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The Role of Cloud Computing in Enhancing Data Management and Fostering Transparency: An Empirical Study of a Sample of Algerian Economic Institutions

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Abstract:
This study aims to examine the impact of adopting cloud computing on data management and the level of transparency within Algerian economic institutions. To achieve this objective, a descriptive and analytical approach was employed, utilizing a survey distributed to a sample of 120 institutions representing diverse sectors. The study focused on testing three main hypotheses concerning the role of security strategies, regulatory framework, and the integration of cloud systems with traditional ones.
The results revealed a statistically significant positive relationship between the development of security strategies and the enhancement of data security levels. Additionally, it was found that a clear regulatory framework facilitates the effective adoption of cloud computing, while technical integration contributes to improving the quality of financial auditing and transparency. The study recommends sustainable investment in security infrastructure, the development of digital legislation, and the strengthening of professional training programs to ensure successful digital transformation in Algerian institutions.
Key words: Cloud Computing, Data Management, Transparency, Economic Institutions, Technological.
Jel Classification Codes : L86, C80, D82, D02, O30.

Introduction:
In the last 10 years, businesses globally have gone through a paradigm shift in how they handle data management and transparency using modern technology such as cloud computing. One of the most effective digital aids is cloud computing, which allows companies to store, process and access data online flexibly and securely

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while reducing costs and increasing operational efficiency. This shift is made possible thanks to the advantages provided by cloud computing, including on-demand storage, cross-location access, less dependency on on-premises infrastructure, and improved velocity of IT services.

In Algeria, the sweeping digitalization efforts in its economic institutions have emerged as a fertile ground for cloud computing to serve as a complementary solution that would effectively meet modern day data management, alongside significant transitional efforts toward financial and administrative transparency, especially in light of the challenges posed by expansion of the already burgeoning digital economy. While this transformation brings massive opportunities, it poses numerous technical and regulatory challenges such as institutional trust in the[`] cloud storage services, security issues, unawareness, and unreliable internet connectivity infrastructure for some areas.

The cloud computing model asserts itself as a modern way of managing data in response to the growing volume and complexity of data which requires reliable advanced mechanisms for processing and auditing that will indirectly strengthen internal control mechanisms designed to curb opportunities for corruption and financial fraud within the organization. However, the availability of cloud computing has led to the possibility of creating integrated accounting systems which can be updated and controlled in real time thus stimulating auditing and accounting processes and making them more transparent for regulatory authorities and interested parties.

This field study is a response to this question based on the case of Algerian economic institutions for studying how real cloud computing adoption improves both data management and transparency in actual working conditions. It aims as well to identify the challenges organizations experience during their shift towards this technology so that in response it can formulate propositions that consolidate the process and strengthen its contribution to the support of good governance, economic development in Algeria.

Research Question:

Based on the foregoing, the research question of our study is as follows:

How can cloud computing contribute effectively and rigorously to improving data management and enhancing transparency in Algerian economic institutions, while taking into account the technical and organizational challenges facing its implementation?

Hypotheses: To address the research problem, the following hypotheses were formulated:

Hypothesis 1 (H_1): The implementation of integrated security strategies improves data security in multi-cloud environments within Algerian economic institutions.

Hypothesis 2 (H_2): The existence of an appropriate regulatory framework enhances the adoption rate of cloud computing in Algerian economic institutions.

Hypothesis 3 (H_3): The integration of cloud and traditional systems improves the quality of financial auditing and enhances transparency in Algerian economic institutions.

Objectives of the Study: This study aims to:

• Explain what cloud computing is and how it can enhance data management in Algerian economic institutions.

• Evaluate the level of use and adoption of cloud computing in these institutions, including employee awareness about its benefits and challenges.

• Study the role of cloud computing in promoting transparency associated with administrative and financial operations of Algerian institutions.

• To analyze the technical and organizational barriers to cloud computing adoption among Algerian institutions and suggest ways to encourage a successful move.

Scope of the Study: This study is limited to the following dimensions:

Fit with Other Influencing Factors: The study focuses on an interlocking influence of specific intervention (strategies) over time, but it cannot necessarily confirm which strategies are important compared to other institutional influences or eventual results.

Temporal Limitations: Data were collected at a particular point in time (in 2025), therefore the results represent the reality of that moment and are likely to evolve as new technological or regulatory advances develop.

Human limitations: The study was based on 120 organizations (a convenience sample), part of the overall population of organizations that have adopted or are attempting to adopt cloud computing; it may not be representative of all organizations, and responses depend on the respondents' ability to be accurate and honest.

