Digital Transformation and Cloud Computing: System Dynamics Modeling Approach

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Abstract

Digital transformation allows organizations to use new technologies to rebuild and redefine relationships with customers, employees and partners. Organization are creating high-performance virtual machines on the cloud platform to accelerate the digital transformation of organizations. Organizations are solving data analytics problems by moving to modern data storage on Google Cloud. This study aims to explore the determinants of cloud-based digital transformation in organizations using a System Dynamics Model. Positive factors for cloud-based digital transformation are unparalleled accessibility, cost efficiency, high scalability, automation possibilities, enhanced security and flexibility. Cloud-based digital transformation is also affected by negative factors such as data security and service quality, performance and cost, and integration of existing systems with the cloud and requires strict control. This study develops a framework for successful cloud-based digital transformation in organizations. This research contributes to the understanding of the decision-making process of cloud-based digital transformation in organizations.

Keyword: Digital Transformation; Cloud Computing; System Dynamics Model; Google Cloud; Data warehouse

I. INTRODUCTION

Digital transformation covers everything from updating applications to creating new business models to creating new products and services in business. Cloud computing is the delivery of computer services over the Internet to enable faster change, greater flexibility, and economies of scale [6]. Organizations from small to large use the cloud for email, data backup, virtual desktops, software development and testing, disaster recovery, and big data analytics. Google Cloud helps organizations streamline data migration for Big Data and accelerate business insight [7]. Al-Ruit et al. [1] suggested that cloud computing is an important pillar of the digital transformation ecosystem.

According to Gartner's latest report (2023), almost more than 45% of IT spending on infrastructure, application software and business outsourcing will shift from cloud computing to cloud solution [19]. It is also estimated that by 2025, 55% of large organizations will use a cloud-only strategy [16]. Digital transformation of the economy requires the adaptation of business models to remain competitive in a dynamic ecosystem. Companies must continue to innovate to maintain their leadership positions, and cloud computing is the driver of innovation. As organizations begin to adapt their business processes to the digital environment, they need scalability, cost and operational efficiency, flexibility and agility [16].

The recent Covid-19 epidemic has further increased the need for companies to implement digital business models. Only cloud platforms can provide the business agility, scalability and new capabilities required for this transformation [16]. Despite the goal of digital transformation, cloud computing is an important technology for business transformation.

Cloud models help save costs and create new business opportunities for organizations with the ability to synchronize modern and legacy processes, connect products and services to everyone and everywhere, and create excellent business models[7]. Organizations are increasingly using cloud platforms to run their business and deliver value at scale. According to a study by Business and Industry, the global cloud computing market size is expected to grow from US$ 445.3 billion in 2021 to US$ 947.3 billion in 2026, growing at 16.3% per year (CAGR) during the forecast period [18] IT spending will continue to shift to public cloud computing and IT leaders will be able to transform their businesses.

According to the Gartner report, more than 45% of IT spending on infrastructure, infrastructure, software and business process outsourcing will shift from cloud solutions by 2024 [13]. Companies are shifting their focus to getting more value from data, improving operations and infrastructure to achieve operational efficiencies using the cloud, and strengthening security policies to ensure economic resilience.

Cloud computing uses remote control over the internet. These servers can provide storage, processing, security, analytics, and other functions. Companies need to transform their existing business processes and create digital impact by using technologies such as the Internet of Things (IoT), augmented reality, artificial intelligence and machine learning, and big data analytics. This technology requires huge computing power, IT infrastructure and storage. Cloud computing provides these services according to the individual needs of the company.

Due to the global pandemic, companies and governments began to transfer their legacy applications and core systems to the cloud to accompany digital transformation[20]. There is no doubt that the cloud is at the heart of digital transformation. From finance, sales and marketing, human capital to purchasing, supply chain and more, the cloud produces unprecedented data and insights that can help businesses replicate for a long time [20].

The rapid development of technology has changed the strategy and IT services of software companies. An interesting and widespread digital technology in the software industry is cloud computing, which allows sending desired software applications anywhere on the Internet [2]. Therefore, cloud computing has emerged as a disruptive technology that changes business processes and redesigns business models [2]. Sanchez et al. [3] emphasized that cloud computing has unlimited potential and will play an important role in digital transformation.

