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THE EVOLUTION OF CLOUD COMPUTING POLICIES IN EMERGING ECONOMIES: A COMPARATIVE STUDY OF PAKISTAN AND INDIA

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Abstract
Cloud computing has redefined IT resource alloca- tion by empowering on-demand access to computational capacity, data storage, and software applications by means of the Internet without the need for expensive infrastructure. Countries have de- veloped cloud management policies in order to improve economic development, guarantee information security, stimulate foreign investment, and mitigate regulatory uncertainties. The purpose of this study is to examine the development of cloud policies implemented in developing countries, centering on Pakistan and India. Hence, examining the differences in cloud infrastructure, data security strategies and regulatory frameworks between these two countries. This study also explores the effect of these policies on startups, businesses, foreign investment and international race. This research also examines key issues, for example policy execu- tion, data confidentiality, and processing methods by reviewing government policy documents. The results show that the India has employed advanced laws supporting innovative technology and strong data security policies. In contrast, Pakistan is experiencing a gap in comprehensive structure, although it is still developing its regulatory framework. This research determines the root cause of these differences and their impact on the customer rights and business operations. In conclusion, recommendations are provided for both countries to strengthen cloud policies by addressing regulatory gaps, improving compliance with inter- national standards, and enhancing data security frameworks. In order to strengthen cloud policies in both countries by addressing regulatory gaps, enhancing compliance with international stan- dards, regulations and data security frameworks. The results of this research will help guide the development of the regulatory landscape of cloud computing, especially in both countries.

INTRODUCTION

Cloud computing (CC) represents an innovative technique for managing information technology (IT) by accessing all IT related resources over the Internet on demand while minimiz- ing the cost of physical infrastructure [1]. These resources include computer hardware, storage, operating systems, soft- ware applications, etc [2]. It plays a crucial role in developing markets by promoting novelty, securing foreign funding and empowering technological shift. Still, the policy framework surrounding CC differs greatly across different counties [3].

The legal framework for cloud computing shows a vital part in determining its implementation and enduring effect. Nations with explicit cloud policy framework offer a con- sistent environment for companies, guaranteeing information security, compliance, and scalability. Conversely, nations with vague regulatory frameworks encounter problems related to cybersecurity breaches, undefined legal landscape, as well as inadequate foreign investments. Developing nations like Pakistan and India are trying to maintain a harmony between promoting novelties and guaranteeing regulatory oversight is still a problem. Changes in cybersecurity policies, data localization necessities, in addition to global data transfer guidelines considerably impact cloud implementation and technological innovation projects.

Furthermore, with the advancement of CC, the evolving technologies are becoming progressively integrated into cloud- based projects. These technologies include artificial intelli- gence (AI), edge computing, blockchain (BC), machine learn- ing (ML), Internet of Things (IoT), etc. The efficiency of cloud governance at the national level determines how proficiently these developments can be used for financial development. Nations with effective legal frameworks and pro-industry reg- ulations are in a superior situation to invite international cloud vendors. As a result, assessing the developmental progress of cloud policies in developing countries like Pakistan and India is vital for recognizing gaps, issues, and opportunities in determining a development-centered digital infrastructure.

The objectives of this study are:

1) To study the progress and employment of CC policies in Pakistan and India to measure their effect on evolving businesses and foreign fundings.
2) To provide a comparison of the regulatory frameworks regarding information security, compliance, and confi- dentiality.
3) To provide future recommendations to optimize CC regulations in Pakistan and India.

The remaining part of this paper is structured as follows: Section 2 provides a brief literature review for this study. Section 3 discusses research methodology. Section 4 discusses CC policies in Pakistan and India. Section 5 shows com- parative analysis, results and discussion. Section 6 presents recommendations, whereas conclusion is presented in Section 7.

I. LITERATURE REVIEW

Cloud computing (CC) has progressed from outdated on- site information storage to a distributed computing model that enables continuous sharing of resources through the Internet [4]. As a result of technological popularity across the globe, the governments and companies have started implementing cloud solutions for scalability and optimized efficiency [5]. Nevertheless, the regulatory frameworks governing CC vary remarkably across different countries which results in various implementation issues and opportunities [6].

The regulatory landscape of CC can be examined by means of numerous theoretical models such as, institutional theory, diffusion of innovation (DOI) theory and technology acceptance model (TAM). These models deliver a basis for understanding how regulatory frameworks impact cloud imple- mentation in both countries. The institutional theory proposes that cloud-based regulations are formed by socio-economic, administrative and legal factors [7], whereas, DOI shows how policies can affect the implementation of CC in diverse areas [8]. Similarly, TAM enlightens how perceived accessibility and usefulness can influence cloud acceptance [9].

A. Cloud computing (CC) policies across different nations

Numerous nations have implemented different methods to cloud governance. All these policies set standards for de- veloping countries, as they design

their cloud computing policies [6]. For an instance, People's Republic of China implements stringent laws related to data localization due to national security concerns. These laws demand businesses to store information within national boundaries. Similarly, United States (US) of America implements strict data protection laws which assists empowers governmental access to information stored by cloud providers based in US [10]. These policies define criterion for evolving countries in determining their cloud regulations.