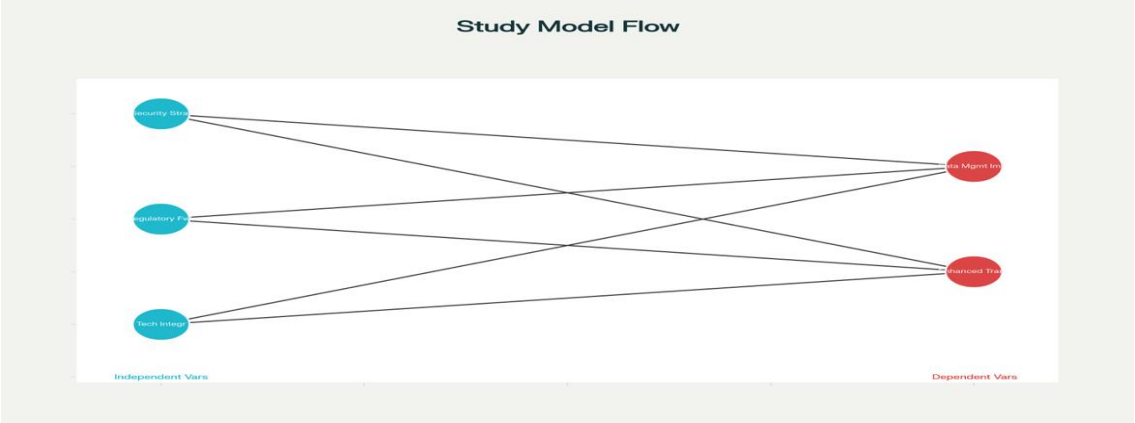
Methodological bounds: Using a closed-ended questionnaire limits the diversity and depth of participants' responses, limiting potential discovery of unanticipated or interpretive factors requiring other qualitative study designs like interviews or in-depth field studies.

Study Variables (Study Model): Defining and controlling study variables is central to the scientific research process. Our study included the following variables:

1. Independent Variables:
   - Integrated security strategies (Security_Strategies)
   -Regulatory clarity (Regulatory_Clarity)
   -Level of integration between cloud and traditional systems (Cloud_Integration)
2. Dependent variables:
   -Data Security Level (Data_Security_Level)
   -Cloud Adoption Rate (Cloud_Adoption_Rate)
   -Audit Quality and Transparency (Audit_Quality_and_Transparency)
3. Control Variables:
   -Firm Size (Firm_Size)
   -Economic Sector Type (Sector_Type)
   -Firm's IT Experience (IT_Experience)
4. Objective Variables (Mediating/Moderating Variables):
   -Cloud Investment Cost (Cloud_Investment_Cost)
   -Staff Competence (Staff_Competence)
   -Technical Infrastructure (IT_Infrastructure)

This model allows for the testing of the three hypotheses by measuring the effect of independent variables on dependent variables while controlling for the influence of control and subject variables.

Figure 1. Flowchart for the study model



Source: Compiled by the researchers, drawing upon the aforementioned data.

Previous Studies:

There are numerous studies that have addressed our topic—the role of cloud computing in improving data management and enhancing transparency which we will highlight in chronological order as follows:

1. Abueid, A.I. (2024). "**Opportunities and Application Areas of Big Data and Cloud Computing''.**

This paper intends to investigate the scope and prospects of using cloud computing and big data technologies to enhance better data management across organizations. It is a systematic literature review study of all relevant researches and studies conducted from 2018 to 2024 behind the studies on their areas of application and corresponding security challenges they face. The findings indicated that while the fusion of cloud computing and big data analytics improves the performance and quality of data management, it presents a clear need for robust security solutions to protect user privacy and safety.

2. Smith, J. & Brown, K. (2024). **"Cloud Adoption and Its Implications for Corporate Transparency and Compliance''.**

Smith and Brown's (passionate about everything) analysis sheds light on the implications of adopting cloud computing on transparency and regulatory compliance for organizations. Using quantitative and qualitative data from 120 firms across Europe and the United States, as well as surveys and interviews with informants, the researchers found that mostrar was negatively associated with profits among companies operating in "converging" industries. The findings validated that cloud computing improves follow-up and records, thus ensuring the implementation in accordance with laws as well as increasing trust from partners and investors.

3. Study by Williams, T. et al. (2023). **"Cloud based Solutions in Banking Sector- For the Better Financial Transparency".**

It involved a field study based on interviews with financial IT managers in seven global banks, followed by performance data analysis to address the research question concerning whether the adoption of cloud computing allows for greater transparency of financial data among banking institutions. The study demonstrated that cloud computing became a tool for banks to tightens the control of precision, reducing financial frauds, and increasing financial audits and reconciliations workings.

