International Journal of Computer Engineering and Technology (IJCET)
Volume 15, Issue 2, March-April 2024, pp. 249-273, Article ID: IJCET_15_02_027
Available online at https://iaeme.com/Home/issue/IJCET?Volume=15&Issue=2
ISSN Print: 0976-6367 and ISSN Online: 0976-6375
Impact Factor (2024): 18.59 (Based on Google Scholar Citation)
DOI: https://doi.org/10.34218/IJCET_15_02_027

MAXIMIZING COST EFFICIENCY AND PERFORMANCE OF SAP S/4HANA ON AWS: A COMPARATIVE STUDY OF INFRASTRUCTURE STRATEGIES

Venkata Ramana Reddy Bussu

Senior Cloud Solutions Engineer, Codetech Inc, USA.

ABSTRACT

Cloud hosting of SAP S/4HANA has been central to the strategies through which organizations optimize the efficiency of their operations through cost cuts. This paper will consider several cloud infrastructural strategies to ensure maximization of cost-efficiency and performance in executing SAP S / 4HANA on Amazon Web Services (AWS). Due to the complicated nature of managing cloud resources, the paper discusses architecture designs like optimum instance types, storage auto-scale designs, and best practices in cost management. Upon comparing these strategies, the present paper draws into the limelight the implication of each of these strategies on the system's performance and the total cost of operations. After reviewing the innovative characteristics of AWS, which are elastic compute cloud (EC2), simple storage service (S3), and AWS cost management, the study formulates workable recommendations that businesses can implement to limit their costs in high-performance computing. The research will aim to educate companies on optimizing their SAP S/4HANA apps on AWS and enabling them to scale and sustainably on the cloud.

Keywords: SAP S/4HANA, AWS Infrastructure Optimization, Cloud Cost Efficiency, Performance Tuning, AWS EC2 for SAP.

Cite this Article: Venkata Ramana Reddy Bussu. (2024). Maximizing Cost Efficiency and Performance of SAP S/4HANA on AWS: A Comparative Study of Infrastructure Strategies. *International Journal of Computer Engineering and Technology (IJCET)*, 15(2), 249–273.

https://iaeme.com/MasterAdmin/Journal_uploads/IJCET/VOLUME_15_ISSUE_2/IJCET_15_02_027.pdf

1. INTRODUCTION

With the current fast-changing digital environment, enterprise resource planning (ERP) systems are becoming very important in the sense that they can assist organizations in unifying essential business procedures and enhancing operations and efficiencies. SAP S/4HANA is one of the most popular ERP software. It is considered to be an effective next-generation business suit aimed at working with in-memory computing, real-time analytics, and simplification of IT landscapes. The migration towards the implementation of SAP S/4HANA has been considered to be an organization's business strategy to update its business processes and realize business agility. According to the tendency of enterprises to migrate SAP S/4HANA to the cloud environment, Amazon Web Services (AWS) are now seen as one of the most popular platforms, as they have the strength of design and diverse amounts of services and scalability. Nevertheless, this movement also causes serious challenges, especially those related to the management of costs and the optimization of performance. The complex nature of SAP workloads requires to be coupled with the elastic nature of cloud resources, which requires that infrastructure strategies be given adequate thought to provide a balance between the expected performance of the operations and the financial gains.

As much as there exist possibilities of flexibility in scaling services in cloud environments and possible cost reductions, poor configurations may result in unexpected costs and poor performances. Thus, the choice of the most appropriate infrastructure approach on AWS to deploy SAP S/4HANA also turns into a success indicator. There are several different possibilities for using the cloud, including reserved instances, on-demand instances, auto-scaling, and hybrid architectures, which have different advantages and restrictions and need to be thoroughly discussed. Very little literature is available comparing systematically various AWS infrastructure approaches of SAP S/4HANA implementations in terms of costs and performance. Filling the gap in this knowledge is essential to decision-makers who need to support their investments in the cloud but do not want to compromise the high-performance requirements.

The research article will perform a comparative analysis of the significant infrastructure strategies for operating SAP S/4HANA on AWS, focusing on the aspects of utilizing cost-efficient construction and optimizing system performance. The study-based analysis of real-world settings and practical use cases gives useful and evidence-based tips and recommendations to IT leaders and enterprise architects. Finally, the current study aims to raise further insight into how companies should tactically take advantage of AWS to obtain the ideal level of the SAP S/4HANA environment based on their corporate and financial objectives.

1.1 Background of SAP S/4HANA

SAP S/4HANA is a single package of business applications developed on the SAP HANA in-memory database. It has empowered organizations to simplify their operations, work on a large amount of data simultaneously in real time, and make quicker and well-informed decisions. Being an ERP system of the new generation, it is capable of supporting major business processes, including finance, supply chain, sales, and manufacturing. Thus, it is an essential asset to contemporary businesses that require to be more agile and efficient. With businesses boosting their efforts to digital transform, SAP S/4HANA is being considered a key backbone when it comes to data convergence and intelligent processes. Its capacity to leverage real-time analytics and robust automation enables businesses to be fast enough to adapt to the dynamics of the market and customer demands. This change demonstrates a more general tendency of organizations that focus on data-based approaches to remain competitive in fast-evolving global markets.

Nevertheless, migration to SAP S/4HANA presents significant risks and obstacles. Organizations normally face issues in data migration, system integration and business process redesign as pointed out by Chang et al [1]. When not addressed, such challenges may result in the additional costs, operational disturbances, and change pushback. Consequently, the strategic planning of the goals and implementation of suitable infrastructure strategies is vital to the achievement of maximum benefits of SAP S/4HANA.

1.2. Importance of Cost Efficiency and Performance

Whether it is the cost-effectiveness or the performance of their SAP S/4HANA, optimizing both aspects is important to deliver long-term value and maintain a competitive edge to the company in the case of organizations running SAP S/4HANA on cloud platforms. Real-time data processing and business workflow streamlining are the benefits of SAP S/4HANA.

However, its resource consumption is enormous, and infrastructure must be designed with a high-intensity level to prevent operation bottlenecks. Poroca [2] points to the fact that SAP S/4HANA lies at the core of organizations pursuing digital transformation, shortening decision-making time and overall agility. Nevertheless, unless there is an appropriate combination of cost and performance, the advantages of such a mighty ERP program may be compromised through unnecessary expenditures or insufficient speed of the system. The transition to the cloud, primarily toward AWS, is an opportunity to create an infrastructure planning environment that is flexible but intricately complex. According to Madhava Varma et al. [3], although cloud-based ERP systems such as the SAP S/4Hana are characterized by scalability and sophisticated security risks, matching the resource allocation with business requirements might be challenging. Organizations should consider different deployment strategies: reserved instances, spot instances, or hybrid configurations to address the minimum cost needs without deteriorating the scientific key performance indicators. This is because inefficient configurations may result in an unpleasant cost surprise, undermining the overall return on investment and impeding the digital transformation process.

