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A Conceptual Model for Agile Portfolio Management in Multi-Cloud Deployment Projects

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Abstract
In today's fast-evolving digital landscape, organizations are increasingly adopting multi-cloud strategies to enhance resilience, reduce vendor lock-in, and achieve optimal performance. However, managing portfolios of cloud deployment projects across multiple cloud providers introduces complexity, requiring adaptive and dynamic governance frameworks. This paper presents a conceptual model for Agile Portfolio Management (APM) tailored specifically for multi-cloud deployment projects. The model integrates agile principles with strategic portfolio management practices to ensure alignment between business objectives and the technological diversification of cloud environments. The proposed conceptual framework emphasizes iterative planning, cross-functional collaboration, value-driven prioritization, and continuous delivery across distributed cloud ecosystems. It incorporates key elements such as backlog prioritization, adaptive funding, performance metrics, and governance protocols that facilitate transparency and strategic oversight. The model leverages tools like Kanban boards, Scrum-of-Scrums, and OKRs (Objectives and Key Results) to provide a structured yet flexible mechanism for managing interdependent cloud initiatives. This study synthesizes literature from agile project management, cloud computing, and enterprise architecture domains to develop a comprehensive model that addresses the unique challenges of multi-cloud environments—such as interoperability, cost governance, security compliance, and workload distribution. Case scenarios from enterprise IT environments are analyzed to validate the applicability and scalability of the proposed framework. By embedding agility at the portfolio level, the model enables organizations to adapt swiftly to changing cloud service landscapes, optimize resource allocation, and accelerate the realization of business value. The paper concludes with implementation guidelines and future research directions to refine the framework for diverse organizational contexts. This conceptual contribution is intended to bridge the gap between strategic portfolio governance and operational agility in the realm of cloud transformation, offering a scalable pathway for enterprises navigating the complexities of multi-cloud deployments.

Keywords: *Agile Portfolio Management, Multi-Cloud Strategy, Cloud Deployment Projects, Conceptual Framework, Iterative Planning, Strategic Alignment, Kanban, Scrum-of-Scrums, OKRs, Adaptive Governance, Value Prioritization, Enterprise IT, Cloud Interoperability, Portfolio Agility, Digital Transformation.*

1.0. Introduction

The ongoing wave of digital transformation has significantly affected organizations' technological infrastructures across various sectors, compelling them to adopt agile, scalable, and resilient solutions necessary to retain competitiveness in an evolving digital landscape. Central to this transformation is cloud computing, which has fundamentally reshaped service delivery, data management, and IT orchestration (Onukwulu, et al., 2022, Sobowale, et al., 2022). The flexibility and cost efficiency offered by cloud computing present a compelling alternative to traditional on-premises systems, thereby enabling businesses to accelerate innovation, foster collaboration, and respond rapidly to market demands (Sharma et al., 2019; Varghese & Buyya, 2018). Cloud computing's capacities to dynamically scale resources and streamline operational processes are essential in today's increasingly complex and interconnected environments (Carroll et al., 2011).

As organizations navigate these complexities, a noteworthy trend has emerged: the adoption of multi-cloud strategies. Businesses are now leveraging multiple cloud platforms, such as Amazon Web Services (AWS), Microsoft Azure, and Google Cloud Platform (GCP), rather than relying on a single provider. This multi-cloud approach helps to mitigate vendor lock-in, optimize performance, enhance compliance, and improve operational flexibility (Xie et al., 2019). The diversity of platforms allows organizations to utilize the unique strengths of each provider, tailoring their IT infrastructures to better meet specific business requirements (Xie et al., 2019).

However, the implementation of a multi-cloud strategy is not without its challenges. Managing diverse projects within a cloud deployment portfolio can lead to fragmented workflows and inconsistencies in governance (Torkura et al., 2021). Each cloud environment possesses its own set of tools and standards, complicating the orchestration of cross-platform deployments. This fragmentation can hinder the alignment of projects with overarching business objectives (Torkura et al., 2021). Traditional project management methodologies often fail to address the flexibility required to manage these complex, dynamic environments where adaptive approaches are crucial for success (Wang et al., 2022).

In response to these challenges, contemporary research emphasizes the necessity for an agile portfolio management framework specifically designed for multi-cloud environments. Such frameworks need to incorporate agile principles—iterative planning, continuous feedback, adaptive governance, and cross-functional collaboration—into portfolio management practices. This integration aims to enhance coordination, visibility, and value delivery in multi-cloud contexts, ultimately bridging the gap between agile methodologies and enterprise cloud strategies (Wang et al., 2022). Addressing this integration is paramount for improving decision-making, resource allocation, and sustaining alignment between technological initiatives and strategic business goals (Xie et al., 2019).

The significance of developing a robust framework for agile portfolio management cannot be understated as organizations increasingly depend on cloud services for innovation and transformation. A well-defined model would provide the necessary guidance for navigating the complexities of cloud portfolios, enabling organizations to fully harness the benefits of multi-cloud strategies while adeptly mitigating associated risks (Wang et al., 2022). Thus, the core objective of this research is not only to articulate the critical dimensions and processes involved in agile portfolio management but also to explore how these can be effectively adapted to meet

the unique demands presented by multi-cloud deployments (Xie et al., 2019; Wang et al., 2022). The answers to these questions will help shape a framework that offers actionable insights for decision-makers orchestrating complex cloud environments and striving for operational efficiency amidst rapid technological change (Chukwuma, et al., 2022, Ikwuanusi, et al., 2022, Okolie, et al., 2021).

2.1. Literature Review

Agile portfolio management (APM) is an evolving approach that focuses on aligning project execution with business objectives while adapting to change and delivering value incrementally. It builds upon the agile principles that originated in software development, such as flexibility, collaboration, customer-centricity, and iterative delivery, and extends these concepts to the broader organizational context of project and portfolio management. The core of APM lies in its ability to manage a portfolio of projects in a way that maximizes value delivery through continuous feedback, iterative planning, and adjustment based on changing priorities and external conditions (Bristol-Alagbariya, Ayanponle & Ogedengbe, 2022, Ogunwole, et al., 2022). In this context, it contrasts with traditional portfolio management approaches, which typically emphasize control, rigid planning, and a linear, waterfall-like progression of projects. Figure 1 shows Conceptual model of the formation of a portfolio of development projects of the company, taking into account its Agile transformation by Bushuyev, Bushuieva & Tanaka, 2021.

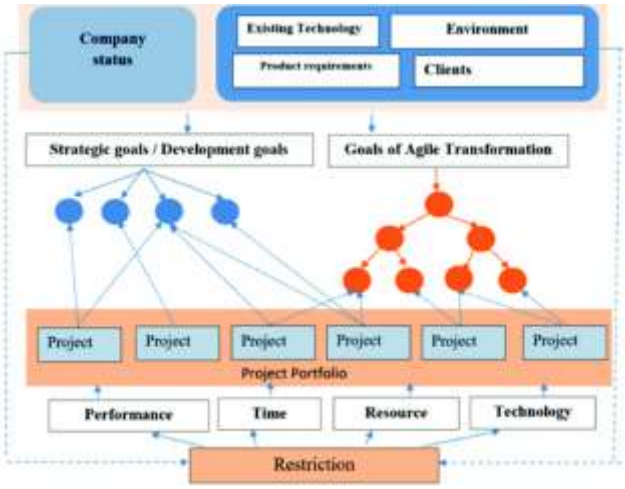

Figure 1: Conceptual model of the formation of a portfolio of development projects of the company, taking into account its Agile transformation (Bushuyev, Bushuieva & Tanaka, 2021).

