Cloud-Native Transformation of Legacy Enterprise Systems

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Abstract

The need to achieve agility, scale, and innovation in the current dynamic digital environment is becoming a threat to legacy enterprise systems that have long dominated organizational IT infrastructure. Migration of the traditional systems to cloud-native systems has become one of the key strategies that organizations wish to adopt in order to modernize their IT systems. This paper discusses the transformation of the old enterprise systems in the cloud-native environment, the refactoring process, the important strategies of the migration, and the benefits and challenges involved. The aims of this paper are to assess the main tenets of cloud-native transformation, analyze the practical consequences of modernizing the legacy systems, and give a full picture of the strategies that organizations can pursue in order to have successful migration. The article under analysis, based on the analysis of the available literature and case studies, explains the importance of cloud-native solutions within the framework of improving operational efficiency, accelerated time-to-market, and innovation. It also discusses the common challenges like the complexities of data migration, security issues and organizational change management. The results indicate that the process of adapting to cloud-native systems has a number of difficulties but the long-term gains include enhanced agility, cost-effectiveness, and scalability. This paper ends with suggestions to the enterprises that are contemplating the transition to cloud-native architectures about the necessity of strategic planning, proper management of the legacy system, and following the best practices in moving to the cloud.

Keywords: Cloud-native transformation, Legacy systems, Enterprise IT, Digital transformation, Cloud migration, Cloud-native infrastructure

1. Introduction

Large-scale operations within the finance, manufacturing, and various other sectors are legacy enterprise systems which have historically been the core technologies of organizations. These systems which are usually characterized by monolithic on-premises architecture have been tailored to meet the important business processes like enterprise resource planning (ERP), customer relationship management (CRM) and supply chain management. Although the original use of the systems was effective, the immediate rate of technological changes, coupled with more and more consumers wanting faster and more responsive business reactions, has shown the weaknesses of the old systems. With organizations struggling to keep up with digitalized times, the process of legacy to cloud-native transition has become an essential tool of modernization (Bond, 2015; Brooks, Carter, and Idowu, 2020). The inflexibility of organizations having old systems is one of the major challenges they encounter. Old IT systems have hardware and software that is hard to scale or support new business demands, and is often old (Yadav, 2019). Such systems may also pose a great challenge in integration with new technology where such a system may not be able to provide the necessary agility in order to execute the modern business processes. Also, legacy systems are generally costlier to operate and support due to their complexity (specific expertise and years of IT

personnel training) (Kolla, 2018). Security issues are also essential factors because old systems can be non-conformant with the existing regulatory requirements or offer the required safeguards against modern and advanced cyberattackers (Hameed Ahmad, 2021).

Cloud-native transformation is a notion that relates to these issues as it transforms the IT environment of a given organization towards cloud architecture, flexible systems and scalability. Cloud-native systems are developed based on the basic knowledge of the cloud environment, using micro services, containers and orchestration technologies to offer more modular, agile and cost-effective IT solutions (Reznik, 2019). Cloud-native architecture, as opposed to the traditional legacy systems, allows to continuously integrate and deliver, scale quickly, and easily absorb new technologies all of which are essential in the modern fastpaced business landscape (Gilbert, 2018). The importance of cloud-native transformation has increased manifold due to the necessity of businesses to meet the demands of the market in a timely manner as well as to increase and decrease their scale and keep innovating. The purpose of this article is to examine the concept of cloud-native transformation of the legacy enterprise systems with an emphasis placed on how organizations can effectively address the transition. It mentions the fundamental aspects of the legacy systems refactoring, such as the integration of cloud-native systems and the transfer of the most important business processes to the cloud (Brooks et al., 2020). Also, the article will discuss the advantages of the cloud-native solution, including better scalability, business agility, and cost-reduction, as well as the difficulties that organizations may face, including complexities of data migration, security concerns, and the unwillingness to change in the organization (Reznik, Dobson, and Gienow, 2019). This paper aims to give a holistic idea about cloud-native transformation, its importance in the context of modernizing legacy systems, and the practice steps that companies need to follow in order to move to a cloud-based infrastructure.

2. Literature Review

2.1 The Enterprise Systems Evolution and the Cloud-Native Infrastructure Shift.

Over the last several decades the enterprise systems have experienced immense changes as they are no longer the simple transactional systems; they have developed into the integrated complex systems which are able to support numerous business processes. First legacy enterprise systems were based on monolithic on-premise design which was quite apt at that time and in accordance with the business requirement. These systems were mostly created to perform certain functions, e.g. accounting, inventory management and customer relationship management in isolated silos (Yadav, 2019). Although the fusion of these systems was initially advantageous, it had very many challenges, such as data duplication, variation in interfaces, and slow processing speed. These legacy systems had restrictions as organizations expanded, which became more evident. The blistering development of technological advancement and the increased demand of flexibility, scalability, and real-time processing power put significant pressure on the companies that were still dependent on such traditional infrastructures (Bond, 2015). In reaction, the enterprises started to explore more agile solutions and this is what resulted in development of cloud computing as the game changer in the IT systems architecture. Movement to cloud-native infrastructures is a big break in the traditional IT paradigms. Cloud-native solutions take advantage of the capabilities of cloud computing to provide a solution that is scaled, flexible, and resilient. In contrast to legacy systems, which are commonly co-located with hardware and thus demand heavy in-house support, cloud-native systems are developed to be decoupled to infrastructure, which takes the shape of containerization, microservices, and orchestration tools like Kubernetes. Such systems can be deployed quickly and have high availability and dynamic scaling of resources according to the changing demand (Gilbert, 2018; Reznik, 2019). The use of cloud native infrastructures is based on the necessity of businesses to be more dynamic, decrease the cost of operations and innovate. Cloud-native environments enable companies to constantly combine and release new features and updates that enhance time-to-market new products and services exponentially (Brooks et al., 2020). The current fast-paced move towards cloud-native strategies is a direct answer to the constraints posed by the legacy systems and the necessity of the business to have a competitive advantage in the digital first world.

