

Digital Transformation as an Approach to Developing Governance and Smart Control in Economic Institutions: A Comparative Study between the Algerian Experience and Selected International Models

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Abstract: In light of the rapid developments in the digital world, economic institutions are increasingly required to reconsider their control systems to meet the demands of the Fourth Industrial Revolution. This study aims to examine the impact of digital transformation on the development of control systems within economic institutions by analyzing the relationship between digitization, governance, and smart control. The findings reveal that the integration of modern technologies such as artificial intelligence, big data, and the Internet of Things (IoT) contributes to enhancing transparency, efficiency, and accountability while reducing administrative and financial risks. The results also indicate that the success of digital transformation depends on a strong digital infrastructure, qualified human resources, and a supportive legal framework. The study concludes that digital transformation serves as a key driver for achieving good governance and building smart economic institutions capable of adapting to the challenges of the digital age.

Keywords: Digital Transformation O33, Smart Control M42, Good Governance G34, Artificial Intelligence M15, Economic Institutions L21.

Introduction:

Over the past two decades, the world has witnessed a profound transformation in management and governance models, driven by the rapid advancement of information and communication technologies (ICT). This evolution has positioned digital transformation as one of the most prominent strategic trends affecting all economic sectors. Digital transformation is no longer regarded as a complementary option; rather, it has become an essential prerequisite for organizations seeking to survive and remain competitive in an environment characterized by intense competition and rapid change.

Digital transformation is not merely the introduction of technological tools; it is a comprehensive process that involves restructuring administrative and operational processes, fostering a new

organizational culture based on innovation and transparency, and enhancing governance and control systems to become more intelligent and responsive to the digital business environment.

The Fourth Industrial Revolution has imposed new realities on economic organizations. Digitalization, artificial intelligence (AI), and big data analytics have become fundamental tools for managing organizational performance and developing smart governance and control systems. This stage represents a transition from traditional bureaucratic models to dynamic management approaches that rely on data-driven insights and real-time interaction in decision-making processes.

Technological advancements have also redefined the concept of organizational control. Control mechanisms are no longer limited to detecting errors after they occur; instead, they have become proactive and predictive, relying on artificial intelligence to anticipate risks and analyze organizational behaviors. This evolution has given rise to what is commonly referred to as **smart control**, which is now considered one of the key pillars of modern governance within organizations.

Research Problem

In light of global digital transformations and the integration of economic organizations into a comprehensive digital environment, there is a growing need to understand the relationship between digital transformation, governance, and smart control. Accordingly, the central research problem can be formulated as follows:

"To what extent does digital transformation contribute to the development of governance and smart control systems within economic organizations, and what lessons can be drawn from international experiences to facilitate this transformation in the Algerian context?"

Research Hypotheses

- Digital transformation directly contributes to improving governance systems and enhancing transparency within economic organizations.
- The implementation of artificial intelligence and data analytics technologies increases the effectiveness of internal control systems.
- The success of digital transformation in advancing corporate governance is closely linked to the qualification of human resources and the adoption of a digital culture within organizations.
- International experiences (France, the United Arab Emirates, and South Korea) provide successful models that can be leveraged to enhance the Algerian experience.

Research Objectives

This study aims to achieve several objectives, including:

- Analyzing the theoretical concept of digital transformation and its relationship with governance and smart control.
- Highlighting the role of digital transformation in improving organizational performance and strengthening transparency and accountability.
- Examining the current state of digital transformation implementation in Algerian organizations and identifying the obstacles hindering the development of digital governance systems.
- Comparing the Algerian experience with selected international models to derive lessons learned and best practices.

- Proposing a practical framework for activating governance and smart control within the context of the transition toward the Fourth Industrial Revolution.

Significance of the Study

The importance of this research stems from its focus on a contemporary and evolving topic within the modern economic environment, where digitalization has become one of the primary determinants of organizational competitiveness. The significance of the study can be highlighted through the following dimensions:

- **Scientific Significance:** Contributing to the theoretical literature by linking the concept of digital transformation with governance and smart control systems.
- **Practical Significance:** Providing a practical perspective for developing control systems within Algerian organizations in line with the requirements of the Fourth Industrial Revolution.
- **National Significance:** Aligning with Algeria's national digital transformation policies, particularly government programs aimed at digitalizing public services and institutions.

1. Theoretical Framework of Digital Transformation, Governance, and Smart Control

This section aims to establish the theoretical foundation necessary for understanding the relationship between digital transformation, governance, and smart control within economic organizations. It examines the key concepts and theoretical approaches that explain this transformation and analyzes the technological and organizational dimensions that influence its practical implementation.

1.1. Concept of Digital Transformation

Digital transformation is considered one of the most significant contemporary concepts that has gained considerable importance with the advancement of technology and its integration into various fields of economic activity. It is defined as the process of utilizing digital technologies to transform business models, services, and organizational procedures with the aim of improving efficiency, enhancing customer value, and developing innovative approaches to management and production.

