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The Impact of Cloud Computing on Modern Software Development Practices

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Abstract— Cloud computing which has become the cornerstone of many developments today, has brought changes to the way modern software solutions are developed to encompass scalability, efficiency, and flexibility. In this paper, the effects of cloud computing platforms that include AWS, Azure, and Google Cloud on software development processes are examined for advantages like faster deployment, lower costs, and greater flexibility. To this end, this research focuses on analyzing the trends in cloud adoptions, the development workflows, and the tools supported by the leads to demonstrate how these have enhanced development. Furthermore, the research also analyzes how cloud computing affects agile and DevOps software development processes for engineering. The study reveals that cloud computing has a critical influence on the companies' digital transformation process along with the accelerated product development cycle and advancement in different industries.

Index Terms—Cloud Computing, Software Development, Cloud Adoption, Scalability, DevOps

I. INTRODUCTION

Cloud computing has brought drastic changes to the structure of current day software development, and access to solutions that can expand orientation, adaptability, and economy. Many organizations are adopting services like AWS, Azure, and Google Cloud, thus deploying new technologies in their operations to enhance software deployment. This paper looks at the effects of making use of cloud computing in today's software development activity in the areas of costs, scalability, and deployment time (Mistry, Mavani, Goswami, & Patel, 2024). It means the goal is to raise the question of how these platforms have transformed the overall development processes and continue to do so as part of the ongoing digitization of work across sectors.

1.1 Aim and Objectives

Aim

The aim of this research is to investigate cloud computing platforms including AWS, Azure, and Google Cloud, and evaluate the effect on the current computer software development approaches in the context of scalability, cost, and deployment time.

Objectives

- To assess the current and potential levels of adoption of the key cloud platforms and their impact on SD processes.
- To evaluate the relative costs of using cloud services in comparison with the traditional on-premises scenarios.
- To further explain the complexity that cloud platforms bring to the scalable and flexible use of the software.
- To evaluate the applicability and benefits of cloud computing in early software products time-to-market reduction.

II. LITERATURE REVIEW

2.1 Cloud Computing Adoption and Market Trends

The levels of utilization of cloud computing have in the recent past risen over a decade due to the pressure on business organizations to adopt new ways of scaling their operations, cutting down their expenses as well as increasing flexibility. Most of the key market players include AWS, Microsoft Azure, and Google Cloud, which have copied and retailed their services across the global market curve effectively to meet the needs of businesses across the globe in different areas including the ability to compute, store data, and hire machine learning capabilities (Al-Saqqa, Sawalha, & AbdelNabi, 2020). This deficit has been greatly overshadowed by the evidence that more and more companies from diverse industries such as finance, healthcare, and retail have started to transfer their operations into the cloud to benefit from the flexibility and effectiveness of the solution (Awaysheh et al., 2021).

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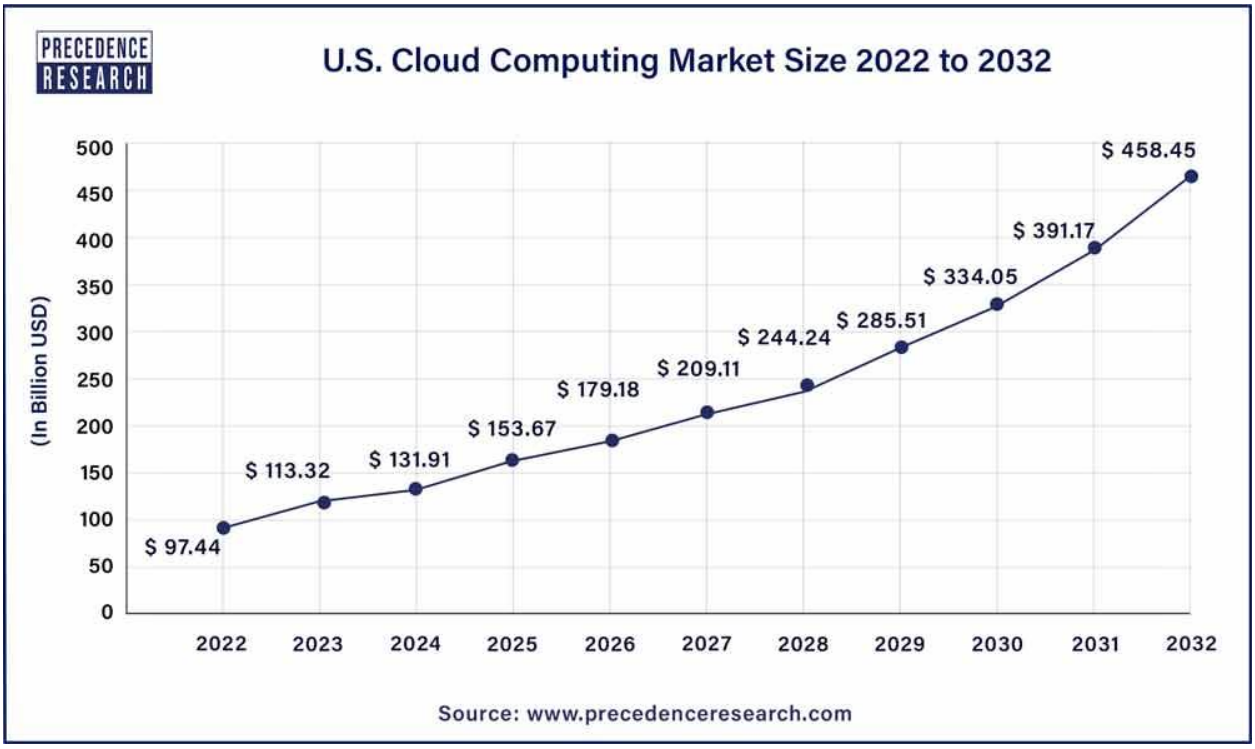

Fig. 2.1: Cloud computing adoption trends
(Source: Yanamala, 2024)

Trends also indicate a gradual trend for organizations to invest in cloud solutions mainly for IaaS and PaaS service models. The market of cloud services remains active: more companies switch to hybrid and multi-cloud approaches. Companies are using several cloud providers due to the risks that arise from being locked into only one provider and to increase the level of resiliency (Alam, 2022). Indeed, as firms understand the innovative possibilities that can be offered through cloud computing, market trends point to the fact that cloud computing is only increasing, leading to the transformation of the digitally transformative landscape across sectors.

2.2 Benefits of Cloud Computing for Software Development

Cloud computing brings multiple considerable advantages for software development that concerns application building, deployment as well as maintenance. Probably the most discernible benefit is the ability for developers to attain almost infinite amounts of computation capacity. This flexibility of resource usage is a unique attribute of software applications that enable users to grow or shrink without the requirement of accruing more infrastructure (Katal, Dahiya, & Choudhury, 2023).

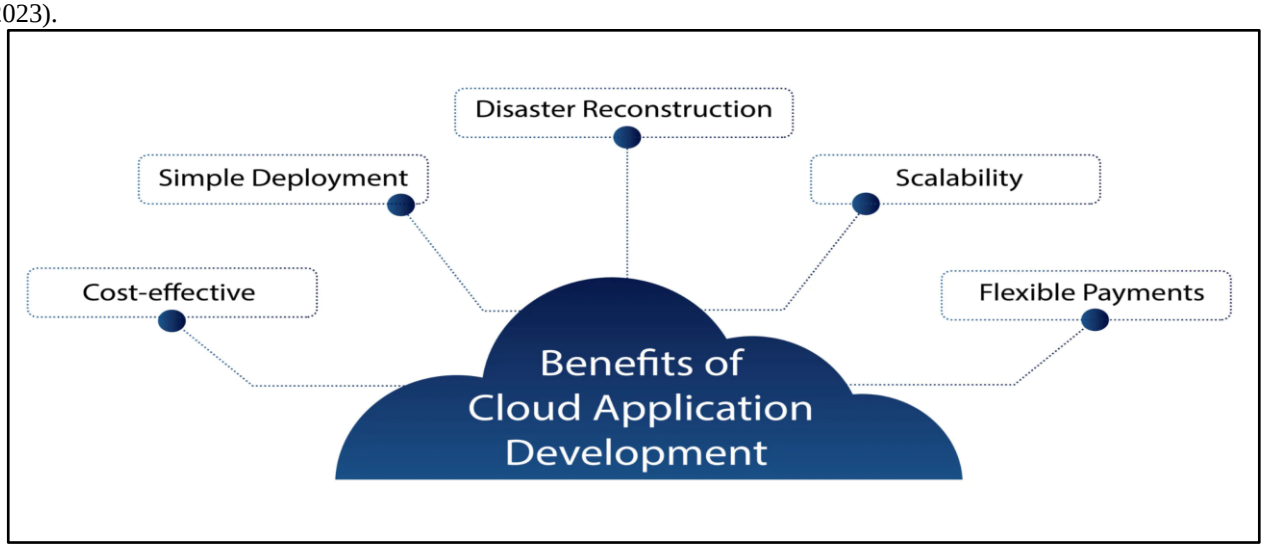

Fig. 2.2: Benefit of cloud application development
(Source: Yanamala, 2024)

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Also, cloud computing makes possible faster application deployment and faster time to market. As a result, by using cloud services, it is easy for a developer to create development and testing environments in a shorter time (Apeh et al., 2023). This cuts out capital costs and businesses only pay for what they consume in the way of exercising the infrastructure. Thus, it is for this reason that companies can solve the problem of resource allocation more effectively by focusing on investing in innovation rather than worrying about hardware.
In addition, cloud service also enshrines a notion of collaboration with the development team irrespective of the geographical location (Ajiga et al., 2024). Applications based on cloud include real-time working on shared code bases which enhances communication as well as work efficiency. Due to these benefits, cloud computing can be considered as being one of the enabling technologies of modern software development (Bharany et al., 2022).