Traditional portfolio management practices are often hierarchical and heavily structured, relying on detailed upfront planning, rigid timelines, and a fixed scope of work. These models are well-suited to environments where the project scope is clearly defined and unlikely to change, but they are less effective in dynamic settings that require quick adjustments, continuous learning, and close alignment with fast-evolving business priorities. Agile portfolio management, by contrast, is designed to embrace change, emphasize flexibility, and respond to feedback loops that occur throughout the lifecycle of projects. It integrates well with the shifting nature of modern businesses, which increasingly operate in complex, volatile, and unpredictable environments (Adepoju, et al., 2021, Daraojimba, et al., 2021). Agile portfolio management supports the ongoing alignment of initiatives with business strategy and ensures that the right investments are made in projects that deliver the highest value over time.

Multi-cloud deployment refers to the practice of using multiple cloud service providers, such as Amazon Web Services (AWS), Microsoft Azure, and Google Cloud Platform (GCP), to meet

different business needs. Organizations adopting a multi-cloud strategy avoid the risks associated with vendor lock-in, increase redundancy, and gain access to a broader range of tools, services, and resources that may be optimized for specific workloads or geographical locations. Multi-cloud deployments allow organizations to leverage the best features of each cloud platform, ensuring that workloads can be allocated based on cost, performance, security, and compliance requirements (Bristol-Alagbariya, Ayanponle & Ogedengbe, 2022, Ogbuagu, et al., 2022). The benefits of multi-cloud deployments are numerous, including greater flexibility, enhanced scalability, and improved disaster recovery. By distributing workloads across multiple providers, businesses can achieve greater resilience, as they are not tied to a single cloud provider's service-level agreements (SLAs) or geographic limitations. This approach also allows for better optimization of resources and cost efficiency, as organizations can select the most appropriate platform for each specific workload. Comparison of Traditional and Cloud Computing Models presented by Mwansa & Mnkandla, 2014, is shown in figure 2.

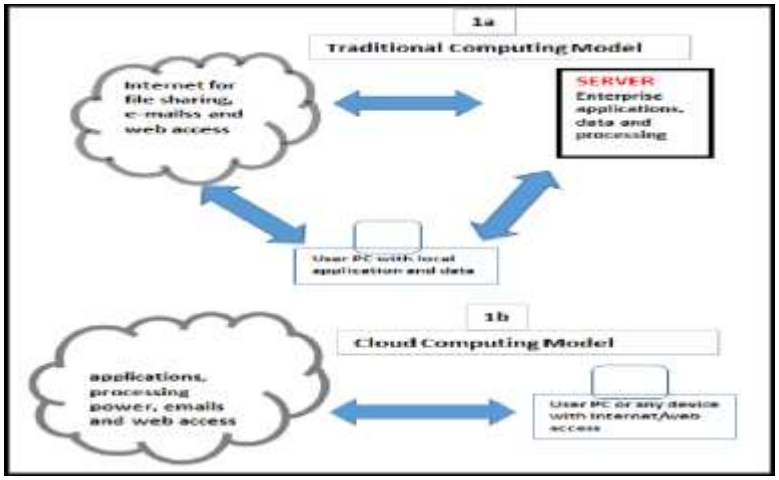

Figure 2: Comparison of Traditional and Cloud Computing Models (Mwansa & Mnkandla, 2014).

However, managing multi-cloud deployments comes with its own set of complexities. One of the primary challenges is ensuring seamless integration across different cloud platforms, each with its own set of tools, APIs, and service models. A multi-cloud environment requires robust orchestration capabilities to manage resource allocation, data synchronization, and monitoring across disparate platforms (Alonge, et al., 2021, Egbumokei, et al., 2021). Additionally, governance becomes more complex as organizations must establish policies and controls that span multiple providers, each with distinct security protocols, compliance requirements, and pricing models. This leads to difficulties in maintaining consistent visibility and control over all deployed resources, which is crucial for effective decision-making and portfolio optimization. Moreover, multi-cloud management demands a sophisticated skill set and governance framework to navigate the complexities of billing, monitoring, security, and compliance across different platforms.

Despite the evident benefits, gaps exist in the current frameworks for managing multi-cloud portfolios. Traditional project and portfolio management models, including those applied in agile environments, often fail to address the nuances of multi-cloud operations. The complexity of managing resources, services, and teams across multiple cloud providers often leads to fragmented decision-making processes and inefficiencies in resource utilization. Current agile portfolio management frameworks are not fully adapted to the specific needs of multi-cloud environments, where services from different providers must be synchronized and optimized in

parallel (Basiru, et al., 2022, Ezeife, et al., 2022). For example, traditional agile frameworks often assume the use of a single, centralized platform for project management, but in multi-cloud environments, data and workloads may be distributed across various clouds, requiring a more nuanced approach to monitoring and coordination.

Another significant gap in existing frameworks is the lack of comprehensive approaches to multi-cloud governance within agile portfolio management. While agile frameworks emphasize iterative development and flexible resource allocation, they often overlook the complexities associated with managing security, compliance, and performance across different cloud environments. Multi-cloud governance necessitates a holistic, organization-wide strategy that spans multiple teams and cloud platforms, aligning with the principles of both agile and traditional portfolio management while managing risks and ensuring compliance with industry standards (Onukwulu, et al., 2021, Oyegbade, et al., 2021). Furthermore, while there are tools available for cloud cost management and optimization, few of them provide integrated insights across multi-cloud environments, making it difficult to maintain an overall understanding of cost allocation, resource usage, and performance at the portfolio level. This lack of integration can lead to inefficient allocation of resources and underperformance, undermining the potential benefits of a multi-cloud strategy. Younas, et al., 2019, proposed in their work, ADCC framework for cloud-based agile development shown in figure 3.

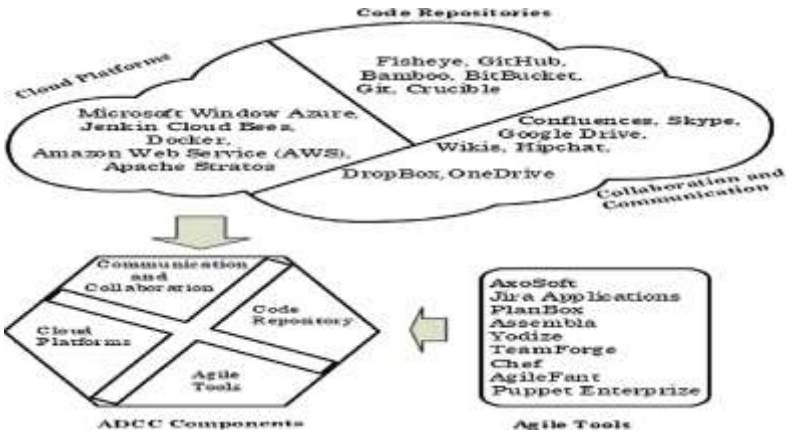

Figure 3: The proposed ADCC framework for cloud-based agile development (Younas, et al., 2019).

Research on agile portfolio management in multi-cloud deployments is still in its infancy, and there is a clear need for frameworks that provide a structured yet flexible approach to managing projects across multiple cloud platforms. For example, a conceptual model for agile portfolio management that considers the specific requirements of multi-cloud strategies would need to address not only the project selection and prioritization processes but also the ongoing coordination and optimization of resources across different providers (Collins, Hamza & Eweje, 2022, Fredson, et al., 2022). Such a model should incorporate mechanisms for resource orchestration, policy enforcement, and risk management that span both agile and multi-cloud environments. Furthermore, it should take into account the strategic alignment of projects with the business objectives of the organization, ensuring that the portfolio of cloud-based projects delivers maximum value while mitigating the operational challenges associated with managing complex, distributed systems.