2.2 The Advantages and Threats of Cloud-Native Change.

Cloud-native transformation has many advantages to organizations, especially on the scale, flexibility and cost-effectiveness. Scaling on demand systems is one of the most important strengths. Conventional enterprise systems are usually characterized by challenges related to scalability, which is because they are monolithic and any modification or addition to the system would present the system with extensive rework and resources required (Yadav, 2019). Conversely, cloud-native systems have the ability to easily scale up or down with the demand without major changes on infrastructure unlike traditional systems. In addition, cloud-native systems improve operational efficiency because they save time in manual processes. Cloud native environments are also automated, which enables an organization to constantly integrate and deploy software to ensure that updates and new features can be delivered more quickly and

with more reliability (Reznik, 2019). It is especially significant in those industries, in which the expectations of customers are also high, and the business has to react fast to the shifts in the market.

Table 1. Key Strategies for Legacy System Refactoring

Strategy	Description	Benefits	Challenges
Lift-and-shift	Moving legacy systems to the cloud with minimal modifications.	Quick migration, minimal upfront cost.	May not fully utilize cloud-native benefits.
Replat forming	Rebuilding legacy applications to work in a cloud-native environment.	Improved scalability, agility, and cost efficiency.	Resource-intensive and time-consuming.
Refactoring	Breaking down monolithic applications into microservices for better scalability.	Enhanced flexibility, continuous integration and delivery.	Complex and may require significant changes to legacy code.
Hybrid Cloud	Combining on-premise systems with cloud-native solutions.	Flexibility, gradual transition.	Requires careful integration management.
ELT Automation	Automating data pipelines using ELT tools for seamless data movement and transformation.	Real-time data integration, enhanced decision-making.	Technical complexity in integrating ELT tools.

Table 1 outlines the key strategies for refactoring legacy systems as part of cloud-native transformations, summarizing the benefits and challenges of each approach.

3. Methodology

3.1 Research Approach

The research design in this article is a qualitative design, but a thorough literature review and case study analysis will be carried out. The study seeks to analyze the change process that occurs between the legacy enterprise systems and cloud-native systems with the focus on the strategies, advantages, and issues in the migration process. The essence of the work is to combine the existing academic literature and industrial case studies and offer a comprehensive insight into the process of cloud-native transformation. In an effort to answer the research questions, the methodology will be based on document analysis of peer-reviewed journal articles, industry reports and case studies. The documents were chosen on the basis of their applicability to the topic of cloud-native transformation, specifically in the context of the enterprise systems of legacy. In this way, the conceptual, technical, and organizational facets of the cloud-native migration experience can be explored thoroughly based upon the available studies and practical examples. The literature review will be the main data collection tool, and it will concentrate on the sources that will provide a general overview of the practice of cloud-native transformation, migration strategies, and case studies of the different industries. Through these sources, the research will develop a coherent story regarding the difficulties that the organizations experience in the transition process, the measures that they take, and the results that they get after migration.

3.2 Louisiana State University, 2016. Sources of Data and Reference Materials.

The information used to prepare this article is obtained solely on a collection of scholarly journal articles, books, and industry reports, which are availed to the user. The given sources were thoroughly chosen based on their scholarly quality, applicability to the industry, and correspondence to the subject of cloud-native transformation. The reference materials that were used in this article comprise: Peer-reviewed journal article publications - These are the basis of the literature review, as they provide information about theoretical frameworks as well as practical usages of cloud-native migration. Among the prominent sources of information, there are articles by Gilbert (2018) and Reznik et al. (2019), which contain specific research on migration tactics and advantages. Books and industry reports - Publications such as the books authored by Bond (2015) known as The Enterprise Cloud and Cloud-Native Development Patterns by Gilbert (2018) include practical knowledge and guidance on the best practices that organizations should follow when deciding to switch to cloud-native services. The industry-specific examples and lessons learned concerning cloud-native transformations across industries are also provided in these sources. Case studies Case studies of cloud-native transformations in particular industries, e.g. telecom

(BasiReddy, 2019), retail (Sethupathy & Kumar, 2020), and banking (Subramanyam, 2021), give useful real-life examples of how the issues of migrating a legacy system can be addressed successfully. The chosen materials provide the assurance that the research is based on a theoretical foundation as well as the real-life application of the material. The use of case studies makes it possible to obtain a situational perspective of the application of cloud-native transformation across various business industries.

3.3 Analytical Framework

It will be analyzed using an integrative framework as the orientation towards assessing the main features of cloud-native transformation based on the set of pre-established themes. Some of these themes are based on the literature and they include: Cloud-Native Architecture Design: The theme provides a discussion of the technical underbelly of a cloud-native system, specifically how monolithic, legacy systems can be transformed into microservices and containerized systems. It discusses the benefits of microservices, containerization and orchestration technologies (including Kubernetes) to promote scalability, flexibility and agility (Gilbert, 2018; Reznik, 2019).