Moreover, IT and all parts of the company, in different respects, should treat achieving cost efficiency and high performance as a strategic concern. Such aspects as business continuity, user experience, and compliance requirements are based on the reliability and responsiveness of the system. Finding the golden mean authorizes organizations to innovate confidently, spend budgets more wisely, and facilitate more growth in the future. Consequently, the design question of how cost-efficiency and performance relate is critical to comprehending and achieving SAP S/4HANA installations in AWS clouds and impacting organizations that want to succeed in a highly digitalized and data-powered business environment.

1.3. Overview of AWS as a Cloud Infrastructure

One of the most powerful cloud providers, Amazon Web Services (AWS) has become a market leader with its cloud platform housing a wide scope of services and infrastructure that can support a great variety of enterprise workloads, including the most demanding mission-critical infrastructure, such as SAP S/4HANA. AWS environment delivers very scalable compute, data storing and networking services serving organizations to adapt dynamically based on business requirement. This scalability is especially a valuable attribute to SAP S/4HANA that needs a lot of memory and processing power to provide real time analytics and presence of business transactions. Besides scalability, AWS provides a wide array of services that intend to improve performance and operational efficiency. The Amazon Elastic Compute

Cloud (EC2) and Amazon Elastic Block Store (EBS) services or Amazon Simple Storage Service (S3) allow flexible design of the infrastructure and services such as AWS Auto Scaling and Elastic Load Balancing provide high availability and performance regardless of the achieved workload. Part of the study by Simkin et al. [4] highlights the necessity of having an efficient IT infrastructure based on AWS as the wakeup in that, a full potential of SAP S/4HANA could not be achieved without having an effective one.

In addition, AWS offers cost control instruments and buying alternatives including saves, pay-as-you-go pricing, and reserved instances, which can be very cost-effective in IT expenditure optimization. Such capabilities allow organizations to optimize infrastructure investments so that investments meet real patterns of usage and business requirements, which means more cost-effective investments overall. Enterprises will be able to build a scalable, safe, and cost-effective environment of SAP s 4 HANA using the flexible and powerful AWS infrastructure and, ultimately realize their digital transformation objectives and gain a competitive edge.

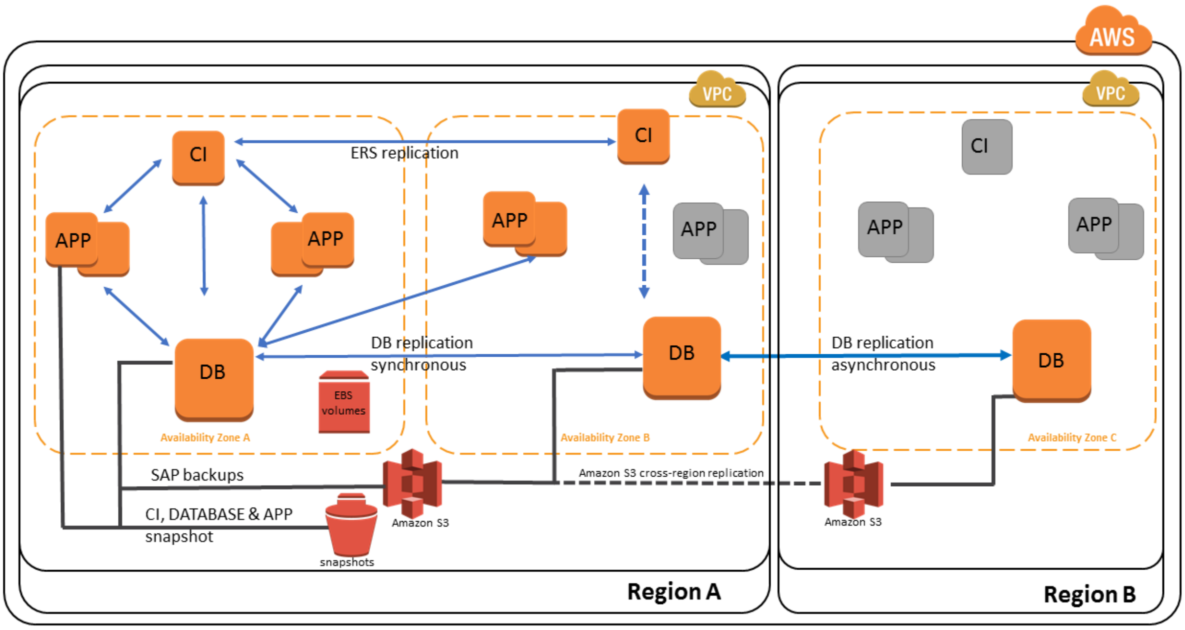

Figure 1: High-Level Architecture of SAP S/4HANA Deployment on AWS Infrastructure.

1.4 Purpose and Scope of the Study

The purpose of this study is to explore how to scale cost-effectiveness in different infrastructure approaches to AWS while maintaining high performance on SAP S/4HANA. The study aims to compare the results of test AWS configurations, including those of compute resources and storage, with the cost and performance results of SAP S/4HANA.

1.5 Research Questions and Hypotheses

The study will address several key research questions, including:

- What is the impact of the AWS infrastructure approach on the cost-effectiveness and performance of SAP S/4HANA applications?
- Which AWS configurations offer a cost-benefit-performance balance benefit to SAP S / 4HANA?

  The research hypothesis is that AWS configurations can substantially decrease the cost of running without diminishing the performance of SAP S/4HANA and, in some cases, increase it in accordance with past findings on cloud cost optimization and performance tuning [5], [6].

2. LITERATURE REVIEW

2.1 Overview of SAP S/4HANA

SAP S/4HANA is a significant upgrade within enterprise resource planning (ERP) systems that have been developed to support the requirements of the contemporary digital business world. Based on the enhanced SAP HANA in-memory database, it enables processing and analysis of data in real-time and offers organizations real-time insights to make decisions in a faster and more informed way. Chang et al. [1] state that the integrated architecture of SAP S/4HANA enables smoother business processes, terminates the redundancy of business data sets, and enables agile practices. Its transactional and analytical capabilities in the same platform enables an enterprise to act swiftly to market changes and customer needs. In addition, SAP S/4HANA has intelligent features, including machine learning and predictive analytics, that can help an organization to automate regular activities and identify new efficiency and growth opportunities. Its streamlined data model simplifies IT, which lowers cost of maintenance and increases the performance of the system. All these features make SAP S/4HANA an effective tool that can help companies to reach digital transformation and sustain a competitive advantage in the data-driven economy.