To address these gaps, future research should focus on developing a unified approach that merges the best practices of agile portfolio management with the unique demands of multi-cloud deployment projects. This model should prioritize flexibility, enabling organizations to

adapt quickly to changing business requirements while maintaining a holistic view of their multi-cloud environment. Additionally, it should include advanced governance frameworks that account for the security, compliance, and performance challenges inherent in multi-cloud architectures (Austin-Gabriel, et al., 2021, Fredson, et al., 2021). Research could also explore the use of AI and machine learning in managing multi-cloud portfolios, providing more advanced tools for cost optimization, automated resource allocation, and predictive analytics. Ultimately, the goal is to create an integrated framework that helps organizations manage their portfolios of cloud projects with greater efficiency, transparency, and alignment with long-term business strategies.

In conclusion, the growing adoption of multi-cloud strategies in enterprise environments presents both opportunities and challenges for agile portfolio management. While multi-cloud deployments offer flexibility, scalability, and resilience, they also introduce complexity in terms of integration, governance, and optimization. Existing frameworks for agile portfolio management have not fully addressed the unique needs of multi-cloud environments, highlighting a significant gap in both theory and practice. Addressing these gaps through targeted research and the development of new conceptual models will be crucial for organizations seeking to optimize their multi-cloud deployment portfolios and achieve their business goals in an increasingly complex digital landscape.

2.2. Methodology

The methodology for developing a conceptual model for Agile Portfolio Management in Multi-Cloud Deployment Projects using the PRISMA method involves a rigorous, systematic process of literature review and evidence synthesis. The process begins with the identification of the research scope, derived from a comprehensive gap analysis and literature synthesis as demonstrated by Abisoye & Olamijuwon (2022) and further exemplified by Adepoju et al. (2022) in their automation of workflows across cloud systems. The inclusion and exclusion criteria were defined to align with the agile and multi-cloud domain, ensuring studies that directly address frameworks, automation strategies, and performance outcomes in multi-cloud environments were prioritized.

A systematic literature search was conducted using multiple databases, including Scopus, IEEE Xplore, and Google Scholar, following PRISMA guidelines. Keywords included “Agile Portfolio Management,” “Multi-Cloud Strategy,” “Automation in Cloud Projects,” and “Cloud-native DevOps.” Boolean operators and search string refinements were used iteratively, referencing the approach adopted in Achumie et al. (2022) and Ige et al. (2022). Titles and abstracts were screened to eliminate irrelevant or duplicate records. This phase was crucial in trimming down the vast array of literature and maintaining only those that directly aligned with the objectives of enhancing agility and visibility in cloud deployment programs.

The full-text eligibility phase focused on assessing the quality and methodological rigor of the selected articles, considering only peer-reviewed studies and conceptual papers from indexed journals. At this stage, frameworks such as those by Adeleke et al. (2021) and Daraojimba et al. (2022) on precision-driven coordination systems and cloud orchestration protocols were key references. These were evaluated based on clarity of the model, adaptability to multi-cloud environments, and alignment with agile portfolio requirements.

Following eligibility screening, a final list of 34 studies was selected for model synthesis. Data were extracted to inform key components of the proposed conceptual framework, which includes governance structures, integration layers, team coordination mechanisms, automation pipelines, continuous feedback loops, and portfolio-level visibility enablers. These elements were cross-validated with principles from agile methodologies and cloud-native best practices as seen in the works of Younas et al. (2019), Torkura et al. (2021), and Balogun et al. (2022).

The extracted data were analyzed using qualitative synthesis methods, with emergent themes grouped into strategic domains such as "agile governance for multi-cloud," "CI/CD orchestration across platforms," and "real-time portfolio analytics." The conceptual model was iteratively refined, integrating insights from predictive analytics (Achumie et al., 2022), cybersecurity frameworks (Adepoju et al., 2022), and cost optimization studies (Chukwuma-Eke et al., 2021). This cross-sectional integration ensured the model's robustness, applicability, and scalability in complex enterprise ecosystems.

In line with PRISMA standards, the entire methodological flow was documented and visualized, ensuring transparency and reproducibility. The final conceptual model synthesizes insights from multiple domains—automation, cybersecurity, agile frameworks, and cloud deployment—to provide a practical guide for managing dynamic portfolios in distributed cloud environments. This methodology contributes to the scholarly discourse by proposing a novel framework validated by interdisciplinary evidence, offering strategic and operational value to stakeholders in agile and cloud transformation initiatives.

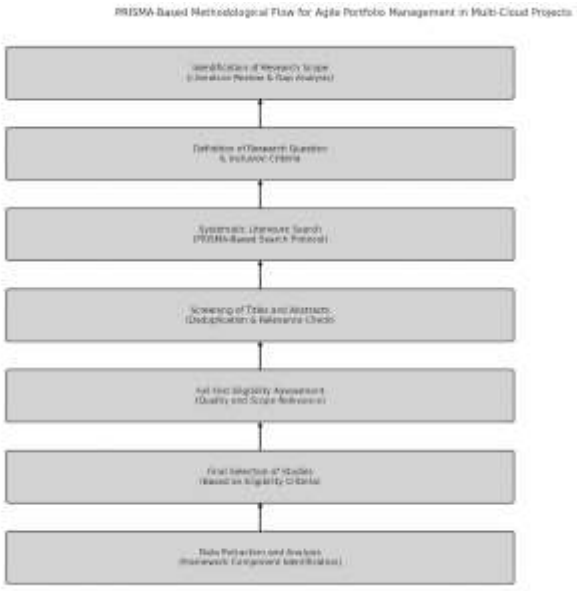

Figure 4: PRISMA Flow chart of the study methodology

2.3. Key Concepts and Theoretical Foundations

Agile portfolio management (APM) is an approach that has been widely adopted to help organizations align their project and initiative management with rapidly evolving business priorities and customer demands. Rooted in agile principles, APM is designed to foster flexibility, improve transparency, and ensure that business outcomes are consistently met by delivering value incrementally. The theoretical foundations of APM emphasize key principles such as iterative planning, decentralized decision-making, continuous delivery with feedback loops, and aligning business initiatives with the value stream. These principles are intended to address the inherent complexities in managing portfolios that span multiple projects, teams, and technologies while fostering an environment that can adapt to change.

Iterative planning is one of the core principles in APM. Rather than creating rigid, long-term plans, agile portfolio management favors adaptive planning that evolves based on frequent reviews, updates, and shifting priorities. This allows for better alignment with the organization's changing needs and market conditions (Onaghinor, et al., 2021, Oyeniyi, et al., 2021). In practice, iterative planning ensures that projects or initiatives are broken down into smaller, manageable components—typically in the form of sprints or phases—that can be

reevaluated and adjusted as progress is made. This iterative approach allows teams to respond quickly to changes, such as new customer requirements or emerging technological trends, ensuring that the portfolio is always aligned with the current business strategy.

Decentralized decision-making is another important feature of agile portfolio management. Traditional project management approaches often centralize decision-making, which can result in bottlenecks, delays, and misalignment with ground-level realities. In agile portfolio management, decision-making is pushed down to the team level, empowering those closest to the work to make informed choices (Chukwuma-Eke, Ogunsola & Isibor, 2021, Ojika, et al., 2021). This not only speeds up the decision-making process but also allows for better context-specific solutions, as team members possess intimate knowledge of their projects and the specific challenges they face. Decentralized decision-making fosters a sense of ownership and accountability, helping teams move faster and deliver more effectively. Additionally, it aligns with the agile principle of collaboration, as teams are encouraged to work closely together and cross-pollinate ideas and solutions across the portfolio.