Digital transformation differs from traditional mechanization or automation because it is not limited to the introduction of technological tools. Rather, it involves a cultural and organizational transformation that changes the way individuals think, interact, and operate within the organization. This transformation encompasses several domains, including digital services, e-commerce, artificial intelligence, big data, and blockchain technologies (Al-Hashimi, 2021, pp. 27–29).

Furthermore, some scholars view digital transformation as a continuous journey aimed at reimagining the way value is created within organizations through the effective utilization of modern technologies. It is considered one of the most important drivers of organizational innovation, as it enables the redesign of processes and activities to become more interactive and flexible (Westerman, Bonnet, & McAfee, 2019, pp. 3–7).

1.2. Stages of Digital Transformation

The digital transformation process progresses through several integrated stages. It begins with **Digitization**, which involves converting paper-based information into digital data. The second stage is **Digitalization**, which refers to the integration of technology into organizational procedures and operations. The final stage is **Digital Transformation**, which entails a comprehensive change in both the business model and the organizational culture.

Recent studies indicate that organizations that successfully achieve digital transformation are those that adopt a gradual approach based on assessing the current situation and identifying technological and human-resource priorities before embarking on a full-scale transformation process (Souad, 2022, pp. 44–46).

The literature further emphasizes that the success of each stage depends on the degree of integration of digital infrastructure, strategic leadership, and human resource capabilities. Digital transformation is not merely a technological upgrade but rather a comprehensive system that requires process redesign and the adoption of a new managerial mindset founded on transparency and accountability (Kane, 2021, pp. 11–15).

1.3. Governance: Concept and Dimensions

Governance is one of the fundamental concepts that emerged in response to recurring financial and administrative crises affecting organizations worldwide. It refers to the set of rules, principles, and procedures that ensure the sound management of organizations by balancing the interests of various stakeholders, including shareholders, management, employees, customers, and society.

Governance is built upon the principles of transparency, accountability, fairness, and responsibility. Its primary objective is to ensure the efficient utilization of resources while preventing administrative and financial corruption (Leila, 2020, pp. 18–20).

From a theoretical perspective, governance is supported by several approaches, most notably **Agency Theory**, which views governance as a mechanism for reducing conflicts of interest between owners and managers, and **Stakeholder Theory**, which argues that organizations are accountable to all stakeholders rather than exclusively to shareholders (Solomon, 2020, p. 35).

1.4. Smart Control: Concept and Characteristics

Smart control has emerged as one of the most significant outcomes of digital transformation. It represents the new generation of control systems that rely on artificial intelligence and predictive data analytics to detect deviations and risks before they occur.

Unlike traditional control systems, smart control is real-time and proactive in nature. It relies on **Big Data** and decision-support systems to provide accurate analyses of organizational performance. It also enables management to respond rapidly to operational challenges, thereby enhancing efficiency and reducing opportunities for fraud and errors (Nadia, 2022, p. 71).

Smart control is considered an integral component of digital governance systems, as it strengthens transparency and accountability through the collection and analysis of real-time data. It utilizes tools such as **Machine Learning** systems and behavioral pattern recognition technologies to identify anomalies in organizational performance (Chen, 2021, p. 57).

1.5. The Relationship Between Digital Transformation, Governance, and Smart Control

The relationship between digital transformation, governance, and smart control is characterized by functional and strategic interdependence and integration. None of these dimensions can be effectively achieved in isolation from the others. Digital transformation constitutes the fundamental technological foundation upon which modern governance and control systems are built within economic organizations. It enables the conversion of raw data into valuable knowledge that supports performance improvement and informed decision-making. In this context, digital transformation provides advanced tools such as **Artificial Intelligence (AI)**, **Big Data Analytics**, the **Internet of**

Things (IoT), and Blockchain, all of which are revolutionizing the management of organizational resources and operations.

Governance, on the other hand, represents the organizational, legal, and administrative framework that guides digital transformation and ensures that digital technologies are utilized in ways that promote transparency, accountability, credibility, and integrity. Without sound governance, digital transformation may result in digital disorder, cybersecurity risks, or the misuse of data. Consequently, digital governance establishes clear rules for assigning responsibilities, regulating stakeholder relationships, and strengthening trust in digital operations, thereby enabling technology to be implemented within a secure and well-structured environment.

Smart control serves as the third complementary component, functioning as the operational mechanism through which governance principles are implemented using digital technologies. It represents the stage at which technological tools are employed to monitor and analyze activities in real time, with the objective of identifying deviations or irregularities proactively rather than retrospectively, as is the case with traditional control systems. For example, intelligent systems within financial institutions can monitor transactions continuously and generate instant alerts whenever unusual patterns or suspicious activities are detected, thereby enhancing control effectiveness and reducing opportunities for fraud and administrative corruption.

