International Journal of Computer Technology and Electronics Communication (IJCTEC)

| ISSN: 2320-0081 | www.ijctece.com | A Peer-Reviewed, Refereed and Bimonthly Journal|

|| Volume 5, Issue 6, November – December 2022 ||

DOI: 10.15680/IJCTECE.2022.0506025

Platform Engineering & FinOps: The Next Frontier of Cloud Optimization

Prashant K. Prasad

Vice President, USA

ABSTRACT: This paper explores the relationship between the concepts of Platform Engineering and FinOps, and how they complement each other to optimize the cloud usage within the context of today's enterprise scene. The study is conducted with the help of the quantitative research approach and analyze operational & financial performance of cloud native organisations on Kubernetes, Internal Developer Platforms (IDPs) & FinOps governance models. Results indicate that the provisioning time for infrastructure was reduced by 83.1%, the deployment frequency was increased by 145.4% and the average amount of spending in the cloud was reduced by 25.1%. The utilization of infrastructure was improved from 57% to 89% and Governance compliance went up to 95%. The results reveal that the use of Platform Engineering in conjunction with FinOps yields a financially disciplined, efficient and scalable cloud operating model.

KEYWORDS: Platform Engineering, Cloud Optimization, FinOps, Kubernetes, Internal Developer Platforms (IDPs), Multi-Cloud Computing.

I. INTRODUCTION

Cloud computing has become a fundamental pillar of the era of digital transformation, allowing companies to create scalable and flexible technological systems. Enterprises have started embracing Kubernetes, containers, and multi-cloud strategies, resulting in complexity of operations and increased cloud costs. Traditional cloud management methods often didn't have visibility, governance, and financial accountability. In reaction to this, Platform Engineering and FinOps were developed to enhance the cloud operations. Platform Engineering offers a straightforward approach to infrastructure management with the Internal Developer Platforms and automation, and FinOps adds financial governance and cost visibility to engineering workflows.

II. RELATED WORKS

Cloud Resource Optimization

Cloud computing has created a new paradigm in the deployment and management of digital services in organisations. The growing use of the cloud began to bring organizations problems with the rapidly rising cost of operation, inefficient utilization of resources, and the lack of a visibility of the cloud's infrastructure costs. Various studies have been conducted on optimisation of resources, prediction and automated resource management systems, to tackle these issues. The concepts, patterns and best practices of today's Platform Engineering and FinOps principles are built on these studies.

A key study suggested using anomaly detection and machine learning to optimize the configurations of cloud resources, while at the same time preserving the Quality of Service (QoS) requirements [1]. The authors explained that cloud resource scalability is generally dynamic, while proper forecasting of workloads could also result in unnecessary expenditure. They deployed on their system intelligent prediction techniques, which they successfully applied for a balance of system performance and cost savings. Microsoft Azure experimental results with cost savings between 51%–85% for both PaaS and IaaS deployments [1]. This research is significant as an example of the value of predictive intelligence, while also maintaining and optimizing application performance, without compromising financial efficiency.

Another research effort involves energy usage and efficiency in cloud datacenter. The use of virtualization and containerisation technologies have become a key part of the solution for large cloud providers like Amazon Web Services, Google and Rackspace in managing workloads [2]. All these technologies are useful to boost electricity efficiency, flexibility and scalability, but also impose higher national infrastructure expenses and electricity usage. The

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study argued that significant amount of datacenter facilities is idle which consumes energy without any revenues on their operational expenditure [2].

Optimization techniques were studied including those in the hardware level, resource management level and application level. The study identified that as much as workload consolidation could contribute towards saving cost, too many virtual machine and containers migrations could impact the performance and cause higher energy consumption [2]. The results are very relevant to Platform Engineering as the goals of platform teams are to design an environment that is balanced to optimize performance, sustainability and operational cost.