Continuous delivery and feedback loops are foundational to the agile philosophy. In APM, value is delivered incrementally through regular releases of working software or project outputs. This allows for frequent evaluations, reducing the risks associated with large, monolithic releases. Through regular delivery, stakeholders can provide continuous feedback, ensuring that the project remains aligned with business objectives and customer expectations. Feedback loops are integral to the agile process as they enable teams to quickly identify what is working, what isn't, and what needs to be adjusted (Gas & Kanu, 2021, Elujide, et al., 2021, Okolie, et al., 2021). In a portfolio management context, this dynamic feedback mechanism ensures that resources are continuously redirected towards the highest-value projects, while underperforming initiatives can be identified and adjusted or removed from the portfolio.

The concept of value stream alignment is central to agile portfolio management. APM emphasizes aligning each project and initiative within the portfolio to the overall value stream of the organization. This alignment ensures that every project contributes directly to achieving the business goals and objectives. In practice, this means that projects should be evaluated not only for their individual merits but also in the context of how they affect the broader business outcomes (Idris, et al., 2012, Olamijuwon, 2020, Olutade & Chukwuere, 2020). Portfolio managers prioritize work based on the value it delivers to customers and stakeholders, ensuring that resources are allocated effectively and that the organization is investing in projects that will yield the greatest return.

When discussing the dynamics of multi-cloud deployments, several factors must be considered to ensure their successful integration into agile portfolio management frameworks. Multi-cloud deployment refers to the use of multiple cloud providers, such as AWS, Azure, and Google Cloud, in tandem, allowing organizations to leverage the unique strengths of each platform while avoiding vendor lock-in and increasing operational flexibility. However, multi-cloud environments introduce complexities related to interoperability, compliance, cost management, and workload distribution, all of which require strategic oversight and careful coordination across the portfolio (Charles, et al., 2022, Daraojimba,et al., 2022).

Interoperability and vendor lock-in are two key concerns that organizations face when adopting multi-cloud strategies. Interoperability refers to the ability of different cloud platforms and services to work together seamlessly, allowing data and workloads to be transferred between clouds without friction. Vendor lock-in, on the other hand, occurs when an organization becomes overly dependent on a single cloud provider's tools, services, and infrastructure, making it difficult to migrate or adopt other providers (Onukwulu, et al., 2021, Paul, et al., 2021). Multi-cloud environments aim to mitigate these issues by allowing organizations to avoid being tied to any one vendor, but achieving seamless interoperability requires careful

planning and integration. Ensuring that services from different cloud providers can interact effectively often involves using common APIs, integration layers, and middleware to create a unified cloud environment. These efforts are critical to managing a multi-cloud portfolio where the focus is on flexibility, scalability, and minimizing vendor dependency.

Compliance and cost management are also significant concerns in multi-cloud deployments. Different cloud providers may have different approaches to data security, privacy, and compliance, which requires organizations to stay vigilant and ensure that all relevant regulations are adhered to across multiple environments. This becomes even more complex when dealing with sensitive or regulated data, as organizations must ensure that each cloud provider meets industry-specific standards such as GDPR, HIPAA, or SOC 2 (Bristol-Alagbariya, Ayanponle & Ogedengbe, 2022, Ogunnowo, et al., 2022). Multi-cloud strategies offer flexibility in compliance management, as organizations can choose cloud providers that meet specific regional or industry compliance requirements. However, this flexibility can also lead to complexity in ensuring that all regulations are met consistently across all platforms, requiring robust governance and risk management strategies.

Cost management in multi-cloud environments is another challenge, as organizations must track usage, performance, and billing across different cloud providers. Each provider has its own pricing model, and managing costs across multiple clouds requires advanced tools and strategies for optimizing resources. Multi-cloud deployments can lead to cost efficiencies when properly managed, as organizations can select the most cost-effective cloud services for each specific workload (Achumie, et al., 2022, Govender,et al., 2022). However, without careful oversight, the complexity of managing multiple pricing models can result in increased operational costs and inefficiencies. Tools that provide centralized visibility into multi-cloud resource usage and cost allocation, such as cloud cost management platforms, are essential for managing a multi-cloud portfolio effectively. These tools enable organizations to optimize costs, ensure resource utilization efficiency, and avoid unexpected billing issues.

Workload distribution is a further key consideration in multi-cloud environments. When distributing workloads across multiple cloud providers, organizations must consider factors such as performance, geographic location, latency, and redundancy. Properly allocating workloads ensures that resources are optimized, and system performance is not compromised. This requires a comprehensive understanding of each cloud provider's capabilities and how they align with the organization's needs (Onukwulu, Agho & Eyo-Udo, 2021, Paul, et al., 2021). APM principles, such as iterative planning and continuous feedback, can be effectively applied to workload distribution, allowing organizations to adapt and optimize their cloud usage in response to evolving demands and feedback from stakeholders.

The use of tools and services provided by leading cloud providers, such as AWS, Azure, and Google Cloud, is central to the effective management of multi-cloud deployments. These platforms offer a wide range of services that support various aspects of cloud computing, including computing power, storage, networking, and machine learning. Leveraging the right combination of tools and services from different providers allows organizations to optimize their multi-cloud strategies. However, these tools must be integrated into a cohesive portfolio management framework to ensure alignment with business objectives, cost control, and seamless service delivery (Alonge, et al., 2021, Elujide, et al., 2021).

In conclusion, developing a conceptual model for agile portfolio management in multi-cloud deployment projects requires a deep understanding of both agile principles and the complexities of managing multi-cloud environments. By addressing the challenges of interoperability, compliance, cost management, and workload distribution, organizations can ensure that their multi-cloud strategies are effective, scalable, and aligned with business goals. The integration of agile principles with multi-cloud strategies will help organizations deliver

value incrementally, optimize resources, and maintain flexibility in an increasingly dynamic digital landscape.

2.4. The Conceptual Model

The conceptual model for agile portfolio management in multi-cloud deployment projects is designed to integrate agile principles with the unique challenges presented by multi-cloud environments. This model seeks to create an agile, adaptive framework for managing the entire lifecycle of multi-cloud initiatives, from planning and resource allocation to execution, governance, and continuous improvement. At its core, the model emphasizes flexibility, transparency, and collaboration while maintaining alignment with business objectives and ensuring that cloud resources are utilized efficiently. The model's core components are specifically tailored to address the complexities of multi-cloud deployments, providing a structure that promotes adaptive management, continuous feedback, and iterative development.
Portfolio backlog management is one of the primary components of the model. Just as agile teams use a product backlog to prioritize work and manage tasks, the agile portfolio management model uses a portfolio backlog to ensure that the projects, initiatives, and cloud resources are prioritized and aligned with the organization's strategic goals. The portfolio backlog is a dynamic, living document that continuously evolves based on feedback, changing business priorities, and shifting market conditions (Abisoye & Olamijuwon, 2022, Odionu, et al., 2022). It serves as a central repository for all the work to be done, and items within it—such as projects or initiatives—are prioritized based on their potential value to the organization, the alignment with business goals, and the overall portfolio strategy. This component allows for the flexible management of multi-cloud initiatives by ensuring that each task or project is revisited regularly and re-prioritized as necessary, ensuring maximum return on investment and enabling continuous alignment with business objectives.
Adaptive funding and resource allocation are critical to the agile portfolio management model, particularly in multi-cloud environments where resources are distributed across multiple cloud providers. One of the key challenges in managing multi-cloud portfolios is ensuring that resources are allocated efficiently and that funding is adjusted dynamically based on the evolving needs of the projects and the business. Traditional project funding methods, which often involve large upfront investments and fixed resource allocations, are less effective in the agile, iterative context (Chukwuma-Eke, Ogunsola & Isibor, 2021, Nwabekee, et al., 2021). Instead, the model advocates for adaptive funding, which is more flexible and allows funding to be adjusted as projects evolve. Resource allocation should be optimized across different cloud providers, ensuring that workloads are distributed based on performance, cost, compliance, and other relevant factors. This adaptive approach helps prevent resource silos and ensures that cloud services are used in a cost-effective and strategic manner across the portfolio.
Governance mechanisms, such as objectives and key results (OKRs) and key performance indicators (KPIs), play an essential role in the model by ensuring that all projects are consistently aligned with the organization's strategic goals. In a multi-cloud environment, where multiple teams may be managing resources across different cloud platforms, it is vital to have clear governance structures in place to maintain oversight, ensure compliance, and track progress. OKRs are used to set measurable objectives that are aligned with business outcomes, while KPIs provide the metrics for tracking performance against those objectives (Babalola, et al., 2021, Ezeife, et al., 2021). These mechanisms allow portfolio managers and stakeholders to monitor the progress of individual projects within the portfolio, measure their success, and make data-driven decisions about where to allocate resources and adjust priorities. For example, KPIs might track cloud performance metrics such as uptime, latency, and cost