Nonetheless, transition to SAP S/4HANA is not devoid of severe challenges. Poroca [2] points out the complexity of the migration process that many organizations are grappling with, such as, data harmonization, process redesign, and change management. The large technical infrastructure and skilled human resource requirements of deployment may be stressful to budgets and schedules. Consequently, although the advantages of SAP S/4HANA are immense, proper planning, as well as an awareness of its requirements are also necessary so as to perfect its implementation and to eventually get the most out of its value.

2.1.1 Features and Benefits

The characteristics of SAP S/4HANA, such as a simplified data model and simplified interface, significantly contribute to operational efficiency. Madhava Varma et al. [3] indicate that SAP S/4HANA is more responsive, data-driven, and agile and enables an organization to control its resources. It also improves business operations by automating tasks, as Simkin et al. [4] noted, who further demonstrate cloud infrastructure's capacity to promote advanced capabilities.

2.1.2 Challenges in Implementation

Implementation of SAP S/4HANA may prove difficult and expensive despite its benefits. Wang et al. [5] mention such obstacles as change resistance, skills shortage, and initial migration costs as the barriers to successful SAP S/4HANA in their deployment. Moreover, it is stated that the SAP S/4HANA performance is primarily connected to the infrastructure [6], which may serve as an extra challenge when choosing an adequate cloud platform.

2.2 Cloud Computing and Infrastructure Strategies

SAP S/4HANA can be delivered to customers in a flexible, scalable environment using cloud computing. Specifically, AWS represents a prominent solution to hosting SAP S/4HANA, as it is more scalable and performs better. Simkin et al. [4] discuss the optimization of IT infrastructure with the help of AWS and emphasize that cloud systems like AWS can offer organizations the capabilities essential to scaling SAP S/4HANA systems.

2.2.1 Types of Cloud Infrastructure (IaaS, PaaS, SaaS)

There are three primary cloud infrastructure models: Software-as-a-Service (SaaS), Platform-as-a-Service (PaaS), and Infrastructure-as-a-Service (IaaS). All the models have various advantages for SAP S/4HANA implementations. Alomari et al. [7] explain that the IaaS and PaaS models are especially effective when hosting ERP solutions, such as SAP S/4HANA, which offer elastic computing resources and the possibility of storing information.

2.2.2 Cost Models in Cloud Computing

Cloud computing provides a range of costs, some of which are pay-as-you-go and reserved instances, which can affect the total cost of the deployments of SAP S/4HANA. Cheng et al. [8] discuss the digital services they offer using cloud systems and how they meet the financial requirements of an enterprise. Moreover, Lin et al. [6] also consider the cost model of the cloud applications and reconcile the budget and the outstanding performance of the organizations using the cloud.

Table 1: Comparative Analysis of AWS Cost Models for SAP S/4HANA Deployments Based on Cost, Flexibility, and Use Case Suitability

Cost Model	Description	Cost Predictability	Flexibility	Use Case Suitability	Advantages	Limitations
On-Demand Instances	Pay for compute capacity by the hour or second with no long-term commitments.	Low	High	Short-term, unpredictable workloads, testing environments	No upfront cost, flexible scaling	Most expensive over time; not cost-efficient for steady use
Reserved Instances	Commit to a one- or three-year term for a significant discount on usage rates.	High	Low	Steady-state, predictable workloads	Up to 75% cheaper than on-demand; ideal for SAP core tasks	Less flexibility; risk of over-provisioning
Spot Instances	Use unused EC2 capacity at deep discounts—subject to termination at any time.	Very Low	Medium	Non-critical or batch processing workloads	Up to 90% cheaper; cost-effective for parallel tasks	Can be interrupted anytime; not ideal for SAP core services
Savings Plans	Flexible pricing model providing discounts in exchange for consistent usage.	Medium	Medium	Workloads with known usage patterns across instance families	More flexible than RIs; supports broader usage types	Requires upfront planning and estimation
Dedicated Hosts	Physical servers dedicated to a single tenant for compliance or licensing.	High	Low	Regulated industries, BYOL (Bring Your Own License) needs	Improved compliance; license optimization	Expensive; limited scalability

2.3 Previous Studies on SAP S/4HANA Performance

The performance of SAP S/4HANA has also been tested in a few studies, especially in infrastructure strategies and optimization methods. Such studies are of great help in understanding performance measures and how various infrastructure models influence the performance of SAP S/4HANA. Researchers have also raised the benefits of operating SAP S/4HANA in cloud systems, pointing to the benefits of the system's scalability, agility, and real-time data processing needs. Looking at the cloud equivalent deployments, it is possible to adapt to changing business needs much faster and increase innovations using advanced analytics and artificial intelligence.

Further, prior studies have also analyzed the variability in the performance when different cloud infrastructure models are used, including dedicated instances, shared environments, and hybrid environments. Results indicate that dedicated infrastructure can ensure a high level of consistency in performance, but increased operations costs might accompany it. On the other hand, shared or multi-tenant environments might help save costs but cause latency issues or resource contention during spikes. Such trade-offs explain why any organization should choose an infrastructure strategy that matches the workload demands and budget limitations. Moreover, certain literature has also pointed towards the concept of optimization techniques, i.e., optimizing system size, workload balancing, and tuning the databases, which could help to improve the SAP S/4HANA on cloud performance. As an example, applying configuration settings to HANA databases, as well as using in-memory computing capabilities, has been proven to tremendously cut processing time and increase transaction throughput. These studies, however, present a good technical insight, though there is the need to have complete comparative studies that consider both the elements of performance and cost efficiency together in the case of AWS. The current study will aim to extend and generalize these results by determining the views of various infrastructure strategies in a systematic way that can support decision-making in practice.

2.3.1 Performance Metrics

The SAP S/4HANA performance metrics are response time, transaction throughput, and system availability. According to Wang et al. [5], such metrics are considered to be primary instruments to measure the efficiency of cloud infrastructure, and Zhang et al. [9] emphasize the role of hyperparameter tuning and performance optimization in enhancing the effectiveness of systems in cloud settings.