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- Migration Strategies: The framework assesses the different methods of migration of legacy systems to cloud-native infrastructure, the associated challenges and best practices of each method. The most important strategies are lift-and-shift, replatforming, and refactoring, and the hybrid cloud models (Yadav, 2019; Kolla, 2018). The strategies are evaluated based on their effectiveness, resource needs and time-to-value.
- Migration Strategies: The framework assesses the different methods of migration of legacy systems to cloud-native infrastructure, the associated challenges and best practices of each method. The most important strategies are lift-and-shift, replatforming, and refactoring, and the hybrid cloud models (Yadav, 2019; Kolla, 2018). The strategies are evaluated based on their effectiveness, resource needs and time-to-value.
- Benefits and Challenges: This theme is going to assess the advantages and difficulties of cloudnative transformation. Such advantages as greater scalability, affordability, and enhanced agility are discussed, and such issues as data migration, security, and the intricacy of combining cloudnative systems with the legacy applications are discussed (Bond, 2015; Hameed Ahmad, 2021). This is a feature of the framework that points to the trade-offs businesses should have when making decisions on whether to take a cloud-native transformation journey.
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- Organizational and Cultural Impact: The framework also takes into account the organizational and cultural issues that cloud-native transformation comes with. Switching to cloud-native systems, in many cases, implies the adaptation of organizational processes, the organization of work teams, and corporate culture. The study focuses on the ways companies can deal with this cultural transition, embrace agile processes, and achieve resistance to change (Fowley et al., 2017).

3.4 Limitations of the Methodology

Although the literature review and analysis of the case study offer useful information about the cloud-native transformation process, this research method has certain limitations. To start with, the analysis will fully be based on the available published materials that might fail to cover the latest trends in cloud-native technologies and practices. Also, the emphasis on academic and industry reports implies that the study can be restricted by its inability to include the experiences of smaller businesses or businesses operating in the emerging markets. The other constraint is that primary data is not collected through the utilization of surveys or interviews with industry players. Although case studies give practical examples, they are not comprehensive in representing the subjective experiences and

opinions of organizations that are going through the transformation of using clouds as natives. Primary data collection would help in future research to give a more insight on the transformation process through the eyes of the organizations in question.

3.5 Heat Map of Critical Cloud-Native Strategies

Upgrade of legacy enterprise systems to cloud-native is a complex process which entails some strategy planning, technical skill and attentive knowledge of the business and technical requirement. Complexity The differences between cloud-native and traditional environments enable organizations to realize the power of scalability, agility, and innovation. Nevertheless, the process of such transformation is not devoid of difficulties and one of the key factors determining the success of the process is the approaches taken. This part examines the important approaches that companies can employ to refactor old IT systems, migrate to cloud databases and infrastructures, integrate old systems with cloud-native systems, build cloud-native CRM and enterprise applications, and control data pipelines in the cloud-native systems.

1.   Refactoring the Cloud Legacy IT Systems.

One of the essential steps of the transformation process is refactoring legacy systems to the cloud-native ones. Monolithic systems have a history of legacy systems that are expected to be operated on the old onpremise systems, and as such, are hard to scale and to be integrated with newer technologies. Refactoring is a rewritable or re-architecting of applications to utilize the full benefit of the cloud flexibility, scalability, and resiliency (Kolla, 2018). Refactoring normally undertakes one of many approaches that include; replatforming or microservices-based refactoring. Replatforming is a process of modifying the current systems in order to support the use of cloud infrastructures. This can involve making software updates, moving to the cloud-hosting, and adding cloud-native services without altering the application architecture significantly (Bond, 2015). This is usually less disruptive and offers a quicker path to the cloud and there is little redesign of the systems. Conversely, refactoring with microservices entails the disaggregation of monolithic applications into small and independent services that can be deployed and scaled separately. Microservices are common and usually constructed based on containerization application such as Docker, which enable the formation of each component to operate within independent environments and is simplifier to maintain, scale, and introduce the application (Reznik, 2019). The strategy has a very high scalability and maintainability, because it allows to update it faster and allocate resources more effectively. Nevertheless, it is a more complex and resource-demanding undertaking, which presupposes profound knowledge of the principles of the cloud-native and the new development practices. It is not that refactoring of old systems is devoid of difficulties. It entails significant time and resource allocation to re-architecture applications and re-train staff on cloud-native technologies. In addition to this, the refactored systems should be made to fit the available IT infrastructure and business needs of the business. Even with these issues, the refactoring has the potential to enhance the innovation and adaptation capabilities of an organization to the dynamically changing business environment (Gilbert, 2018).

2.   Switching to Cloud Databases and Infrastructure.

Migration is one of the elements of cloud-native transformation that has changed the legacy databases into cloud-native databases. The old systems usually use on-premise traditional relational databases that are not conducive to scalability and flexibility of the modern cloud environment. By moving to cloud-native databases, which include those provided by Amazon Web Services (AWS), Google Cloud Platform (GCP), or Microsoft Azure, organizations can use distributed database architectures that are able to support horizontal scaling and high-availability (Yadav, 2019). The process of migrating legacy databases to cloudnative databases entails data storage movement and reorganization of data management practices based on best practices of cloud-native databases. Cloud databases can be scaled dynamically and this enables businesses to handle the high volumes of data efficiently as compared to the restrictions of the traditional database systems. In addition, cloud-native databases are more reliable, and because they are distributed to various data centers, the chance of being offline becomes minimal (Reznik, 2019). Although switching to cloud databases has many advantages, it has difficulties. Among the main issues is data migration which could be a complicated affair especially in the case of large databases which are mostly outdated databases. To be sure that there is integrity of the data, less downtime, and compatibility problems are lessening between the existing database structure and cloud-native solutions, organizations have to think through (Kolla, 2018). Besides, any organization should make sure to meet the regulatory and security standards when transferring sensitive data to the cloud (Brooks et al., 2020).