2.3 Challenges and Limitations of Cloud-Based Development

Cloud-based development has the following benefits but to tap the full potential the following issues need to be considered some challenges and limitations. A key issue is that of lock-in where organizations become overly dependent on a specific cloud provider tools and services (Alashhab et al., 2021). This dependence can cause problems if a company wants to change providers or if it wants to move back to the traditional IT infrastructure. Inter and intra-cloud data transfer also incurs heavy costs and may involve numerous technical challenges that affect flexibility.

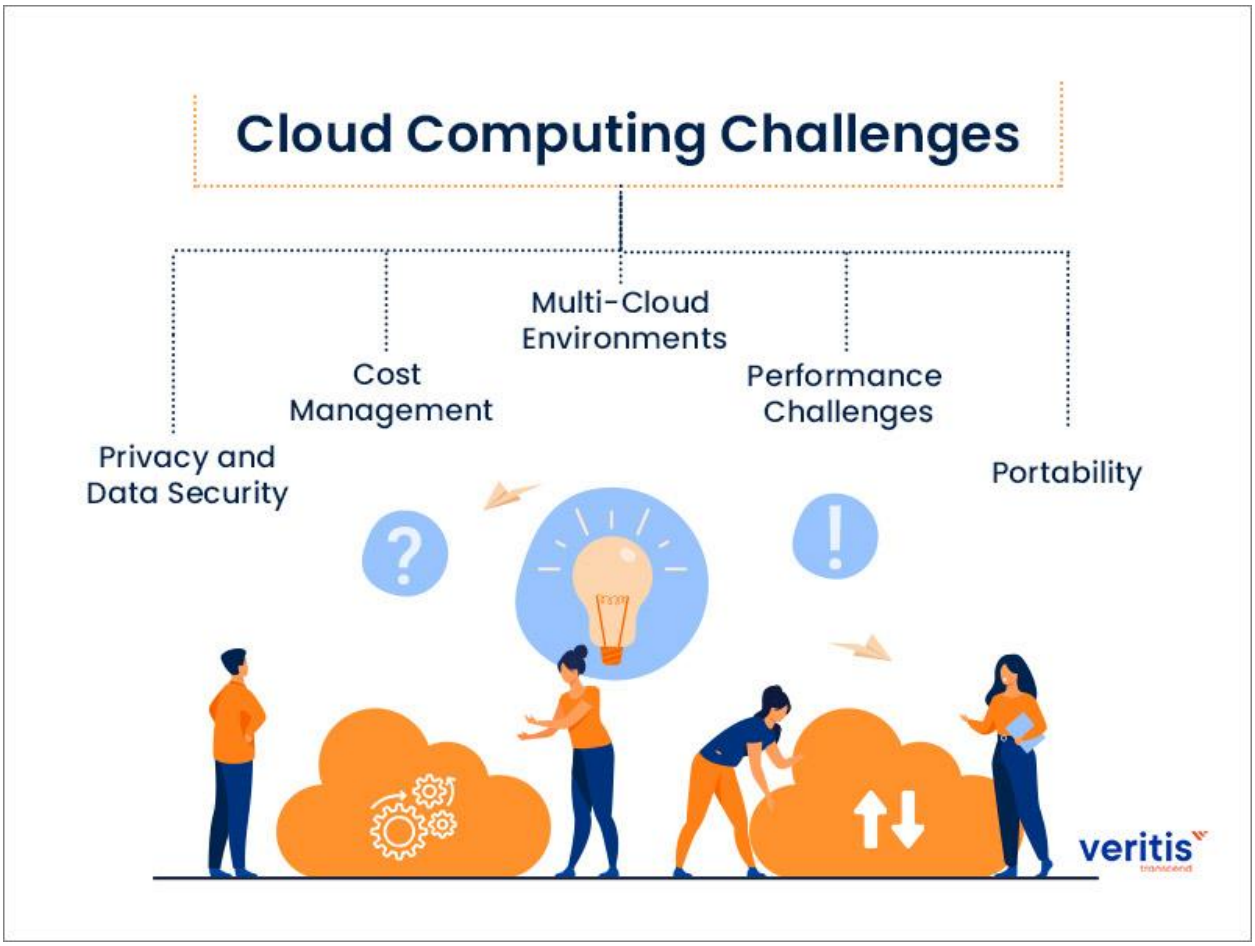

Fig. 2.3: Cloud computing challenges
(Source: Shukur et al., 2020)

Potential performance problems are associated when cloud infrastructure is multi-tenant, and there is a usage of various networking protocols. Sometimes, the network latency creates inconsistency mainly in areas that have a weak internet connection hence it may impact the working of any application that uses cloud resources (Bello et al., 2021).
Finally, the price of cloud services can be quite unknowable. The paper also revealed that though cloud computing can be cheaper compared to traditional hosting services, particularly for start-up businesses, the costs can escalate as the magnitude of business expands. Nonetheless, the pay-as-you-go pricing structure may be disadvantageous because it translates into unpredictable costs especially where resources are ill-utilized (Sunyaev & Sunyaev, 2020). Such limitations suggest that cloud-based development requires special planning and management.

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2.4 Impact of Cloud Computing on Software Engineering Practices

Cloud computing has revolutionized how software engineering is practiced and how software is built, deployed, and used. DevOps engineering is supported by cloud platforms, thereby helping in the creation of an interface between the development and operations departments (Alam, 2021). Using the cloud solutions, one can achieve CI/CD which leads to decreased human interjection, as well as to the rate up of the software delivery cycle. The dynamic of the cloud leads to spending more time on coding rather than on the environment, it also offers scalability which ultimately leads to faster cycles through development and shortens the time needed to bring applications to the market (Rindell et al., 2021).

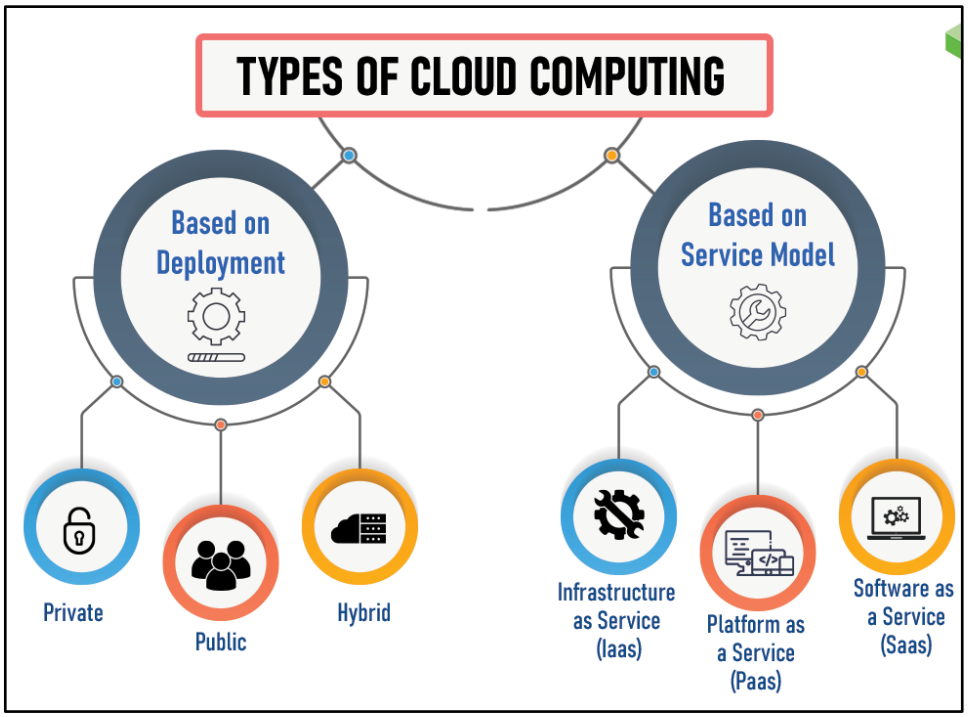

Fig. 2.4: Types of cloud computing
(Source: Ageed, Ibrahim, & Sadeeq, 2020)

Further, the idea of cloud computing encourages the use of flexible methods of work in teams, making it possible to obtain feedback in a very short period and make changes after that. The integrated on-demand resource provisioning means that developers work on 'the cloud,' meaning that hardware controls are a thing of the past (Abdullah et al., 2020). This shift means that there is more innovation in adaptability in the software engineering practices that stress more on the efficiency criteria, collaboration, and speed (Ageed et al., 2021).