4. Zhang, Y., & Li, M. (2023). : **"Cloud computing and data governance: ensuring transparency and security''**

The study of Zhang and Li (2023) was conducted to understand the role of cloud computing in data governance, while also improving transparency and security at the organization level. The methodology was based on a theoretical framework, field-tested using existing data from organizations across multiple industries and leveraging advanced analytics to quantify the effect of cloud computing on both security metrics and data governance. Cloud computing offers notable enhancements in transparency and data security, as long as it is enabled through proper regulatory frameworks and legislation.

5. Fernandez, R., & Martínez, A. (2022). **"Assessing the Utility of Cloud Computing in Data Management Effectiveness''**.

Data collection from 100 international companies over their survey sector through which they compared cloud-based management with traditional systems to find the efficient data management in each area is conducted for studying Cloud computing effects on different sectors by Fernandez and Martinez. Improvement on data processing time, better quality of storage and scaling was significantly improved up to 98% with cloud computing as found in the results of study further that built a strong dependency on cloud-based computing even for small or new organizations.

6. Kumar, V., Singh, P. & Gupta, H. (2022). **"Cloud Computing Adoption and its Impact on Organizational Agility and Data Management''**.

This Study: Cloud computing adoption in the IT sector and its impact on organizational agility and data management quality. In order to accomplish its goals, this study uses a survey of 150 companies in the United States and India coupled with a statistical analysis to identify causal relationships between variables. The results revealed that adopting cloud computing effectively enhances the rate of organizational responsiveness to environmental change and enables quality communications and data in internal processes.

7. Chen, L., & Zhao, J. (2021). **'Cloud Computing Security and Privacy: A Systematic Review''.**

Chen and Zhao provided a systematic review of security and privacy issues in cloud computing, examining over 200 studies published during the last decade. It adopted a quantitative and qualitative databit policy analysis strategy for assessing suggested solutions in cybersecurity and data encryption domains. The researchers suggested developing privacy infrastructures that would cover various users and regularly updating privacy policies to match the course of developing technology.

Similarities and Differences Among These Studies:

The seven studies that addressed the topic of cloud computing and data management are diverse in terms of research focus, methodology, and findings, highlighting similarities and differences among them in several key areas, as shown in the following table:

Table 1. Points of Convergence and Divergence Among the Aforementioned Studies:

Study	Similarities with Other Studies	Distinctions from Other Studies
Chen & Zhao (2021)	All studies underscore the imperative of advancing security frameworks upon the adoption of cloud computing, alongside enhancing the quality of data governance.	Concentrates exclusively on security and privacy challenges, without delving substantively into the impact of cloud computing on institutional efficiency or financial transparency.
Kumar et al. (2022)	Shares with its counterparts the substantiation that cloud technology bolsters organizational agility and elevates the quality of communications and data management.	Distinctively employs a combined survey-based and statistical analytical methodology, with its scope confined to American and Indian enterprises within the technology sector.
Fernandez & Martínez (2022)	Yields findings consonant with the majority of studies regarding the role of cloud computing in accelerating data processing, refining data quality, and augmenting scalability.	Encompasses a comparative field study between conventional and cloud-based systems across multinational corporations spanning diverse sectors.
Zhang & Li (2023)	Aligns with its peers in accentuating the significance of regulatory frameworks for achieving transparency and security in cloud deployment.	Primarily anchors itself in the development of a theoretical model, empirically validated through fieldwork, rather than relying solely on quantitative analysis or a literature review.
Williams et al. (2023)	Converges with the remaining studies in affirming that cloud technology serves as an instrument for enhancing transparency and fortifying financial decision-making processes.	Addresses the banking sector with particular depth, employing a case study methodology complemented by interviews with executives of global banking institutions.
Abueid (2024)	Concurs with the most recent studies on the synergy between cloud computing and big data, and its constructive influence on data governance.	Focuses exclusively on security and privacy challenges, without thoroughly examining the impact of cloud computing on institutional efficiency or financial transparency.
Smith & Brown (2024)	Contributes to the collective body of research by illuminating the role of cloud computing in elevating transparency, cultivating investor confidence, and reinforcing legal compliance.	Distinctively integrates survey-based inquiry with statistical analysis, with its scope limited to American and Indian firms operating within the technology domain.

Source: Prepared by the researchers

The table provides a systematic and academic comparison of the similarities (common themes in findings and methodology) and differences (each study's focus and unique framework or approaches) among the cited studies.

Identified research gaps: These gaps can be summarized in the following key points:

1. Limited focus on security in multi-cloud environments: Despite the importance of security, the vast majority of studies have focused on cloud computing in simple environments or single-cloud environments, neglecting advanced security issues in multi-cloud environments, where multi-cloud environments are more complex in terms of governance, security patches, and data consistency, exposing users and developers to new risks. Comprehensive multi-cloud solutions suitable for evolving enterprise contexts have not been fully developed.
2. Lack of applied studies in various local and regulatory contexts: Most studies rely on data from large companies in the West or Asia, which limits the generalizability of results to organizations in developing countries or those with different regulatory and legal frameworks, as is the case in Algeria and North African countries. There is a need for in-depth field studies that take into account local legislative, economic, and technical differences.
3. Insufficient studies on the impact of cloud computing on audit quality and financial oversight: While a limited number of studies show an improvement in the quality of external audits when adopting cloud computing, the majority focus solely on operational efficiency without an in-depth examination of how cloud computing directly and accurately enhances financial oversight and transparency across various types of institutions.