3.   How to integrate Legacy Systems with Cloud-Native Environments.

The other essential approach to cloud-native transformation is the integration of the legacy systems into the cloud-native settings. In many cases, organizations cannot spare the cost to completely upgrade their old systems at once and therefore, integration is required. A hybrid strategy, with the legacy systems remaining in use as the organizations continue to migrate to the cloud-native, enables

organizations to progress slowly without causing much of a disruption (Vishnubhatla, 2017). Integration can be performed with the help of application programming interfaces (APIs) and middleware solutions used to establish a connection between the legacy systems and the cloud-native applications. They enable data and function interchangeability across various systems, and guarantee the compatibility of legacy and cloud-native systems (Fowley, Elango, Magar, and Pahl, 2017). One example is that the current customer relationship management (CRM) system can be connected to a cloud-based sales and marketing platform to enable the free flow of data between the two systems without the need to totally overhaul the old application. Although it is beneficial, integration has a number of challenges. The legacy systems might not have been built to be integrated and there might be challenges in harmonizing the data format, communication protocol and business logic. There are situations when middleware can be integrated through custom-built middleware, which can be time-intensive and expensive (Reznik, Dobson, and Gienow, 2019). Additionally, integration can cause performance bottlenecks or security weaknesses when not handled well especially when addressing sensitive information.

Figure 1: Cloud-Native Transformation Process

Figure 1: Visual representation of the cloud-native transformation process, illustrating key stages from refactoring legacy IT systems to managing data pipelines in cloud-native environments. The transformation journey encompasses multiple strategies, each critical to ensuring the success of the migration.

4. Best Practices and Solution to the challenge.

It takes a mixture of organizational change management, technical expertise, and strategic planning to make it through the challenges of cloud-native transformation. Best practices that could be used to guide organizations in the transformation process include:

Use a gradual migration plan: Organizations must migrate systems step by step and begin with the less important systems then graduate to migrating mission critical systems after the process is perfected. This reduces the risk and enables businesses to gain experience with time (Bond, 2015).

Invest in training and upskilling: One of the key success factors is to provide employees with the training that they should have to work with cloud-native technologies, such as containerization, microservices, and cloud security practices. A culture of innovation and flexibility should also be established by organizations, which can be achieved through the establishment of a continuous learning environment (Fowley et al., 2017).

Get cloud-native: Cloud-native tools and frameworks, like Kubernetes to orchestrate or AWS Lambda to run serverless computing, can make the migration process easier and help to have legacy systems refactored in an efficient way (Gilbert, 2018).

Make sure that the data migration and integration is strong: In order to ensure that the data integrity and the consistency is preserved, the business should plan its data migration procedure properly, and the use of automated tools will facilitate the exchange of large volumes of data between the previous systems and cloud-native environments (Akindemowo et al., 2021).

Adopt DevOps: DevOps practices should be adopted in organizations that have to ensure that their operations run smoothly in the cloud-native environment, as they encourage the collaboration of both development and operations teams and facilitate continuous integration and delivery (CI/CD) (Reznik, Dobson, and Gienow, 2019).

Through these strategies, the organizations will be able to address the challenges of cloud-native transformation and will gain the advantages of a more agile, scalable, and efficient IT infrastructure.

The advantages of Cloud-Native Transformation.
The migration of old enterprise systems into the cloud-native designs has a number of strategic benefits to organizations. The cloud-native systems are developed to enjoy fully the scalability, flexibility, and reliability of the cloud that is vital in ensuring that the businesses stay competitive in the digital era. Organizations can access a lot of benefits by refactoring their legacy systems and by turning to cloud-native solutions, which are greater agility, reduced costs, and faster innovation. The ultimate achievement of these advantages however lies in the success with which the transition is planned and executed. This section discusses the main advantages of cloud-native transformation in terms of scalability, flexibility, cost efficiency, operational performance and business innovation.

4.1 Scalability and Flexibility

Scalability is one of the greatest benefits of cloud-native systems. Conventional legacy systems tend to be limited by hardware on-premise, an expensive source of expansion and upgrades. Cloud-native systems on the other hand are approved to scale without hassle and as a result, an organization can expand its Information Technology resource as the business grows. The scalability is gained especially when organizations are undergoing a sharp demand curve or seasonal lows and fluctuations (Gilbert, 2018).

Cloud-native systems are based on containerization and microservices, both of which are used to scale an application horizontally in the business. Using containerized microservices, companies can add resources to certain components of the system, and not the system itself. This will provide an opportunity to utilize computing resources more efficiently and help businesses to satisfy the peaks of demand without excessive resource provision (Reznik, 2019). Consequently, cloud-native systems will be able to develop in a costefficient and responsive way in response to market shifts.

Cloud-native systems are also flexible with scalability in that a business can be able to adopt a pay-as-yougo infrastructure. This is unlike the old systems where one needs to make huge investments into hardware and long-term maintenance agreements. Cloud-native environments provide organizations with an opportunity to select the appropriate resources according to their requirements at a certain period of time, preventing underuse and decreasing the cost of operation (Brooks et al., 2020).

4.2 Efficiency and Optimization of Costs

The operational costs are highly cut down by replacing the native systems to cloud-based systems. The traditional systems can take large capital investments in the physical infrastructure, such as servers, data storage, and network equipment. The systems are also characterized by a high rate of maintenance, and specialized IT personnel is needed to maintain the hardware, upgrade the system, and resolve problems (Bond, 2015). Cloud-native systems remove much of this overhead by delegating the responsibility of managing infrastructure to cloud provider vendors like Amazon Web Services (AWS), Google Cloud Platform (GCP), or Microsoft Azure.