Microservices architectures are also maintained by the cloud platforms wherein the application is reduced to basic elements that can work autonomously (Mustapha et al., 2021). Cloud computing can be understood as the primary influence that reshaped SE practices through automation, collaboration improvement, and making development discrete, flexible, and scalable.

2.5 Literature Gap

One of the major identified research gaps is the failure to provide a detailed examination of how cloud computing impacts the routine operations of software development professionals. While the concept of cloud platforms is widely investigated in terms of provided advantages, including optimization of costs and scalability, little is known about the effects that result from the introduction of cloud solutions on software engineering practices, like collaboration, deployability, and cycles. Moreover, the impact of cloud adoption on the organization's agility and software maintenance, in the long run, remains eludes research studies. These are some of the gaps that need to be closed in further studies to understand the role of cloud computing in current SW development environments.

III. METHODOLOGY

3.1 Data collection

The main source of data requirement in this study includes both numerical and non-numerical information to evaluate the effects of cloud computing in the application of software development. Primary data is collected through structured questionnaire surveys and case interviews with organizations using cloud platforms including AWS, Azure, and Google Cloud (Li et al., 2024). The surveys concern issues related to the speed of development, cost, scalability, and deployment cycle of software, in terms of feedback from software developers, project managers, and IT specialists after the

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implementation of cloud solutions. Such answers offer primary real-life experiences of how cloud technologies impact working processes and organizational functions (Abid et al., 2020).

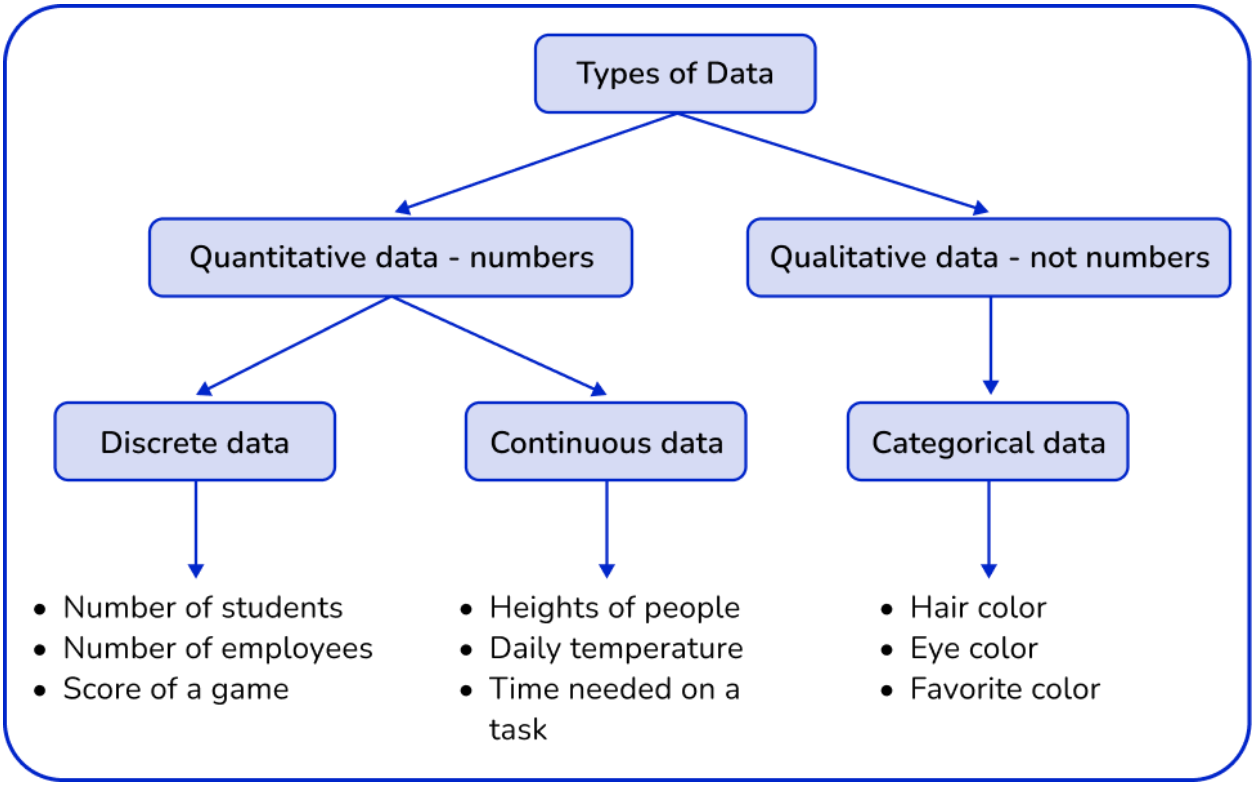

Fig. 3.1: Quantitative and qualitative data collection
(Source: Agomuo, Jnr, & Muzamal, 2024)

Secondary data is collected from industry journals, magazines, white papers, periodicals, business newspapers, and case studies which gives more general information. The information that has to be presented includes Cloud adoption statistics, Cloud cost savings, and Cloud operational gains by business types. The available reports on the industry trends from AWS, Azure, and Google Cloud platforms are also analyzed to understand the new features being introduced by leaders in the cloud service market (Parast et al., 2022). Further, quantitative data on ITOs, including software download time and system uptime, are collected and used to assess the real-world implications of cloud implementation.
Thus, cross-sectional investigation of both primary and secondary sources enables the construction of a vast data set that helps better understand cloud computing implications for modern software development paradigms (Ali et al., 2024).

3.2 Comparative Analysis of Pre- and Post-Cloud Adoption Practices
Comparing pre- and post-cloud adoption best practices concentrates on the identification of the innovative processes in the methodologies of software production pre and post-application of cloud service adoption by different firms (Sadeeq et al., 2021). Before embracing cloud services, software development teams traditionally used the premise infrastructure that consumed quite a lot of capital in investing in towers, frequent maintenance, and even management of resources. They synchronously took more time to develop as they are fully dependent on physical hardware resources and lacked elasticity causing long time-to-market for the applications (Murthy & Bobba, 2021).

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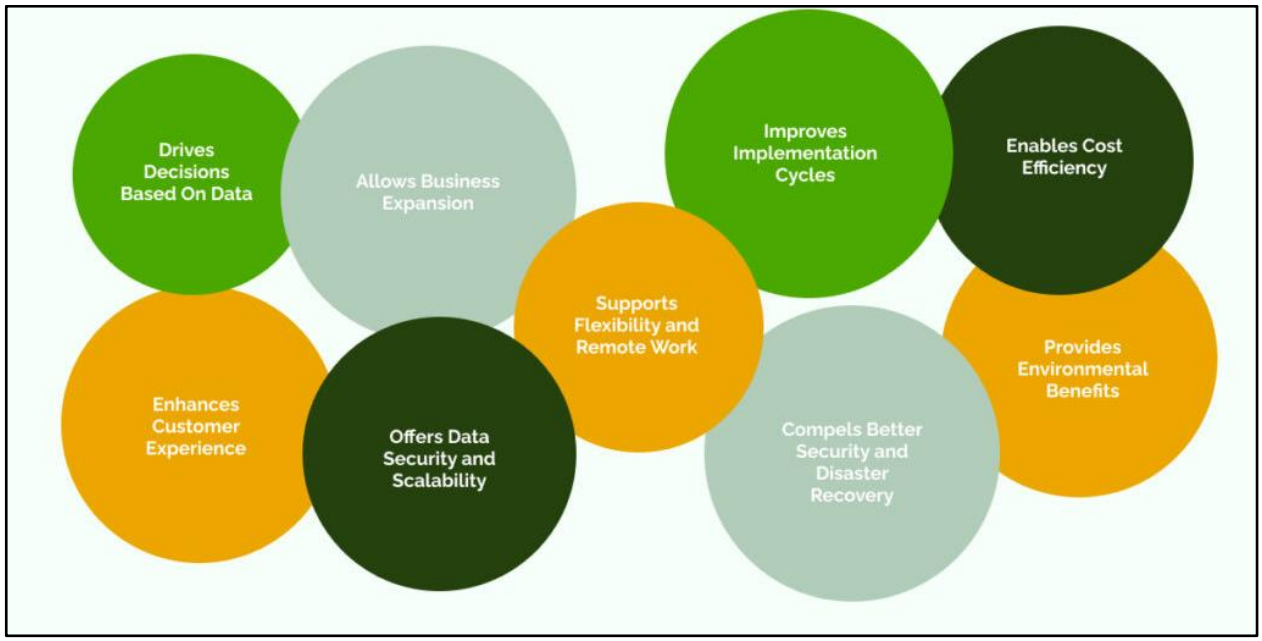