Table 2: Key Performance Indicators Used to Evaluate SAP S/4HANA Performance on AWS Cloud Infrastructure

2.3.2 Comparative Analyses of Different Infrastructure Strategies

Comparisons of cloud infrastructure approaches to SAP S/4HANA have found the benefits of particular setups. Simkin et al. [4] benchmark AWS against other cloud providers and evaluate the performance and cost results of various setups. In addition, the paper by Cui et al. [9] discusses the cost-efficiency of hierarchical federated learning models in cloud computing, which provides the framework for optimizing SAP S/4HANA performance in cloud environments.

3. METHODOLOGY

3.1 Research Design

This study has a research design based on a comparative analysis intended to determine various AWS infrastructure strategies for implementing SAP S / 4HANA. The combination of both qualitative and quantitative means to approach the study ensures that it not only collects measurable elements of system performance (in terms of time and resources consumed during response time, throughput, and resource utilization) but also includes cost-related performance indicators (referring both to the total cost of ownership (TCO) and operational expenditures (OPEX)). The two-sided view is necessary to have a comprehensive picture of the effects of both approaches to infrastructure, both in terms of technical performance and financial performance. The mixed-method approach is especially successful when applied to technology-based research, as indicated by Lin et al. [6], since it allows combining the numerical data and the personal experiences and strategic considerations of its users.

There is also the qualitative aspect, which will incorporate the opinions and reviews of specialists and users among IT managers and SAP architects with experience working with AWS-based deployment. This feedback enhances the analysis because the practicalities of the analysis and the grounds upon which decisions are made are also presented, as well as the best practices likely unseen just by working off other quantitative data. The synthesis of these approaches ensures that the results are present on earth and can be applied in organizations that aim to maximize their SAP S/4HANA atmosphere on AWS. The design eventually helps in coming up with practical recommendations that would satisfy performance, cost, and operational flexibility.

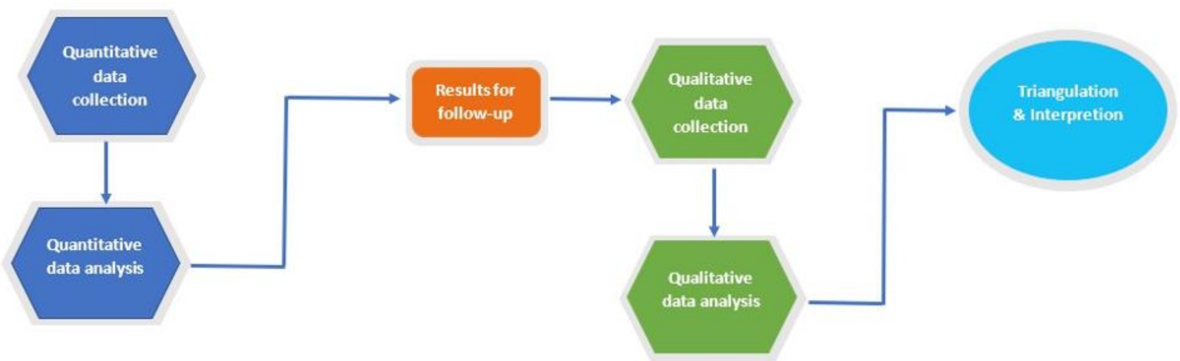

Figure 2: Mixed-Methods Research Framework for Evaluating AWS Infrastructure Strategies.

3.1.1. Qualitative vs. Quantitative Approach

The research is based on a mixed-method using qualitative and quantitative strategies to conduct a complete analysis of various AWS infrastructural approaches to SAP S/4HANA. Quantitative data is essential in the objective measurement of system performance quantities like response time, throughput and usage of system resources and the analysis of cost effectiveness by use of detailed billing and usage reports. These quantifiable metrics make it possible to deduce graded comparisons among the different configurations and settle on the most cost-effective and high-performing configurations.

Conversely, qualitative information will complement the study with perspectives of stakeholders with direct experience in the SAP S/4HANA operations on AWS. The study also reveals practical issues, best practices, and user satisfaction responses, which may easily be missed in data that consists entirely of figures as a result of the deep interviews with cloud architects, information technology managers, and the end-users. Instead, by integrating them, as Poroca et al. stress [2], a more comprehensive picture becomes possible to achieve, where hard performance numbers are paired with human experience-based information to make more productive decisions about which strategic routes IT infrastructure should take.

3.1.2. Comparative Case Study Method

This study utilizes a comparative case study method to assess the performance and cost efficiency of SAP S/4HANA on various AWS infrastructure setups. A comparative case study is ideal for evaluating different configurations in real-world scenarios. According to Abouzour et al. [15], case studies provide detailed insights into the practical implications of cloud infrastructure strategies, making them a valuable tool for understanding SAP S/4HANA's performance on AWS.

3.2. Data Collection

The study will use quantitative performance data and qualitative user responses to collect the data since the true parameters of evaluating the Amazon Web Services infrastructure strategies regarding SAP S/4 HANA will be based on the fact that both the short-term and long-term responses of the performance will be measured, including the user commentary. The quantitative data will contain performance indicators of the systems, the response times, transaction throughput, CPU and memory use, and the overall availability of the system. These measures will be collected during monitoring tools and performance records during specific testing times, and the possible positive or negative influence of each infrastructure strategy in realistic round loads can be compared objectively.

Besides the technical measures, qualitative data via structured interviews and surveys will also be gathered among the IT administrators and end-users interacting with the SAP S/4HANA system directly on AWS. Their comments will give a picture of apparent reliability of systems, experiences concerning using the system and challenges faced in the everyday use of the system. The combination of quantitative and qualitative perspective should allow the study not only to take into account the measurable outcomes of a system but also the effect of infrastructure decisions on business performance and user satisfaction.

3.2.1. Selection of Case Studies

The case studies selected for this research will be drawn from organizations that have deployed SAP S/4HANA on AWS. These organizations will be selected based on their size, industry, and the specific AWS infrastructure configurations they have implemented. Simkin et al. [4] suggest that selecting diverse case studies with varying AWS configurations will provide a more comprehensive understanding of the impact on performance and costs.

3.2.2. Data Sources (Surveys, Interviews, Performance Reports)

The research data will be collected from several sources: surveys and interviews with the SAP S/4HANA ecosystem users, cloud architects, and performance reports of organizations that use AWS to deploy SAP. A survey and interviews will facilitate the capturing of user perspectives regarding their experience in performance, cost, and satisfaction with the various configurations of AWS. Alomari et al. [7] assert that the views of cloud infrastructure experts can be obtained through interviews and are vital in determining the technicalities and dilemmas of application in SAP S / 4HANA.