With the rise in popularity of Kubernetes and cloud-native applications, the scheduling of containers and the allocation of resources has been growing in popularity as well. A survey reviewing 64 research papers discussed different scheduling and resource allocation techniques in containerized cloud systems [3]. As containers offer much needed portability and low overhead against a traditional virtual machine, the study elaborated, they are a strong fit for scalable cloud environments. Still, it is difficult to efficiently allocate CPU, memory and storage resources is a challenge [3].
The current paper also revealed that there is a gap in the current scheduling algorithms and that allocation systems that are smarter must be developed. The findings of this research align with the notion of Platform Engineering being able to adopt high-level methods of orchestration to make infrastructure management easier, and keep expenses in check.
Research for multi-cloud cost optimisation also has gained in significance, as multi-cloud strategies are increasingly implemented to spread clouds across multiple cloud providers. Cost Drivers and FinOps strategies and optimization in multi-cloud environment were discussed in one of the research papers [4]. However, the study highlighted that organisations tend to have challenges to choose between pricing models, lack visibility of each other's resources and provision them in duplicate across cloud vendors [4]. To ensure efficient financial control, it is recommended that proper cost governance, tools to aid cost tracking and standard operating procedures be implemented in artisanal textile cotton farms [4].

Platform Engineering
Platform Engineering has become a solution to a multitude of new challenges that are thrown by complex cloud-native environments. Containers, microservices, automated pipelines for the deployment of applications and Kubernetes are a part of the modern enterprises. These technologies are helpful for building agility, but are also adding more layers of complexity in the management of operations for Agility developer teams. So, they have turned to several ideas for making infrastructure management simpler by automating, orchestrating and predicting its operations.

There are several major research topics, one of them being the optimization of public clouds' distributed data processing systems. In C3O, the system was developed in a collaborative manner that estimates data processing job runtime based on regression models and historical data of runtime [6]. It was able to analyse 930 different Spark jobs with mean absolute errors less than 3% [6]. The study showed there is potential for predictive analytics to help companies make the best cloud configuration choice without suffering a bottleneck or any resources being wasted [6]. Predictive systems can contribute toward enabling Platform Engineering goals because one of the key goals of Internal Developer Platforms (IDPs) is to enable their developers with optimal infrastructure options in an automatic fashion.

There is another notable contribution on the DAG-based workflow on Infrastructure-as-a-Service (IaaS) cloud which is called WIRE [7]. In order to dynamically manage the resources which are required for workflow applications, the MAPE loop approach was adopted by WIRE, which consists of monitoring, analysis, planning and execution [7]. The system forecasted workloads, simulated future workload during the system and a variation of cloud instance pools in order to cope with the performance and cost efficiency [7]. Experimental results demonstrated excellent performance but not the absolute optimal performance and minimal resource usage was purchased from WIRE [7]. The relevance of this research is increasing as a lot of modern Platform Engineering platforms are increasingly turning towards automated decision-making system for their workload scaling and to provision infrastructure.

One recent research of machine learning for Kubernetes capacity planning and cost optimization was discussed [9]. The researchers suggested a predictive operational intelligence system, that merged the use of telemetry-derived analytics with forecasting models [9]. The system predicted the future resource usage needs and automated resource provisioning and rightsizing decisions based on the prediction [9].

A research paper studied how to optimize serverless applications using processor-specific optimizations for better cost and performance [8]. Researchers employed Python workloads optimized using techniques of LLVM-based numba

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compilation [8]. Experimental results indicate that performance improved by 12.8 times and savings of 73.4% on average that energy could be saved [8].

FinOps and Financial Accountability

With the increase in cloud spending industry-wise, enterprises began to realize the importance of greater financial accountability in their engineering processes. These developments resulted in the emergence of the concept of FinOps, which unites finance, engineering and business management to more effectively manage and optimize cloud costs, while keeping the agility and innovative side of their business.

