
From On-Premises to Cloud: Trends and Best Practices in Cloud Migration

Muhammad Adam Zaidan¹, Mochamad Teguh Kurniawan²

^{1,2}Universitas Telkom

E-mail: adamzaidan@student.telkomuniversity.ac.id¹, teguhkurniawan@telkomuniversity.ac.id²

Article History:

Received: 19 Juli 2024

Revised: 02 Agustus 2024

Accepted: 04 Agustus 2024

Keywords: Cloud Migration, On-premises, Network Infrastructure, Systematic Literature Review

Abstract: In the modern era of information technology, it has been a rising trend in implementing cloud-based services in businesses and organizations. The main goal of this paper is to provide an overview of the current state and research on cloud services and migration, focusing on the strategies, trends, and best practices both old and newly surfacing trends. Through a comprehensive analysis of several articles, journals, and case studies, this literature review aims to be a rough guideline for cloud migration, explaining the benefits such as business continuity, scalability, and cost effectiveness. This paper also aims to explore several migration tactics, including lift-and-shift, refactoring, and replatforming, and offers a critical assessment of their benefits and drawbacks. The review also discusses typical obstacles encountered in cloud migration, such as organizational resistance, data integration problems, and security worries. By investigating real-world instances and acquired knowledge, this paper offers practical insights and recommendations for organizations that are planning or undergoing cloud migration through real-world findings and lessons learned. The results highlight the importance of crucial planning, effective change management, and ongoing performance optimization in achieving successful cloud transitions. This literature review highlights the need for continuous innovation and adaptation in the quickly changing cloud landscape by consolidating current knowledge and outlining future research.

INTRODUCTION

Cloud migration has increased in popularity in recent years, with rising trends for both small and large businesses transferring their services to the cloud. According to The National Institute of Standards and Technology (NIST), the definition of cloud computing is “An accumulation of services, applications, and resources that are offered to the user both flexible and scalable via the internet without requiring long-term capital commitment and IT-specific expertise” (Bremer, et. al,

2021). The cloud migration process calls for moving existing digital assets, IT resources, and the organization's applications to a cloud-based environment, which can then be separated into three service models, namely Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS). Cloud migration brings many benefits to the table, including scalability, costs, and enhanced business process agility. However, these benefits don't necessarily come without drawbacks. Some of the main risks that come with cloud migration include data security, network latency, uptime, and integration issues, to name a few. Some other major difficulties in this field include (i) the migration of existing applications into the cloud and (ii) the increasing vendor lock-in which denotes the inability to leave a certain cloud provider without significant effort.

According to Binz et al., cloud migration can be classified into three types: Standardized Format Migration, Component Format Migration, and Holistic Migration (Binz, et al, 2011). Standardized Format Migration involves transferring applications and data to the cloud with minimal modifications (Zhao & Zhou, 2014). This type of migration typically uses standard interfaces and formats, making the transition relatively straightforward. Holistic Migration involves a comprehensive overhaul of an organization's IT infrastructure, moving entire applications and workloads to the cloud. This approach often requires significant re-architecture and optimization to leverage cloud-native capabilities (Zhao & Zhou, 2014). Whereas Component Format Migration focuses on migrating specific components of an application to the cloud. This type involves breaking down applications into smaller, manageable components or services, which are then migrated individually.

THEORETICAL BASIS

Cloud Computing

Cloud computing is the science of delivering computing services—servers, storage, databases, network infrastructure, software, and intelligence—over the 'cloud' or more commonly known as the the internet, to offer plenty of benefits such as scalability, flexibility of resources, economic advantages, among others. Cloud computing offers a substitute for companies to place their applications and storage on a cloud service provider instead of having to own their personal computing infrastructure or data centers.

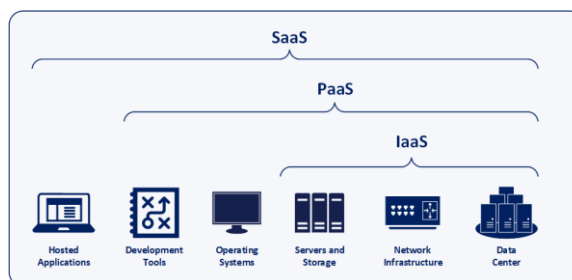


Figure 1. Cloud Computing Models

The National Institute of Standards and Technology (NIST) has defined cloud computing with five essential characteristics: on demand self service, resource pooling, broad network access, rapid elasticity, and measured service. These characteristics differentiate cloud computing from traditional IT services and have driven its rapid adoption in various industries (Mell & Grance, 2011). The primary service models of cloud computing include Infrastructure as a Service,

Platform as a Service, and Software as a Service.

Cloud computing has plenty of benefits, such as cost savings, scalability, flexibility, and disaster recovery (Armbrust, 2010). Nevertheless, it also comes with several challenges, such as security concerns, compliance requirements, documentation, and potential downtime.

Cloud Migration

Cloud migration is the process of moving data, applications, and other elements crucial to the business from an organization's on-premises or on-site infrastructure to a cloud provider's cloud environment. Cloud migration can also be the moving of assets from one cloud environment to another.