3.3. Data Analysis Techniques

This study shall focus on two main dimensions in its analysis based on system performance and cost efficiency. In order to measure performance metrics, quantitative measures will be used in terms of system response time, transaction throughput, CPU and memory usage and system availability. The monitoring tools and AWS performance dashboards will be used, and these measures will offer an inclusive picture of the way in which various infrastructure strategies affect the operational efficiency of SAP S/4HANA. The study will be able to determine configurations that would give the best results in different workloads by comparing the indicators taken systematically in different deployment scenarios.

Simultaneously, an emergent cost analysis model will be utilized to appreciate the financial implication of every strategy. The elements to be covered in this framework will be initial and recurrent costs of infrastructure, licensing fees, and operation costs and expected savings that will be achieved through reserved and spot instances. Cost-benefit and total cost of ownership (TCO) calculations will be provided in order to define which strategies are the most financially efficient ones which do not reduce the quality of the performance and reliability of the system as well. In combination, these analytical methods will grant a complete evaluation wherein organizations can undertake informed decision making during planned designs or SAP S/4HANA on AWS migrations.

3.1.1. Performance Metrics Evaluation

The performance evaluation will use several metrics, including system response time, transaction throughput, and scalability under varying load conditions. As discussed by Wang et al. [5], performance metrics are essential for understanding how different AWS configurations impact SAP S/4HANA's operational efficiency. These metrics will be compared across case studies to identify the most effective infrastructure setups.

3.1.2. Cost Analysis Framework

A cost analysis framework will be used to evaluate the financial efficiency of different AWS configurations. This framework will consider both direct costs (e.g., infrastructure costs, licensing) and indirect costs (e.g., operational overhead). Cheng et al. [8] highlight the importance of understanding cloud cost models when evaluating SAP S/4HANA's financial efficiency, as it allows organizations to optimize both performance and expenditure.

Table 3: Components of Total Cost of Ownership (TCO) for SAP S/4HANA on AWS

Cost Component	Description	Cost Type	Examples / AWS Services Involved	Relevance
Compute Resources	Cost of virtual machines (EC2 instances) used to run SAP S/4HANA.	Direct (Recurring)	EC2 On-Demand, Reserved, Spot Instances	Major contributor to operational costs; impacts performance directly.
Storage Resources	Cost of storing SAP data, logs, and backups.	Direct (Recurring)	EBS (gp3, io2), S3, Glacier	Critical for database performance and disaster recovery planning.
Networking Costs	Charges related to data transfer between AWS services and users.	Direct (Usage-Based)	VPC, Direct Connect, Data Transfer Out	Affects latency and availability; often underestimated in cloud budgets.

Licensing Fees	Cost of SAP software licenses and any other middleware used.	Direct (Fixed/Variable)	SAP HANA licensing, BYOL options	Dependent on licensing model; adds significant overhead to infrastructure.
Support and Maintenance	Costs for AWS support plans, SAP BASIS management, and monitoring tools.	Indirect (Ongoing)	AWS Business/Enterprise Support, CloudWatch, Trusted Advisor	Ensures system reliability, issue resolution, and proactive performance tuning.
Setup and Migration	One-time cost for system setup, data migration, and integration.	Indirect (One-Time)	Migration tools, consulting services	Can be high initially; critical to ensure smooth deployment and transition.
Training and Change Mgmt.	Training users, managing organizational change, and adoption of cloud infrastructure.	Indirect (One-Time)	Training programs, onboarding sessions	Affects long-term ROI; ensures user efficiency and acceptance.
Downtime/Outage Costs	Losses due to system unavailability or performance degradation.	Indirect (Variable)	N/A – measured as lost business productivity	Impacts reputation, productivity, and revenue—should be minimized strategically.
Scaling and Elasticity	Cost variations due to dynamic resource scaling based on workload demands.	Variable (Elastic)	Auto Scaling, Lambda, Spot Instances	Helps optimize costs over time, especially with variable workloads.

4. INFRASTRUCTURE STRATEGIES

4.1. On-Premises vs. Cloud Infrastructure

Today, companies still use on-premises infrastructure to run their SAP applications because of the extensive level of control and customization that comes with it. This model, however, is most of the time accompanied by not only vast amounts of capital expenditures on the hardware but also by the costs of keeping the system ready through maintenance, system upgrades, and even dedicated IT personnel. Moreover, expanding on-premises systems to support the increasing business needs may be time-consuming and expensive, so it needs a lot of lead time and investment of physical resources. Although security and data sovereignty are still good arguments on why an organization should run on-premises deployments, they are now being offset by operational rigidities and the cost of such deployments.

On the contrary, cloud infrastructure, especially AWS, is a more versatile and economical option. Through AWS scale computing and storage, organizations can dynamically allocate computing and storage resources to support real-time workload needs without over-provisioning and accommodating downtime and underutilization. The shift away from the capex-model of expenditure to the operation expenditure (OpEx) implemented by businesses in cloud platforms has ensured that the cash flow is released and that more strategic investments are made, as noted by Wang et al. [5]. Moreover, Simkin et al. [4] point out that AWS and its robust system of tools, including the auto-scaling of instances and high availability opportunities, are more than desirable in the context of the challenges presented by SAP S/4HANA performance needs. Being flexible, available worldwide, and able to offer high levels of security make cloud infrastructure an attractive option to the challenges required of contemporary businesses interested in delivering performance and, at the same time, being cost-effective.

4.2. Hybrid Cloud Models

A hybrid cloud is a model that allows the enjoyment of both an on-premise and cloud environments to provide a unified and flexible IT architecture. This strategy enables organizations to maintain important services, hold sensitive information on-premise, and shift other less or more scalable resources to the cloud. In so doing, businesses stand to enjoy the elasticity and cost-effectiveness nature of cloud services without necessarily losing complete control of their data. This model will allow businesses operating SAP S/4HANA to migrate gradually to experience minimal operational risks and, therefore, limit the risk of experiencing disruptions due to comprehensive cloud migrations. In addition, hybrid deployments enable enterprises to create the most efficient performance by optimizing workloads in a location where they perform the most advantageously (on-premises or cloud) based on needs (latency-sensitive procedures and analytics and peak capacity requirements).

AWS also offers elastic support to hybrid architectures with the help of services like AWS Direct Connect, AWS Outposts, and easy-to-integrate VPNs, meaning that the organization can extend its on-premises data center to AWS securely and efficiently. According to Poroca [2], hybrid models have a special appeal to industries that demand high levels of compliance and data residency because, in this way, it is possible to implement greater security and control. However, it does not exclude the possibility to be innovative and scalable. Finally, a hybrid cloud approach to SAP S/4HANA puts an organization in a position to find a balanced modernization strategy: the speed and flexibility of the cloud with the power and stability of the on-premise infrastructure.