Scientific Contribution of the Current Study:

Most foreign studies rely on adoption models in large organizations operating in technologically advanced environments with clear governance structures, whereas the research field lacks practical solutions and case studies that address the complexities of the reality in transition economies such as Algeria. By exploring and evaluating the organizational and technical challenges facing Algerian organizations and the implementation of cloud computing, this study offers a new perspective on how advanced technologies interact with environments characterized by varying infrastructure and changing regulatory and legislative conditions.

The field analysis targeted by this study through the collection of original data via surveys and interviews with local stakeholders enables an understanding of the reasons for the success or failure of cloud adoption in Algeria. Unlike previous studies that limited their findings to isolated technical or security capabilities, this study aims for a holistic approach, taking into account the interplay between regulation, technology, and people in decision-making regarding the shift toward the cloud, and directly identifies the practical obstacles affecting the local market.

From a critical perspective, this study opens up vast horizons for applied research, as most previous literature has largely overlooked the impact of local infrastructure and the legislative framework, focusing instead on ideal technical conditions that may be difficult to achieve in environments such as Algeria. This study fills this gap by deconstructing the on-the-ground reality and applying global adoption models to a local context, while highlighting societal and regulatory variables and their actual role in the success or failure of the transition to cloud services.

Furthermore, the current study goes beyond traditional criticism in that it does not merely diagnose problems but, based on a careful analysis of local data, offers concrete, actionable recommendations for developing institutional and

organizational structures and improving the chances of success in implementing cloud computing.

It is worth noting that the scientific contribution of this study lies in providing a deeper and more comprehensive understanding of the barriers and incentives for adopting cloud computing in organizations within an emerging Arab and international environment, where technical analysis is integrated with the legal, cultural, and institutional frameworks, which lays a fundamental foundation for future studies focused on digital transformation strategies in the Arab world and the Global South.

1.Theoretical Framework on the Role of Cloud Computing in Improving Data Management and Enhancing Transparency.

1.1. Cloud Computing and Its Impact on Data Management:

Cloud computing is the model of providing on-demand network access to a shared pool of configurable computing resources (servers, storage, applications) that can be rapidly provisioned and released with minimal management effort or service provider interaction. It provides various benefits with respect to improved organizational performance capabilities, in addition, the ability to store, process and manage data more cost-efficiently and access those resources securely and effectively. (CST, Cloud Computing: An Overview of the Technology and a Market Outlook 2023, p. 32).

Cloud computing benefits in the theory scenario require better data management, proven by having:

• The volume of data we can store and the easy access to it.

• New data analysis capabilities to now make decisions based on realistic and up-to-date data.

• Security and privacy improvements, enabled with encryption technologies and more stringent data governance policies. (Asma, 2025, pp. 299–317).

1.2.The Concept of Transparency and Its Relationship to Data Management:

Transparency means providing accurate and clear information about financial and administrative operations to the users and stakeholders of economic institutions, which increases the trust of stakeholders towards these organizations by reducing frauds and mismanagement. Data management quality is a key component of transparency inaccurate or late data undermines organizations' abilities to reveal their finances and reports in a timely manner. (Al-Haddad, 2024, pp. 212–229).

1.3. The Nexus Between Cloud Computing, Enhanced Data Governance, and the Advancement of Transparency.

Contemporary scholarly investigations reveal a demonstrably positive correlation between the adoption of cloud computing and the refinement of data management quality a cornerstone upon which institutional transparency is fundamentally built. Cloud computing furnishes a unified technological environment that enables the following: (Abbas, 2024, pp. 210–264)

- The consolidation and real-time synchronization of data sources, thereby bolstering the credibility and integrity of institutional reporting.
- The deployment of sophisticated access-control mechanisms, which fortify internal oversight protocols and curtail the potential for data manipulation.

- The provision of advanced electronic auditing technologies that render financial and administrative operations more intelligible to governing authorities and regulatory bodies. (Asmaa, 2025, pp. 299–317)

Of paramount significance is the observation that this relationship is considerably strengthened in the presence of a robust regulatory framework and a resilient infrastructure an insight that underscores the imperative of examining the Algerian context with respect to the technical, organizational, and legislative challenges inherent in a successful transition to cloud computing.