The synergy among these three dimensions contributes to the development of an intelligent digital organization capable of adapting to the rapid changes characterizing today's business environment. When modern technologies (digital transformation) are integrated within a clear and rigorous regulatory framework (governance) and supported by an effective real-time monitoring system (smart control), the result is an organization that is flexible, transparent, and sustainable.

From a practical perspective, successful international experiences—such as those of South Korea and the United Arab Emirates—demonstrate that investment in digital infrastructure alone is insufficient. Such investment must be accompanied by institutional reforms and a robust legal framework capable of regulating the relationship between technology, people, and management. Accordingly, the relationship between digital transformation, governance, and smart control is not linear; rather, it is a mutually reinforcing and dynamic relationship in which the development of one dimension continuously strengthens the others.

In other words, digital transformation can be viewed as the **means**, governance as the **methodology**, and smart control as the **guarantee**, all converging toward a common objective: achieving optimal organizational performance within a transparent and secure digital environment (Abdel Raouf, 2023, p. 98).

2. Digital Transformation as an Approach to Enhancing Governance in Economic Organizations

Digital transformation constitutes one of the most important strategic pillars upon which contemporary economic organizations rely to achieve sound governance. Modern technology is no longer merely a supporting tool; rather, it has become the framework within which management, monitoring, and decision-making processes are conducted. This transformation is particularly evident in Algerian economic organizations, which have gradually begun adopting digitalization across their various operations.

2.1. The Relationship Between Digital Transformation and Corporate Governance

Contemporary economic literature demonstrates that the relationship between digital transformation and governance is not a simple linear one; rather, it is a dynamic and integrative relationship characterized by mutual influence. Digital transformation enhances transparency in decision-making and facilitates rapid access to information, while governance provides the institutional and legal framework necessary for the proper utilization of these technologies.

For example, digital transformation enables the development of **electronic disclosure systems (E-disclosure)** that allow investors and regulatory authorities to monitor an organization's financial performance in real time. This reduces opportunities for information manipulation and strengthens stakeholder confidence (Al-Amin, 2023, p. 42).

Furthermore, the implementation of tools such as **Management Information Systems (MIS)** and artificial intelligence in monitoring operational processes enables organizations to manage financial and administrative deviations with greater flexibility and precision, thereby reinforcing accountability and credibility in organizational performance.

2.2. Digital Transformation as a Means of Achieving Transparency and Accountability

Among the primary objectives of corporate governance are transparency and accountability, both of which have become increasingly attainable through digital transformation. The adoption of electronic accounting systems and open databases allows all transactions to be tracked, reviewed, and audited at any time.

In Algeria, several public enterprises, including Sonatrach and Sonelgaz, have begun implementing digital financial and control information systems that enable automated monitoring of accounts and financial transactions. This has enhanced the effectiveness of internal control mechanisms and improved transparency toward supervisory authorities (Rafika, 2021, p. 133).

Digitalization has also contributed to the development of governmental oversight mechanisms through digital platforms such as the Algerian financial transparency portal, which enables the electronic monitoring of public expenditures. This represents a significant step toward achieving effective digital control and governance (Algerian Authority, 2022, p. 24).

2.3. The Impact of Digital Transformation on Financial Disclosure Systems

Financial disclosure is one of the fundamental components of governance, and digital transformation has significantly improved the quality of financial reporting through automation and data-driven analysis.

The following table compares traditional financial disclosure methods with modern digital disclosure approaches in economic organizations:

Table 1. Comparison Between Traditional and Digital Financial Disclosure Methods in Economic Organizations

Dimension	Traditional Disclosure	Digital Disclosure
Publication Method	Paper-based reports and manual correspondence	Electronic platforms and ERP systems
Information Accuracy	Limited and subject to human error	High accuracy due to automated analysis

Dimension	Traditional Disclosure	Digital Disclosure
Reporting Frequency	Quarterly or annual	Real-time (instantaneous)
Control Mechanism	Post-control	Real-time control
Transparency Level	Partial	Near-complete

Source: Abdelghani (2020, p. 60).

The table illustrates a fundamental transformation in accounting and control disclosure systems resulting from the shift from traditional approaches to digital disclosure. The differences can be observed across five key dimensions that directly affect governance and transparency within economic organizations.

With regard to publication methods, organizations have moved from paper-based reports and manual correspondence—often characterized by delays and limited traceability—to integrated electronic platforms supported by **Enterprise Resource Planning (ERP)** systems. This transition has facilitated timely access to information and promoted data integration throughout the organization.

In terms of information accuracy, digital systems provide automated data processing and analysis, significantly reducing human error and improving the reliability and credibility of financial reports.

Regarding reporting frequency, the transition from quarterly or annual disclosure to real-time reporting highlights the ability of digital technologies to provide continuously updated information, thereby enabling managers and stakeholders to make prompt and informed decisions.

Similarly, control mechanisms have evolved from retrospective controls focused on identifying errors after their occurrence to **real-time control systems** that monitor activities as they are performed. This shift reduces opportunities for misconduct and emphasizes prevention rather than correction.

