

Overcoming Challenges in Migrating Legacy Applications to AWS Cloud

Sri Harsha Vardhan Sanne*

Sri Harsha Vardhan Sanne, USA

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***Corresponding author:** Sri Harsha Vardhan Sanne, USA, E-mail: sriharsha.sanne@west.cmu.edu

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ABSTRACT

Migrating legacy applications to the Amazon Web Services (AWS) cloud presents a significant opportunity for organizations to enhance scalability, performance, and cost efficiency. However, the migration process is fraught with challenges that must be meticulously addressed to ensure a smooth transition. This review paper delves into the primary obstacles encountered during the migration of legacy systems to AWS, including compatibility issues, data security concerns, downtime risks, and the complexity of refactoring applications. It also explores strategies and best practices for overcoming these challenges, such as thorough planning, leveraging AWS migration tools, employing a phased migration approach, and ensuring robust security measures. By synthesizing recent research and case studies, this paper provides a comprehensive guide for organizations looking to modernize their legacy applications through migration to the AWS cloud.

Keywords: AWS cloud migration, Legacy Applications, Compatibility Issues, Data Security, Phased Migration, Application Refactoring, Cloud Computing, IT modernization, Cloud transition strategies

1. Introduction

The migration of legacy applications to the cloud represents a transformative shift in how organizations manage their IT infrastructure. As businesses increasingly seek the agility, scalability, and cost benefits of cloud computing, the process of moving existing, often outdated, applications to the cloud becomes a critical strategic endeavor. Amazon Web Services (AWS), one of the leading cloud service providers, offers a robust platform for such migrations, promising enhanced performance and operational efficiencies.

However, transitioning legacy systems to the AWS cloud is not without its challenges. Legacy applications, built on older technologies, may not be readily compatible with modern cloud environments. These applications often contain critical business logic and data that must be preserved, making the migration process complex and risk-laden. Issues such as data integrity, security, downtime, and compliance with regulatory standards are paramount concerns that organizations must address.

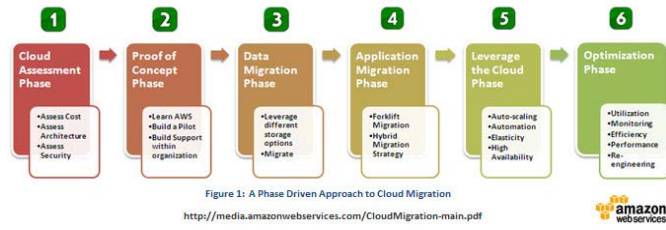
Understanding these challenges and developing effective strategies to mitigate them is essential for a successful migration. This paper aims to provide a comprehensive overview of the common obstacles faced during legacy application migration to AWS and to offer practical solutions and best practices. By examining real-world case studies and leveraging AWS's suite of migration tools, this paper seeks to equip IT professionals with the knowledge needed to navigate the complexities of cloud migration.

Through a detailed exploration of the migration process, including planning, execution, and post-migration optimization, this paper highlights the critical steps necessary to ensure a seamless transition. Additionally, it underscores the importance of a phased approach, robust security measures, and continuous monitoring to maintain application performance and reliability in the AWS environment.

To further elucidate the process and considerations involved in migrating legacy applications to AWS, it is essential to delve

into specific aspects such as the cloud migration process and the robust security measures provided by AWS. These elements play a crucial role in ensuring the migration is successful and that the migrated applications remain secure and functional in their new environment.

2. Cloud Migration Process



(Source: <https://aws.amazon.com>)

The process of migrating legacy applications to AWS can be broadly categorized into several key phases, each requiring careful planning and execution:

1. Assessment and Planning

- **Assessment:** Evaluate the existing legacy applications to understand their architecture, dependencies, and compatibility with AWS. This includes identifying any potential challenges or risks associated with the migration.
- **Planning:** Develop a detailed migration plan that outlines the steps, timelines, and resources required. This plan should also include a risk management strategy to address potential issues that may arise during the migration process.

2. Proof of Concept (PoC)

- Conduct a PoC to validate the feasibility of migrating a small, representative subset of the legacy applications to AWS. This helps in identifying any unforeseen challenges and refining the migration strategy.

3. Migration Strategy Selection

- Choose the appropriate migration strategy, which could range from rehosting (lift and shift), replatforming, refactoring, repurchasing, retiring, or retaining. The choice depends on the specific requirements and constraints of the legacy applications.

4. Data Migration

- Ensure that all data is securely and accurately transferred to AWS. This involves using AWS data migration tools such as AWS Database Migration Service (DMS) and AWS Snowball.