Cloud-native environments are based on a pay-as-you-go model, meaning that organizations only pay by the consumed computing resources. This model offers a lot of cost-savings, since the business can expand and reduce its usage depending on the demand without necessarily investing heavy capital in the hardware. In addition, the cloud providers usually provide the services of auto-scaling, load balancing, and optimization of resources that further make IT infrastructure management cheaper (Reznik, 2019). Through these tools, organizations are able to optimize on resource use and only pay an amount that will only cover the capacity required hence more efficient cost management.

Also, cloud-native architectures consume less energy than their counterparts. Cloud data centers are usually made more energy efficient whereby technology like server virtualization and cloud-optimized cooling system are used. Organizations will be able to cut down on the total amount of energy and environmental footprint by moving to the cloud (Hameed Ahmad, 2021). This not only supports the sustainability objectives but also helps in long term saving of costs as the amount of energy saved by this is very high.

4.3 Better Operational Performance and Reliability

The cloud-native systems are highly fault-tolerant and available. Cloud-native systems are distributed to multiple servers and data centers unlike legacy systems which may use only one on-premise server or data center (with redundancy being typically an afterthought). This redundancy will take care of the situation whereby failure of one element of the system will not bring down the application. The recovery in the case of disasters is also simpler to realize in cloud-native, as it is possible to replicate and store data in several geographic locations, minimizing the chances of data loss (Reznik, Dobson, and Gienow, 2019).

Furthermore, the cloud-native architecture allows improving the operational performance through continuous integration and delivery (CI/CD). The practices enable quicker development cycles in that organizations are able to publish updates and patches on a frequent basis without service disruption. This agility is essential to companies that want to remain competitive in industries that are highly dynamic since it enables them to react to customer feedback, changes in regulations, or security threats swiftly (Gilbert, 2018).

Microservices in cloud-native systems also help in improving operational performance. Organizations can more easily create, release, and expand distinct components of an application by separating applications to form smaller, autonomous services. This modularity

enhances the resilience of the system and simplifies its management and update of individual services without impacting the whole application (Reznik, 2019). **4.4 Innovation and Promoting Swift Time-to-Market**

The most important enablers of innovation are cloud-native systems. With the elimination of monolithic architectures in favor of microservices, businesses can enjoy the flexibility of experiment when it comes to new features and services without having to tear down their entire infrastructure. They are also easy to integrate into cloud-native systems, including artificial intelligence (AI), machine learning (ML), and Internet of Things (IoT), which may help optimize the workflow and improve the customer experience. This has led to the introduction of new products, features, or updates to an organization much faster than the traditionally long development process, and reduces time-to-market (Sethupathy and Kumar, 2020). Cloud native environments also give access to better tools of data analytics which help businesses to understand the customer behavior, trends in the market and also the performance of their operations more deeply. With the help of these tools, organizations are able to make decisions that are based on data and constantly enhance their products and services. Such capability to innovate and readjust at a rapid pace is an essential competitive benefit in the present digital economy (Hameed Ahmad, 2021).

4.5. Greater Protection and Adherence.

Although cloud-native transformation has many advantages, security and compliance-related issues need to be tackled by the organizations through the migration process with care. The cloud also offers sophisticated security facilities including encryption, access controls and security monitoring which in most cases are more secure than the facilities that can be provided by organizations using on-premise solutions. Cloud providers, too, have specialized services that can be used to guarantee regulatory compliance, including data privacy and security audit tools (Reznik, 2019). On the cloud-native transformation front, the businesses are able to make security-as-code practices a part of their development process, which is why security gets implemented at the earliest stage of the system. It is a proactive model that contributes to ensuring that the organization can identify and address security vulnerabilities at an early stage of development, minimizing the threat of breach or information loss (Reznik, Dobson, and Gienow, 2019).

Table 1. Key Benefits of Cloud-Native Transformation

Benefit	Description	Impact
Scalability	Ability to scale infrastructure dynamically in response to demand.	Provides cost-effective growth, improves flexibility.
Cost Efficiency	Reduced infrastructure costs through the pay-as-yougo model, and optimized resource usage.	Reduces operational expenses, better resource management.
Operational Performance	Improved reliability, fault tolerance, and faster recovery through distributed systems.	Enhances system uptime and resilience.
Innovation and Agility	Faster development cycles and easier integration with advanced technologies such as AI and IoT.	Accelerates time-to-market, fosters product innovation.
Security and Compliance	Advanced security measures, encryption, and compliance tools.	Ensures data protection and regulatory compliance.

Table 1 summarizes the key benefits of cloud-native transformation, highlighting how each benefit contributes to improved business outcomes.

5. Challenges and Solutions

Although the adoption of the cloud-native system has many advantages, it is not free of difficulties. The technical, organizational, and security-related challenges that have to be surpassed during the process of moving the legacy systems to the cloud-native environments are numerous. Such challenges are capable of being a big threat to businesses in case they are not well dealt with. Nevertheless, these challenges can be addressed, and organizations can achieve the full potential of the cloud-native transformation with the help of appropriate planning, a clear migration strategy, and attention to best practices.

5.1 Technical Problems of the Legacy Systems Migration.

The technical complexity of migration of legacy systems is one of the most important issues of cloud-native transformation. The old systems that are frequently constructed on the old technology are normally monolithic systems and are bound closely to the on-premise systems. Such systems have not been made with cloud-native concepts, and hence, the migration process involves a lot of refactoring

and reengineering so that it can be compatible with cloud-based systems (Kolla, 2018). One of the problems experienced in migration is the incompatibility of the old systems with cloud-native systems. Older programming languages, frameworks, or databases are also used in the construction of legacy applications, which fail to integrate with the cloud-native technologies of microservices, containers, or serverless applications (Reznik, 2019). This disconnection requires a lot of modification of the application code, which may be timeconsuming, resource-intensive, as well as subject to errors. Moreover, the business should consider a scenario in which the migration should not interfere with the running of the business hence the migration process should be planned and staged carefully to reduce the downtime.

