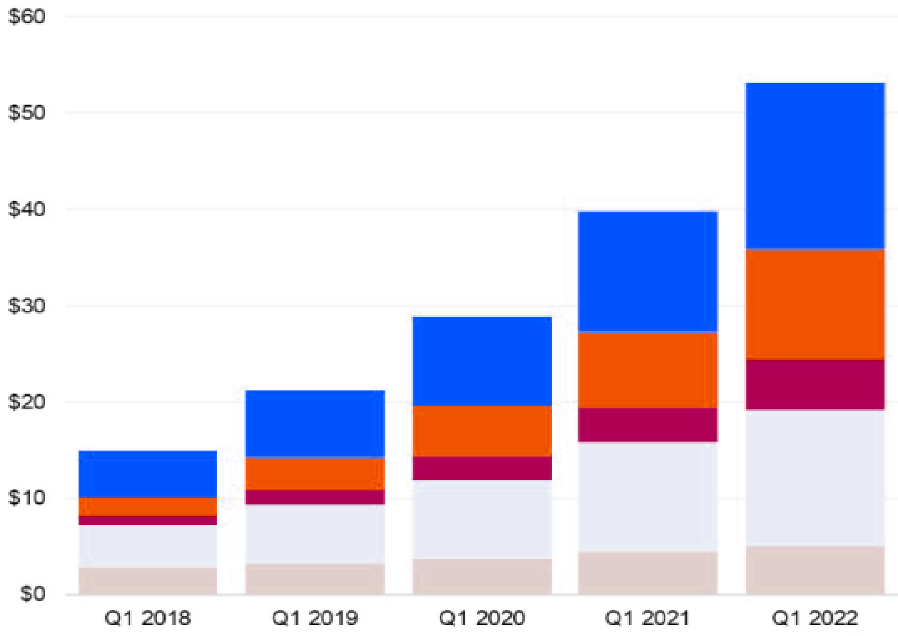

Fig: Comparing AWS Vs Azure Vs Google Cloud

3.5.1. Core Services

Two types of core services are identified, catalog and application service. One type of cloud architectural service is also identified, which is middleware service. In particular, eight types of application services are identified: data analytics service, machine learning service, graphic rendering service, sensor data service, social media data crawling service, e-commerce service, cloud-based storage service, and financial trading service.

Catalog service organizes and provides resources and services which are internally or externally provided resources and services to cloud users (Intelligent Core et al., 2024; Real Business AI, 2025). The resources can either be an application program or any type of IT infrastructure such as computing power, storage, or related data. Through such resources, cloud service providers can provide cloud services. The applications or animated programs can range from simple task operation programs to complex or high-end simulations like movie animation rendering programs. Provided IT resources are likely operating on high-end servers which are then needed to be made available in a cloud-based environment. Monitoring service is used to monitor resources or services internal to the cloud system. Those resources and services are usually provided by the cloud service provider. Through monitoring services, the cloud provider can avoid unexpected service downtimes or other problems. Discovery/lookup service provides the ability to find appropriate services for a particular application or organization. All previously described catalog services are meant to find the internal resources of the cloud provider. However, an organization or user may want an external cloud service which may require access to public available cloud services provided by others. Middleware service is used to interconnect disparate services or resources constructed with different programming languages and protocols so that those resources and services can seamlessly interoperate with each other.

Cloud services can be deployed either in a centrally controlled single provider cloud system or in a decentralized manner where disparate organizations independently deploy core services. Each cloud provider can decide on the type and deployment location of core services. In this section, application services and key application options are discussed. Core services are detailed in this section.

3.6. Comparative Analysis of Cloud Platforms

With the growing popularity of cloud technology in academia and industry, cloud vendors have been working hard to expand cloud service offerings. This resulted in several models offered by cloud vendors and several services provided by these cloud computing platforms. This paper presented design considerations and a comparison between popular cloud platforms; computing, storage, and network models were compared. This shows the variety present in the cloud computing environment. It was attempted to determine and categorize fixed components of a cloud platform that are present or provided either directly by cloud vendors or in a different operation mode.

To see the functionality of cloud platforms, components and services were compared. This showed that there are many common elements/gui interfaces of choices of services in cloud computing platforms. The idea of cloud computing and the reasons for choosing cloud computing were defined. It was attempted to construct a top-down view of cloud computing platform components and functions. Cloud computing elements were described from both business and technological sides such that more comprehensive parameter choices and comparisons of cloud computing platforms can be made. This was followed by parameter comparisons of frequently used cloud computing platforms.

This showed that typing capabilities for some parameters for major cloud computing services are very different and user specific. It concluded that a more in-depth understanding of cloud computing needs is essential to better provision the service. Some of the cloud computing platforms shall be affected more by changes in commodity markets than others. There were many components (plus great many details, variations, and relationships) considered in the selection process for cloud platforms. Comparing these components in detail among cloud vendors requires further studies and wider data collection efforts [8]. Determining what was needed (or desired) from cloud computing service(s) was harder than listing what was already in hand, and it was expected that the relative attractiveness of cloud computing services will evolve rapidly and therefore require constant vigilance.