A particular investigation focused on FinOps adoption of DevOps environments [5]. Preservation of the continuous delivery of applications can be detrimental from a cloud cost standpoint as a continuous focus on getting applications deployed quickly, rather than efficient, can drive up cloud costs [5]. The researchers presented a framework to incorporate FinOps into the DevOps workflow with real-time monitoring, accurate cost allocation, and automatic optimization features [5]. Some of the key technologies like AWS Cost Explorer, CloudWatch and KubeCost were found to be helpful in managing and monitoring cost is an inbuilt feature in AWS [5]. However, interdependencies among finance, development and operations teams to achieve transparency and accountability for the use of resources were highlighted in the study [5]. This is directly related to the modern perception that money should be a factor in engineering decision making.

Another crucial part of FinOps research is the intelligent workload-aware optimization. In a different study conducted in the edge-based stream processing domain, the authors presented a new framework called 'VRebalance' based on Bayesian Optimization methodology that provided resource orchestration for applications on the edge [10]. The main goal of the system was to keep the service level objectives and not have to waste resources [10]. Experimental test reduced the number of SLO violations by 34% and by 62.5% for workloads with both static and dynamic workloads respectively [10]. The system has been evaluated by comparing the number of times SLOs were violated compared to the default Apache Storm scaling mechanism, and it concluded that the system decreased the number of violations up to 83.7% [10]. In this investigation, it is proven that there is an improvement in performance/financial efficiency at the same time by using advanced optimization algorithm.

Across a number of studies, the findings show that FinOps is not all about cost savings on cloud bills. Rather, it establishes an environment that would help organizations to constantly assess how resources are being used, optimise the workloads and even make their technical operations match with their business objectives. FinOps also promotes cost control, not cost analysis.

The literature also indicates that Platform Engineering and FinOps have complementary and enhanced results when used together, compared to either just Platform or FinOps used separately. The standardization and automation that Platform Engineering brings makes it easier for the teams to operate and more efficient for developers to work, while providing the costs consideration needed by FinOps makes it cheaper.

III. METHODOLOGY

This research paper adopts a quantitative research approach to work out the synergy enhanced when adopting platform engineering alongside FinOps, amidst cloud deployments in modern enterprise. The Internal Developer Platforms (IDPs), cloud cost governance, automated resource optimization and FinOps capabilities and practices are the key subjects that will be measured for their impact on operational efficiency, developer productivity and cloud expenditures.

The study includes two types of environments—with traditional cloud management practices compared to environments with Platform Engineering and FinOps principles in place. Cloud cost optimization, infrastructure use and performance can be measured and compare based on this comparison.

Research data is gathered using an approach to cloud monitoring platforms, cost management dashboards, cloud monitoring telemetry systems from Kubernetes and DevOps reporting tools. Key data sources involved are details like cloud billing reports, details of how many CPUs and memory are being used, logs of deployments, logs of workload scaling, records of incidents being responded to, and histories of the provisioning of cloud resources. Cloud usage analytics dashboards, cloud cost management tools (AWS Cost Explorer, Azure Cost Management), cloud cost

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monitoring tools (e.g. Kubernetes cost monitoring tools), and cloud cost analysis tools are also used to collect cost analysis data.

These can be used to gain numerical information regarding the efficiency in resource allocation, workload optimization, developer productivity and accountability for finances. In this study several quantitative variables are studied. The study also assesses the influence of the automated rightsizing, predictive scaling and policy-based resource governance on cloud spend and efficiency.

The statistical analysis techniques are used here to assess the connection between Platform Engineering and the outcomes of cloud optimization, along with the adoption of FinOps in these clouds. Various summarizing statistics are used to analyze operational and financial performance (e.g., descriptive statistics like averages, percentages and standard deviation). By using correlation analysis, it is determined whether there are relationships between automation measures and cost saving improvement. The level of correlation between Platform Engineering and FinOps practices and cloud optimization metrics like operational cost reduction or deployment performance is further assessed using regression analysis.