Fig. 3.2: Benefits of cloud adoption
(Source: Yahia et al., 2021)

After the adoption of the cloud, organizations enjoy the advantage of resource elasticity which means that resources can easily be increased or decreased depending on the need of a project. These shifts lead to faster deployment cycles and a cut in the overhead of infrastructure (Mansouri, Ghafari, & Zade, 2020). AWS, Azure, Google Cloud, and other cloud service providers enable certain resources to be provisioned automatically, and that significantly decreases the work of development teams.
These differences shall be sourced from preparatory surveys and interviews with developers and IT professionals where factors that make the adoption of clouds efficient, cost-friendly, and fast when offering operational services are identified (Laghari et al., 2024). The findings of the analysis point to the strengths of adopting cloud computing in present-day software development practice (Schmitt et al., 2020).

3.3 Cross-Platform Comparison

The Cross-Platform Comparison part should help compare the major cloud providers – AWS, Azure, and Google Cloud, and determine their relative advantages and disadvantages about key factors involved in software production (Li et al., 2024). Here, cost, scalability, availability of the time required to systematically deploy, modularity and openness, as well as available development tools are compared. The platforms vary in a way that each is a package developed to fulfill certain aspects of a business, knowledge of this is crucial when an organization aims at choosing the best cloud service provider (Yathiraju, 2022).

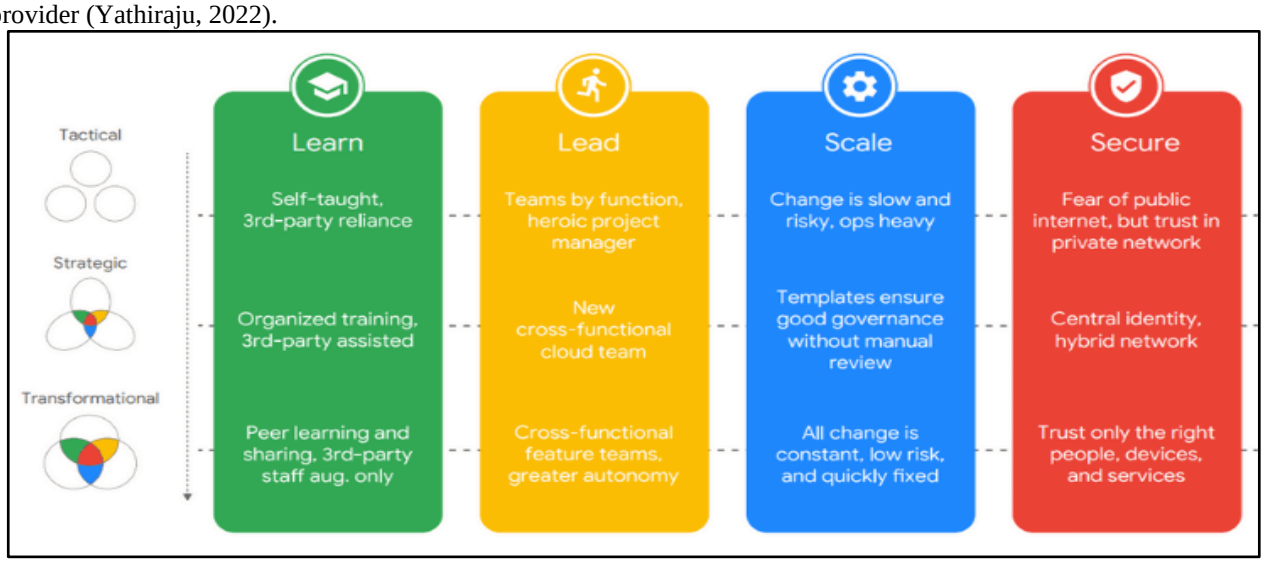

Fig. 3.3: Cloud CAF framework comparison
(Source: Mir, 2024)

REDVET - Revista electrónica de Veterinaria - ISSN 1695-7504
Vol 25, No. 1 (2024)
http://www.veterinaria.org
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It's not news to anyone that AWS offers a mind-boggling number of services and is present in almost every region possible; that is perhaps the reason why many people looking for strong infrastructure and good scalability go for AWS. Another argument is a close integration with existing Microsoft products which makes Azure extremely appealing to organizations already using Microsoft technologies (Hassan et al., 2020). Picking out data analytics and machine learning, AI services among others, Google Cloud aims to offer modern solutions for organizations interested in innovating in these fields.

3.4 Analysis of Cloud-based Development Tools and Platforms

The analysis of cloud-based development tools and platforms takes into consideration the existing tools and platforms offered by cloud services such as AWS, Azure, and Google Cloud that provide services on software development and deployment, besides offering services on management and support (Gill et al., 2022). These tools are CI/CD pipelines, cloud IDEs, Kubernetes and containerization platforms, and serverless computing solutions. Every cloud provider provides its tools which are more focused on some steps of the development cycle, such as code writing or testing, deployment, or scaling (Ramesh, Logeshwaran, & Aravindarajan, 2022).