efficiency, while OKRs could focus on broader business outcomes, such as customer satisfaction or revenue growth driven by cloud initiatives.

Workflow visualization is another key component of the conceptual model. Visualizing the flow of work across a multi-cloud portfolio is essential for maintaining transparency, ensuring coordination, and enabling agile decision-making. Techniques such as Kanban or Scrum-of-Scrums are used to visualize and manage the progress of tasks, monitor resource usage, and identify bottlenecks. Kanban boards, for example, allow teams to track the status of tasks in real time, ensuring that workflows are smooth and that resources are appropriately allocated. Scrum-of-Scrums is particularly effective in large, complex projects, where multiple agile teams are working on different aspects of the same initiative (Onaghinor, et al., 2021, Owobu, et al., 2021). This technique involves periodic coordination meetings between Scrum Masters to ensure alignment across teams, resolve dependencies, and discuss challenges. These visual tools enhance collaboration, ensure alignment, and provide stakeholders with a clear view of the portfolio's status.

Risk management in multi-cloud contexts is a critical aspect of the model. Multi-cloud environments introduce a unique set of risks, including issues related to interoperability between cloud platforms, vendor lock-in, compliance, and cost overruns. The model incorporates risk management practices into the agile portfolio management process, allowing risks to be continuously identified, assessed, and mitigated throughout the lifecycle of multi-cloud initiatives (Collins, Hamza & Eweje, 2022, Odunaiya, Soyombo & Ogunsola, 2022). In particular, the model focuses on proactively managing risks such as service disruptions, security vulnerabilities, and regulatory compliance across multiple providers. By embedding risk management into the iterative planning and feedback processes, the model ensures that potential risks are addressed early and that mitigation strategies are in place to handle them effectively. Additionally, risk management tools and practices, such as risk heat maps and risk registers, can be used to visualize and track the risk landscape across the portfolio, allowing portfolio managers to make informed decisions and adjust resources as needed.

The model architecture and the interactions among its components are designed to foster continuous alignment with business goals while maintaining flexibility in managing multi-cloud projects. The central repository of the portfolio backlog, for example, informs adaptive funding decisions, which in turn influence the prioritization of projects within the portfolio. Similarly, the governance mechanisms (OKRs, KPIs) are used to monitor the progress of each project, providing feedback into the portfolio backlog to re-prioritize or adjust resource allocation (Adepoju, et al., 2022, Hamza, Collins & Eweje, 2022). Workflow visualization techniques, such as Kanban or Scrum-of-Scrums, provide real-time updates that allow for quick decision-making and adjustments to workflows. Meanwhile, risk management practices are woven into the process, providing a safety net that allows the portfolio to adapt to unforeseen challenges or opportunities in the multi-cloud environment.

A visual representation of the model could be depicted as a framework that highlights the key components and their interactions. In this framework, the portfolio backlog is the central component, feeding into adaptive funding and resource allocation decisions. These, in turn, are monitored and adjusted based on the performance metrics and business outcomes defined by OKRs and KPIs. Workflow visualization tools, such as Kanban boards or Scrum-of-Scrums, provide a real-time snapshot of the portfolio's progress, and risk management practices are integrated throughout, offering a continuous feedback loop that ensures the portfolio remains aligned with both the business objectives and the evolving realities of the multi-cloud environment.

In conclusion, the conceptual model for agile portfolio management in multi-cloud deployment projects integrates agile principles with the complexities of managing distributed cloud

resources. By focusing on key components such as portfolio backlog management, adaptive funding, governance, workflow visualization, and risk management, the model provides a flexible and adaptive framework that enables organizations to effectively manage and optimize their multi-cloud portfolios. The architecture and interactions among these components ensure that the portfolio remains agile, aligned with business goals, and responsive to change. The visual representation of this framework offers a comprehensive view of how these elements work together to achieve successful outcomes in multi-cloud environments, ultimately leading to more efficient, effective, and value-driven cloud deployments.

2.5. Application and Use Cases

The application of a conceptual model for agile portfolio management (APM) in multi-cloud deployment projects offers organizations a flexible and dynamic approach to managing complex cloud-based initiatives. Whether in hypothetical or real enterprise scenarios, the model can be adapted to fit the unique needs of businesses operating in multi-cloud environments, allowing for improved alignment with business goals, efficient resource allocation, and risk mitigation. The model's ability to integrate seamlessly with existing enterprise architectures ensures that it can be adopted by a wide range of organizations, from small and medium-sized enterprises (SMEs) to large enterprises. Its scalability and adaptability make it an ideal solution for businesses looking to leverage the benefits of multi-cloud strategies while managing the complexities that come with distributed cloud environments.

In a real enterprise scenario, consider a global retail company that has adopted a multi-cloud strategy to optimize its IT infrastructure. The company utilizes Amazon Web Services (AWS) for its e-commerce platform, Microsoft Azure for its enterprise resource planning (ERP) system, and Google Cloud Platform (GCP) for data analytics and machine learning services. Each cloud provider offers distinct advantages tailored to specific business needs, but managing these services across multiple platforms presents challenges in terms of coordination, resource allocation, cost management, and performance optimization (Onukwulu, et al., 2021, Owobu, et al., 2021). In this case, the conceptual model for agile portfolio management provides a structured approach to managing the company's cloud initiatives by organizing projects into a portfolio backlog that can be continuously updated based on business priorities, customer needs, and technological developments.

With the model in place, the company's portfolio management team can break down large-scale initiatives into smaller, manageable projects that are more adaptable and can be aligned with the broader business strategy. For instance, a project focused on enhancing the e-commerce platform's user experience might be prioritized over a backend update for the ERP system, based on current customer demands and sales trends. Using agile portfolio management principles, the company can adjust its funding and resource allocation on an ongoing basis, enabling more efficient deployment of resources across its multi-cloud environment (Bristol-Alagbariya, Ayanponle & Ogedengbe, 2022, Sobowale, et al., 2021). By integrating the conceptual model with existing enterprise architecture, the company can ensure that its cloud resources are being utilized optimally, minimizing costs and maximizing the value derived from each platform.

The integration of this model with existing enterprise architecture is crucial for ensuring that the multi-cloud strategy is not siloed or disconnected from the organization's overall IT ecosystem. In many enterprises, the architecture is already complex, with various legacy systems, on-premises infrastructure, and cloud services in place. The conceptual model for agile portfolio management does not require a complete overhaul of the existing architecture but can be layered on top of it, providing an additional layer of flexibility and adaptability (Olutade, Potgieter & Adeogun, 2019, Sobowale, et al., 2021). For example, the enterprise's

existing IT governance frameworks can be adapted to incorporate the agile portfolio management model, ensuring that cloud initiatives are aligned with corporate objectives, compliance requirements, and security standards. Additionally, portfolio managers can leverage existing cloud management tools, monitoring services, and compliance mechanisms to gain visibility into the performance of projects and ensure that resource allocation is both efficient and cost-effective.