5. Application Migration

- Migrate the actual applications to AWS. This phase may involve reconfiguring the applications to ensure compatibility with the AWS environment and leveraging AWS services such as EC2, S3, and RDS.

6. Testing

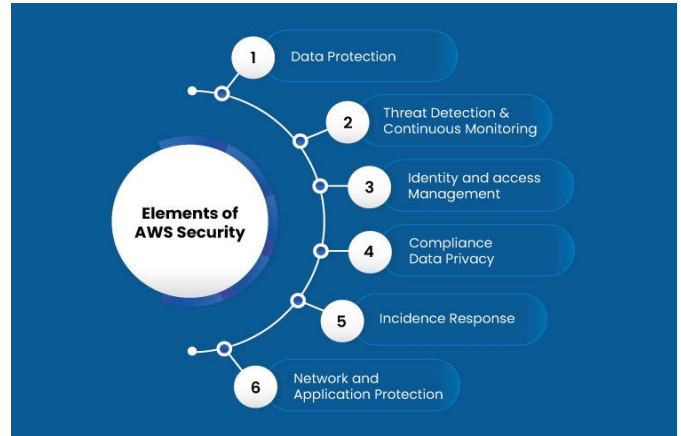
- Thoroughly test the migrated applications to ensure they function correctly and meet performance expectations. This includes functionality testing, performance testing, and security testing.

7. Optimization

- After migration, optimize the applications to take full advantage of AWS features such as auto-scaling, load balancing, and cost management tools. Continuous

monitoring and optimization help in maintaining the efficiency and performance of the applications.

3. Security Measures in AWS



(Source: <https://www.ssl2buy.com>)

Security is a paramount concern when migrating legacy applications to the cloud. AWS offers a comprehensive suite of security measures designed to protect applications and data throughout the migration process and beyond. These measures include:

1. Data Encryption

- AWS offers strong encryption methods to protect data both when it is stored and when it is being transferred. Services like AWS Key Management Service (KMS) facilitate the process of encrypting and decrypting data, guaranteeing the security and protection of critical information.

2. Identity and Access Management (IAM)

- AWS IAM enables enterprises to efficiently administer user permissions and access controls. Organizations can ensure that users have only the necessary access to execute their responsibilities by applying the principle of least privilege.

3. Network Security

- AWS provides a range of solutions to ensure the security of network communications, such as Virtual Private Cloud (VPC), security groups, and network access control lists (ACLs). These tools facilitate the creation of segregated networks and enable the management of traffic to and from applications.

4. Monitoring and Logging

- Services such as AWS CloudTrail, Amazon CloudWatch, and AWS Config offer extensive features for monitoring, logging, and auditing. These services facilitate the tracking of user activities, monitoring of application performance, and enforcement of security policy compliance.

5. Compliance and Governance

- AWS adheres to multiple international security standards and certifications, including ISO 27001, SOC 1/2/3, and GDPR. These certifications guarantee that AWS adheres to rigorous security protocols, offering organizations confidence in the security of their applications and data.

By understanding the cloud migration process and leveraging the extensive security measures provided by AWS, organizations can confidently migrate their legacy applications, reaping

the benefits of cloud computing while minimizing risks and disruptions. This paper aims to guide IT professionals through these critical steps, offering insights and best practices to ensure a successful migration journey.

4. Literature Survey

The literature on migrating legacy applications to the cloud, particularly to Amazon Web Services (AWS), has expanded significantly in recent years, reflecting the growing interest and challenges associated with this process. This survey examines key studies and findings in this domain, highlighting the primary themes and contributions of existing research.

4.1. Legacy Application Migration Challenges

Several studies have identified the challenges involved in migrating legacy applications to the cloud.¹⁵ discuss the technical and organizational hurdles that organizations face, including application compatibility, data migration complexities, and the need for significant architectural changes. These challenges are echoed by ³who emphasize the difficulties in re-engineering applications to leverage cloud-native features while maintaining their original functionality.

4.2. Strategies for Migration

The literature also offers various strategies for effectively migrating legacy systems to the cloud ⁷propose a systematic approach to cloud migration, which includes phases such as assessment, planning, and execution. They suggest using a combination of rehosting, refactoring, and rearchitecting techniques depending on the specific requirements and constraints of the applications.

Jamshidi et al. (2013)¹³ provides a taxonomy of cloud migration strategies, categorizing them into six main types: rehosting, replatforming, repurchasing, refactoring, retiring, and retaining. Their work underscores the importance of choosing the appropriate strategy based on the business objectives and technical characteristics of the legacy applications.