4.3. AWS-Specific Infrastructure Strategies

AWS provides various infrastructure planning to streamline performance and economical-friendly SAP S/4 HANA implementations. These strategies involve the use of the best EC2 instance type, storage, and type of networking.

- **EC2 Instance Types**

  The computing power that is required in order to operate SAP S/4HANA workloads is made possible by EC2 instances that form the heart of AWS cloud computing. The instance types are optimized to different use cases, including the following: general-purpose instance types, memory-optimized instance types, and compute-intensive instance types. According to Lin et al. [6], the correct choice of EC2 instance types is crucial to finding the perfect balance between the cost and performance of a cloud-based application such as SAP S/4HANA. The choice of EC2 instance influences the computation capacity as well as the running cost of SAP S/4HANA using AWS.

- **Storage Solutions**

  AWS provides multiple storage options, which involves Elastic Block Store (EBS), Simple Storage Service (S3) and Glacier that support various SAP S/4HANA workloads. Alomari et al. [7] emphasize the importance of selecting the suitable storage option to achieve total performance and cost optimization of SAP applications. The example of S3 and EBS: S3 offers scalable storage that is affordable and can be used to store infrequently accessed data and the EBS storage provides a high-performance storage that can be used to support transactional workloads.

- **Networking Options**

  AWS supports the use of AWS networking alternatives like Virtual Private Cloud (VPC), Direct Connect, and Elastic Load Balancing to boost connectivity, data protection, and performance of SAP S/4HANA in the cloud. Simkin et al. [4] stress the contribution of AWS networking services to high availability and latency reduction of SAP applications, which are essential factors of real-time business operations.

4.4. Cost Management Tools on AWS

One of the factors that may be of value when optimizing cloud infrastructure is cost. AWS provides a few tools, including the AWS Cost Explorer, the AWS Budgets, and the AWS Trusted Advisor, to enable an organization to manage and track its cloud cost. Such tools enable businesses to monitor usage, generate budget reminders, and maximize resource management to make efficient SAP S/4HANA deployments cost-effective (Cheng et al. [8]). Secondly, such cost management tools may assist organizations in making an informed decision regarding the scaling of their infrastructure and control over expenditure details.

5. COMPARATIVE ANALYSIS

5.1. Performance Metrics

The actions to be taken when assessing the success of SAP S/4HANA implementations on different infrastructure AWS strategies depend on performance metrics. It is crucial to monitor key parameters to gauge the performance of SAP S/4HANA in cloud infrastructure regarding the capability of real-time business transactions, namely system response time, transaction throughput, and data processing speed. Moreover, performance indicators such as CPU usage, memory usage, and disk I/O performance give one a feel of how different types of instances in AWS and storage configurations affect application behavior when deployed in different workload environments. The close attention to these metrics will allow organizations to optimize their SAP systems to ensure their high availability and reliability and support core business processes without delays or disruption.

Comparing these metrics in the context of different AWS strategies, such as reserved instances, on-demand instances, and auto-scaling groups, may help an organization select the most balanced strategy regarding its most significant and average usage of the resources. For example, reserved instances can provide more consistent performance at a reduced price on predictable workloads, so auto-scaling groups can help achieve a better response time in the face of an unanticipated surge of demand. Finally, with a rich collection of performance metrics, the IT teams can better distribute the resources, ensuring bottleneck-free experience and aligning any cloud investments to the performance requirements. This makes the entire SAP S/4HANA deployments on AWS most valuable.

Table 4: Comparative Performance and Cost Efficiency of AWS Infrastructure Strategies for SAP S/4HANA

Infrastructure Strategy	Performance Score (1–5)	Cost Efficiency Score (1–5)	Response Time	Throughput	Scalability	TCO Impact	Best Use Case
On-Demand Instances	3	2	Medium	Medium	High	High (Ongoing Cost)	Short-term or variable workloads; testing environments
Reserved Instances	4	4	Fast	High	Moderate	Low (Predictable Budget)	Steady-state, predictable SAP workloads
Spot Instances	2	5	Variable	Variable	Low–Medium	Very Low (if stable)	Batch jobs, non-critical processing
Savings Plans	4	4	Fast	High	High	Moderate–Low	Balanced workloads across regions or instance types
Auto Scaling Groups	5	4	Very Fast	Very High	Very High	Variable (Pay-per-use)	Dynamic workloads; high availability SAP environments
Hybrid Cloud Models	4	3	Fast	High	High	Medium (CapEx + OpEx)	Industries with compliance need

5.1.1. Response Time

Response time is a key performance measure; it measures the time between when the system and a user interacted and when the system retrieved data and gave feedback. Lin et al. [6] point to its importance regarding cloud-based deployments, saying that it also dictates the user experience and operational efficiency. Response time can be significantly reduced due to heterogeneous resource allocation, especially the selection of Amazon EC2 instances and configurable networking parameters.

5.1.2. Throughput

Throughput can be understood to be the total number of transactions that are undertaken by SAP S/4HANA during a certain period. As Wang et al. note [5], the ability to maintain a high throughput level is crucial for the facilitation of efficient workload management in SAP environments. Tweaking of the performance, especially the fine-grained nature of EC2 instance settings and storage designs, thus continues to hold the key to getting optimum performances realized on Amazon Web Services platforms.

5.1.3. Scalability

Scalability is the ability of the infrastructure to handle increased load without compromising performance. AWS's auto-scaling features enable SAP S/4HANA deployments to scale resources dynamically based on demand. Simkin et al. [4] highlight how auto-scaling in AWS allows SAP S/4HANA to adjust to fluctuating workloads, maintaining consistent performance levels even under high demand.

5.2. Cost Efficiency Metrics

Cost-effectiveness is an important organizational evaluation in selecting cloud infrastructure for hosting SAP S/4HANA. Although initial capital expenditure is an important concern, enterprises must be highly vigilant about ongoing operating expenses, particularly the consumption of computing, storage, and network resources, alongside contracted support services. A thorough cost analysis should thus entail indirect benefits, including reduced on-site maintenance burdens, less frequent hardware upgrading requirements, and exposure to fewer service downtimes. By implementing advanced cost-tracking tools and AWS cost-management services, companies can identify unused assets and re-tune settings to maximize their value with minimal risk of losing the performance of critical workloads.