B. A comparative study of cloud policies in evolving countries

Evolving nations have implemented different regulatory methods. For an instance, India has employed advanced cloud
security strategies and initiatives which motivates cloud im- plementation. On the contrary, current research on Pakistan's cloud policies shows a deficiency of inclusive regulations, inadequate enforcement and inconsistent policies [11]. Nevertheless, inadequate comparative studies are present examining Pakistan and India's cloud regulatory frameworks. It is impor- tant to understand these differences for businesses working in these counties, to assist guiding in planned decision-making. Even though earlier researchers have discovered policies, there is an absence of comparative research assessing the efficiency of cloud based regulations in Pakistan and India. This research fills this gap by offering a parallel investigation of regulatory frameworks, classifying pros and cons, and recommending methods to optimize policy efficiency [4], [11].

Significant differences comprise of followings:

Data Autonomy: Government of India commands strict observance under the personal data protection bill (PDPB), where Pakistan remains dependent on outdated prevention of electronic crimes bill (PECB) 2016 regula- tions [11].

- Cybersecurity Readiness: India imposes computer emer- gency response team (CERT) in guidelines, which opti- mizes cybersecurity infrastructure. Whereas, Pakistan has no strong cybersecurity framework [5].
- International investments: The government of India's promising regulatory environment has fascinated key CC vendors like Amazon Web Services. On the other hand, Pakistan is still struggling as a result of undefined policies [4].

Table 1 presents the CC regulations in different countries.

Hence, the future of CC regulations is formed by evolving technologies and global political impacts [10]. For an instance, AI-based risk recognition is becoming a crucial element of cloud security frameworks [13]. Also, the nations are review- ing cloud-based regulations to accommodate edge computing which assists in decreasing dependence on central data centers [14].

In spite of present research on cloud regulations, inadequate comparative study inspects Pakistan and India's regulatory efficiency, security approaches, as well as business effects. This research addresses that gap by examining their policies, recognizing advantages and disadvantages, and offering rec- ommendations for regulatory enhancements.

II. RESEARCH METHODOLOGY

This study utilizes a comparative analysis method using qualitative and quantitative data obtained from different re- sources. The aim of this research methodology is to inspect and contrast CC regulations, security structures, and their influence on business development in both countries, Pakistan and India. The qualitative data offer visions into the regulatory frameworks and cloud implementation movements in Pakistan and India. In contrast, quantitative data evaluate the effect of cloud computing strategies on the performance and investment of business in Pakistan and India.

TABLE I
CLOUD COMPUTING REGULATIONS IN DIFFERENT COUNTRIES

Citation	Country	Findings	Impact on Cloud Implementation
[3]	Global South	Governments are implementing CC	Its impact remains unpredictable.
[12]	Japan, South Korea and Singapore	CC in healthcare is employed to advance healthcare quality and decrease financial burdens.	Momentous developments in healthcare delivery and financial development.
[13]	Southern and Northern Eu- ropean coun- tries	Southern firms' emphasis on price minimization whereas Northern firms emphasis on revolution.	Southern firms are focused on instant, cost-motivated advantages, whereas Northern firms adopt CC for revolution, novelty, and teamwork purposes.
[14]	Africa and US	CC improves initiates novelty and enables cross-border association but faces information security challenges.	Consistent proto- cols and strong cybersecurity ac- tions are vital for cloud implemen- tation.

Figure 1 shows the research methodology for proposed study. First step is to find the research problem and summarize the research questions and aims of the study. Second step is collecting data from research papers, business reports, admin- istration policy papers, as well as statistical studies. Once the data is collected, we examine the data to observe trends and visions. Then the criteria are evaluated to assess CC policies in both countries based on regulatory frameworks, security ethics, and financial influence. The results are then summarized to determine important differences and strengths in cloud-based policies between Pakistan and India. The research is then concluded recommendations are provided for cloud regulatory frameworks.

III. CLOUD COMPUTING POLICIES

A. Islamic Republic of Pakistan's Cloud Computing Policy

Cloud computing is extremely regarded internationally, which makes it important for Pakistan to implement cloud- based solutions. But Pakistan is a developing country and because of insufficient data centers, the ICT infrastructure of Pakistan is not well organized which has restricted Pakistan to outperform in the field of CC. Pakistan is undergoing a digital revolution with numerous plans intended to provide ICT solutions, which opens doors for cloud service providers to collaborate with the government. Pakistan needs to integrate infrastructure to assist governments for effective resource