3.6.1. Strengths and Weaknesses

Using cloud platforms for cross-industry digital innovation relies on their strengths: demand flexibility, low entry threshold, and self-management, along with their weaknesses: relatively inapplicable function choices and data store challenges. In a cloud environment, new services are consumed and discarded by other services according to requests, and each unit of a service's capability corresponds to billing units. Thus, demand spikes will be resolved with ease through elastic resources and application distribution, and enterprises using a given service may downsize or undergo divestiture of it without much concern. Meanwhile, an application and its service provisioning can be changed on the fly in a given system, which is reflected in the more adjustable programming interface of cloud-specific frameworks or open-source light-weighted PaaS engines. In consumer services, enterprises simply pay for the amount of data and functionality needed. Some cloud platforms even provide new entrants with bills in credits. The cloud platform businesses provide scalability and uninterruptible service through an extra layer of management services designed for application distribution and user avoidance for service fitting requirements. Under this architecture, the pan-platform (demand-side) design benefits its users more than industrial clouds (supply-side) regarding self-management tools.

Except for the management level, there is much choice of PaaS. There is more uncertainty regarding splitting and composing facilities for services due to the less formal use of this methodology, and by switching to a different cloud system or service, data conversion becomes cumbersome. However, the dynamism of a given application cycle in a cloud-based PaaS cannot be achieved with the round partitioning on stacks of compilers, as system updates still require application interruptions or resource vacancies.

Currently, service brokering only has been studied, when it is decided to execute a new workflow step. Thus, it remains a challenge to prevent a cloud passing a PaaS to lose self-management after maintaining the continuous coexistence of functionality. Moreover, some data store layers impose data processing in the form of an additional query language.

3.7. Conclusion

This study advances prior knowledge on the significance of existing cloud platforms for multi-industry cross-industry digital innovation. It provides detailed illustrations of the dual and complementing roles that cloud platforms may play for multi-industry cross-industry digital innovation from both intra-platform and inter-platform perspectives, shedding light on how firms involved in such innovation capitalize on them. While this study primarily focuses on cloud platforms, future studies can investigate how other platforms may promote cross-industry digital innovation for platform providers, third-party firms, and even end-users in their respective ecosystems and platforms.

By considering the rankings of leading cloud platforms in different industries and the importance of platform-end customer relationships for these platforms, future research can deepen the understanding and contribute to the literature on the use of cross-industry cloud platforms for cross-industry digital innovation. Given the importance of cloud platforms to firms, they are worthy of independent studies to bridge the gap in understanding them, and particularly, cloud service platforms. Cloud service platforms provide the core activities of cloud computing services in service ecosystems, and how they may affect firms' cloud computing service innovation is increasingly critical for the ecosystem. Cloud service platforms provide platform components where value co-creation occurs, and how they affect the emergence of multi-industry cross-industry cloud computing service innovation is a promising but underexplored research path.

The emergence of market-oriented service innovation platforms, currently seen in many industries worldwide, should spur research and managerial interest in this topic. Service innovation cannot be understood without a comprehensive consideration of the role of cloud computing. Future studies may examine how cloud computing technology affects service innovation to provide a better theoretical foundation for technology strategy. Business process outsourcing is another interesting avenue for research, as market-oriented cloud-based outsourcing platforms are emerging in a wide range of outsourcing areas. Evaluating the benefit and liability of these platforms for cross-industry outsourcing innovations from a strategic perspective should examine socio-environmental factors intervening in this dynamic should prove fruitful.

3.7.1.Emerging Technologies

Selective adoption of emerging technologies to build new capabilities is key to a firm's ability to innovate new products, services, and business models. What eases or worsens a firm's accessibility to emerging technologies is influenced by two drivers: technological advancements and vendor offerings. Emerging technologies encompass augmented reality, blockchain, cloud, digital currency, the Internet of Things, and artificial intelligence. Cross-industry leverage of a cloud platform prior investments such as cloud data storage, cloud data processing, cloud apps, and mobile cloud apps was found to build new application capabilities for large inventions such as autonomous driving and blockchain-based authentication. Emerging technology providers tend to initially focus on a specific application, industry, or activity segment, leaving customers to manually integrate their offers. IT platform vendors that offer data, module, and app interfaces further achieve cross-industry leverage.

Failure to consistently consider the cloud platform's full portfolio of products and services is incumbent on managers who are held responsible for specific innovations. A cloud platform's modular architecture allows for the selective adoption of different technologies at different points in time, but it requires coordination and alignment between different units for successful cross-product applications. To realize desirable front-end synergies, applications need to seamlessly interact and exchange data, necessitating back-end integration across different operational infrastructures. Today's innovations increasingly imply the cross-industry leverage of previous cloud platform innovations. To mobilize prior cloud platform investments for new purpose developments, managers are advised to consider how these capabilities align with cross-industry developments. Emerging technology providers tend to initially focus on a specific application, industry, or activity segment.

Cloud platforms that act as multi-tenant architectures and interchangeable modular components are likely to foster the cross-industry leverage of preceding technology investments for new application capabilities. Established IT vendors are in a strong position to provide integrated solutions for the cross-industry leveraging of prior capability investments, provided by independently operated information, communication and technology service firms. By providing expert guidance in developing cross-industry applications, cloud vendors could significantly strengthen their positions. The importance of developing cross-industry applications for new technologies was recognized, as well as the underlying challenges.

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