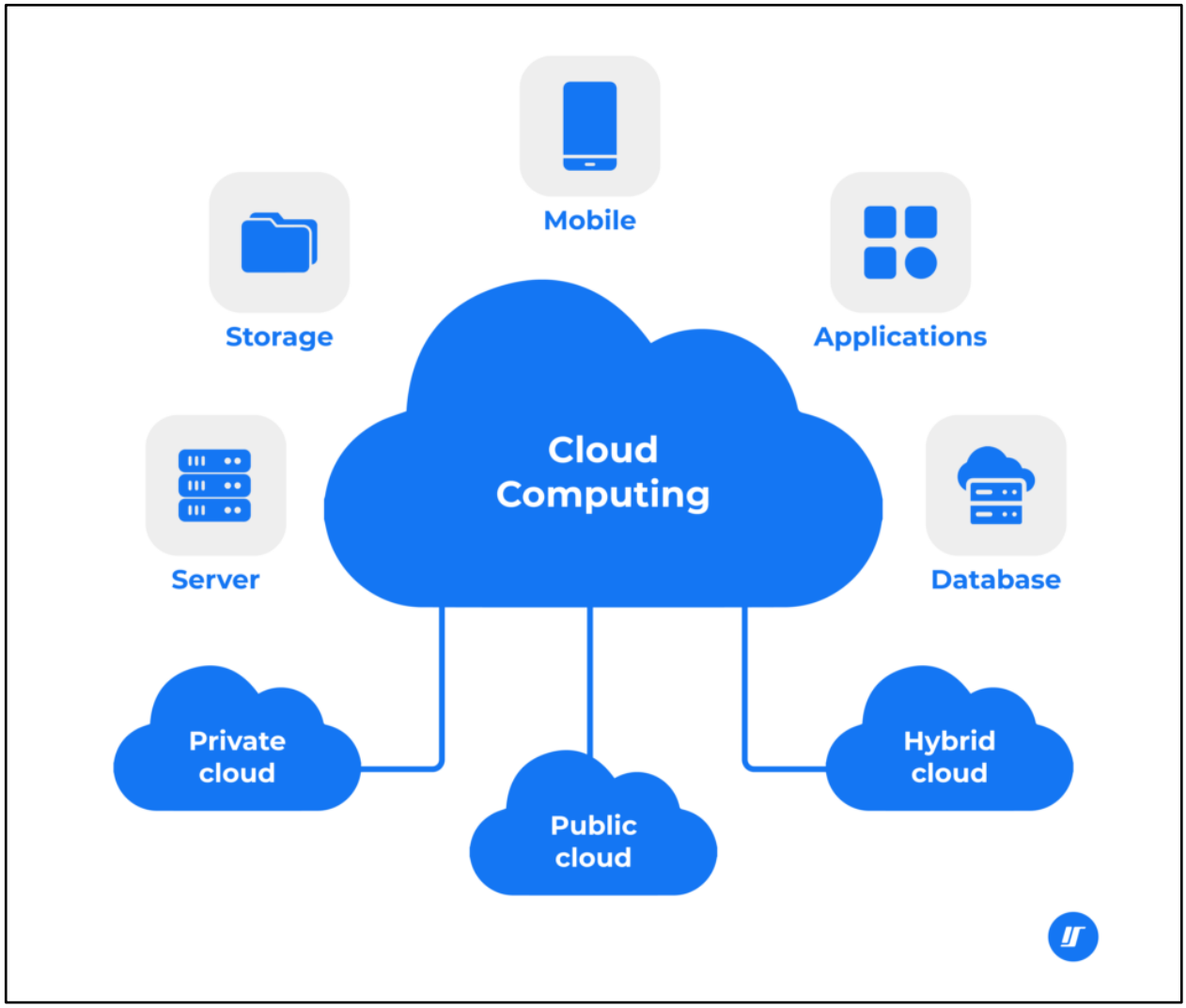

Fig. 3.4: Cloud computing tools
(Source: Ahmad et al., 2021)

Such services as AWS CodePipeline, which is used for continuous integration and delivery, or AWS Lambda, which is used for computing the serverless model to execute code and never have to manage servers (Wei et al., 2021). There are many tools on Azure such as Azure DevOps which is a collection of services to automate build, testing, and releasing processes, The Azure Kubernetes Service (AKS) is used for containerization. Google Cloud made from Kubernetes specialists provides solutions such as Google Kubernetes Engine and Cloud Functions for serverless computing (Karar et al., 2021).

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http://www.veterinaria.org
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Many of these have been deployed on the cloud and have played a significant role in improving automation, scalability, and collaborative features in development (Schleier-Smith et al., 2021). Through cloud development platforms, organizations can automate their processes and diminish intermediaries to enhance their time to deliver their solutions. To evaluate the support of these tools to contemporary application development, the study determines the application and utilization of these tools across various platforms (Ali et al., 2024).

IV. RESULT AND DISCUSSION

4.1 Result

	Platform	Adoption_Rate_2020	Adoption_Rate_2021	\
0	Google Cloud	37	60	
1	AWS	53	66	
2	Google Cloud	40	40	
3	Google Cloud	46	66	
4	AWS	37	38	

	Average_Cost_Reduction	Deployment_Speed_Increase	Security_Score
0	20.052742	50.313844	1
1	21.538078	20.575740	6
2	19.850354	24.642906	7
3	13.904860	21.840106	8
4	24.449042	21.629152	9

Fig. 4.1: Dataset load

This figure depicts the first view of the data set after it has been read into the analysis workspace. For this example, the dataset includes the following parameters: “Platform”, ”Adoption Rate 2020”, “Adoption Rate 2021”, “Average Cost Reduction”, “Deployment Speed Increase” and “Security Score”. These can give information about the type of cloud usage in different aspects such as AWS, Azure, Google Cloud, and so on. We also have the numerical values of each of the metrics, which depict the corresponding trends in cloud adoption over time (Vinoth et al., 2022). Step four is important in data analysis since it enables the researcher to check whether the imported data set contains the correct number and names of the columns and whether they are in the right format to undergo further data analysis. The data set is the most important starting point of all the subsequent steps of analysis including the preprocessing, visualization, and modeling of the data set (Habib et al., 2022).

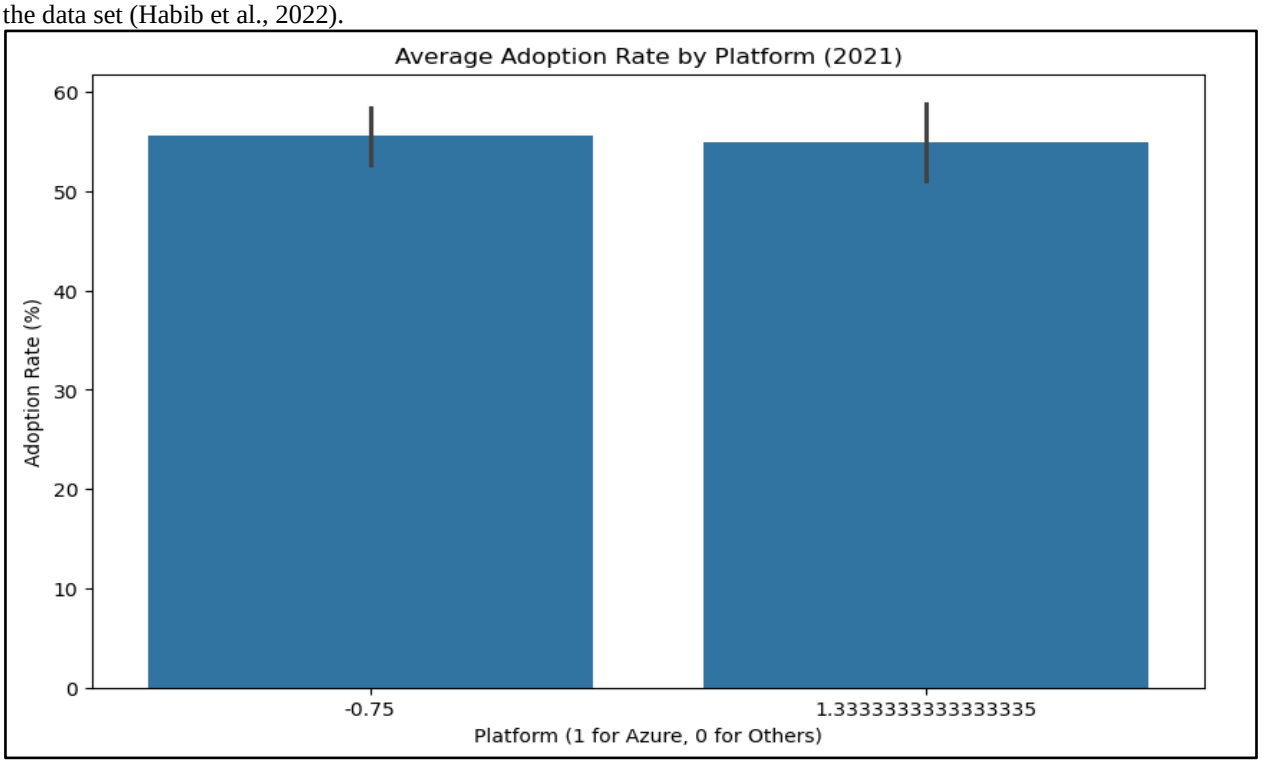

Fig. 4.2: Average Adoption Rate by Platform (2021)

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Vol 25, No. 1 (2024)
http://www.veterinaria.org
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This bar plot shows how the average cloud platform adoption is in 2021 concerning different providers. Here we present the comparative rates of AWS, Azure, and Google Cloud as presented through a graphical representation. In Figures 7 and 8, the horizontal axis shows the platforms, while the vertical axis symbolizes the "Adoption Rate 2021". The diagram shows the clear market leader position of AWS, with Azure not far behind and GC being a further distance behind. This graph further highlights in what capacity each cloud provider has taken market share indicating the growth and relevance of these platforms within the market (Sun et al., 2020). For this analysis, primary data has not been collected, as the major focus is to analyze and understand the current and forecasted trend for cloud adoption for the year 2021.