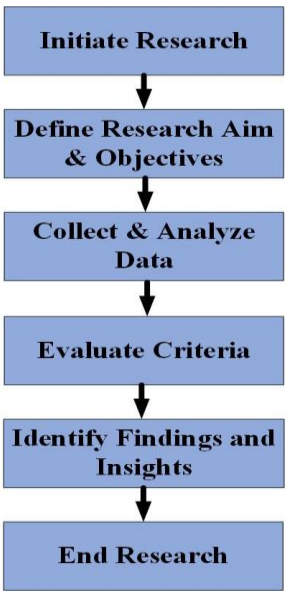

Fig. 1. Research methodology for proposed study.

management. The regulatory framework for Pakistan includes the following policies:

1) Governments should prioritize cloud-based services for ICT investments.
2) A centralized cloud office needs to be created to imple- ment, utilize and supervise the CC technologies in all public sector organizations. The purpose of this office is to guarantee that all CC practices must follow the protocols.
3) The policy contains plans for training government per- sonnel to successfully utilize cloud skills.
4) For the purpose of information security, cloud service providers (CSP) should meet security standards and must practice encryption techniques and constant security assessments to maintain the confidentiality, integrity, and availability (CIA) of data.
5) Public sector organizations can choose how their data is shared, utilized, stored, accessed and handled i.e.; they have complete data ownership.
6) Stakeholders should consult the CSP while transferring data across boundaries to ensure suitable security mea- sures for the confidentiality and integrity of information.
7) CSP must offer reports to verify their appropriate infor- mation protection.
8) The data is categorized according to its sensitivity including security measures for each category. For an instance secret data has highest level of security and is stored in a private/government cloud using accredited cloud service providers. Similarly, sensitive data and restricted data are stored in a public sector cloud by an accredited CSP with high- and medium-level security, respectively. Lastly, open data with basic-level security and is stored in a public cloud by a registered CSP.
9) The policy also involves details on how the data will be returned and also guarantees that duplicated data are made inaccessible upon the expiration of agreement.

B. Republic of India's Cloud Computing Policy

This Policy emphases on:

1) Making flexible rules for cloud services to be modified with the rise of novel technologies.
2) The cloud must adhere to rules with current govern- mental policies, comprising information security and confidentiality.
3) The policy guarantees that the cloud-based services are well-matched with state ethics and guidelines.
4) The information on cloud should be private, and the cloud auditors will contribute in defining the strategies.
5) Applications and information should be considered to understand how delicate they are. Data should be sorted by sensitivity to provide the right protection.
6) Security-related procedures should be executed to halt illegal admittance to confidential data.
7) The policy says that the infrastructure must manage development and flexibility for additional technical im- provements.

IV. COMPARATIVE ANALYSIS, RESULTS AND DISCUSSION

After comparing both policies, the results suggests that Pakistan is facing problems because of nonexistence of in- frastructure, whereas India is facing challenges because of executing cloud on a larger level. Pakistan is suffering from an undecided direction and an absence of a policy that restricts the development of any initiative taken. On the other hand, India is suffering with uncompromising rules regarding national security which is unacceptable disturbing foreign flow of information. Last but not least, Pakistan is suffering because of the absence of experienced individuals whereas India has huge expertise gaps among qualified individuals.

V. FUTURE RECOMMENDATIONS

Pakistan's cloud policy should provide a strong and com- prehensive regulatory framework and must guarantee the confidentiality and safety of national data. These policies should also execute rapid initiatives for a consistent cloud infrastructure and must start community awareness plans on cloud-based services.

On the other hand, India's cloud policy aims to combine the current infrastructure and cloud computing to present cyber security laws for information flow across the border, and address data location and ownership problems.

1) Recommendations for provincial

collaboration:

1) Policies should be standardized, information protection rules should be followed, and agreement between coun- tries should be followed.

2) Establish provincial training workshops to increase tech- nological skills and endorse knowledge sharing.

3) Develop a cloud-based service platform across nations which helps in enhancing competition and quality of service.

VI. CONCLUSION

Pakistan and India are both determined to advance their cloud framework in order to meet global standards, motivated by the necessity for economic viability, adaptability, growth potential, and foreign investment. Both these countries focus on cost minimization for industries and startups by less- ening expenditures in information technology infrastructure. Furthermore, scalability and flexibility are important features of policies, empowering businesses to regulate their cloud resources as desirable, nurturing fast development. A foremost objective is to appeal foreign investment by encouraging cloud implementation. Identifying the significance of cloud- based expertise, both policies should focus on skill develop- ment and workers revolution to guarantee successful cloud implementation. This study highlighted comparisons among Pakistan and India's policies. Both give importance to cost efficacy, scalability, information control, confidentiality, and invention, targeting to enhance public service delivery and financial evolution. Nevertheless, the cloud policy for India is extra structured, reinforced by a strongly built infrastructure given its more developed history of cloud implementation. On the contrary, because of an underdeveloped infrastructure, the cloud based policy in Pakistan is still in its evolving phase. Additionally, India delivers a comprehensive supervi- sory framework, however Pakistan's policy is still vaguely defined. In spite of these differences, both Pakistan and India have a common goal of utilizing cloud technology to motivate financial development and improve governance, making cloud implementation a vital footstep in the direction of technical development.

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