Finally, transparency levels have increased from partial disclosure to near-complete transparency due to the availability of open data and the ease of digital traceability. This has strengthened trust between organizations, shareholders, and regulatory authorities.

Overall, the table demonstrates that digital disclosure serves as a fundamental pillar of smart governance by ensuring accuracy, speed, and transparency in information management and financial oversight.

2.4. Digital Governance and Its Role in Decision-Making Support

Digital governance represents the natural extension of traditional governance within the digital environment. Its purpose is to regulate the use of technology within organizations in a manner that ensures security, transparency, and accountability.

Within economic organizations, digital governance enables management to make strategic decisions based on predictive data analysis through the use of artificial intelligence tools and **Decision Support Systems (DSS)**.

For example, large organizations employ predictive data analytics algorithms to identify accounting irregularities and anomalies, thereby enhancing the efficiency of both administrative and financial control systems. A study conducted by the **Korea Advanced Institute of Science and Technology (KAIST)** reported that organizations implementing digital governance achieved a 37% increase in transparency compared with non-digital organizations (Ahmed, 2022, p. 25).

2.5. Challenges Facing the Implementation of Digital Transformation in Algerian Governance

Despite the relative progress achieved in digital transformation initiatives, Algerian organizations continue to face several challenges that hinder the realization of effective digital governance.

Among the most significant challenges are the following (Al-Zahraa, 2023, p. 102):

- Inadequate digital infrastructure in certain regions.
- A shortage of specialized competencies capable of managing digital systems.
- Weak coordination between financial and regulatory departments.
- The absence of a comprehensive legal framework governing digital governance.

In addition, limited trust in digital systems persists due to concerns regarding cybersecurity threats and data breaches. Addressing these concerns requires the establishment of a comprehensive national framework for institutional cybersecurity capable of protecting sensitive data and ensuring business continuity.

3. Digital Transformation as a Tool for Modernizing Internal Control Systems and Smart Control in Algerian Organizations

Today, digital transformation has become a central component in the redesign of internal control systems. The integration of technology into auditing and monitoring processes has enhanced transparency, improved the effectiveness of early warning systems, and supported data-driven decision-making.

Modern control practices are now conducted within an environment that relies on artificial intelligence, data analytics, and the Internet of Things (IoT), leading to the emergence of what is known as **Smart Control**, which is based on real-time information rather than traditional reporting systems.

3.1. Digital Transformation and Its Impact on the Structure of Internal Control Systems

Digital transformation has fundamentally altered the structure and functions of internal control systems by shifting from traditional paper-based systems to integrated digital platforms that enable real-time monitoring of organizational activities.

In major Algerian organizations, particularly banks and energy companies, the implementation of **Enterprise Resource Planning (ERP)** systems has improved control over transaction flows and enhanced the integration of financial and accounting data.

A field study conducted on 45 Algerian organizations in 2023 revealed that organizations adopting digital control systems experienced a 31% reduction in accounting errors compared with non-digital organizations (Nasser, 2023, p. 113).

Another study demonstrated that digital systems facilitated real-time monitoring of contracts and financial transactions, particularly within the banking sector, where the new Algerian **Core Banking System (CBS)** was implemented to enable the tracking of all banking operations in real time (Algeria, 2022, p. 31).

3.2. Digital Transformation in the Development of Internal Auditing Systems

The introduction of automated analytical tools and artificial intelligence into internal auditing functions has brought about a significant improvement in the efficiency and effectiveness of audit processes within organizations. Instead of relying on traditional sample-based manual examinations,

auditors increasingly utilize **Data Analytics Auditing** tools capable of analyzing entire datasets rather than limited samples.

The following table compares the characteristics of traditional auditing and digital auditing in Algerian organizations.

Table 2. Comparison Between Traditional Auditing and Digital Auditing in Algerian Organizations

Criterion	Traditional Auditing	Digital Auditing
Working Method	Manual sample examination	Comprehensive automated data analysis
Completion Time	Long	Short
Type of Data	Paper-based or partial data	Real-time digital data
Error Detection	Retrospective	Real-time and proactive
Cost	High	Moderate to low in the long term

Source: Hanan (2022, p. 90).

The table highlights the profound transformation brought about by digitalization in the auditing profession. Organizations have moved from traditional approaches based on manual procedures and paper documentation to intelligent digital auditing systems that rely on advanced technologies and real-time data analysis.

Regarding working methods, auditing has evolved from limited manual sample testing to comprehensive automated analyses covering the entirety of financial and operational data. This significantly reduces the likelihood of overlooking errors or irregularities.

In terms of completion time, the use of analytical software and artificial intelligence tools has considerably accelerated audit procedures, enabling auditors to conduct reviews more efficiently and accurately than traditional methods, which often required extensive periods to complete.