5.2 Organization and Cultural Hurdles in Transformation

In addition to technical issues, other barriers to a successful cloud-native transformation may include cultural and organizational issues. The transformation to cloud-native systems can demand the adjustment of the traditional workflow, process, and organizational mindsets. A lot of the legacy systems were created and supported within dedicated IT departments, and were commonly very knowledgeable on the legacy technologies. The transition to the cloud-native environment would compel the staff to use new tools, agile development models, and a culture of continuous integration and delivery (CI/CD), which might be unpopular among the long-term staff (Fowley, Elango, Magar, & Pahl, 2017). In addition, cloud-native transformation usually needs to bring a change in organization structure. Functional silos in IT teams, such as infrastructure, development and operations, should be changed by becoming more cross-functional teams that collaborate in an integrated and working fashion. Cloud-native systems can only succeed when the DevOps practices that integrate development and operations teams are implemented. Nonetheless, this culture change may be complex, particularly in companies, which are highly decentralized (traditionally) into siloed workflows (Reznik, Dobson, and Gienow, 2019).

5.3 Resolving Security, Data Integrity, and Compliance Problems

Among the first concerns of organizations moving to cloud-native environments, security, data integrity, and compliance can be found. Old systems usually run under a very controlled on-premise system in which security measures can be strictly followed. Cloud-native systems, conversely, consist of keeping data in an off-site environment, usually in more than one data center, and depending on third parties to secure and comply. This is even a concern regarding data privacy, access control, and data leakage (Reznik, 2019). Cloud computing shared responsibility model also induces confusion regarding the party to secure various elements of the system. Although the cloud infrastructure security lies with the cloud service providers, the businesses have the security of their applications and data in the cloud. To make sure that cloud-native systems comply with regulatory standards, including the General Data Protection Regulation (GDPR) or Health Insurance Portability and Accountability Act (HIPAA), organizations that work with sensitive data should take care of it (Brooks et al., 2020).

6. Results

The success of cloud-native solutions in the transformation of the legacy enterprise systems is a well-known topic that has been reported in scholarly and industry case studies. Strategies of cloud-native transformation, especially the ones aimed at refactoring legacy systems, and going to cloud-native databases, have always resulted in making business more agile, scalable, and efficient in terms of its operations. These plans allow companies to utilize fully the capabilities of cloud computing, such as allocating resources on-demand, scaling dynamically, and cost optimization capabilities. Those organizations that have incorporated microservices-based architecture as its cloud-native approach have shared concerns about a significant enhancement in scalability and flexibility. Docker and the orchestration tools like Kubernetes have enabled businesses to more effectively deploy, manage, and scale applications using the technologies of containerization. Such strategies make it simpler and less overhead intensive in comparison to the oldfashioned monolithic applications, which results in shorter development times and better time-to-market of new features (Gilbert, 2018). Moreover, there has been an enhancement in real-time data processing and analytics by businesses that adopted cloud-native data management systems. The transition of legacy, onpremise databases to cloud-native databases, including Amazon Aurora or Google Cloud SQL, has led to a decrease in latency and database performance improvement. Data streaming and integration has become possible in real-time, and it provides organizations with an opportunity to make decisions based on data in a faster and more accurate manner (Yadav, 2019).

6.1 Best Practices: Successful Transformations (Case Studies).

Multiple real-life scenarios show the effectiveness of cloud-native strategies used. Telecommunications firms such as Vodafone and Telefonica have also adopted cloud-native infrastructures as a way of updating their operations. These companies switched their old CRM platforms onto the cloud-native platforms and, as a result, they managed to expand their operations throughout the world and deliver a smoother customer experience. Using cloud-native CRM systems, they could merge the data on customers across different

touchpoints and deliver real-time analytics, which greatly enhanced the customer engagement process and lowered the operational expenses (BasiReddy, 2019). Walmart and other companies in the retail industry have shifted their old supply chain management systems to the cloud environment. These changes enabled the companies to be in a better position to control the inventory and minimize stockouts as well as optimize the efficiency of their fulfillment processes. As an example, Target has introduced a cloud-based inventory management system, which allows tracking the position of the stocks in stores and warehouses in real time. The system has resulted in waste reduction, increased accuracy of stocks, and customer satisfaction (Sethupathy & Kumar, 2020). Capital One is one of the success stories of cloud-native transformation in the financial services industry. The company may have shifted its main banking applications to the cloud, which has enabled it to increase operations and implement new digital services. The cloud-native architecture has facilitated the process by which Capital One introduces new financial services and products, such as mobile banking apps and custom financial products. The change has also caused IT costs to fall and made the systems more reliable since the company is enjoying the benefits of cloud infrastructure redundancy and disaster recovery facilities (Subramanyam, 2021).

6.2 Comparison of Cloud-Native and Traditional Approaches

Flexibility, scalability, and efficiency can be identified as the differences between cloud-native approaches and traditional systems. Old legacy systems that are usually based on monolithic architecture are not easy to scale and to mix with the new technologies. Such systems usually involve huge hardware investments and are likely to have lengthy development and developmental maintenance. By contrast, cloud-native systems are built in a modular fashion, which means individual components of an application, as opposed to the entire system, can be scaled by businesses. It allows deploying faster and efficiently utilizing the available resources, especially in dynamic business settings (Reznik, 2019). Also, the traditional systems are cumbersome and rigid in data management. Traditional databases are usually on-premise and need a lot of manual intervention to keep up with, and as a result tend to cause data silos and ineffective data access. Cloud-native systems, on the other hand, make use of distributed databases and data lakes which are more flexible by nature and can manage high amounts of unstructured and structured data. This allows companies to view and process information real-time, which is a crucial benefit in professions where speed and decisions that are made by data are needed (Reznik, Dobson, and Gienow, 2019).