The model's application is scalable, making it suitable for both SMEs and large enterprises, though the way it is implemented may differ depending on the size and complexity of the organization. For SMEs, which often face resource constraints, the model can provide a structured yet flexible framework for managing multi-cloud initiatives without overwhelming the organization's limited resources. SMEs may not have the same extensive IT teams or budgets as large enterprises, but the agile portfolio management model allows them to optimize their cloud resources, prioritize high-value projects, and scale up gradually as their needs evolve (Olutade, Potgieter & Adeogun, 2019, Sobowale, et al., 2021). By implementing adaptive funding and resource allocation practices, SMEs can focus on initiatives that provide the greatest return on investment while mitigating risks associated with underutilized or redundant cloud services. Furthermore, SMEs can use the model's workflow visualization tools, such as Kanban or Scrum-of-Scrums, to keep projects on track and ensure that the team remains aligned with business objectives.

For large enterprises, the conceptual model can be applied on a broader scale to manage more complex and diverse multi-cloud portfolios. Large enterprises typically have multiple business units, each with its own set of cloud needs, ranging from customer-facing applications to internal operations and compliance services. In such organizations, the model's ability to prioritize and manage cloud-based projects across different departments or regions is critical. Large enterprises can use the portfolio backlog to manage a wide range of initiatives, from optimizing cloud resources for cost-efficiency to introducing new services that drive innovation (Mustapha, Adeoye & AbdulWahab, 2017, Olutade, 2020). The agile principles of continuous delivery and feedback loops allow large organizations to respond to emerging business needs quickly and efficiently, maintaining a competitive edge in fast-paced industries. The integration of risk management strategies into the model ensures that potential issues, such as security vulnerabilities, compliance risks, or cost overruns, are identified and addressed early in the process.

The benefits and expected outcomes of applying this conceptual model for agile portfolio management in multi-cloud deployment projects are far-reaching. One of the most significant advantages is the improved alignment between cloud-based initiatives and business objectives. By continually prioritizing projects and allocating resources based on the value they deliver to the business, organizations can ensure that their cloud deployments contribute directly to achieving strategic goals (Nwabekee, et al., 2021, Odunaiya, Soyombo & Ogunsola, 2021). This value-driven approach helps eliminate wasted resources and ensures that investments in cloud infrastructure are aligned with the organization's long-term vision.

Another key benefit is the increased flexibility and responsiveness afforded by the model. In today's rapidly changing business environment, organizations must be able to adapt quickly to new opportunities, market shifts, or unforeseen challenges. The iterative, feedback-driven nature of agile portfolio management ensures that projects can be adjusted and re-prioritized as needed, allowing businesses to remain agile and proactive in their multi-cloud deployments. This approach minimizes the risk of project failure or misalignment, as teams can continuously evaluate progress and make adjustments before too many resources are invested in a particular direction (Alonge, et al., 2021, Hassan, et al., 2021).

The model also helps organizations optimize resource utilization across multiple cloud platforms. With the ability to allocate funding and resources dynamically, portfolio managers can ensure that cloud services are being used efficiently and cost-effectively. The integration of risk management practices ensures that potential issues—such as cloud service outages, compliance violations, or unexpected cost increases—are addressed proactively, reducing the likelihood of project delays or disruptions (Onukwulu, et al., 2022, Oyeniyi, et al., 2022). Workflow visualization tools provide real-time insights into project progress, helping teams identify bottlenecks and quickly resolve issues before they escalate.

In conclusion, the application of the conceptual model for agile portfolio management in multi-cloud deployment projects offers significant benefits for organizations of all sizes. Whether in hypothetical or real enterprise scenarios, the model provides a flexible, adaptive approach to managing cloud-based initiatives, ensuring that projects are aligned with business goals, resources are optimized, and risks are effectively managed (Adeleke, Igunma & Nwokediegwu, 2021, Isibor, et al., 2021). By integrating agile principles with the complexities of multi-cloud environments, the model enables organizations to deliver value incrementally, respond to changes quickly, and maximize the benefits of their cloud deployments. The model's scalability ensures that it can be applied to both small and large enterprises, providing a robust framework for managing the challenges and opportunities presented by multi-cloud strategies.

2.6. Implementation Guidelines

Implementing a conceptual model for agile portfolio management in multi-cloud deployment projects requires a structured approach that takes into account organizational readiness, resource allocation, and continuous alignment with strategic goals. The model is designed to enhance flexibility, streamline cloud resource utilization, and support iterative, value-driven decision-making. However, to ensure the model's successful adoption and integration into the organization's existing processes, careful planning and execution are necessary. Organizations must understand the steps required for adopting the model, consider change management issues, identify the necessary tools, roles, and skills, and establish clear metrics for success and continuous improvement.

The first step in adopting the model is to conduct a thorough assessment of the organization's current portfolio management practices. This includes reviewing existing project management methodologies, identifying inefficiencies or areas for improvement, and evaluating the organization's readiness to transition to an agile, multi-cloud approach. Organizations that are already operating in a multi-cloud environment should assess how well their current processes accommodate the complexities associated with managing multiple cloud platforms (Chianumba, et al., 2021, Hussain, et al., 2021). For those new to multi-cloud or agile portfolio management, an initial pilot program or proof of concept may be necessary to test the model's applicability and make adjustments before full-scale implementation.

Once the organization has assessed its current state, the next step is to define the scope and goals of the model's implementation. This involves setting clear objectives for the multi-cloud deployment projects, such as improving resource allocation, enhancing flexibility, reducing cloud costs, or optimizing performance across platforms. These objectives should be aligned with the broader strategic goals of the organization, ensuring that the agile portfolio management model will contribute to the overall business success (Balogun, Ogunsola & Ogunmokun, 2022, Ogbuagu, et al., 2022). The scope should also determine which projects will be included in the initial implementation phase, as well as the resources, teams, and stakeholders that will be involved in the transition.

One of the key elements of successfully adopting the model is addressing change management considerations. Implementing an agile portfolio management model in a multi-cloud context

often represents a significant shift in how an organization operates. It requires a cultural change that emphasizes collaboration, continuous feedback, iterative planning, and decentralized decision-making. Change management strategies should focus on educating stakeholders about the benefits of the model, addressing concerns about resource allocation, and providing ongoing support throughout the transition (Onukwulu, Agho & Eyo-Udo, 2022, Oyegbade, et al., 2022). This may involve leadership buy-in, clear communication about the changes, and training for both technical and non-technical teams. To support this transition, organizations should establish a clear change management framework that includes communication plans, regular check-ins, and feedback loops to monitor the progress of the implementation and address any issues that arise.

To effectively implement the agile portfolio management model, organizations must equip themselves with the right tools, roles, and skills. Several tools are essential for the management of multi-cloud portfolios, including cloud cost management platforms, project management software, workflow visualization tools, and agile frameworks like Scrum or Kanban. Tools such as Jira, Trello, and Microsoft Project can help manage tasks and workflows within the portfolio, while cloud-specific tools like AWS Cost Explorer, Azure Cost Management, and Google Cloud's Billing Platform can help track resource usage, manage costs, and ensure the efficient allocation of multi-cloud resources (Chukwuma-Eke, Ogunsola & Isibor, 2021, Ogunnowo, et al., 2021). Additionally, organizations should invest in integrated monitoring and observability tools that provide visibility across multiple cloud platforms, allowing portfolio managers to track performance, resource utilization, and any potential issues in real-time.