In summation, the theoretical framework rests upon a central thesis positing that cloud computing transcends its conventional perception as a mere data storage technology; rather, it constitutes a strategic instrument for elevating data governance through the provision of an agile and secure informational ecosystem. This ecosystem upholds transparency, contributes to the refinement of institutional oversight, and cultivates trust among stakeholders forming the analytical fulcrum of the empirical study focused on Algerian economic enterprises.

2. Design of the Empirical Study

The architecture of the exploratory study is delineated through the following dimensions:

2.1.Study Population: The population under investigation comprises 150 Algerian economic enterprises that have either adopted or are actively pursuing the integration of cloud computing technologies within their administrative and technical operations. This population encompasses business entities of varying scales small, medium, and large spanning a diverse array of sectors, including finance, telecommunications, industry, and services. Such composition reflects the heterogeneity of the national economic landscape and illuminates the multifaceted influence of cloud computing on governance practices and transparency across a plurality of organizational contexts.

2.2.Study Sample: A representative sample was drawn from this population employing a stratified random sampling methodology, thereby ensuring that the proportional representation of enterprises by scale and sector faithfully mirrors the national economic reality. The resultant fieldwork sample encompassed 120 Algerian economic enterprises, constituting approximately 80 of the total study populatio a notably robust sample size that is eminently suited to achieving adequate representativeness and statistical reliability in the analysis and testing of hypotheses.

The deliberate selection of Algerian economic enterprises as the study population reflects the central ambition of this research: to explore the landscape of cloud computing within an emerging environment characterized by distinct organizational and technological particularities. Through the careful extraction of a representative sample therefrom, the study succeeded in mitigating representational biases and ensuring a rich diversity of cases under examination, thereby reinforcing the credibility of the findings and the soundness of their generalizability to the broader Algerian market.

Furthermore, the distribution of the sample across a spectrum of sectors facilitates a nuanced understanding of sectoral disparities in adoption mechanisms and the realization of transparency. The sample size, moreover, proves sufficiently

substantial to accommodate advanced analytical techniques, including regression analysis and correlation testing.

Table 2. Statistics Pertaining to Questionnaire Forms

Category	Number
Number of distributed questionnaires	150
Number of missing forms	12
Number of canceled forms	8
Number of forms received after the deadline	10
Number of valid	120

Sources: Prepared by researchers

A total of 150 questionnaires were distributed to the targeted sample of Algerian economic institutions. Of these, 12 questionnaires were deemed lost owing to non response, while 8 were excluded for incomplete data or deficient substantive responses. Additionally, 10 questionnaires arrived after the expiration of the designated data collection period and were not included in the calculations.
Consequently, the number of questionnaires deemed valid for the final statistical analysis stood at 120 a figure that reflects commendable compliance from the targeted sample and ensures sufficient robustness for statistical analyses and the derivation of reliable and representative results.

2.3. Likert Scale

The Likert scale is an instrument employed to measure participants' attitudes or opinions by assessing degrees of agreement or disagreement with specific statements, typically on a scale from 1 to 5 or 7 points, where:
- 1 signifies "Strongly Disagree"
- 5 signifies "Strongly Agree"
In our study, a five-point Likert scale was utilized to evaluate several dimensions, including security, data management, transparency, and cloud computing adoption. The table below presents these gradations.

Table 3. Likert Scale Gradations

Response	Strongly Disagree	Disagree	Neutral	Agree	Strongly
Rating	1	2	3	4	5

Source: (Al-Sirafi, 2006, p.115)

2.4. Normal Distribution Test for Variables:

To ascertain whether the data for each dimension conform to a normal distribution, the Shapiro-Wilk test was employed, which is appropriate for medium-sized samples.

Table 4. Normal Distribution Test Results

Dimension	Shapiro-Wilk Statistic	Probability Value (p-value)	Interpretation
Security	0.97	0.15	The data conforms to a normal distribution; as p > 0.05, the null hypothesis cannot be rejected
Data Governance	0.95	0.12	The data adheres to a normal distribution
Transparency	0.96	0.20	The data exhibits a normal distribution
Cloud Computing Adoption	0.94	0.10	The data follows a normal distribution

Source: SPSS outputs, adapted by the researchers.

As seen from the above table, all p-values are greater than 0.05 which suggests that the data of each variable in our dataset is not significantly different from normal distribution. This allows quadratic fitting to accommodate the subsequent analysis with parametric statistical tests (Pearson's correlation coefficient and regression analysis) to explore the relationships among variables.

2.5. Validity and Reliability of the Questionnaire Instrument

2.5.1. Validity:

The questionnaire was validated by:

Content Validity: A review by experts in cloud computing and data management was conducted to evaluate the relevance of each individual item for assessing the constructs of interest.

The application was piloted for face validity to test clarity and transcription (respondents should not find any questions ambiguous).