Ii. System Dynamics Model of Cloud-Based Digital Transformation
System Dynamics (SD) is a mathematical model used to design, understand and discuss complex problems related to systems [5]. SD is a way to analyze the behavior of complex systems. The dynamics result from the interaction of two types of feedback loops (positive and negative). Positive cycles are self-reinforcing and have the power to support everything that happens in the system. The negative cycle is self-healing

with the ability to resist and resist changes in the body. In this study, the causal loop diagram in the SD model was used to identify the positive and negative feedback mechanisms that support cloud-based digital transformation. A positive (+) sign on the arrow indicates that the effect is positively related to the cause. However, the negative sign (-) on the arrow indicates that the effect depends on the cause [15].

A dynamic model has been developed and is shown in Figure 1. It explains the advantages and disadvantages of the proposal as factors affecting cloud-based as changes in organizations. These characteristics can be divided into two groups: good and bad. Advantages include unparalleled accessibility, cost efficiency, high scalability, automation possibilities, multi-cloud strategy, enhanced security and flexibility. Its disadvantages are information security and service quality, performance and cost, integration of existing systems with the cloud and the need for strict management.
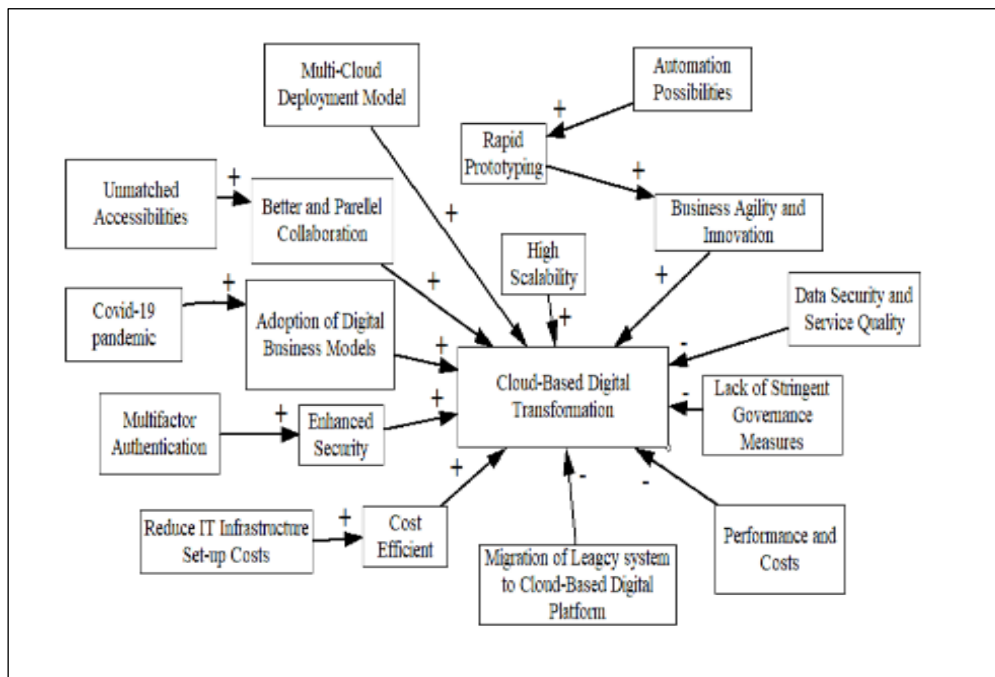

Fig. 1. System dynamics model for Cloud-Based Digital Transformation

III. DETERMINANTS OF CLOUD-BASED DIGITAL TRANSFORMATION

A. Unparalleled Accessibility

Microsoft 365, Salesforce, Adobe, Amazon Web Service (AWS), Google Workspace etc. are the cloud-based business applications that have become an important part of the organization's information technology [10]. As application adoption increases, the need to manage the integration of multiple business applications emerges. To jointly run these applications, a connected IT environment is required, which can be done through the cloud [12]. Organizations are taking advantage of the unparalleled accessibility of cloud computing and are rapidly adopting application programming interfaces (APIs) and integration processes that together provide the model used for the integration of various industries. Integration of business applications requires coordination and organizational performance [7].