With respect to data types, organizations have transitioned from relying on paper-based or fragmented information to utilizing integrated real-time digital data. This enables immediate analysis and the prompt detection of irregularities as they occur, thereby enhancing both audit effectiveness and the quality of financial reporting.

Regarding error detection, digital auditing is distinguished by its ability to identify anomalies proactively and in real time, allowing organizations to address issues before they escalate. Traditional auditing, by contrast, primarily relies on retrospective reviews after errors have already occurred.

Although the initial implementation costs of digital auditing systems may be relatively high, long-term costs decrease substantially due to automation and reduced dependence on manual labor. As a result, digital auditing is considered both more efficient and more financially sustainable.

Overall, the table confirms that digital auditing represents a significant advancement toward more effective and transparent control systems based on big data and intelligent analytics, thereby reinforcing the principles of modern governance within economic organizations.

3.3. Smart Control and Its Role in Risk Prediction

One of the most significant advantages of digital transformation is its ability to enable organizations to move from retrospective control to predictive control through the use of advanced data analytics. Smart control relies on **predictive algorithms** that identify unusual behavioral patterns in operational processes before failures or irregularities occur. This allows organizations to implement corrective measures proactively rather than reactively.

In Algeria, national organizations such as Sonatrach have begun utilizing data analytics systems to detect operational deviations during production and transportation processes. These systems reportedly contributed to reducing industrial incidents by 18% in 2023.

Similarly, a study conducted in the United Arab Emirates found that the implementation of smart monitoring systems within financial institutions reduced operational losses by 35% over a two-year period, demonstrating the effectiveness of digital control mechanisms in risk management (Sonatrach, 2023, p. 47).

3.4. Digital Transformation in Strengthening Information Security and Cyber Control

With the expansion of digitalization, **cybersecurity** has become one of the most critical components of modern control systems. Control functions are no longer limited to financial aspects; they now encompass the protection of digital systems and sensitive organizational data.

In Algeria, recent years have witnessed the establishment of cybersecurity monitoring units within several ministries and major economic organizations. These units are responsible for overseeing information flows and preventing cyberattacks.

In 2021, the Algerian Cybersecurity Center was established to monitor cyber threats and simulate digital risk scenarios. Today, some organizations employ intelligent protection systems such as **Security Information and Event Management (SIEM)** solutions, which collect and analyze digital logs to identify threats in real time. This approach strengthens preventive control mechanisms rather than relying solely on corrective actions (Ministry of Digitalization and Statistics, 2023, p. 14).

3.5. Indicators for Measuring the Effectiveness of Digital Control in Algerian Organizations

To evaluate the success of digital transformation in enhancing control systems, a set of quantitative and qualitative indicators may be employed.

The following table presents selected indicators derived from field studies conducted on Algerian organizations in 2023.

Table 3. Indicators Derived from Field Studies Conducted on Algerian Organizations in 2023

Indicator	Before Digital Transformation	After Digital Transformation	Improvement Rate
Accounting Error Rate	7.5%	2.9%	-61%
Report Preparation Time	12 days	3 days	-75%
Number of Annual Audits	2	5	+150%
Financial Irregularities Detected	38 cases	14 cases	-63%

Indicator	Before Digital Transformation	After Digital Transformation	Improvement Rate
Shareholder Satisfaction Level	68%	89%	+21%

Source: National Office of Statistics (2024, p. 35).

The table demonstrates a substantial improvement in organizational performance and control indicators following the implementation of digital transformation initiatives, reflecting a direct positive impact on governance efficiency and smart control systems.

The accounting error rate decreased by 61%, indicating that the adoption of digital accounting and auditing systems significantly reduced human errors and enhanced the accuracy of financial operations.

Similarly, report preparation time decreased from 12 days to 3 days, representing a 75% improvement. This reflects the benefits of digital automation in accelerating access to information and facilitating data analysis.

The number of annual audit activities increased from two to five, corresponding to a 150% increase. This demonstrates enhanced continuous monitoring capabilities and highlights the ability of digital systems to support frequent auditing without requiring substantial additional effort.

At the same time, the number of financial irregularities declined by 63%, providing evidence of the effectiveness of early detection mechanisms and automated risk-analysis tools.

Finally, shareholder satisfaction increased from 68% to 89%, reflecting improved transparency and greater confidence in organizational management following digital transformation.

Overall, the table confirms that digital transformation extends beyond merely accelerating processes; it also contributes significantly to improving governance quality and strengthening internal control systems by reducing errors, enhancing transparency, and increasing stakeholder satisfaction.

3.6. Toward Building an Integrated Smart Control System

Based on the foregoing analysis, it is evident that digital transformation in Algeria is still evolving. Nevertheless, its initial outcomes indicate a gradual transition toward an integrated smart control system founded on:

- Full automation of accounting and administrative processes.
- The use of artificial intelligence for risk analysis and prediction.
- Integration between internal auditing systems and financial control mechanisms.
- Expansion of open-data initiatives to enhance transparency.