A thorough assessment also requires the total cost of ownership (TCO) for the system's entire life cycle. Relationship studies between other pricing models, such as reserved instances, savings plans, and spot instances, are to be conducted to match spending with regular patterns of work volume and business needs. Seeing how the SAP S/4HANA workloads, by their very nature, are volatile, it is crucial to include elasticity and scalability in cost-efficiency measurement. A sensible way of reconciling performance and cost-saving goals allows organizations to re-invest the financial capital released by their show to focus on innovation and growth activities that would place them in a better position to compete in the increasingly digital market niche.

5.2.1. Total Cost of Ownership (TCO)

TCO (total cost of ownership) is an overall measure that considers all the costs faced in the implementation process, maintenance, and operation of the SAP S/4HANA hardware in the AWS cloud, including direct and indirect costs. Alomari et al. [7] provide a model for calculating TCO within cloud-based environments and suggest calculating both explicit and implicit costs of evaluating AWS on SAP S/4HANA.

5.2.2. Return on Investment (ROI)

According to Cheng et al., ROI measures the monetary benefit that SAP S/4HANA implementation can bring compared to the cost one has to incur [8]. Complete estimates of the ROI also necessitate a discussion of the productivity of these deployments, cost savings, and efficiency gained as part of the overall cloud-based SAP deployment. The positive ROI will, therefore, mean that the cloud infrastructure will not only drive improvements in performance measurements but will also be associated with significant financial benefits.

5.3. Case Study Comparisons

Comparative case studies of different organizations using AWS for SAP S/4HANA provide valuable insights into the real-world implications of infrastructure choices. These case studies allow for the evaluation of performance and cost efficiency metrics in diverse business contexts. Simkin et al. [4] highlight several case studies where AWS infrastructure strategies were optimized to enhance SAP S/4HANA's performance while minimizing costs. Abouzour et al. [15] also provide case studies on the integration of cloud-native storage solutions, offering a useful reference for organizations considering AWS for their SAP applications.

6. FINDINGS AND DISCUSSION

6.1. Summary of Key Findings

The study's analysis of various AWS infrastructure strategies for SAP S/4HANA reveals several key findings. First, EC2 instance types and storage configurations significantly impact both performance and cost efficiency. As noted by Lin et al. [6], optimizing EC2 instance types for specific SAP workloads can enhance response times and throughput. Additionally, the use of AWS’s auto-scaling features allows for efficient resource allocation, ensuring that SAP S/4HANA remains scalable under fluctuating workloads, as emphasized by Simkin et al. [4]. Second, the total cost of ownership (TCO) varies depending on the infrastructure choices, with hybrid cloud models providing a balance between performance and cost, as suggested by Poroca [2]. Finally, AWS's cost management tools, such as AWS Cost Explorer and Trusted Advisor, enable businesses to effectively track and control their cloud spending [7], [8].

6.2. Implications for Businesses

The findings suggest several implications for businesses considering the deployment of SAP S/4HANA on AWS. For organizations seeking cost efficiency, adopting a well-optimized cloud infrastructure strategy—such as selecting the right EC2 instance and leveraging cost management tools—can result in substantial savings. Wang et al. [5] highlight that cloud infrastructures, particularly when optimized, can lead to reduced upfront and operational costs. Furthermore, businesses can achieve significant performance improvements by aligning their infrastructure strategies with best practices, as outlined by Alomari et al. [7]. These insights underscore the importance of careful planning and evaluation of cloud resources before deploying SAP S/4HANA on AWS.

6.3. Limitations of the Study

While the study provides valuable insights, it also has several limitations. One limitation is the reliance on case studies from a select group of organizations, which may not fully represent the broader industry landscape. As noted by Cheng et al. [8], cloud-based deployments can vary widely depending on organizational size, industry, and specific business needs. Additionally, the study did not account for long-term operational costs beyond the initial deployment phase, which may vary as businesses scale their SAP S/4HANA environments.

6.4. Recommendations for Future Research

Future research should aim to explore the long-term cost and performance implications of SAP S/4HANA deployments on AWS, especially in larger, more complex organizations. Additionally, further studies could investigate the impact of emerging technologies such as machine learning and artificial intelligence on SAP S/4HANA's performance in the cloud. Zhang et al. [9] suggest that performance tuning with high-performance computing and machine learning can lead to more efficient cloud applications, including ERP systems like SAP S/4HANA. Lastly, more research on the adoption of hybrid cloud models for SAP S/4HANA is necessary, as this approach may offer a more flexible solution for businesses with specific regulatory and data security requirements, as discussed by Poroca [2].

7. CONCLUSION

7.1. Recap of Research Objectives

This study set out to critically examine how infrastructure choices on Amazon Web Services (AWS) impact both the cost efficiency and system performance of SAP S/4HANA deployments. Given the growing enterprise trend toward migrating mission-critical ERP systems to the cloud, the research focused on identifying which AWS infrastructure strategies such as the selection of EC2 instance types, storage tiers, and networking configurations yield the best outcomes in terms of financial optimization and workload responsiveness. The study emphasized the need to balance performance and cost, two often conflicting priorities in cloud-based ERP environments. To achieve these objectives, the research incorporated a comparative analysis approach using performance benchmarks, resource utilization metrics, and cost modeling across different AWS configurations. The study also examined real-world case studies and deployment patterns to evaluate practical applications and industry trends. Key variables analyzed included compute scalability, memory throughput, IOPS performance, and hourly versus reserved instance pricing models. This comprehensive evaluation allowed for a granular understanding of the trade-offs involved in infrastructure decisions, particularly for organizations operating under strict performance SLAs and budgetary constraints.

Ultimately, the study aimed to generate practical, evidence-based guidance for IT decision-makers, cloud architects, and enterprise stakeholders involved in digital transformation initiatives. By highlighting the infrastructure strategies that deliver the most value in real-world scenarios, the research supports informed planning, risk reduction, and strategic investment in cloud-based ERP systems. The findings contribute to the broader discourse on cloud optimization and provide a blueprint for maximizing the return on investment when deploying SAP S/4HANA in AWS environments.

7.2. Conclusion on Cost Efficiency and Performance

The findings of the study indicate that AWS offers a flexible and scalable environment for SAP S/4HANA that can significantly enhance both cost efficiency and performance. As highlighted by Simkin et al. [4] and Lin et al. [6], careful selection of EC2 instance types and storage configurations is crucial for optimizing performance. Furthermore, cost management tools available on AWS, such as AWS Cost Explorer and Trusted Advisor, allow organizations to monitor and control their cloud expenditures effectively [7], [8]. Overall, with the right infrastructure strategy, businesses can achieve a balance between high performance and low costs in their SAP S/4HANA deployments.