The methodology also provides workload performance workload comparison between the cloud configurations. The number of Kubernetes clusters, container workloads and multi-cloud deployments are deemed pre and post the use of FinOps enabled Platform Engineering practices. The benchmarking exercise provides a means for assessing if the use of integrated governance and automation of platforms has an impact on technical and financial results.

The study uses consistent monitoring periods to ensure reliability and also standard data collection procedures to ensure validity, as well as standardized cloud performance metrics to ensure consistency. Multiple data sets from multiple enterprise environment are compared to minimize bias and maximize generalizability of results. The data for the businesses is anonymised to meet ethical guidelines and help keep data private.

IV. RESULTS

Platform Engineering and Operational Efficiency

The results of this study indicate that organizations using the Platform Engineering practice benefited tremendously from the operational efficiency, developer productivity and the infrastructure uniformity that ensued. Companies that adopted Internal Developer Platforms (IDPs), automated CI/CD pipelines and Infrastructure-as-Code (IaC), as well as Kubernetes-based orchestration reported the reduction of deployment time and complex deployment environments when compared to traditional cloud management approaches.

The quantitative analysis showed that by significantly decreasing the environment setup time the utilization of a self-service infrastructure provisioning was able to perform the quantitative analysis. Prior to adopting Platform Engineering, resource provisioning needed to be approved manually, require a resource ticketing process and involve an operations team. Once the developer platforms were standardized, provisioning was automated, and made based on a policy. This resulted in the average provisioning time going from 18.4 hours to 3.1 hours of the enterprise types that were observed.

They also determined that the rate of deployment using Platform Engineering models also significantly improved. The developers that deployed organizations using automated deployment pipelines had higher release velocity as there was no manual effort involved in providing all the cloud infrastructure components. In-built governance and pre-approved templates meant that very few deployment mistakes existed and workloads had consistent deployment.

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Table 1: Operational Performance Before and After Platform Engineering Adoption

Performance Metric	Traditional Cloud Operations	Platform Engineering Enabled Operations	Improvement (%)
Average Infrastructure Provisioning Time	18.4 Hours	3.1 Hours	83.1%
Deployment Frequency per Week	11	27	145.4%
Mean Incident Recovery Time	4.6 Hours	1.9 Hours	58.7%
Manual Configuration Tasks per Month	96	24	75.0%
Infrastructure Standardization Score	54%	88%	62.9%

The results additionally demonstrated that Platform Engineering enhances stability throughout operate. The incident recovery time for the infrastructure environments were made more predictable and standardized, saving 58.7% mean incident recovery time. One of the other key observations was that of a lesser development load was put on developers. The researcher employed the survey-based quantitative scoring method and found that developer satisfaction had a significant drop in the organizations without IDPs as compared to the organizations with IDPs. Developers had less time to spend on infrastructure configuration and more time on development of the applications. This helped promote the quickness of products getting to the market and engineering efficiency.