However, achieving this objective requires strengthening technological infrastructure, developing specialized competencies in digital analytics and cybersecurity, and establishing a clear legal framework to ensure data protection and effective digital governance (Abdel Raouf, 2023, p. 125).

4. Comparative Study: Algeria versus France, the United Arab Emirates, and South Korea

This comparative analysis aims to identify successful national and organizational practices and policies in the fields of digital transformation, governance, and smart control that can be adopted or adapted within the Algerian context. The comparison focuses on three main dimensions: the strategic

framework and national policies, digital infrastructure and cybersecurity, and governance and smart control mechanisms in key sectors (energy/oil, banking, and public administration).

4.1. France: A Strong Institutional and Legislative Framework with Emphasis on Security and Governance

France has adopted a well-defined institutional and legal approach based on the establishment of specialized bodies, such as the **French National Cybersecurity Agency (ANSSI)**, to ensure cybersecurity and digital resilience. In addition, France has implemented national digitalization programs targeting small and medium-sized enterprises (SMEs), notably the **France Num** initiative, alongside comprehensive policies aimed at enhancing digital transparency within the public sector. This combination of institutional support and regulatory oversight has facilitated the adoption of smart control systems, particularly in the financial and energy sectors. Furthermore, compliance with European data protection regulations, especially the **General Data Protection Regulation (GDPR)**, has significantly influenced disclosure standards and governance practices, reinforcing transparency and accountability within organizations (ANSSI, 2019, p. 15).

4.2. United Arab Emirates: An Ambitious National Strategy for Smart Cities and Digital Governance

The United Arab Emirates has implemented a comprehensive national digitalization strategy centered on large-scale initiatives such as **Smart Dubai** and the **Dubai Blockchain Strategy**. The country has explicitly linked digital governance with economic development and public-sector modernization. The UAE adopted a pragmatic approach based on pilot projects and flagship initiatives, including the **paperless government program** and the development of trusted digital records. These initiatives have facilitated the deployment of real-time control solutions across sectors such as energy and public services.

Moreover, the UAE has invested substantially in cybersecurity centers and domestic cloud infrastructure to support digital governance frameworks, thereby strengthening the security, efficiency, and transparency of digital operations (Smart Dubai Office, 2020, p. 10).

4.3. South Korea: A Model of National Technological Leadership Through the “Digital New Deal”

South Korea has distinguished itself through ambitious national policies, particularly the **Digital New Deal**, which promotes large-scale investment in telecommunications infrastructure, cloud computing, and artificial intelligence.

The Korean government has also established financing mechanisms to support small and medium-sized enterprises in adopting digital solutions. In addition, South Korea benefits from advanced cybersecurity policies led by organizations such as the **Korea Internet & Security Agency (KISA)**. A key characteristic of the Korean model is the strong integration between academic research institutions and the private sector, which facilitates the development of practical smart-control solutions applied within banks and industrial enterprises. This collaboration has enabled South Korea to maintain a leading position in digital innovation and governance (ICT, 2020, p. 20).

4.4. Algeria: Current Situation and Characteristics of the National Experience

Algeria's experience in digital transformation and the transition toward smart government and smart organizations remains at a developmental stage. It is characterized by increasing efforts and initiatives on the one hand, and by structural and organizational challenges on the other.

In recent years, Algeria has launched several national initiatives aimed at digitalizing public services and improving administrative and economic performance. These include the **National Digitalization Strategy** supervised by the Ministry of Digitalization and Statistics, e-government development programs, and the establishment of digital portals providing services to citizens and public administrations, such as those operated by the Ministry of Interior and the Ministry of Finance.

These initiatives reflect a clear political commitment to positioning digitalization as a driver of administrative modernization and economic development.

However, practical implementation remains partial and uneven. A significant digital divide persists between sectors, institutions, and geographical regions. For example, sectors such as energy—particularly organizations such as Sonatrach and Sonelgaz—as well as the banking sector, have achieved notable progress in adopting digital systems. These organizations have implemented **Enterprise Resource Planning (ERP)** systems and digital services such as online payment platforms and smart transaction systems, contributing to improved operational efficiency and transparency.

In contrast, other sectors, particularly local administrations and certain public institutions, continue to rely heavily on paper-based procedures, limiting the pace of comprehensive digital transformation. Furthermore, Algeria faces disparities in digital infrastructure readiness between major urban centers and rural or remote regions. While the capital and coastal cities benefit from relatively high levels of broadband connectivity, several inland and southern regions continue to experience inadequate network coverage and frequent service interruptions, restricting access to digital services for organizations and citizens alike.

Another major challenge concerns the shortage of qualified human resources. Effective digital transformation requires specialists in cybersecurity, data analytics, artificial intelligence, and information systems engineering. Despite recent efforts by Algerian universities to expand educational programs in these fields, the availability and geographical distribution of such expertise remain limited.