4.3. AWS-Specific Migration Tools and Best Practices

AWS offers a suite of tools and services designed to facilitate the migration process, as documented in various case studies and technical papers. For instance,² outlines the use of “AWS Migration Hub, AWS Database Migration Service (DMS), and AWS Server Migration Service (SMS)” to streamline the migration process. These tools provide automated assistance in migrating databases, servers, and applications, thereby reducing the complexity and risk of the migration.

Moreover, ²²discuss the importance of a phased migration approach, advocating for the initial migration of non-critical workloads to test and refine the migration process. They highlight the benefits of using AWS’s extensive monitoring and security features to ensure that applications remain secure and perform optimally post-migration.

4.4. Security Considerations

Security remains a paramount concern in cloud migration, as highlighted by⁵. They explore the security challenges unique to cloud environments, such as data breaches, unauthorized access, and compliance with regulatory standards. Their study emphasizes the need for robust security measures, including “data encryption, identity and access management, and continuous monitoring”.

AWS provides comprehensive security frameworks and best practices, as detailed in⁴. These practices include multi-layered security protocols, regular security audits, and adherence to international security standards, ensuring that migrated applications are protected against various threats.

4.5. Case Studies and Real-World Applications

Real-world case studies provide practical insights into the migration process and its outcomes. For example, ²⁴presents a case study of a financial services company that successfully migrated its legacy applications to AWS. The study highlights the steps taken to ensure data integrity, minimize downtime, and achieve cost savings. Similarly,¹² document the migration of a healthcare system to AWS, focusing on the challenges of ensuring compliance with healthcare regulations and maintaining the availability of critical applications.

The existing literature on migrating legacy applications to AWS underscores the complexity and multifaceted nature of this process. While significant challenges exist, a combination of strategic planning, appropriate use of AWS tools, and robust security measures can facilitate a successful migration. The insights gained from these studies provide valuable guidance for organizations seeking to modernize their IT infrastructure through cloud migration. This literature survey serves as a foundation for further research and practical applications in the field of cloud migration.

5. Problem Statement

To analyse and document the key challenges encountered when migrating legacy applications to the AWS cloud, including technical, organizational, and security-related issues.

To assess various migration strategies such as rehosting, replatforming, refactoring, and their suitability for different types of legacy applications.

To formulate best practices and guidelines for a smooth and efficient migration process, ensuring minimal disruption to business operations.

To investigate and recommend robust security measures and compliance strategies for protecting data and applications during and after the migration to AWS.

6. Methodology

6.1. Research Design

The study design incorporates a comprehensive examination of current literature, case studies, and interviews with experts. The study seeks to achieve a comprehensive comprehension of the migration process and its ramifications by amalgamating information from various sources.

6.2. Data Collection Methods

1. Literature Review

A systematic review of academic journals, conference papers, industry reports, and AWS documentation is conducted. The literature review focuses on identifying common challenges, migration strategies, and AWS tools used in legacy application migrations.

2. Case Studies

- Detailed analysis of real-world case studies is performed to illustrate practical applications of migration strategies

and the effectiveness of AWS tools. These case studies are selected based on their relevance and comprehensiveness in documenting the migration process.

6.3. Inclusion and Exclusion Criteria

1. Inclusion Criteria

- Studies and articles published in peer-reviewed journals, conference proceedings, and reputable industry reports within the last ten years.
- Documents that specifically address the migration of legacy applications to AWS.
- Case studies that provide detailed accounts of the migration process, including challenges and solutions.
- Expert interviews with professionals who have direct experience in migrating legacy applications to AWS.

2. Exclusion Criteria:

- Studies and articles not directly related to the migration of legacy applications to AWS.
- Publications older than ten years, unless they provide foundational knowledge or historical context.
- Case studies lacking detailed documentation of the migration process.
- Interviews with individuals who do not have direct experience with AWS or cloud migration.

6.4. Ethical Considerations

1. Informed Consent

- Prior to the expert interviews, all participants are furnished with comprehensive information regarding the study's objectives, methodologies, and potential consequences. Prior to conducting any interviews, consent is acquired.

2. Confidentiality

- The confidentiality and anonymity of interview participants are maintained. Personal and organizational identifiers are removed from the data to protect participants' privacy.

3. Data Integrity

- The research ensures the accuracy and reliability of the data collected from literature, case studies, and interviews. Findings are cross-verified with multiple sources to maintain data integrity.