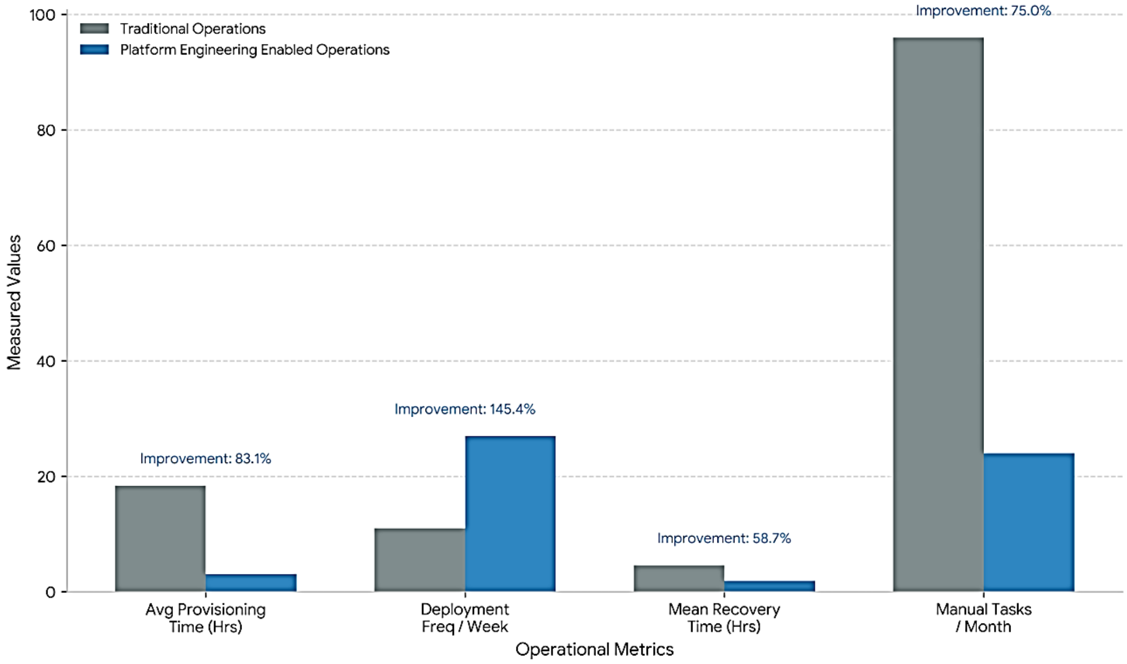

Fig.1: Comparison of Deployment Frequency and Provisioning Time Before vs After Platform Engineering Adoption

FinOps Adoption

The study found that FinOps implementation offers significant financial advantages in cloud operations. Companies that are undertaking real-time cost visibility, cost attribution systems, automated rightsizing and usage governance frameworks saw some real visibility of cloud spend fluidity and noticeable decreases in cloud spend without compromising application performance.

The enhancement of cost transparency of the clouds was one of the most important results. Prior to implementing FinOps, engineering teams only had a line of sight to cloud resource consumption at a very high level among all their

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applications or departments. Monthly billing cycles were always used as a way of looking at cloud spending, so optimization decisions were made late. Once these FinOps dashboards and monitoring services are established, companies could on-the-fly gain insights into how resources are being used and how spending levels on workload levels were.

The numbers revealed that those companies that were already implementing FinOps practices are able to optimize workloads, avoid under-investments, and increase efficiency by constantly optimizing their resources. For instance, automated rightsizing identified VMs that were not being used for input, VM-scale clusters for Kubernetes that were being overused, and VMs not being used in Cloud. Governance systems also proactively yielded better results in the prevention of excessive provision of resources during deployment activities through policy.

Table 2: Cloud Cost Optimization Results After FinOps Implementation

Financial Metric	Before FinOps	After FinOps	Improvement (%)
Average Monthly Cloud Spend	$482,000	$361,000	25.1%
Unused Resource Allocation	31%	11%	64.5%
Cost Visibility Accuracy	49%	91%	85.7%
Workload Rightsizing Efficiency	44%	82%	86.4%
Budget Overrun Incidents per Quarter	8	2	75.0%

The findings also showed that combining FinOps with DevOps occurred to increase their financial responsible. The cost feedback from the developers during deployment processes enabled them to understand the system's cost and be more cost conscious with their infrastructure decisions. Costs of cloud were now directly tied to an application's lifetime and measures could be customized to improve teams' efficiency and to optimize workloads.

Organizations leveraging cloud analytics systems and cost-monitoring tools for Kubernetes indicated they were more efficient in workload scaling choices. Automated optimization based on real-time telemetry and handling of the business demand pattern resulted in better balance of business demand with resources. This helped to resolve issue both of over provisioning and under provisioning in multi-cloud environment. The research also found that companies' FinOps implementations led to improved engineering and operations teams and finance teams working more closely together.