In addition, weaknesses in the legal and regulatory framework continue to constrain digital transformation efforts. Legislation concerning personal data protection, electronic signatures, digital transactions, and digital governance requires further modernization and alignment with international standards. Although certain legal provisions have been introduced, such as Law No. 18-07 on the protection of personal data, their practical implementation remains relatively limited.

A further challenge is the slow pace of comprehensive institutional adoption. Many public organizations lack unified digital visions and integrated transformation strategies, resulting in fragmented and poorly coordinated initiatives that reduce the overall impact of digitalization on organizational performance.

Nevertheless, the prospects for digital transformation in Algeria remain promising. Growing governmental commitment and the expansion of digital initiatives in areas such as electronic payments, digital invoicing, distance learning, and electronic administrative services indicate a

gradual movement toward the establishment of an integrated national digital ecosystem. Achieving this objective, however, requires sound governance, smart control systems, and sustained investment in human capital to ensure transparency, efficiency, and long-term sustainability in organizational performance (Ministry of Digitalization and Statistics of Algeria, 2023, p. 31).

4.5. Comparative Analytical Table of the Four Countries (Strengths, Weaknesses, and Transferable Practices)

Table 4. Comparative Analysis of Digital Transformation, Governance, and Smart Control

Dimension / Country	Algeria	France	United Arab Emirates	South Korea
National Strategic Framework	Exists but remains relatively new and unevenly implemented	Strong legal and institutional framework (ANSSI, European policies)	Clear national vision supported by implementation projects (Smart Dubai)	Ambitious national digital strategy (Digital New Deal)
Telecommunications and Internet Infrastructure	Improving but geographically uneven	Strong infrastructure and high-quality networks	Advanced infrastructure and regional data centers	Highly advanced infrastructure with extensive fiber-optic coverage
Cybersecurity	Emerging cybersecurity units requiring further development	Specialized institutions (ANSSI) and European regulatory compliance	Significant investment in cybersecurity and local security centers	KISA-led initiatives and advanced research programs
Digital Governance	Initial progress through electronic portals; moderate effectiveness	Strong emphasis on transparency and regulatory compliance	Practical digital governance with rapid implementation projects	Strong public-private integration and smart oversight mechanisms
Capacity to Adopt Smart Control	Limited due to infrastructure, skills, and regulatory constraints	Advanced in selected sectors	Rapid and widespread implementation	Highly advanced applications in both financial and industrial sectors

The comparative analysis demonstrates that the four countries are at different stages of maturity regarding digital transformation and smart control systems.

In Algeria, substantial efforts have been undertaken through a recently established national digital strategy. However, implementation remains constrained by limited institutional coordination and uneven digital infrastructure development.

France benefits from a comprehensive legal and institutional framework that ensures the effective implementation of digital governance standards, supported by specialized agencies such as ANSSI.

The United Arab Emirates presents a leading model in terms of implementation speed and strategic clarity. Initiatives such as Smart Dubai have significantly accelerated digital transformation in government services and smart control mechanisms.

South Korea stands out as one of the most advanced nations due to its ambitious Digital New Deal strategy and the high degree of collaboration between public and private sectors in digital innovation and governance.

Overall, the comparison highlights that successful digital transformation depends on the clarity of strategic frameworks, the quality of digital infrastructure, the effectiveness of cybersecurity systems, and the level of institutional integration. Algeria can benefit from these international experiences by adopting a unified digital vision and strengthening both technological and human-resource capacities to achieve effective and comprehensive governance and control transformation.

4.6. Practical Lessons Applicable to the Algerian Context

Several practical lessons can be derived from the experiences of France, the United Arab Emirates, and South Korea:

- Establishing an independent and effective national cybersecurity authority, similar to the French ANSSI model, to unify protection policies and provide mandatory guidelines for both public and private sectors.
- Launching smart-city initiatives and pilot projects focused on strategic sectors such as energy, oil and gas, banking, and healthcare, following the example of Dubai's blockchain-based government projects and digital public services.
- Providing financial and technical incentives to encourage small and medium-sized enterprises to adopt smart technologies, including subsidized loans, grants, and training programs, similar to South Korea's digital transformation support schemes.
- Developing a comprehensive legislative framework for data protection and digital governance aligned with international standards, particularly regarding disclosure requirements, privacy protection, and institutional enforcement mechanisms.

These measures would contribute significantly to accelerating Algeria's digital transformation journey and strengthening governance and smart control systems across both public and private organizations.

Conclusion :

This research examined and analyzed the topic of **“Digital Transformation as an Approach to Enhancing Governance and Smart Control in Economic Organizations: A Comparative Study of the Algerian Experience and Selected International Models.”** This subject represents one of the most significant contemporary issues, having become a strategic priority in the economic and administrative reform agendas of both governments and organizations.

At the outset of the study, the primary research problem was formulated around the following question:

To what extent does digital transformation contribute to the development of governance and smart control systems within economic organizations in the context of the transition toward the Fourth Industrial Revolution?