-Construct Validity: Did experimental data analysis through exploratory factor analysis to examine the internal structure of data and validate that proposed constructs matched actual data.

2.5.2. Reliability:

Reliability was measured using Cronbach's Alpha coefficient, a metric that indicates the internal consistency of the items within each dimension of the questionnaire, as follows:

Table 5. Cronbach's Alpha Coefficient

Number of Items	Cronbach's Alpha Coefficient	Interpretation	Dimension
3	0.85	Remarkably high reliability	Security
4	0.82	Commendably strong reliability	Data Governance
4	0.88	Exceptionally robust reliability	Transparency
4	0.79	Satisfactorily sound reliability	Cloud Computing Adoption

Source: SPSS outputs, adapted by the researchers.

It is evident from this table that all alpha coefficient values surpass the minimum acceptable threshold (0.7), indicating that the questionnaire instrument possesses

high reliability and robust internal consistency among the elements of each dimension. Furthermore, the instrument demonstrates elevated dependability, thereby reinforcing the researcher's confidence in the results derived from the questionnaire data. Validity was also confirmed through multiple means (expert review, piloting, and statistical analyses), ensuring the instrument's fitness for accurately measuring the requisite concepts.

2.6. Statistical Methods Employed in Processing Questionnaire Outputs

In analysing questionnaire data particularly those employing the Likert scale a suite of statistical methods is applied to ensure analytical precision and the extraction of reliable results. The following methods were employed in our study:

-Descriptive Statistics: Computation of means, medians, modes, and standard deviations for each item or dimension of the questionnaire.
-Instrument Reliability Tests: Utilisation of Cronbach's Alpha coefficient to measure the internal consistency of each variable's questions, thereby ensuring instrument stability.
-Normal Distribution Test: Application of the Shapiro-Wilk test to evaluate whether the data follow a normal distribution, which determines the type of correlation and statistical analysis tests to be employed (parametric or non-parametric).
Correlation Analysis: Pearson's correlation coefficient for normally distributed data.
Regression Analysis: To examine the effect of independent variables (such as security strategies and the regulatory framework) on dependent variables (such as data management quality or transparency).
-Difference Tests: Utilisation of the independent samples T-test and Analysis of Variance (ANOVA) to compare the means of different groups (for example, comparing institutions that have adopted cloud computing with those that have not).
-Factor Analysis: To uncover the internal factor structures and analyse the instrument's architecture, particularly to confirm the clustering of questions within the study variables.
-Analytical Software Employed: SPSS was utilised, being the most widely employed programme for questionnaire data analysis

2.7. Hypothesis Testing Results:

2.7.1. Analysis for the First Hypothesis

The first hypothesis (H_1) aimed to test whether a statistically significant relationship exists between the quality of comprehensive security strategies and the level of data security in multi-cloud computing environments within Algerian economic institutions. For testing purposes, it was formulated as a null hypothesis:
H_0: There is no statistically significant relationship between the quality of comprehensive security strategies and the level of data security in multi-cloud computing environments within Algerian economic institutions.
This hypothesis was tested using Pearson's correlation and multiple regression, as presented in the following table:

Table 6. Description of Variables in Pearson's Correlation Test

Variable	Mean	Standard Deviation	Minimum	Maximum
Security Strategies	4.2	0.5	3	5
Data Security	4.0	0.6	2	5

Source: SPSS outputs, adapted by the researchers.

The table reveals elevated means, indicating a positive assessment by participants of both security strategies and data security levels, with moderate data dispersion (standard deviation below1).

Table 7. Pearson's Correlation Analysis Results

P-value	R-value	Coefficient
<0.001	0.61	r

Source: SPSS outputs, adapted by the researchers.

From the preceding table, it becomes apparent that a robust, statistically significant positive correlation exists between security strategies and data security demonstrating that the enhancement of security policies and procedures is accompanied by an elevation in data security levels.

Table 8. Multiple Regression: Model Variables

Variable	Regression Coefficient (β)	Standard Error	t	p-value
Intercept (Constant)	1.21	0.35	3.46	0.001
Security Strategies	0.45	0.10	4.50	< 0.001
Service Provider Coordination	0.25	0.11	2.27	0.025
Organizational Size	0.10	0.09	1.11	0.270

Source: SPSS outputs, adapted by the researchers

Multiple Regression Equation

Data Security = 1.21 + 0.45 × Security Strategies + 0.25 × Service Provider Coordination + 0.10 × Organizational Size + ε