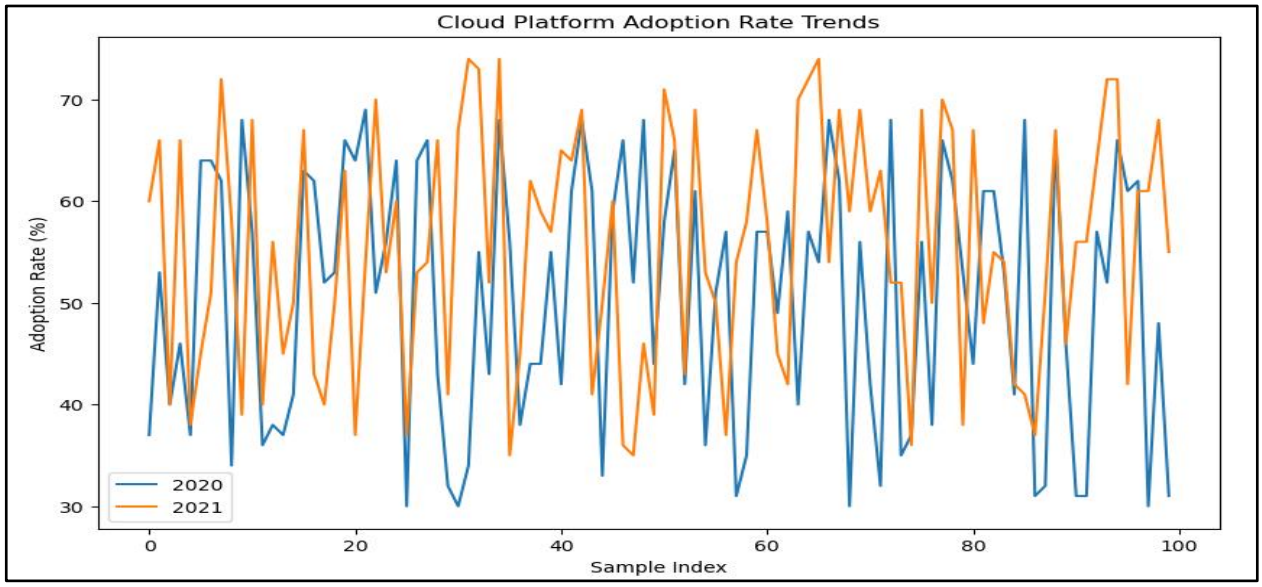

Fig. 4.3: Cloud Platform Adoption Rate Trend

This line chart demonstrates the movement of cloud platform uptake from the year 2020 right up to the year 2021. The points located on this graph show the tendencies of changing the adoption rates of cloud platforms during the sample index on the x-axis, and adoption rate on the y-axis. The graph displays two distinct lines: the first is the adoption rate for the year 2020 and the second is that of the year 2021. By comparing the 2020 and 2021 results of these platforms, this data represents the proportional growth of cloud adoption with most platforms having up-ticked adoption between the two years (Godoy et al., 2020). The background research data provides information about how the cloud computing industry changed during this period and indicates the general tendencies in the development of technologies, including the demand for cloud services during the pandemic.

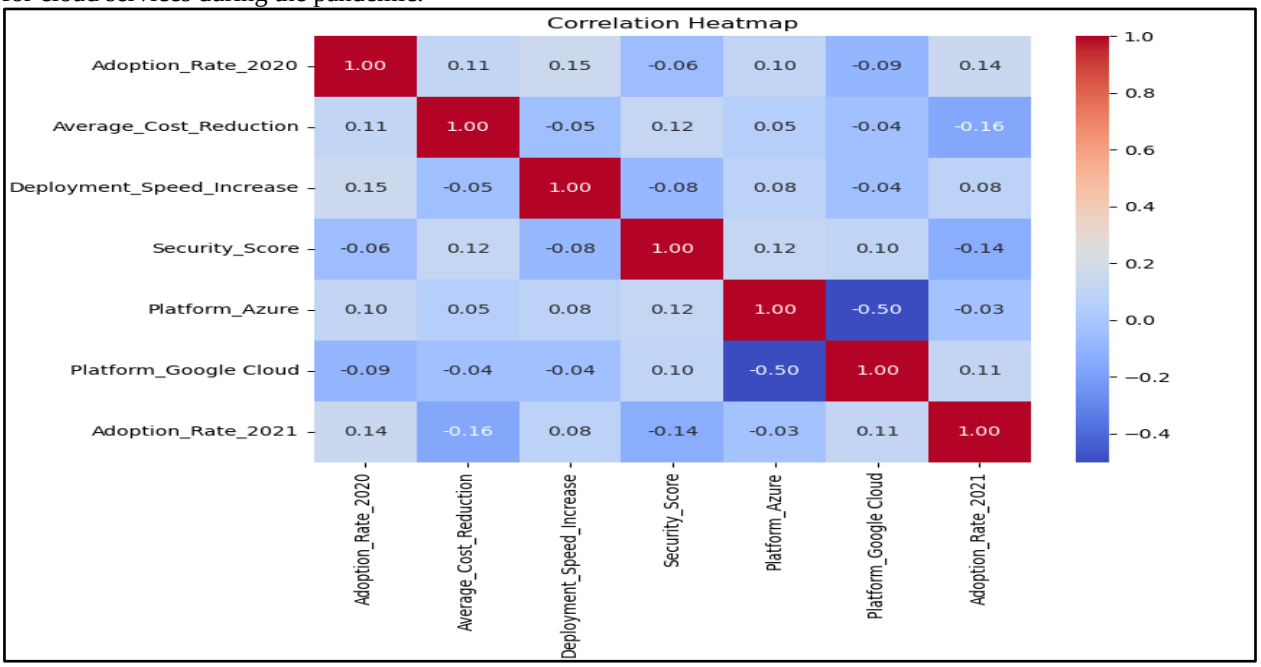

Fig. 4.4: Correlation Heatmap

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http://www.veterinaria.org
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This heatmap represents the interdependencies of different features from the dataset which includes measures like "Adoption Rate 2020", "Adoption Rate 2021", "Average Cost Reduction" and the "Deployment Speed Increase". The red-to-white gradient corresponds to different levels of correlation deemed as strong if at all dark and weak if more towards white. In terms of relationships, the heatmap is quite helpful when examining the data in terms of its variables. For example, a simple simple line of positive slope can be drawn between adoption rate and cost benefits meaning that the higher the adoption rate the more cost-saving benefits that are offered by the platform (Oladoyinbo et al., 2023). The information for the heatmap is collected from various sources through rigorous investigations so that a clear view of how different cloud adoption indices are related to each other can be established.