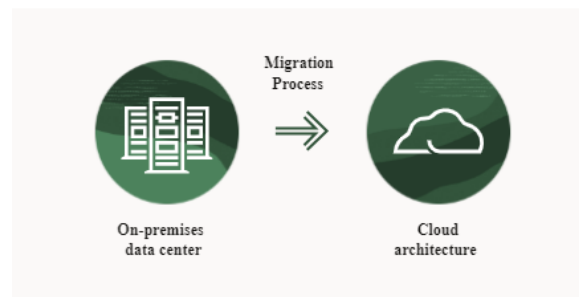


Figure 2. Migration Process

The cloud migration process can be broken down into several phases: Assessment and Planning, Proof of Concept, Migration, and Optimization. Successful cloud migration needs meticulous planning, a great understanding of business goals and performance indicators, while also considering technical and non-technical challenges such as data security, compliance, and cost management (Rimal. et al, 2009).

The first of Assessment and Planning includes evaluation of current infrastructure, identifying suitable cloud solutions, while also developing a migration strategy in the process. The next part in the migration process includes Proof of Concept, which includes testing the migration process on a small scale to identify potential issues and solutions. Then finally comes the migration process which involves executing the migration plan, including data transfer, application deployment, and system integration. Once the system is fully migrated, the Optimization process will help refine and optimize the resources needed to ensure they meet performance and system integration requirements (Shahzad, 2014).

On-Premises

On-premises or On-site infrastructure refers to the resources that are required to be hosted within an organization's own facilities. A traditional IT setup involves owning and managing physical servers, storage devices, and networking equipment. Businesses and organizations usually have control over the entirety of their on-premises environments, which include security, data management, and maintenance (Marston, et. al, 2011).

Some advantages of on-premises infrastructure include control and customization over their hardware and software environments, which allow for deep customization over specific business needs. Increased security also comes with on-premises infrastructure, where organizations can implement robust security measures to protect sensitive data from attacks outside of the organization. It is also easier to comply with regulatory requirements from external governance

bodies, which necessitate on-premises solutions to ensure maximum compliance with data sovereignty and privacy laws (Marston, et. al, 2011).

However, on-premises solutions often come with significant challenges related to costs and maintenance. On-premises solutions usually include high initial costs, due to the setting up needing substantial capital investment in hardware, software, and large-scale facilities in its implementation. Maintenance costs have also been a large worry in implementing an on-premises solution, requiring organizations to allocate resources for ongoing maintenance, upgrades, and troubleshooting (Zhao & Zhou, 2014). Scalability is also an issue, where scaling up an on-premises environment can be very time-consuming and costly, as it involves purchasing and configuring additional hardware.

As businesses scale up and grow, their IT needs also evolve, with many starting to consider hybrid models that take the best of both worlds, combining on-premises infrastructure with cloud solutions to leverage the benefits of both.

RESEARCH METHODS

The Systematic Literature Review (SLR) method is used in conducting this literature review on cloud migration, to ensure a structured, comprehensive, and unbiased synthesis of existing research. This approach involves defining clear research questions, developing a robust search strategy, and selecting relevant academic databases such as IEEE Xplore, Google Scholar, and ScienceDirect. By using targeted keywords, and performing data extraction with regards to methodologies, and practical examples, the extracted data can then be analyzed thoroughly to create conclusions and systemic outlines for future research.

RESULTS AND DISCUSSION

Trends in Cloud Migration

The literature review reveals several notable trends in cloud migration.

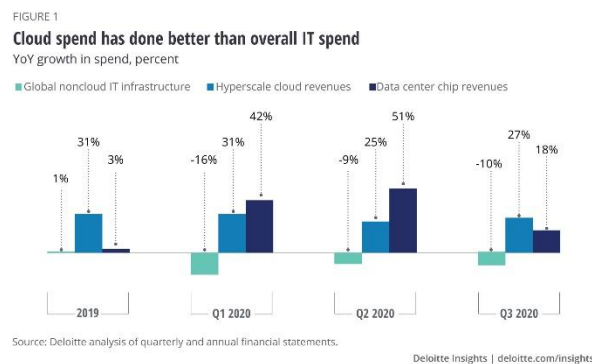


Figure 3. Cloud spend over IT Spend

There has been a significant increase in the adoption of cloud services across several industries. Organizations are increasingly opting to migrate their on-premises systems to the cloud, as shown by the figure above, which show that cloud spend has done multiple times better than IT spend over the last four quarters all the way from 2019 until Q3 of 2020.

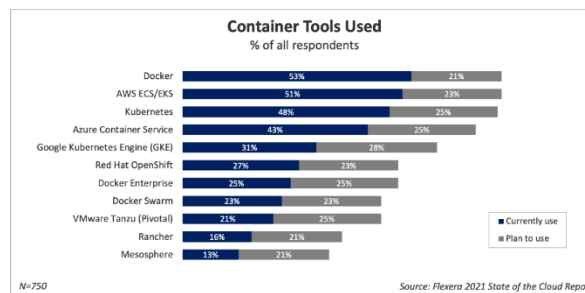


Figure 4. Container Tools Used

Trends also show that development focused on cloud-native applications have risen in the last decade, being able to take full advantage of cloud environments. This includes the use of microservices architecture and containerization with the use Dockerization and Kubernetes having increased in recent years.