7.3. Final Thoughts on Infrastructure Strategies for SAP S/4HANA on AWS

The study concludes that businesses should take a strategic approach when selecting their AWS infrastructure for SAP S/4HANA, ensuring that the configuration aligns with both their performance needs and budget constraints. As Poroca [2] points out, hybrid cloud models can offer a middle ground, enabling businesses to leverage the benefits of both on-premises and cloud solutions. Future advancements in cloud computing and performance optimization, such as the integration of machine learning models [9], may further enhance the efficiency of SAP S/4HANA on AWS. Moving forward, businesses must continually assess and adapt their infrastructure strategies to keep up with technological innovations and changing business demands.

REFERENCES

[1] Chang, V., Arunachalam, P., Xu, Q. A., Chong, P. L., Psarros, C., & Li, J. (2023). Journey to SAP S/4HANA intelligent enterprise: is there a risk in transitions? International Journal of Business Information Systems, 42(3–4), 503–541. https://doi.org/10.1504/IJBIS.2023.129698

[2] Poroca, F. B. (2023). The SAP S/4HANA system and digital transformation in organizations. Revista Científica Multidisciplinar Núcleo Do Conhecimento, 54–77. https://doi.org/10.32749/nucleodoconhecimento.com.br/technology-en/digital-transformation

[3] MADHAVA VARMA, K., CHOWDARY, N. D., CHANDRA, P. P., & KUMAR, G. P. (2023). Cloud based ERP systems and Data Security for Cloud based ERP Applications - SAP S/4HANA. INTERANTIONAL JOURNAL OF SCIENTIFIC RESEARCH IN ENGINEERING AND MANAGEMENT, 07(02). https://doi.org/10.55041/ijsrem17828

[4] Simkin, A., Kopp, A., & Olkhovyi, O. (2023). Research on the optimization model for building an efficient IT infrastructure using the AWS platform. InterConf, (38(175)), 300–315. https://doi.org/10.51582/interconf.19-20.10.2023.027

[5] Wang, X., Niu, Y., Liu, F., & Xu, Z. (2022). When FPGA Meets Cloud: A First Look at Performance. IEEE Transactions on Cloud Computing, 10(2), 1344–1357. https://doi.org/10.1109/TCC.2020.2992548

[6] Lin, C., Mahmoudi, N., Fan, C., & Khazaei, H. (2023). Fine-Grained Performance and Cost Modeling and Optimization for FaaS Applications. IEEE Transactions on Parallel and Distributed Systems, 34(1), 180–194. https://doi.org/10.1109/TPDS.2022.3214783

[7] Alomari, M. F., Mahmoud, M. A., Yusoff, Y. B., Gharaei, N., Abdalla, R. A., & Gunasekaran, S. S. (2023). Data Encryption-Enabled Cloud Cost Optimization and Energy Efficiency-Based Border Security Model. IEEE Access, 11, 104126–104141. https://doi.org/10.1109/ACCESS.2023.331788

[8] Cheng, M., Qu, Y., Jiang, C., & Zhao, C. (2022). Is cloud computing the digital solution to the future of banking? Journal of Financial Stability, 63. https://doi.org/10.1016/j.jfs.2022.101073

[9] Cui, Y., Cao, K., Zhou, J., & Wei, T. (2023). Optimizing Training Efficiency and Cost of Hierarchical Federated Learning in Heterogeneous Mobile-Edge Cloud Computing. IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems, 42(5), 1518–1531. https://doi.org/10.1109/TCAD.2022.3205551

[10] Costa, R. L. de C., Moreira, J., Pintor, P., dos Santos, V., & Lifschitz, S. (2021). A Survey on Data-driven Performance Tuning for Big Data Analytics Platforms. Big Data Research, 25. https://doi.org/10.1016/j.bdr.2021.100206

[11] Harikrishna Madathala , Balaji Barmavat, Srinivasarao Thumala, "Functional Consideration in Cloud Migration," Available:https://www.ijirset.com/upload/2023/december/47_Performance.pdf

[12] Harikrishna Madathala , Balaji Barmavat, Srinivasarao Thumala, "Functional Consideration in Cloud Migration," Available:https://www.researchgate.net/publication/385927582_Functional_Consideration_in_Cloud_Migration

[13] Zhang, F., Petersen, M., Johnson, L., Hall, J., & O'bryant, S. E. (2022). Hyperparameter Tuning with High Performance Computing Machine Learning for Imbalanced Alzheimer's Disease Data. Applied Sciences (Switzerland), 12(13). https://doi.org/10.3390/app12136670

[14] Wu, Q., Zhai, X. B., Liu, X., Wu, C. M., Lou, F., & Zhang, H. (2023). Performance Tuning via Lean Measurements for Acceleration of Network Functions Virtualization. IEEE/ACM Transactions on Networking, 31(1), 366–379. https://doi.org/10.1109/TNET.2022.3193686

[15] Liao, L., Li, H., Shang, W., & Ma, L. (2022). An Empirical Study of the Impact of Hyperparameter Tuning and Model Optimization on the Performance Properties of Deep Neural Networks. ACM Transactions on Software Engineering and Methodology, 31(3). https://doi.org/10.1145/3506695

[16] Mustafa, D. (2022). A Survey of Performance Tuning Techniques and Tools for Parallel Applications. IEEE Access, 10, 15036–15055. https://doi.org/10.1109/ACCESS.2022.3147846

[17] Abouzour, M., Aluç, G., Bowman, I. T., Deng, X., Marathe, N., Ranadive, S., … Smirnios, J. C. (2021). Bringing Cloud-Native Storage to SAP IQ. In Proceedings of the ACM SIGMOD International Conference on Management of Data (pp. 2410–2422). Association for Computing Machinery. https://doi.org/10.1145/3448016.3457563

Citation: Venkata Ramana Reddy Bussu. (2024). Maximizing Cost Efficiency and Performance of SAP S/4HANA on AWS: A Comparative Study of Infrastructure Strategies. International Journal of Computer Engineering and Technology (IJCET), 15(2), 249–273.

Abstract Link: https://iaeme.com/Home/article_id/IJCET_15_02_027

Article Link:
https://iaeme.com/MasterAdmin/Journal_uploads/IJCET/VOLUME_15_ISSUE_2/IJCET_15_02_027.pdf

✉ **editor@iaeme.com**