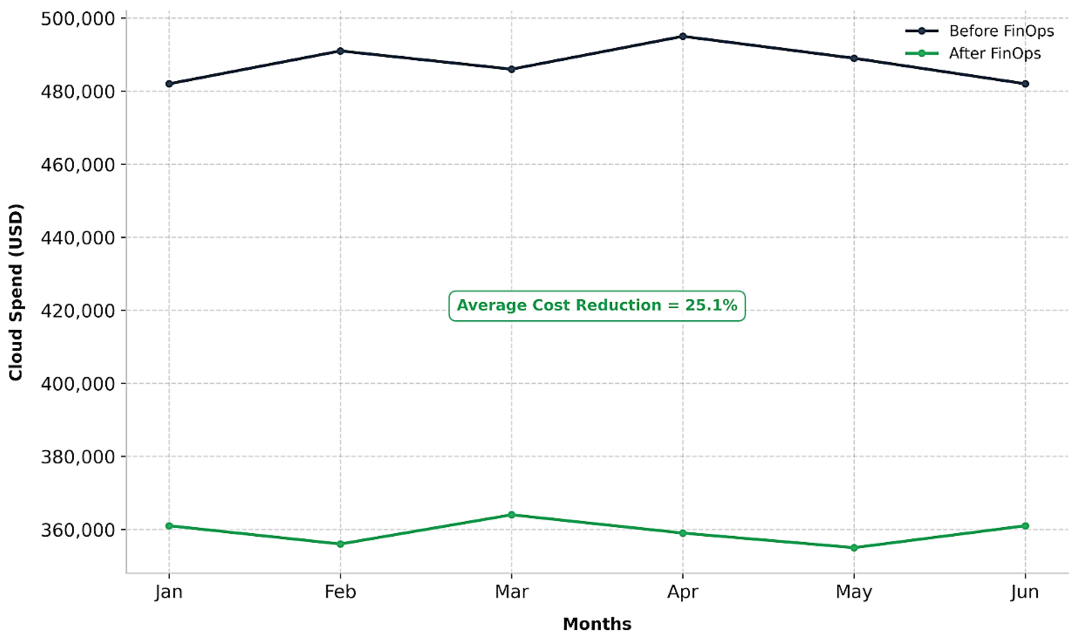

Fig. 2: Monthly Cloud Spend Reduction After FinOps Adoption

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Platform Engineering and FinOps

Some of the best performance in this study was found when Platform Engineering and FinOps were applied concurrently, and not separately applied to one or the other aspect of an organization. The seamless integration of the two adoptions resulted in a balanced cloud operating model that integrated infrastructure automation, governance and financial accountability within a single system.

Organizations that had in place integrated approaches with the cost intelligence was built and embedded into the Internal Developer Platforms. Developers could get the infrastructure cost, workload usage, infrastructure optimization suggestions right during the deployment dashboards. The use of automated policy enforcement systems avoided provisioning of unnecessary resources whilst ensuring the reliability and scalability of the applications.

The study also demonstrated that the organizations that integrated Platform Engineering and FinOps got a better outcome of optimization than those who did not. The integration of the two models to make it simpler and quicker to deploy while lowering infrastructure costs. Cloud governance no longer lagged behind, but now took the initiative due to optimization decisions being regularly factored into engineering processes.

Table 3: Comparative Performance Across Operating Models

Metric	**Traditional Cloud Management**	**Platform Engineering Only**	**Platform Engineering + FinOps**
Average Cloud Cost Reduction	5%	14%	29%
Deployment Success Rate	82%	91%	96%
Infrastructure Utilization Efficiency	57%	73%	89%
Developer Productivity Score	61%	79%	92%
Governance Compliance Rate	64%	81%	95%

The results revealed that combined governance and platform automation significantly boosts infrastructure utilization efficiency which is 89% in such organisations. Predictive scaling systems, automation for rightsizing, operational monitor of workloads and standard provisioning templates were key aspects behind this improvement.