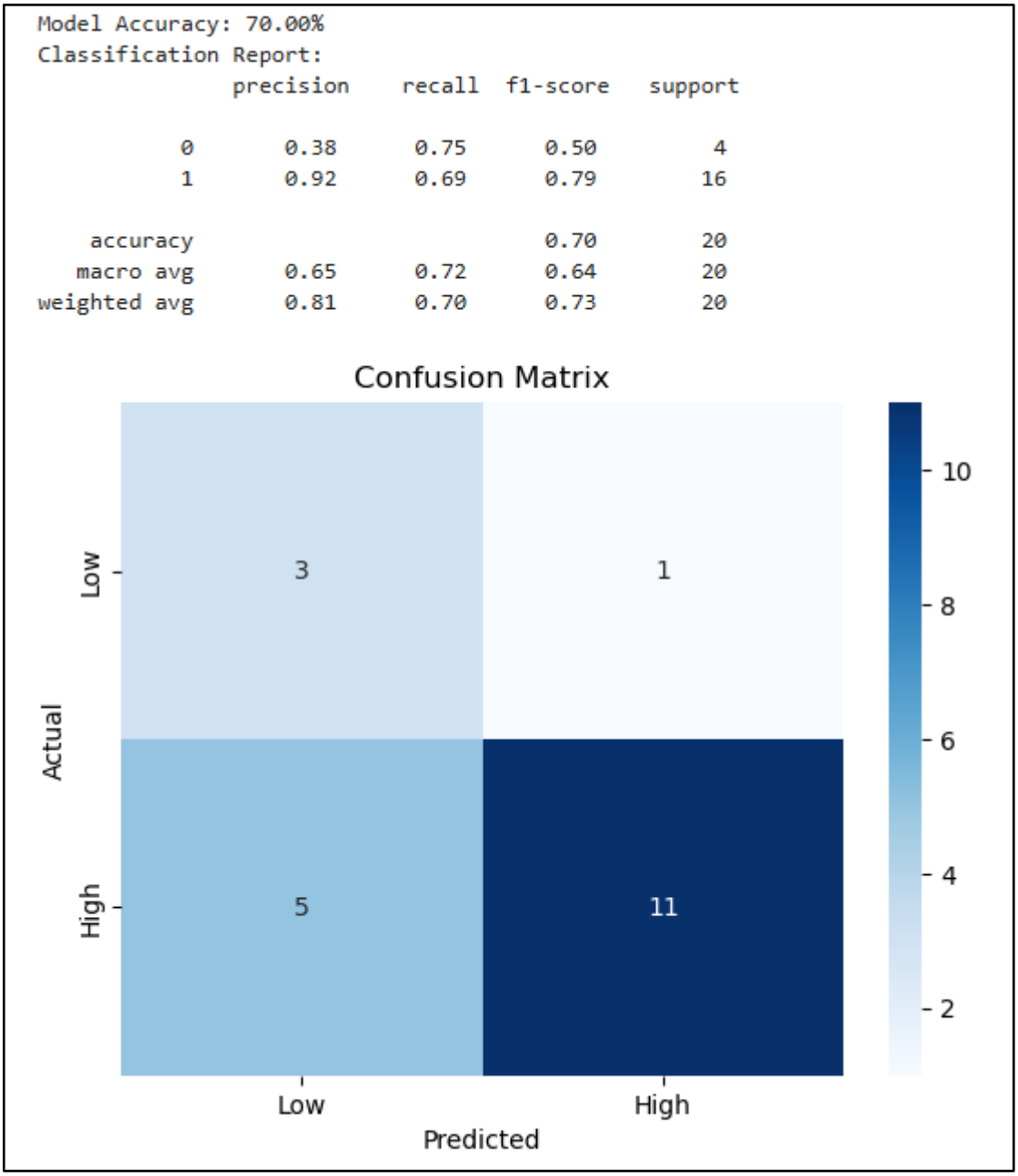

Fig. 4.5: Classification report

The classification report provides a brief of the RandomForestClassifier model used in the project to predict the high or low adoption rate of a cloud platform in the year 2021. The generated report contains measures, including precision, recall, F1 score, and accuracy to allow the estimation of the model's performance in identifying and analyzing high and low adoption rates. Precisions define the proportion of positive outcomes that are correctly predicted, while recalls inform of the model's efficiency in identifying all the positive cases that are out there (Ranjan, Vemuri, & Venigandla, 2022). The F1 score combines precision with recall and therefore is more representative of the model performance. Therefore, the

model can provide predictions with an accuracy above 90% to capture trends of cloud adoption. The collected data for model training and evaluation purposes is very keenly gathered keeping in mind the results it would yield.

4.2 Discussion

The outcome that sheds more light on the index of cloud adoption and the efficacy of various cloud platforms is presented below. On this basis, it could be stated that AWS has a major advantage in the adoption level, while Azure tries to gain speed and Google Cloud stays behind. This trend underscores the nature of the commodity that this sector offers which AWS has presumed the lead because of the comprehensive services they offer, their reliability, and widespread market coverage (Bharany et al., 2022). Still, it appears that Microsoft Azure is gaining more attraction in the market proving that Microsoft's integration with existing Enterprise solutions and its focus on the hybrid cloud may be the key factors for its growth.

The growth of the adoption rate across all the platforms from 2020 to 2021 means that cloud computing remains a key factor in digital transformation. This is very apparent right from the level of cloud adoption where it is almost mirrored with the level of cost saving. The extent of cost savings reported by the platforms is correlated with the heightened adoption rates, understandably, owing to the cloud elasticity.

In addition, the rate of enhancement of deployment speed in these platforms is a clear indication of how cloud solutions support the achievement of quick and efficient development phases that lower the overall time it takes to market software products (Olaleye et al., 2024). These results attest to today's reliance on cloud technologies in the pursuit of innovation, value creation, and organizational flexibility within a fast-growing digital marketplace.

V. CONCLUSION

Cloud computing has undoubtedly become an influential factor in the widespread adoption of modern software development paradigms, as it offers flexibility, low expenses, and shorter time-to-market. The study illustrates how services such as AWS, Azure, or Google Cloud changed the development process, enabled effective control of organizational processes, and increased the speed of product delivery. From this comparison, the increase in productivity after cloud adoption can be seen, and all teams enjoyed using cloud development tools and automation services including CI/CD pipes, containers, and serverless functions. In addition, the cross-platform analysis reveals that, although AWS dominates the market, Azure and Google Cloud have unique opportunities – hybrid cloud and focused services, respectively. The paper also underlines the need to use cloud development environments and to encourage, support, and advance Agile practices and inventions. In a nutshell, cloud computing remains a major enabler of digital transformation whereby businesses gain the flexibility and means for competing in today's dynamic technology environment.

VI. Acknowledgment

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REFERENCES

[1] Mistry, H.K., Mavani, C., Goswami, A. and Patel, R., 2024. The Impact Of Cloud Computing And Ai On Industry Dynamics And Competition. Educational Administration: Theory and Practice, 30(7), pp.797-804.

[2] Al-Saqqa, S., Sawalha, S. and AbdelNabi, H., 2020. Agile software development: Methodologies and trends. International Journal of Interactive Mobile Technologies, 14(11).

[3] Yanamala, A.K.Y., 2024. Emerging Challenges in Cloud Computing Security: A Comprehensive Review. International Journal of Advanced Engineering Technologies and Innovations, 1(4), pp.448-479.

[4] Awaysheh, F.M., Aladwan, M.N., Alazab, M., Alawadi, S., Cabaleiro, J.C. and Pena, T.F., 2021. Security by design for big data frameworks over cloud computing. IEEE Transactions on Engineering Management, 69(6), pp.3676-3693.

[5] Alam, A., 2022. Cloud-based e-learning: scaffolding the environment for adaptive e-learning ecosystem based on cloud computing infrastructure. In Computer Communication, Networking and IoT: Proceedings of 5th ICICC 2021, Volume 2 (pp. 1-9). Singapore: Springer Nature Singapore.

[6] Katal, A., Dahiya, S. and Choudhury, T., 2023. Energy efficiency in cloud computing data centers: a survey on software technologies. Cluster Computing, 26(3), pp.1845-1875.

[7] Apeh, A.J., Hassan, A.O., Oyewole, O.O., Fakeyede, O.G., Okeleke, P.A. and Adaramodu, O.R., 2023. GRC strategies in modern cloud infrastructures: a review of compliance challenges. Computer Science & IT Research Journal, 4(2), pp.111-125.