Digital transformation cannot happen alone, so organizations need to use cloud computing products. Cloud computing allows information to be accessed anytime and anywhere. The user permission level can also be checked to determine the quality of deployment [13]. Cloud infrastructure enables integration, allowing people to collaborate at the same level without the need for higher or lower communication hierarchies.

Different groups can work together and even access the same information remotely, thus simplifying daily tasks and saving time [17].

A. Enhanced Security

Digital transformation is data-driven, such as using robotic process automation (RPA), artificial intelligence (AI) and machine learning (ML) models on existing data, organizations are rebuilding heavy workloads and create smart machines. Security is the top priority in digital transformation projects. Since organizations rely on the cloud for their information projects, they need to secure the cloud environment [12].

As organizations move more processes to the cloud, build more cloud-native applications, and invest in cloud-based solutions, they need to adopt additional cloud security strategies, such as informing all end users about the cloud, use multiple authentication methods, adhere to stringent standards, protect critical data transfers with stringent regulatory controls, work with vendor security controls, and work with cloud-to-cloud backup and disaster recovery plans [12] .

B. Cost-Efficient

The cloud offers a pay-as-you-go model that enables innovation and creates new applications and systems that can integrate with the existing ecosystem within days or weeks [12]. This capability of cloud computing requires large expenses for IT operations and other initiatives. Software and IT teams can reduce new product development times, thus accelerating time to market [6].

On average, moving to the cloud reduces approximately 15% of total IT costs. Small and medium-sized businesses benefited the most from the cloud, with a 36% reduction in IT spend. Moving to the cloud is not a low priority [6]. However, organizations can use cloud pricing models such as faster time to market, greater employee productivity, and innovation to make business more cost-effective from the start.

C. High Scalability

Scalability can be defined as the ability of a system or application to meet increasing demand [1]. Cloud works on virtualization concepts and can build virtual machines according to the needs of the business. Virtual machines are flexible and can handle increased usage and workload as needed [12].

Cloud infrastructure allows vertical and horizontal scaling. Add storage and processing capabilities to vertical expansion to facilitate growth. This increases the ability of existing systems to store more data or increase computing power. Horizontal scaling can add more servers to the existing system and distribute the work of virtual machines, ensuring the company has the longest runtime and higher performance [17]. Scalability is also the most desired feature for digital transformation projects. The cloud increases the organization's ability to measure and improve the performance of IT departments [12]. The cloud allows companies to increase their ability to respond to increasing customer usage. This capability is particularly important during the Covid-19 pandemic, where the shift to digital plumbing has created an urgent and unprecedented need.

D. Automation Possibilities

Compared to local servers that rely on manual processes, cloud computing offers great automation opportunities [2]. The cloud enables rapid design by creating a process with data storage and workflow,

providing governance for the business, managing security through user access, and providing platform-as-a-service model [6].

The cloud can provide a platform for companies to easily build, test and deploy applications without building complex systems. Therefore, during the transition period, companies can try different applications on different platforms [12]. Organizations use cloud services and end-to-end automation to enable thousands of transactions per day. This enables organizations to respond to business needs [12].

Cloud-based digital platforms help create new products. These services not only provide simple tasks but also provide services such as facial recognition, natural language processing, quantum computing, etc. It is rapidly developing and growing by providing advanced tasks such as information gathering [7].

Cloud services have played an important role in digital design as they facilitate direct digital marketing (DDM), often including new 3D printing and modeling technologies. Cloud services reduce the need for equipment and installation because products are produced directly from digital models. Cloud services assist DDM by providing a service model on the internet where customers can select, provision, and use services and services [4] .

Another important aspect of cloud-based manufacturing is resource virtualization because it allows virtualization of household appliances for products, machines and vehicles. It helps balance the value of local energy through dedicated air production. [4]

E. Multi-cloud Strategy

As businesses begin to understand the value of hybrid cloud, business owners will realize the benefits of diversifying services across different clouds [11]. The process behind multi-cloud is to enable businesses to be more robust, efficient and secure. Organizations are adopting more cloud strategies to avoid vendor lock-in and use best-in-class solutions.