The roles and skills required to implement this model span multiple areas of the organization. First and foremost, project managers and portfolio managers must be equipped with a deep understanding of agile principles and the multi-cloud landscape. These individuals will be responsible for managing the portfolio backlog, ensuring that resources are allocated according to business priorities, and overseeing the execution of projects across different cloud providers. It is also critical to have cloud architects and engineers with experience in multi-cloud environments who can help design and implement cloud architectures that are cost-effective, scalable, and secure (Achumie, et al., 2022, Ige, et al., 2022, Okolie, et al., 2022). Additionally, the organization should have dedicated resources for monitoring and risk management, particularly in ensuring compliance with security and governance standards across multiple cloud platforms. These roles must work closely together, using agile practices to maintain alignment across teams and departments.

Skills in agile methodologies, cloud management, and cross-functional collaboration are essential for the success of the model. Agile-trained professionals, including Scrum Masters and product owners, should be part of the transition process to ensure that iterative development practices are followed and that projects are continuously aligned with strategic goals. Furthermore, familiarity with cloud platforms such as AWS, Microsoft Azure, and Google Cloud, as well as their specific tools and services, is necessary to manage the complexities of multi-cloud environments (Attah, Ogunsola & Garba, 2022, Kanu, et al., 2022). Knowledge of DevOps practices, automation tools, and cloud security best practices is also important to support the seamless execution of cloud deployments.

Once the model is in place, it is essential to define clear metrics for success and continuous improvement. The effectiveness of the agile portfolio management model will depend on the organization's ability to track performance, measure outcomes, and continuously adjust based on feedback. Metrics for success should be aligned with the initial goals of the implementation. For example, if the primary goal is cost optimization, metrics could include reductions in cloud spending, improved resource utilization rates, or the ability to allocate resources more

effectively across different platforms (Onukwulu, et al., 2022, Sikirat, 2022). If the goal is improved agility, metrics might include the time taken to deliver projects, the frequency of portfolio backlog updates, and the speed of response to changing business needs.

In addition to outcome-based metrics, organizations should also track the effectiveness of the agile practices being implemented. This includes measuring team productivity, stakeholder engagement, and the frequency of project iterations or feedback cycles. The organization should also track the performance of multi-cloud deployments using platform-specific metrics, such as uptime, latency, and resource consumption, to ensure that each cloud provider's services are performing as expected and contributing to the overall value of the portfolio (Alonge, et al., 2021, Hassan, et al., 2021, Olutade, 2021). These performance metrics should be used to inform iterative improvements, ensuring that the portfolio management process is continuously optimized.

Continuous improvement is a fundamental principle of agile methodologies, and this extends to agile portfolio management in multi-cloud environments. Organizations should foster a culture of learning, where teams regularly review the results of their projects, analyze performance data, and identify areas for improvement. Retrospectives and post-mortem analyses after the completion of projects or major milestones can provide valuable insights into what worked well and what could be improved in future initiatives (Bristol-Alagbariya, Ayanponle & Ogedengbe, 2022). The use of feedback loops at every stage of the portfolio management process allows for rapid adaptation and ensures that the portfolio remains aligned with evolving business goals, market conditions, and technological advancements.

In conclusion, implementing the conceptual model for agile portfolio management in multi-cloud deployment projects requires careful planning, a structured change management approach, and the right tools, roles, and skills. Organizations must be prepared to manage the complexities of multi-cloud environments while fostering a culture of agility, flexibility, and continuous improvement (Onukwulu, et al., 2021, Otokiti, et al., 2021). By adopting the model and aligning it with their business objectives, organizations can optimize their cloud resource usage, improve coordination across teams, and ultimately achieve better outcomes from their multi-cloud deployments. With the right metrics in place and a commitment to ongoing iteration and feedback, the agile portfolio management model can be a powerful tool for driving success in multi-cloud environments.

2.7. Discussion

The proposed conceptual model for agile portfolio management in multi-cloud deployment projects offers an innovative approach to managing the complexities of modern cloud infrastructures while aligning with the strategic goals of organizations. This model integrates agile principles with the unique needs of multi-cloud environments, such as resource optimization, cost management, and performance monitoring across multiple cloud providers. When compared to existing models of portfolio management, particularly those that rely on traditional, waterfall methodologies or siloed cloud platforms, this model introduces significant improvements in flexibility, adaptability, and value delivery (Onukwulu, et al., 2021, Otokiti, et al., 2021). However, while it offers several advantages, the model also comes with limitations and underlying assumptions that must be carefully considered before widespread adoption.

Existing portfolio management models, especially in the context of multi-cloud environments, often operate within a rigid, linear framework. These models typically emphasize upfront planning, fixed budgets, and sequential phases, which can hinder the ability of organizations to respond to changes quickly. Traditional models may be more suitable for environments where projects are predictable, with well-defined scopes and timelines, but they are less effective in managing the dynamic, fast-paced, and often unpredictable nature of multi-cloud

deployments (Onaghinor, et al., 2021, Onukwulu, Agho & Eyo-Udo, 2021). Such models struggle to accommodate the iterative development cycles, continuous feedback, and shifting priorities that characterize modern cloud-based projects. Agile methodologies, by contrast, emphasize flexibility, continuous delivery, and iterative planning, allowing organizations to better manage the constant changes inherent in multi-cloud deployments.

The proposed model addresses many of these shortcomings by incorporating agile portfolio management practices. It emphasizes the importance of iterative planning, adaptive funding, and decentralized decision-making, which enable businesses to continuously realign their cloud initiatives based on changing needs, technological advancements, or market conditions. In multi-cloud environments, this adaptability is particularly crucial because cloud service providers evolve rapidly, and their offerings may change frequently (Babalola, et al., 2022, Odunaiya, Soyombo & Ogunsola, 2022). By focusing on continuous feedback and incremental progress, the proposed model ensures that organizations can quickly pivot, scale, or terminate projects in response to real-time information. This iterative approach is in stark contrast to the rigid, long-term plans characteristic of traditional portfolio management, making it far more suited for the complexities of multi-cloud deployments.

One of the key advantages of the proposed model is its ability to optimize resource allocation across multiple cloud providers. Multi-cloud strategies often involve using the best services from different platforms to meet specific needs, but managing resources across these platforms can be cumbersome without a structured, integrated approach. The agile portfolio management model facilitates resource allocation by continuously evaluating the value and progress of each project, ensuring that cloud resources are used efficiently and effectively (Chianumba, et al., 2021, Juta & Olutade, 2021). By integrating adaptive funding and resource allocation, organizations can scale cloud resources up or down based on evolving project requirements, avoiding resource wastage and ensuring that the most critical initiatives receive the attention and resources they need. The real-time insights provided by agile practices allow organizations to maintain cost control while optimizing performance, which is particularly important in multi-cloud environments where cloud services can quickly become expensive if not monitored carefully.

Another advantage of the proposed model is its emphasis on decentralized decision-making. In large organizations, particularly those managing multi-cloud environments, decision-making can often become bottlenecked at the top levels, slowing down progress and reducing the ability to respond to emerging needs. Agile portfolio management, however, encourages decisions to be made at the team level, where the individuals closest to the work can make informed choices. This decentralization empowers teams to act quickly, adjust priorities based on real-time data, and take ownership of their projects (Onukwulu, et al., 2022, Oyegbade, et al., 2022). In multi-cloud environments, where different cloud services may require specialized knowledge, this decision-making autonomy ensures that teams can optimize cloud resource usage without waiting for top-level approvals, leading to faster implementation and greater operational efficiency.