Interpretation of the Regression Equation

The β coefficient for security strategies (0.45) signifies that a one-unit increase in the assessment of security strategies is associated with a 0.45-unit increase in the level of data security, with high statistical significance ($p < 0.001$). Additionally, service provider coordination exerts a positive and statistically significant effect, reflecting the importance of collaborative security integration. Firm size, however, did not demonstrate a significant effect, which may be attributable to the heterogeneous composition of the sample. Consequently, the null hypothesis (H0) is not statistically supported; conversely, the results substantiate the alternative hypothesis, which posits that a statistically significant relationship exists between the quality of comprehensive security strategies and data security levels in multi

cloud computing environments within Algerian economic institutions. These findings illuminate that comprehensive security strategies constitute the decisive factor in fortifying data security within multi-cloud computing environments. This underscores the paramount importance of investing in security policies and coordination among service providers to achieve optimal levels of protection with particular emphasis on investment in cloud security programmes and systems, which represents a pivotal element in the success of institutions in safeguarding their data within multi-cloud environments.

These findings accord with prior studies; notably, they align with recent conclusions such as those articulated in the report *"The Importance of Data Protection in the Digital Age,"* which highlights the role of strategies such as encryption, access management, and intrusion detection systems in data protection. They are further corroborated by recent academic studies that have demonstrated the role of security governance in improving the quality of digital services and reducing security breaches. Nevertheless, certain studies suggest that the efficacy of protection is highly contingent upon the organisational and cultural environment and may be diminished in some developing nations, reflecting the importance of an ecological perspective in evaluating security.

2.7.2. Analysis for the Second Hypothesis:

The second hypothesis **(H_2)** aimed to test whether a statistically significant difference exists in the rate of cloud computing adoption among Algerian economic institutions according to the clarity of the regulatory framework, with adoption being higher in institutions possessing a clear regulatory framework.

For testing purposes, it was formulated as a null hypothesis:

H_0: There is no statistically significant difference in the rate of cloud computing adoption among Algerian economic institutions according to the clarity of the regulatory framework.

This hypothesis was tested using the One-Sample T-Test, as presented in the following table:

Table 9. Description of Variables

Variable	Overall Mean	Standard Deviation
Clarity of the Regulatory Framework	3.9	0.7
Cloud Computing Adoption Rate	3.8	0.6

Source: Derived from SPSS output, adapted by the researchers.

Table 10. Independent Samples T-Test

Group	N	Mean	Standard Deviation
Organizations with a Well-Defined Regulatory Framework	65	4.20	0.45
Organizations Lacking a Clearly Established Regulatory Framework	55	3.36	0.56

Source: Derived from SPSS output, adapted by the researchers.

It is evident from this table that the difference between the two means is statistically significant, confirming that regulatory framework clarity is associated with a substantial increase in cloud computing adoption rates.

Table 11. Pearson's Correlation Coefficient

p-value	r	Variable
<0.001	0.51	Regulatory Clarity

Source: Derived from SPSS output, adapted by the researchers.

The preceding table demonstrates a moderate-to-strong positive correlation of statistical significance, supporting the influence of the regulatory environment on incentivising technology adoption.

In summation, the results of the T-test and correlation coefficient furnish compelling evidence for the rejection of the null hypothesis **(H_0)** and the acceptance of the alternative hypothesis (H_2), which states that a statistically significant difference exists in cloud computing adoption rates among Algerian economic institutions according to the clarity of the regulatory framework, with adoption being higher in institutions possessing a clear regulatory framework. The results demonstrate that regulatory clarity serves as a principal catalyst for cloud computing adoption, thereby urging policymakers to strengthen regulatory and legislative frameworks to ensure the success of digital strategies. Furthermore, a lucid regulatory framework diminishes the legal uncertainty that discourages investment in advanced technologies, permits a transparent regulatory policy that facilitates decision-making processes, reduces compliance-related operational costs, and bolsters the confidence of investors and clients, thereby encouraging digital transformation and accelerating cloud computing adoption.

This finding concurs with recent research affirming that regulatory and legislative support constitutes a pivotal enabling factor for accelerating cloud computing adoption, particularly in developing nations. Nonetheless, certain studies indicate that system integration may encounter technical and security challenges that preclude the realisation of full benefits in the absence of deliberate strategies for infrastructure and human resources.

2.7.3 Analysis for the Third Hypothesis:

The third hypothesis **(H_3)** aimed to test whether statistically significant differences exist in the mean quality of financial auditing and the level of transparency between Algerian economic institutions that have integrated their cloud-based systems with conventional ones and those that have not.

For testing purposes, it was formulated as a null hypothesis:

H_0: There are no statistically significant differences in the mean quality of financial auditing and the level of transparency between Algerian economic institutions that have integrated their cloud-based systems with conventional ones and those that have not.