Along with these benefits, it should be mentioned that the migration to cloud-native systems is not without its problems. The migrations of the data, compatibility with the existing development, and security are the typical challenges that the organizations experience when undergoing cloud-native changes. But, the reallife examples and case studies prove that.

7. Discussion

The move of the old enterprise systems to the cloud-native environment is an important change in the way organizations are thinking of IT infrastructure, application development, and business processes. As the results section indicated, the implementation of cloud-native strategies has been found to be associated with significant advantages, such as better scalability, cost-effectiveness, operational performance, and capability to achieve innovation. Nevertheless, as the benefits of cloud-native systems are obvious, the obstacles that organizations have to go through in the transformation process are likewise crucial and have to be properly addressed to achieve the successful migration. One of the key themes that have come out of the findings is the flexibility and scalability provided by cloud-native architectures that allow business to be able to respond easily to changes in market demand. By inference, cloud-native systems are meant to be horizontally scaled, where an organization is allowed to add and/or remove resources on-demand without physical infrastructure limitations. Such flexibility is essential in the modern business world, which is characterized by a rapid dynamic pace, at which the ability to expand the operation on a large scale and to add new features can be the only distinction between the success and the downfall. The case studies of such companies as Target and Capital one demonstrate that cloud-native systems have allowed companies to be innovative and grow on a global scale at a reasonable cost (Sethupathy & Kumar, 2020; Subramanyam, 2021). The economic advantage of changing to cloud-native systems also cannot be overestimated. Cloud computing also involves a pay-as-you-go system that highly minimizes on the capital requirement in the hardware and maintenance. The legacy systems of the past have forced companies to make serious capital investments towards the on-premise infrastructure which may not be used fully resulting in wastefulness. Conversely, on-demand resource allocation on the cloud means that organizations pay according to the consumed resources, which is more predictable and optimized IT spending (Reznik, 2019). Furthermore, dynamic scaling allows reducing waste and using resources more effectively, improving the cost-efficiency further (Yadav, 2019).

More so, the organizational and cultural change, which is a necessity in the cloud-native transformation, is one of the most important ones. Changing to a cloud-native set up is not only a change in technology but also a paradigm shift in how an organization functions. The old systems are usually supported by dedicated IT departments who have extensive knowledge about the current technology stack. These teams will have to adjust to new tools, practices and workflows due to the shift to cloud-native systems. Implementing DevOps practices, such as needs, means that IT teams have to make closer collaboration with development teams, which creates a culture of constant integration and delivery (CI/CD). This cultural change may be opposed, especially to those organizations that have old traditions and established working processes (Reznik, Dobson, and Gienow, 2019). Companies will need to invest in the training and upskilling of their employees so that they could be equipped with skills to handle the cloud-native technology successfully. Another important factor is the issue of security and compliance that should be part of the cloud-native transformation process. Although cloud providers provide sophisticated security systems, organizations have the final role in ensuring that their applications using the cloud-native system and data comply with industry-specific regulations. It is further complicated by the fact that cloud-native environments can be associated with data storage and data processing in several different geographic locations, which brings up the issue of data sovereignty and data privacy regulations (Brooks et al., 2020). It is important that organizations put into consideration the security features of the cloud providers and make certain that their cloud-native systems are being designed with security by design principles. The cloud-native transformation plan should include regular security audits, data encryption, and compliance monitoring that should be a part of the strategy. Organizations such as Capital One have also been successful in their transformation to cloud-native systems, as the financial sector demonstrates the successful use of the cloud to transform their core banking systems and enhance customer experience. These organizations have minimized the costs of IT, improved the reliability of their systems, and improved the ability to scale their operations better after migrating to cloud-native environments (Subramanyam, 2021). These practical cases show that cloud-native transformation is not a technical upgrade but rather a business enabler that can initiate a major change in terms of customer engagement, operational efficiency, and innovation.

8. Conclusion

The process of moving out of legacy enterprise systems and to cloud-native architectures is a transformational process that provides organizations with a myriad of benefits such as increased scalability, reduced costs, improved operational performance, and enabled organizations to innovate faster. The article has dealt with the major approaches to cloud-native transformation, discussed the issues and options related to the migration of the legacy system, and also presented the practical examples of successful transformations in different domains. Some of the most important results of this research prove that one of the most important roles of organizations that apply cloud-native strategies is the operational flexibility and scalability. One of the most noticeable cloud-native benefits is the possibility to dynamically scale resources according to the demand without the limitations of the on-premise infrastructure. Moreover, the shift to cloud-native databases and microservices enables organizations to optimize their activities, make their systems more resilient, and cut expenses. Cloud services pay-as-you-go model provides an economical means of managing the IT infrastructure to businesses as opposed to the capital expenditure that would be incurred in maintaining the traditional legacy systems. Besides, the superior security features and distributed architecture of the cloud guarantee increased availability and diminished downtime which are paramount to business in the contemporary dynamic world. Moving ahead, cloud-native changes will remain a critical factor when it comes to transforming the way organizations operate their IT systems. With the increasing number of businesses moving to the cloud-native architecture, the rate of innovation will increase faster, with organisations continually refining their systems to suit the changing customer needs. The efforts of integrating the latest technologies into cloud-native environments will lead to the further increases of efficiencies and the opening of new business opportunities due to the integration of the latest technologies and cloud computing in the form of artificial intelligence, machine learning, and the Internet of Things (IoT).