To address this research problem, an analytical-comparative approach was adopted. The study analyzed the theoretical foundations of digital transformation and governance, examined their implementation within the Algerian context, and compared Algeria's experience with those of leading countries in this field. Particular attention was given to the technological tools that have fundamentally transformed organizational governance and control systems.

The study was structured into six main sections. The first section explored the conceptual framework of digital transformation, governance, and smart control, highlighting the impact of technological developments on modern management and control practices. The second section examined digital transformation as a mechanism for enhancing corporate governance, demonstrating how digital technologies—such as artificial intelligence, big data, and cloud computing—have become essential drivers of transparency and accountability.

The third section focused on digital transformation as a tool for modernizing internal and smart control systems, illustrating how digitalization has transformed traditional auditing practices into proactive systems capable of predicting risks and supporting preventive decision-making.

The fourth section analyzed the Algerian experience, emphasizing governmental efforts to strengthen digital infrastructure and launch digital platforms aimed at improving administrative and economic performance. It also highlighted the challenges that continue to hinder implementation, particularly in the areas of human resource development and data protection.

The fifth section presented a comparative analysis between Algeria and selected international models, namely France, the United Arab Emirates, and South Korea. The comparison revealed that Algeria remains in a transitional stage, whereas these countries have achieved higher levels of institutional digital maturity through the integration of technology into governance and control structures.

Based on the findings of this analysis, it can be concluded that digital transformation is indeed a decisive factor in the development of governance and smart control systems within economic organizations. However, its success depends on the availability of several fundamental conditions, including investment in digital infrastructure, the development of human capital, and the modernization of legislative and regulatory frameworks to address the challenges associated with digitalization.

Regarding the hypotheses formulated at the beginning of the study, the results can be summarized as follows:

Hypothesis 1:

Digital transformation contributes to strengthening the principles of corporate governance, particularly transparency and accountability.

This hypothesis was **partially confirmed**, as comparative evidence demonstrated that digital systems effectively enhance transparency. Nevertheless, their effectiveness largely depends on organizational culture and the degree of commitment to governance principles and practices.

Hypothesis 2:

Digital transformation enhances internal and smart control systems within economic organizations.

This hypothesis was **largely confirmed**, as the findings showed that digitalization enables organizations to monitor performance in real time, anticipate risks, and improve the quality and effectiveness of control-related decisions.

Hypothesis 3:

Algeria is progressing toward the establishment of an effective digital governance and control system but continues to face institutional and human-resource challenges.

This hypothesis was **confirmed**, as official data indicate notable progress in several sectors. However, digital transformation remains partial and has yet to achieve full integration across institutions and industries.

In light of these findings, it can be argued that digital transformation is not merely a technological option but rather a strategic pathway for rebuilding governance and organizational control systems on the foundations of efficiency, transparency, and accountability. Consequently, Algeria is called upon to accelerate its digital transformation efforts by adopting a comprehensive vision that effectively integrates technological innovation with administrative reform.

Recommendations and Practical Proposals

Based on the findings regarding the impact of digital transformation on governance and smart control systems within economic organizations, a number of practical recommendations can be proposed for policymakers, organizational leaders, and researchers with the aim of fostering a digital transformation culture and improving institutional performance.

At the Level of Government and Policymakers

- Establish a comprehensive national strategy for digital transformation and e-governance based on effective coordination among economic and administrative sectors, supported by measurable performance indicators to assess digitalization progress.
- Strengthen the legislative and regulatory framework governing digital governance by updating laws related to personal data protection, electronic signatures, and information security to enhance trust in digital transactions.
- Create an independent national authority for digital oversight responsible for monitoring the implementation of smart control systems in both public and private organizations and conducting regular performance evaluations.
- Encourage investment in technological infrastructure by supporting startups operating in artificial intelligence and big data fields and promoting public-private partnerships in digital transformation projects.

At the Level of Economic Organizations

- Integrate artificial intelligence technologies into internal control and auditing processes to facilitate real-time monitoring of operational activities, risk analysis, and the development of early warning systems for irregularities and violations.
- Adopt integrated **Enterprise Resource Planning (ERP)** systems that connect administrative and financial departments to ensure seamless information flow and greater transparency.

- Invest in human capital by implementing continuous training programs aimed at developing digital competencies and enabling employees and managers to effectively utilize smart control tools and data analytics techniques.
- Foster a digital organizational culture by encouraging innovation, supporting the transition toward electronic management, and strengthening trust among stakeholders.

At the Level of Scientific Research and Universities

- Promote academic research in digital control and smart governance through the establishment of specialized research laboratories and by encouraging graduate theses and dissertations that examine digital applications within Algerian organizations.
- Develop international academic partnerships with leading universities and research centers specializing in digital governance and digital transformation to facilitate knowledge exchange and technology transfer to the Algerian context.

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