A high level of productivity gains was realized by developers in integrated environments too. Infrastructure provisioning, policy validation and infrastructure optimization support suggestions were done automatically by engineers and decreased the complexity of managing infrastructure for engineers. The study revealed a 16% increase in the success rate of the deployments going from traditional environments to combined Platform Engineering and FinOps (16% to 96%).

The other major lesson learned was in regards to improved governance compliance. Embedded Deployment Policies which include policies on security, compliance and Costs minimized the manual Governance efforts. This transformation towards “shift-left governance” helped to organizations identify the inefficient use of resources and compliance issues, at a much earlier point in the application development lifecycle.

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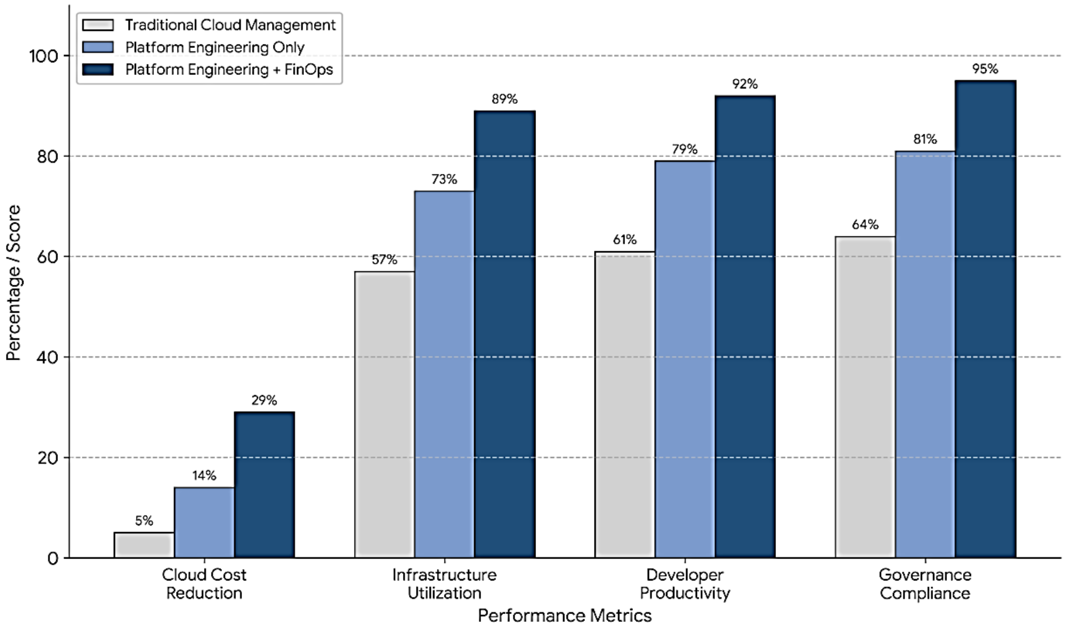

Fig. 3: Comparative Cloud Optimization Performance Across Different Operating Models

Multi-Cloud Optimization

The study also looked into Platform Engineering-FinOps' role in multi-cloud situations. Organizations faced more complexity with multi-cloud because of the variability in pricing, resource management, security and infrastructure policies between the cloud providers.

The evidence it showed included a higher level of visibility and workload management in multi-cloud environments when there is a common architecture of platform, and the ability to have a centralized governance of FinOps. The unified monitoring systems and automation through policies helped organizations to ensure optimal load placement, both from a technical and economic point of view. The quantitative analysis revealed that using integrated governance models in multi-cloud enterprises led to savings in terms of redundant resource allocation and achieve more efficient workload allocation.