Most cloud computing decisions are based on our assumptions. These include streamlining processes, avoiding or reducing vendor lock-in, and using modern applications and controls to manage policies, procedures, and processes across multiple cloud vendors [10]. Many cloud benefits cited by customers include better disaster recovery and easy transfer of some data and applications [11].

F. Need of digital business model during the Covid-19 pandemic

The Covid-19 pandemic has led to a digital revolution driven by the cost, flexibility and speed of cloud computing [14]. Gartner's senior research director said: "The pandemic's impact on businesses, organizations and society will continue to be a catalyst for digital innovation and adoption. Buy cloud services" [16]. This fact applies to remote work. Epidemics showed that workers had to enter the company's business using air [13]. Companies increasingly need to integrate cloud services, applications and security to support their remote workers.

To remain competitive in the digital society, more and more companies are embarking on digital transformation. The COVID-19 pandemic has forced businesses of all types to adopt new digital strategies to support their business, and this will only accelerate this shift[13]. Businesses across most verticals are embracing the turn to cloud migration, where data and analytics are at the forefront of moving to the cloud [16].

Financial institutions and financial services companies use the cloud to manage customer integration throughout the entire lifecycle, including credit origination, customers' behavior analysis, data management, debt collection and accounting. The insurance industry is using the cloud to integrate AI-

based business processes in areas such as customer relations, claims and policy management, AI-controlled underwriting, rates and reservations.

Businesses use cloud computing with artificial intelligence and machine learning capabilities in areas such as product development, demand planning, and new product forecasting [16]. In utilities and utilities, companies are using the cloud for meter reading, fault detection, and predictive maintenance. Government agencies are using artificial intelligence and cloud analytics to manage customer complaints and sentiment analysis [16].

IV. CHALLENGES OF CLOUD-BASED DIGITAL TRANSFORMATION IN THE BUSINESS

A. Data Security and Service Quality

Additional security measures are required when data is transferred to the cloud. The user's security and privacy management are controlled by the cloud service provider, which may expose important information to attacks [16]. Poor cloud service is another problem. Maintaining data management and allowing real-time audits through dashboards can solve this problem. Other important factors to consider are the performance, capacity, and availability of cloud services [16].

B. Performance and Costs

Data-rich and data-driven applications generally result in higher costs. Bandwidth requirements continue to increase as detailed and complex information is sent across the network [17]. To reduce costs, companies need to identify and develop dynamic cost models. Cloud service providers should be flexible in determining the price of customized services [16].

C. Migrating and integrating Existing Systems

Converting legacy systems to digital platforms is a daunting task. This is done with support and significant funding [16]. The real challenge is to integrate existing systems with the cloud to achieve productivity and efficiency.

D. Governance

Management ensures that the use of data and information complies with rules and approved procedures [16]. IT management should be compatible with the main goals and objectives of the business. Cloud-based systems only have control over how the system is built and operated. Therefore, strict control is required [16].

V. CONCLUSION

This study shows that the cloud is essential to support digital transformation. In this digital economy, data and analytics will leverage the cloud to drive digitalization across the business. In an age where business success is measured by the customer, cloud support and cloud deployment can help companies find new ways to provide a better user experience.

The cloud provides developers with a set of APIs, a simple and scalable low-code platform, a powerful engine for complex analysis processes, a large database to collect more data, and a strict privacy and security framework to bring innovation [9] . In the digital transformation process, cloud services constitute the fundamental basis for the development of organizational decentralization, easy development and data-based decision-making [9].

Outsourcing and decentralization of IT services through cloud services increases agility and productivity, enables businesses to focus on business priorities and enables the integration of IT applications [9]. By 2025,

half of the world's data (about 100 ZB) is expected to be stored in the cloud. 50% of job profiles already exist; this figure was 30% in 2015. This is where cloud services come into play.

Cloud services allow companies to work, store and manage large amounts of information more efficiently, securely and effectively [21]. Digital transformation helps reduce internal fraud and friction by providing SMEs with new technology tools to increase internal transparency. Companies are using cloud computing like Oracle and SAP, as well as cloud applications like Ash Cloud, to document and manage the purchasing process, allowing them to compare prices from different vendors at the time, check out product, and review orders for specific products [5].

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