Best Practices in Cloud Migration

Successful cloud migration starts with thorough and considerate planning, including a highly detailed assessment of the current implementation of the on-premises infrastructure, clear identification of business objectives and KPIs, and the development of a precise migration roadmap (Vetle, et al, 2010). Adopting a phased approach to migration—starting with non-critical applications and gradually moving to critical workloads—helps organizations manage risks and ensure smooth transitioning between on-premises and cloud infrastructure (Marston, et l, 2011).

Engaging stakeholders from various departments in the organization ensure that diverse perspectives are considered, fulfilling the needs of many, and potential issues are addressed proactively (Armbrust, 2010). After the migration process has finished, continuous monitoring and optimization of cloud resources are crucial for achieving the highest ratio of cost-efficiency and maintaining the best performance standards (Rimal, et al, 2009).

Challenges and Solutions in Cloud Migration

Several challenges have been associated with cloud migration in general, with some being consistently highlighted in the literature being reviewed. Ensuring high-level security and privacy of data during and after migration is a major challenge. With solutions include the implementation of strong encryption technologies, multi-level access controls, and regular security audits to ensure compliance with external laws and regulations (Shahzad, 2014).

Downtime and operational disruption are the two main enemies of cloud services. Minimizing these two issues is critical. Using strategies such as detailed migration planning, proof-of-concept testing, and phased migration can all help mitigate these risks (Vetle, et al, 2010). In-house expertise also needs to be considered. Investing in training and partnering with experienced cloud service providers can ensure that the organization knows what is going on within the cloud environment (Marston, 2011).

CONCLUSION

The transition from on-premises infrastructure to cloud-based environments represents a significant shift in the IT landscape, highly driven by the needs for increased scalability, cost efficiency, and flexibility in IT infrastructures across organizations. This paper has reviewed the existing literature on various topics such as scalability, cost efficiency, and flexibility, hoping to

provide a comprehensive overview of current trends and previously documented research associated with cloud migration.

The analysis revealed that there is a clear trend towards a rising adoption of cloud services across industries, with a growing preference for hybrid cloud solutions which combine the benefits of both on-premises and cloud environments. Several literatures also emphasize the importance of complete planning, phased migration, stakeholder engagement, and post-migration scaling and optimization. These practices are crucial to minimize risks, ensure smooth transitions, and achieve long-term success in the process.

Despite the numerous benefits, cloud migration also presents several challenges, particularly concerning data security, downtime, and skill gaps. Concluding these challenges requires several solutions, such as robust security measures, strategic planning, and investing in training and development to build in-house expertise in cloud technology to improve and build on the current infrastructure.

In summary, successful cloud migration requires a strategic approach that balances both the benefits of cloud with the inherent risks and challenges. Businesses and organizations that adopt and take advantage of the best practices listed above will be better positioned to leverage the full potential of cloud computing. As the technology continues to evolve, ongoing research and development are important in addressing emerging challenges and capitalizing on new opportunities in the cloud computing landscape.

REFERENCES

- Armbrust, M., Fox, A., Griffith, R., Joseph, A. D., Katz, R., Konwinski, A., ... & Zaharia, M. (2010). A view of cloud computing. *Communications of the ACM*, 53(4), 50-58.
- Binz, T., Leymann, F., & Schumm, D. (2011, December). CMotion: A Framework for Migration of Applications into and between Clouds. In *2011 IEEE International Conference on Service-Oriented Computing and Applications (SOCA)* (pp. 1-4). IEEE.
- Bremer, M., Walter, T., Fjodorovs, N., & Schmid, K. (2021). A systematic literature review on the suitability of cloud migration methods for small and medium-sized enterprises. *ESSN: 2701-6277*.
- Cloud, H. (2011). The nist definition of cloud computing. *National institute of science and technology, special publication*, 800(2011), 145.
- Marston, S., Li, Z., Bandyopadhyay, S., Zhang, J., & Ghalsasi, A. (2011). Cloud computing—The business perspective. *Decision support systems*, 51(1), 176-189.
- Rimal, B. P., Choi, E., & Lumb, I. (2009, August). A taxonomy and survey of cloud computing systems. In *2009 fifth international joint conference on INC, IMS and IDC* (pp. 44-51). Ieee.
- Shahzad, F. (2014). State-of-the-art survey on cloud computing security challenges, approaches and solutions. *Procedia Computer Science*, 37, 357-362.
- Velte, A. T., Velte, T. J., & Elsenpeter, R. C. (2010). *Cloud computing: a practical approach*. McGraw-Hill.
- Zhao, J. F., & Zhou, J. T. (2014). Strategies and methods for cloud migration. *international Journal of Automation and Computing*, 11(2), 143-152.