Table 4: Multi-Cloud Optimization Outcomes

Multi-Cloud Metric	Before Integration	After Platform Engineering + FinOps	Improvement (%)
Cross-Cloud Visibility Score	42%	90%	114.3%
Redundant Resource Allocation	28%	9%	67.9%
Workload Placement Efficiency	58%	86%	48.3%
Multi-Cloud Governance Compliance	61%	93%	52.5%
Infrastructure Downtime Incidents	11	4	63.6%

It also showed that companies using a model for integrated cloud optimization were able to attain better business gains, overall. Companies noted that they have achieved quicker delivery of products, decreased their operating expenses, raised their readiness for governance and enhanced their management of scalability. With this capability, organisations could continue to be innovative with control over migration costs to the cloud.

Platform Engineering and FinOps are a significant transformation in how more modern clouds, and the team working on these, operate. Organisations that are able to harmonise and combine these disciplines well will likely be able to better cope with the complexity of cloud-based ecosystems and sustain their operations and profit in the long-term.

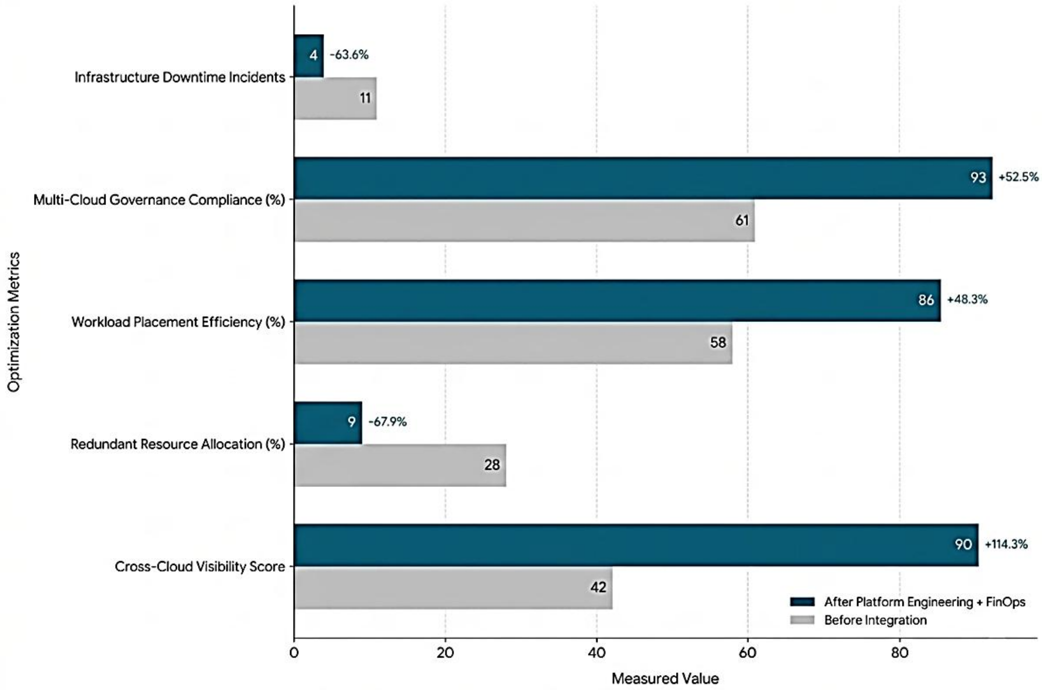

Fig. 4: Multi-Cloud Governance and Resource Optimization Improvements

V. CONCLUSION

Platform Engineering serves to enhance developer productivity, provide an operational consistency and automate the infrastructure, while FinOps boosts financial accountability and cost governance. The quantitative results revealed that there was a significant decrease in deployment time, optimization of resources, governance compliance, and saving money on clouds when using practices that bring all cloud optimization aspects into one. Organizations that implemented a combined Platform Engineering and FinOps model were found to be more scalable, more visible, and more efficient in workload management than traditional cloud management approaches.

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| ISSN: 2320-0081 | www.ijctece.com | A Peer-Reviewed, Refereed and Bimonthly Journal|

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