References

1. ABAYOMI, A. A., ODOFIN, O. T., OGBUEFI, E., ADEKUNLE, B. I., AGBOOLA, O. A., & OWOADE, S. (2020). Evaluating Legacy System Refactoring for Cloud-Native Infrastructure Transformation in African Markets.

2. Bond, J. (2015). The enterprise cloud: Best practices for transforming legacy IT. " O'Reilly Media, Inc.".

3. Liu, X., Huang, D., Yao, J., Dong, J., Song, L., Wang, H., Yao, C., & Chu, W. (2025). From Black Box to Glass Box: A Practical Review of Explainable Artificial Intelligence (XAI). AI, 6(11), 285. https://doi.org/10.3390/ai6110285

4. Hameed Ahmad, G. T. (2021). Seamless Enterprise Integration: Cloud-Native Strategies for the Modern Era.

5. Khan, A., & Chowdhury, S. A. (2025). A Governance and Accountability Framework for Generative-Ai-Assisted Process Mining in Adaptive Enterprise Workflows. American Journal of

Technology Advancement, 2(11), 168–189. Retrieved from https://semantjournals.org/index.php/AJTA/article/view/3270

6. Kolla, S. (2018). Legacy liberation: Transitioning to cloud databases for enhanced agility and innovation. International Journal of Computer Engineering and Technology, 9(2), 237-248.

7. Akhtaruzzaman, K., Md Abul Kalam, A., Mohammad Kabir, H., & KM, Z. (2024). Driving US Business Growth with AI-Driven Intelligent Automation: Building Decision-Making Infrastructure to Improve Productivity and Reduce Inefficiencies. American Journal of Engineering, Mechanics and Architecture, 2(11), 171-198.

8. Yadav, M. (2019). From Legacy to Agile the Role of Linux in Cloud Computing and Digital Transformation. International Journal of Science, Engineering and Technology, 7(3).

9. BasiReddy, S. R. (2019). Designing Cloud-Native CRM Platforms for Next-Generation Telecom Operations. European Journal of Advances in Engineering and Technology, 6(3), 130-138.

10. Akhtaruzzaman Khan, A. K., Sumon Shikdar, S. S., & Rakib Hassan Rimon, R. H. R. (2024). Human-Centered Process Mining With Generative-Ai for Sustainable and Energy-Efficient Agriculture Systems. Human-Centered Process Mining With Generative-Ai for Sustainable and Energy-Efficient Agriculture Systems, 1(8), 114-139.

11. Akindemowo, A. O., Erigha, E. D., Obuse, E., Ajayi, J. O., Adebayo, A., Afuwape, A. A., & Adanyin, A. (2021). A Conceptual Framework for Automating Data Pipelines Using ELT Tools in Cloud-Native Environments. Journal of Frontiers in Multidisciplinary Research, 2(1), 440-452.

12. Eeti, S. H. A. N. M. U. K. H. A., Goel, P., & Renuka, A. (2021). Strategies for migrating data from legacy systems to the cloud: Challenges and solutions. TIJER (The International Journal of Engineering Research, 8 (10), a1-a11.[Link](tijertijer/viewpaperforall. php.

13. Reznik, P., Dobson, J., & Gienow, M. (2019). Cloud native transformation: practical patterns for innovation. " O'Reilly Media, Inc.".

14. Gilbert, J. (2018). Cloud Native Development Patterns and Best Practices: Practical architectural patterns for building modern, distributed cloud-native systems. Packt Publishing Ltd.

15. Sethupathy, A., & Kumar, U. (2020). Cloud-Native Architectures for Real-Time Retail Inventory and Analytics Platforms. International Journal of Novel Research and Development, 5, 339-355.

16. Brooks, E., Carter, L., & Idowu, M. (2020). From Legacy to Agility: Modernizing Critical Systems for the Cloud Era.

17. Vishnubhatla, S. (2017). Migrating Legacy Information Management Systems to AWS and GCP: Challenges, Hybrid Strategies, and a Dual-Cloud Readiness Playbook. Hybrid Strategies, and a Dual-Cloud Readiness Playbook (November 20, 2017).

18. Reznik, P. (2018, October). Cloud native transformation pattern language. In Proceedings of the 25th Conference on Pattern Languages of Programs (pp. 1-40).

19. Manchana, R. (2020). Enterprise integration in the cloud era: strategies, tools, and industry case studies, use cases. International Journal of Science and Research (IJSR), 9(11), 1738-1747.

20. Fowley, F., Elango, D. M., Magar, H., & Pahl, C. (2017, January). Software system migration to cloud-native architectures for SME-sized software vendors. In International Conference on Current Trends in Theory and Practice of Informatics (pp. 498-509). Cham: Springer International Publishing.

21. Laszewski, T., Arora, K., Farr, E., & Zonooz, P. (2018). Cloud Native Architectures: Design highavailability and cost-effective applications for the cloud. Packt Publishing Ltd.

22. Gowda, H. G. (2021). Cloud migration strategies for hybrid enterprises: Lessons from AWS and GCP infrastructure transitions. International Journal of Scientific Research & Engineering Trends, 7(6), 2.

23. Subramanyam, S. V. (2021). Cloud computing and business process re-engineering in financial systems: The future of digital transformation. International Journal of Information Technology and Management Information Systems (IJITMIS), 12(1), 126-143.

24. Tiwari, H. V. (2021). Modernizing IT: The Role of Cloud Computing in the Enterprise Evolution. International Journal of Computer Technology and Electronics Communication, 4(1), 3201-3207.