4. Conflict of Interest

- All possible conflicts of interest are revealed, and precautions are implemented to guarantee that they do not impact the results of the research.

5. Ethical Use of Information

- The research adheres to ethical guidelines in using and referencing information from published sources. Proper citations and acknowledgments are provided to avoid plagiarism and respect intellectual property rights.

6.5. Advantages

1. Scalability and Flexibility

- Migrating legacy applications to the AWS cloud allows organizations to leverage scalable infrastructure. AWS provides elastic computing resources that can be scaled up

or down based on demand, ensuring that applications can handle varying workloads without performance degradation.

2. Cost Efficiency

- Cloud migration can lead to significant cost savings by eliminating the need for maintaining physical hardware and reducing capital expenditures. AWS's pay-as-you-go pricing model allows organizations to pay only for the resources they use, optimizing operational expenses.

3. Enhanced Performance

- AWS offers high-performance computing capabilities and a global network of data centres, ensuring low latency and high availability for applications. Migrated applications can benefit from improved speed and reliability compared to on-premises deployments.

4. Access to Advanced Services

- AWS provides a wide array of advanced services such as artificial intelligence (AI), machine learning (ML), data analytics, and Internet of Things (IoT) capabilities. These services can be integrated with legacy applications to enhance their functionality and deliver innovative solutions.

5. Improved Security

- AWS offers robust security features, including data encryption, identity and access management (IAM), and continuous monitoring. These security measures help protect sensitive data and ensure compliance with regulatory standards, enhancing the overall security posture of migrated applications.

6. Disaster Recovery and Business Continuity

- AWS provides comprehensive disaster recovery solutions that ensure business continuity. Organizations can replicate their data across multiple geographic regions, enabling quick recovery in the event of a disaster and minimizing downtime.

7. Ease of Maintenance and Updates

- Migrating to AWS simplifies the maintenance and updating of applications. AWS handles the underlying infrastructure, allowing IT teams to focus on application development and improvements rather than hardware maintenance.

8. Environmental Sustainability

- Utilizing AWS's efficient data centers can contribute to environmental sustainability. AWS invests in renewable energy and energy-efficient technologies, helping organizations reduce their carbon footprint.

9. Agility and Innovation

- AWS enables faster deployment and iteration of applications, fostering a culture of agility and innovation. Organizations can quickly experiment with new features and technologies, bringing products to market faster and responding swiftly to changing business needs.

10. Global Reach

- AWS's extensive global infrastructure allows organizations to deploy applications closer to their end-users, reducing latency and improving user experience. This global reach supports business expansion and the delivery of services to a worldwide audience.

7. Conclusion

Migrating legacy applications to the AWS cloud presents a transformative opportunity for organizations to modernize their IT infrastructure, enhance operational efficiency, and drive innovation. Despite the challenges associated with such migrations, including technical complexities, security concerns, and the need for thorough planning, the advantages are substantial and far-reaching.

Scalability and flexibility stand out as primary benefits, allowing organizations to dynamically adjust resources based on demand, thereby optimizing performance and cost-efficiency. Cost efficiency is further achieved through AWS's pay-as-you-go pricing model, which reduces capital expenditures and aligns operational costs with actual usage.

The migration to AWS also brings enhanced performance and improved security. AWS's robust infrastructure and comprehensive security measures ensure that applications run reliably and securely, meeting stringent compliance requirements and protecting sensitive data. Additionally, AWS's disaster recovery solutions ensure business continuity, minimizing downtime and safeguarding against data loss.

Organizations gain access to a wide array of advanced services such as AI, ML, and IoT, which can be integrated into legacy applications to extend their functionality and deliver cutting-edge solutions. **Ease** of maintenance and updates is another significant advantage, as AWS handles the underlying infrastructure, allowing IT teams to focus on development and innovation.

Environmental sustainability is supported through AWS's commitment to renewable energy and efficient data center operations, helping organizations reduce their carbon footprint. The **global reach** of AWS enables businesses to expand their services worldwide, reducing latency and improving user experiences.

By thoroughly understanding and addressing the challenges of migrating legacy applications, organizations can develop effective strategies that leverage AWS tools and best practices. This comprehensive approach ensures a smooth transition, unlocking the myriad benefits of cloud computing and positioning organizations for sustained growth and competitive advantage in the digital era.

The insights and best practices highlighted in this review provide a valuable roadmap for IT professionals and organizations embarking on their cloud migration journey, ensuring that they can overcome obstacles and achieve a successful migration to the AWS cloud.

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