The model also offers significant improvements in risk management, particularly in the context of multi-cloud deployments. Multi-cloud strategies, by nature, introduce additional complexities in terms of security, compliance, and platform interoperability. Existing models often fail to adequately address these risks, leading to potential vulnerabilities that could compromise the entire portfolio. The proposed model embeds risk management practices directly into the agile processes, ensuring that risks are continuously identified, assessed, and mitigated (Adepoju, et al., 2022, Kanu, et al., 2022, Ogunwole, et al., 2022). By integrating risk management into iterative planning cycles, organizations can respond quickly to emerging threats, ensuring that security and compliance are maintained across all cloud platforms. This

continuous risk evaluation helps prevent costly disruptions and ensures that multi-cloud deployments are secure, compliant, and resilient.

Despite its numerous advantages, the proposed model does have limitations and assumptions that need to be carefully considered. One limitation is that the model assumes a high level of organizational maturity in terms of agile practices. Organizations that are new to agile methodologies may find it challenging to implement the model effectively without significant upfront investment in training, process reengineering, and cultural change (Chukwuma-Eke, Ogunsola & Isibor, 2021, Odio, et al., 2021). Agile portfolio management requires a mindset shift, where flexibility, collaboration, and continuous improvement are prioritized over rigid planning and control. For organizations with little experience in agile frameworks, the transition to the proposed model could be a slow and difficult process, potentially undermining its effectiveness in the short term.

Another limitation is that the model assumes that the necessary tools and infrastructure are in place to support multi-cloud deployments. While cloud service providers offer a wide array of tools to manage resources, monitor performance, and maintain security, integrating these tools across multiple platforms can be complex. The proposed model assumes that organizations can easily implement integrated cloud management platforms and observability tools that provide real-time insights into their multi-cloud portfolios (Onukwulu, Agho & Eyo-Udo, 2022, Otokiti, et al., 2022). However, these tools may require significant customization and coordination to work across different cloud platforms, and the integration process can introduce additional complexity and overhead. Moreover, the availability of such tools may vary depending on the specific cloud providers being used, making it difficult for some organizations to fully leverage the benefits of the model.

Additionally, the model assumes that organizations will have access to sufficient expertise and resources to manage the intricacies of multi-cloud environments. While decentralized decision-making can be highly effective, it also requires teams to possess specialized knowledge of the different cloud platforms they are using. The model assumes that organizations have the capability to recruit and retain skilled professionals with expertise in cloud architectures, security, compliance, and cost management across multiple providers. For smaller organizations or those with limited technical resources, this could pose a significant challenge, limiting the effectiveness of the proposed model (Alonge, et al., 2021, Isi, et al., 2021, Okolie, et al., 2021).

In conclusion, the proposed conceptual model for agile portfolio management in multi-cloud deployment projects offers a robust framework for addressing the challenges associated with managing complex, distributed cloud environments. By emphasizing flexibility, iterative planning, decentralized decision-making, and continuous risk management, the model provides significant advantages over traditional portfolio management practices. It enables organizations to optimize cloud resource allocation, improve coordination across teams, and ensure that projects remain aligned with strategic goals (Adepoju, et al., 2022, Isibor, et al., 2022, Ogunwole, et al., 2022). However, the model's success depends on an organization's ability to embrace agile principles, integrate the necessary tools and resources, and navigate the complexities of multi-cloud environments. While it offers substantial benefits, organizations must be prepared to overcome the limitations and assumptions inherent in the model to fully realize its potential.

2.8. Future Research Directions and Conclusion

Future research directions for the conceptual model for agile portfolio management in multi-cloud deployment projects are essential to refine its applicability, validate its effectiveness, and expand its relevance to various domains. One of the most pressing areas for future research is

the empirical validation of the model. While the model is grounded in agile principles and multi-cloud deployment complexities, it has yet to be tested extensively in real-world scenarios. Research could focus on collecting data from organizations that have implemented this model in their multi-cloud environments to assess its effectiveness in optimizing portfolio management, resource allocation, and risk mitigation. By conducting case studies or large-scale surveys, researchers could gain insights into the practical challenges and benefits that organizations experience when adopting the model. These empirical studies could also help refine the model by identifying areas that need adjustment or further development to better align with real-world applications.

Another promising direction for future research is the adaptation of the model to specific domains. Industries such as healthcare, finance, and manufacturing have unique requirements when it comes to multi-cloud deployments, particularly concerning regulatory compliance, data privacy, and security. In healthcare, for example, organizations must ensure that patient data is securely managed across multiple cloud environments while adhering to strict HIPAA regulations. Similarly, in finance, maintaining compliance with financial regulations, ensuring secure transactions, and optimizing cost efficiency are critical. Research could explore how the conceptual model can be tailored to meet the specific needs of these domains. This would involve integrating industry-specific best practices, regulatory frameworks, and performance metrics into the agile portfolio management model, thus ensuring that it delivers optimal value while addressing domain-specific challenges.

As multi-cloud environments become more complex, integrating AI-driven decision support systems into the model represents another key area for future research. AI and machine learning technologies can play a significant role in optimizing resource allocation, predicting project outcomes, and improving decision-making processes. By incorporating AI algorithms, the agile portfolio management model could automate many of the decision-making processes, such as dynamically adjusting resources based on workload demand, forecasting potential risks, and providing recommendations on portfolio prioritization. AI could also enhance the governance mechanisms of the model, providing real-time insights into cloud resource performance and potential issues. Future research should focus on developing AI-powered tools that integrate with the model to provide intelligent recommendations, automate routine tasks, and offer predictive analytics that improves the overall management of multi-cloud portfolios.

In terms of contributions, this conceptual model for agile portfolio management introduces a novel approach to managing multi-cloud deployment projects by combining agile methodologies with the complexities of managing resources across multiple cloud providers. The integration of iterative planning, decentralized decision-making, continuous feedback, and risk management into a single framework provides a flexible and adaptive solution that allows organizations to optimize their multi-cloud environments. The model also emphasizes the importance of aligning cloud initiatives with business objectives, ensuring that the value delivered by multi-cloud projects directly contributes to the strategic goals of the enterprise. This flexibility makes the model suitable for a wide range of organizations, from small and medium-sized enterprises (SMEs) to large corporations, providing scalable solutions for managing complex, multi-cloud portfolios.

The strategic importance of the model for enterprises adopting multi-cloud solutions cannot be overstated. As organizations increasingly migrate to multi-cloud environments to avoid vendor lock-in, optimize performance, and enhance scalability, the need for effective portfolio management becomes even more critical. This model provides the tools and frameworks necessary to manage the complexities of multi-cloud deployments while ensuring alignment with business priorities. By allowing enterprises to manage their portfolios iteratively and dynamically, the model empowers them to make informed decisions, adapt to changing

conditions, and optimize cloud resources more effectively. As enterprises continue to embrace digital transformation and leverage multi-cloud strategies, the role of agile portfolio management will become increasingly important in helping organizations navigate the complexities of modern cloud environments.

In conclusion, the conceptual model for agile portfolio management in multi-cloud deployment projects represents a significant advancement in the way organizations manage their cloud-based initiatives. By integrating agile principles with the challenges of multi-cloud environments, the model offers a flexible, adaptive framework that supports value-driven decision-making, continuous feedback, and risk management. Future research should focus on empirically validating the model, adapting it to domain-specific needs, and integrating AI-driven decision support systems to further enhance its applicability and effectiveness. The strategic importance of this model for enterprises adopting multi-cloud solutions lies in its ability to optimize resource allocation, improve project coordination, and ensure that multi-cloud initiatives remain aligned with business objectives. Ultimately, the impact of agile governance in cloud transformation will be profound, as organizations increasingly turn to agile portfolio management practices to drive success in an era of rapid digital change.

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