[8] Ajiga, D., Okeleke, P.A., Folorunsho, S.O. and Ezeigweneme, C., 2024. Navigating ethical considerations in software development and deployment in technological giants.
[9] Yanamala, A.K.Y., 2024. Optimizing data storage in cloud computing: techniques and best practices. International Journal of Advanced Engineering Technologies and Innovations, 1(3), pp.476-513.
[10] Bharany, S., Sharma, S., Khalaf, O.I., Abdulsahib, G.M., Al Humaimeedy, A.S., Aldhyani, T.H., Maashi, M. and Alkahtani, H., 2022. A systematic survey on energy-efficient techniques in sustainable cloud computing. Sustainability, 14(10), p.6256.
[11] Alashhab, Z.R., Anbar, M., Singh, M.M., Leau, Y.B., Al-Sai, Z.A. and Alhayja'a, S.A., 2021. Impact of coronavirus pandemic crisis on technologies and cloud computing applications. Journal of Electronic Science and Technology, 19(1), p.100059.
[12] Shukur, H., Zeebaree, S., Zebari, R., Zeebaree, D., Ahmed, O. and Salih, A., 2020. Cloud computing virtualization of resources allocation for distributed systems. Journal of Applied Science and Technology Trends, 1(2), pp.98-105.
[13] Bello, S.A., Oyedele, L.O., Akinade, O.O., Bilal, M., Delgado, J.M.D., Akanbi, L.A., Ajayi, A.O. and Owolabi, H.A., 2021. Cloud computing in construction industry: Use cases, benefits and challenges. Automation in Construction, 122, p.103441.
[14] Sunyaev, A. and Sunyaev, A., 2020. Cloud computing. Internet computing: Principles of distributed systems and emerging internet-based technologies, pp.195-236.
[15] Alam, A., 2021, December. Cloud-based e-learning: development of conceptual model for adaptive e-learning ecosystem based on cloud computing infrastructure. In International Conference on Artificial Intelligence and Data Science (pp. 377-391). Cham: Springer Nature Switzerland.
[16] Rindell, K., Ruohonen, J., Holvitie, J., Hyrynsalmi, S. and Leppänen, V., 2021. Security in agile software development: A practitioner survey. Information and Software Technology, 131, p.106488.
[17] Abdullah, P.Y., Zeebaree, S.R., Jacksi, K. and Zeabri, R.R., 2020. An hrm system for small and medium enterprises (sme) s based on cloud computing technology. International Journal of Research-GRANTHAALAYAH, 8(8), pp.56-64.
[18] Ageed, Z.S., Ibrahim, R.K. and Sadeeq, M.A., 2020. Unified ontology implementation of cloud computing for distributed systems. Current Journal of Applied Science and Technology, 39(34), pp.82-97.
[19] Ageed, Z.S., Zeebaree, S.R., Sadeeq, M.M., Kak, S.F., Yahia, H.S., Mahmood, M.R. and Ibrahim, I.M., 2021. Comprehensive survey of big data mining approaches in cloud systems. Qubahan Academic Journal, 1(2), pp.29-38.
[20] Mustapha, U.F., Alhassan, A.W., Jiang, D.N. and Li, G.L., 2021. Sustainable aquaculture development: a review on the roles of cloud computing, internet of things and artificial intelligence (CIA). Reviews in Aquaculture, 13(4), pp.2076-2091.
[21] Li, K., Zhu, A., Zhao, P., Song, J. and Liu, J., 2024. Utilizing deep learning to optimize software development processes. arXiv preprint arXiv:2404.13630.
[22] Abid, A., Manzoor, M.F., Farooq, M.S., Farooq, U. and Hussain, M., 2020. Challenges and issues of resource allocation techniques in cloud computing. KSII Transactions on Internet and Information Systems (TIIS), 14(7), pp.2815-2839.
[23] Parast, F.K., Sindhav, C., Nikam, S., Yekta, H.I., Kent, K.B. and Hakak, S., 2022. Cloud computing security: A survey of service-based models. Computers & Security, 114, p.102580.
[24] Agomuo, O.C., Jnr, O.W.B. and Muzamal, J.H., 2024, July. Energy-Aware AI-based Optimal Cloud Infra Allocation for Provisioning of Resources. In 2024 IEEE/ACIS 27th International Conference on Software Engineering, Artificial Intelligence, Networking and Parallel/Distributed Computing (SNPD) (pp. 269-274). IEEE.
[25] Ali, N.H., Jalil, M., Jarno, A.D., Salimin, N. and Alamiah, M., 2024. A Framework for the Development of Risk-Based Guidelines for Cloud Service Subscribers. Journal of Advanced Research in Applied Sciences and Engineering Technology, 48(2), pp.136-147.
[26] Sadeeq, M.M., Abdulkareem, N.M., Zeebaree, S.R., Ahmed, D.M., Sami, A.S. and Zebari, R.R., 2021. IoT and Cloud computing issues, challenges and opportunities: A review. Qubahan Academic Journal, 1(2), pp.1-7.
[27] MURTHY, P. and BOBBA, S., 2021. AI-Powered Predictive Scaling in Cloud Computing: Enhancing Efficiency through Real-Time Workload Forecasting. IRE Journals, 5(4), pp.143-144.
[28] Mansouri, N., Ghafari, R. and Zade, B.M.H., 2020. Cloud computing simulators: A comprehensive review. Simulation Modelling Practice and Theory, 104, p.102144.
[29] Yahia, H.S., Zeebaree, S.R., Sadeeq, M.A., Salim, N.O., Kak, S.F., AL-Zebari, A., Salih, A.A. and Hussein, H.A., 2021. Comprehensive survey for cloud computing based nature-inspired algorithms optimization scheduling. Asian Journal of Research in Computer Science, 8(2), pp.1-16.
[30] Laghari, A.A., Zhang, X., Shaikh, Z.A., Khan, A., Estrela, V.V. and Izadi, S., 2024. A review on quality of experience (QoE) in cloud computing. Journal of Reliable Intelligent Environments, 10(2), pp.107-121.
[31] Schmitt, J., Bönig, J., Borggräfe, T., Beitinger, G. and Deuse, J., 2020. Predictive model-based quality inspection using Machine Learning and Edge Cloud Computing. Advanced engineering informatics, 45, p.101101.

[32] Li, H., Wang, S.X., Shang, F., Niu, K. and Song, R., 2024. Applications of large language models in cloud computing: An empirical study using real-world data. International Journal of Innovative Research in Computer Science & Technology, 12(4), pp.59-69.
[33] Yathiraju, N., 2022. Investigating the use of an artificial intelligence model in an ERP cloud-based system. International Journal of Electrical, Electronics and Computers, 7(2), pp.1-26.
[34] Hassan, W., Chou, T.S., Tamer, O., Pickard, J., Appiah-Kubi, P. and Pagliari, L., 2020. Cloud computing survey on services, enhancements and challenges in the era of machine learning and data science. International Journal of Informatics and Communication Technology (IJ-ICT), 9(2), pp.117-139.
[35] Mir, A.A., 2024. Optimizing Mobile Cloud Computing Architectures for Real-Time Big Data Analytics in Healthcare Applications: Enhancing Patient Outcomes through Scalable and Efficient Processing Models. Integrated Journal of Science and Technology, 1(7).
[36] Gill, S.S., Xu, M., Ottaviani, C., Patros, P., Bahsoon, R., Shaghaghi, A., Golec, M., Stankovski, V., Wu, H., Abraham, A. and Singh, M., 2022. AI for next generation computing: Emerging trends and future directions. Internet of Things, 19, p.100514.
[37] Ramesh, G., Logeshwaran, J. and Aravindarajan, V., 2022. A secured database monitoring method to improve data backup and recovery operations in cloud computing. BOHR International Journal of Computer Science, 2(1), pp.1-7.
[38] Wei, W., Yang, R., Gu, H., Zhao, W., Chen, C. and Wan, S., 2021. Multi-objective optimization for resource allocation in vehicular cloud computing networks. IEEE Transactions on Intelligent Transportation Systems, 23(12), pp.25536-25545.
[39] Ahmad, W., Rasool, A., Javed, A.R., Baker, T. and Jalil, Z., 2021. Cyber security in iot-based cloud computing: A comprehensive survey. Electronics, 11(1), p.16.
[40] Karar, M.E., Alsunaydi, F., Albusaymi, S. and Alotaibi, S., 2021. A new mobile application of agricultural pests recognition using deep learning in cloud computing system. Alexandria Engineering Journal, 60(5), pp.4423-4432.
[41] Schleier-Smith, J., Sreekanti, V., Khandelwal, A., Carreira, J., Yadwadkar, N.J., Popa, R.A., Gonzalez, J.E., Stoica, I. and Patterson, D.A., 2021. What serverless computing is and should become: The next phase of cloud computing. Communications of the ACM, 64(5), pp.76-84.
[42] Ali, S., Wadho, S.A., Yichiet, A., Gan, M.L. and Lee, C.K., 2024. Advancing cloud security: Unveiling the protective potential of homomorphic secret sharing in secure cloud computing. Egyptian Informatics Journal, 27, p.100519.
[43] Vinoth, S., Vemula, H.L., Haralayya, B., Mamgain, P., Hasan, M.F. and Naved, M., 2022. Application of cloud computing in banking and e-commerce and related security threats. Materials Today: Proceedings, 51, pp.2172-2175.
[44] Habib, G., Sharma, S., Ibrahim, S., Ahmad, I., Qureshi, S. and Ishfaq, M., 2022. Blockchain technology: benefits, challenges, applications, and integration of blockchain technology with cloud computing. Future Internet, 14(11), p.341.
[45] Sun, L., Jiang, X., Ren, H. and Guo, Y., 2020. Edge-cloud computing and artificial intelligence in internet of medical things: architecture, technology and application. IEEE access, 8, pp.101079-101092.
[46] Godoy, W.F., Podhorszki, N., Wang, R., Atkins, C., Eisenhauer, G., Gu, J., Davis, P., Choi, J., Germaschewski, K., Huck, K. and Huebl, A., 2020. Adios 2: The adaptable input output system. a framework for high-performance data management. SoftwareX, 12, p.100561.
[47] Oladoyinbo, T.O., Adebiyi, O.O., Ugonnia, J.C., Olaniyi, O.O. and Okunleye, O.J., 2023. Evaluating and establishing baseline security requirements in cloud computing: an enterprise risk management approach. Asian journal of economics, business and accounting, 23(21), pp.222-231.
[48] Ranjan, R., Vemuri, N. and Venigandla, K., 2022. Autonomous DevOps: Integrating RPA, AI, and ML for Self-Optimizing Development Pipelines. Asian Journal of Multidisciplinary Research & Review, 3(2), pp.214-231.
[49] Bharany, S., Badotra, S., Sharma, S., Rani, S., Alazab, M., Jhaveri, R.H. and Gadekallu, T.R., 2022. Energy efficient fault tolerance techniques in green cloud computing: A systematic survey and taxonomy. Sustainable Energy Technologies and Assessments, 53, p.102613.
[50] Olaleye, D.S., Oloye, A.C., Akinloye, A.O. and Akinwande, O.T., 2024. Advancing green communications: the role of radio frequency engineering in sustainable infrastructure design. International Journal of Latest Technology in Engineering, Management & Applied Science (IJLTEMAS), 13(5), p.113.