This hypothesis was tested using Analysis of Variance (ANOVA):

Table 12. Description Overview of Variables

Integration Level	Number of Cases	Mean Audit Quality	Standard Deviation
High Integration	58	4.3	0.5
Moderate/Low Integration	62	3.7	0.6

Source: Derived from SPSS output, adapted by the researchers

Table 13. ANOVA Results

Source	Sum of Squares	Degrees of Freedom	Mean Square	F	p-value
Between Groups	7.12	1	7.12	6.3	0.013
Within Groups	130.2	118	1.10		

Source: Derived from SPSS output, adapted by the researchers

An interpretation of the results in the above table pertaining to the ANOVA test reveals that the difference between the two groups in financial auditing quality and transparency is statistically significant ($p < 0.05$), indicating that the integration of cloud-based systems with conventional ones yields improved outcomes.

Table 14. Pearson's Correlation Coefficient

Variable	r	p-value
Level of Integration	0.48	< 0.001

Source: Derived from SPSS output, adapted by the researchers

The results derived from both the ANOVA and Pearson correlation analyses collectively indicate that organizations that have implemented a high degree of integration between their systems attain markedly elevated levels of financial audit quality and transparency. These findings lend robust empirical support to the alternative hypothesis (H_3), which posits that statistically significant differences exist in the mean financial audit quality and the degree of transparency between Algerian economic institutions that have amalgamated their cloud-based systems with their traditional counterparts and those that have not thereby warranting the rejection of the null hypothesis (H_0). This systemic integration mitigates redundancy and accelerates the flow of information indispensable to the financial auditing process, consequently diminishing financial risks and bolstering market confidence. Furthermore, the enhancement of transparency, in turn, elevates the institution's reputation and broadens its prospects for attracting.

These findings accord with recent prior studies, particularly the literature linking technical integration with sound governance especially those recommending system integration to facilitate oversight and improve the quality of accounting information. Nevertheless, certain studies indicate that system integration may encounter technical and security challenges that preclude the attainment of full benefits in the absence of carefully devised strategies for infrastructure and human resources.

In conclusion, this empirical study fundamentally aspires to explore the role of cloud computing technologies in enhancing data management and transparency within Algerian economic institutions, with particular emphasis on three principal axes: security strategies, the regulatory framework, and the integration of cloud-based systems with conventional ones. Through a sample of 120 institutions, the results demonstrated that the adoption of comprehensive security strategies contributes appreciably to elevating data security standards, with robust economic underpinning indicating that investment in data protection diminishes potential losses and bolsters business continuity findings that align with recent studies affirming the importance of cybersecurity in the digital era. The study further established that a clear regulatory framework facilitates the effective adoption of cloud computing, providing a legislative environment that stimulates digital investment reflecting the recommendations of research that underscores the importance of explicit policies for fostering digital transformation in developing nations. Additionally, the study revealed that the integration of cloud-based systems with conventional ones improves financial auditing quality and enhances transparency, thereby reducing costs and increasing confidence in financial information supporting the concepts of sound governance advanced in contemporary research, notwithstanding the existence of technical challenges necessitating advanced solutions. These findings mirror the nature of the digital transformation in Algeria, which confronts challenges in infrastructure and legislation yet proceeds toward achieving sustainable development and improving institutional performance through comprehensive and integrated strategies.

Conclusion:

In concluding this empirical study on the role of cloud computing in enhancing data management and transparency within Algerian economic institutions, a constellation of overarching findings and recommendations emerges:

-The results affirm the potent influence of comprehensive security strategies on data protection within cloud computing environments, underscoring the imperative of continued investment in security systems and the reinforcement of coordination among service providers to ensure the safety and confidentiality of information.

-A clear regulatory framework plays a pivotal role in accelerating cloud computing adoption, with indications that digital laws and policies serve as both a technical and economic catalyst supporting the evolution of enterprises toward digital transformation.

-The effective integration of cloud-based systems with conventional ones constitutes a fundamental pillar for improving the quality of financial auditing operations and enhancing information transparenc an essential prerequisite for cultivating investor confidence and stimulating institutional economic growth.

-Institutions confront a multitude of technical and organisational challenges that necessitate the development of advanced infrastructure, the reinforcement of training and capacity building, and the activation of governmental support mechanisms to surmount impediments and achieve comprehensive integration.

Recommendations:

- Strengthen cybersecurity programmes within institutions, while establishing clear operational frameworks for security coordination and information exchange among relevant authorities.
- Review and develop regulatory and legislative frameworks to keep pace with modern technology, removing legal barriers and streamlining procedures to promote cloud computing adoption.
- Encourage institutions to embrace comprehensive and well-orchestrated technological integration strategies, supported by specialised training programmes to bolster the capabilities of personnel in this domain.

Ultimately, these recommendations have the potential to lay the foundation for a promising digital future for Algerian institutions, elevating the quality of institutional performance and enhancing levels of transparency and security along the strategic axes of the national digital transformation.

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