

Responsible Innovation: Ethics and Sustainability in the Use of Institutional Technologies

Innovation responsable : éthique et durabilité dans l'usage des technologies institutionnelles

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Date submitted : 15/08/2025

Date of acceptance : 24/10/2025

To cite this article :

HATHOUT S. (2025) «Responsible Innovation: Ethics and Sustainability in the Use of Institutional Technologies», Revue Internationale des Sciences de Gestion « Volume 8 : Numéro 4 » pp : 901 - 932

Abstract

Objective: This study explores the impact of responsible innovation on Moroccan institutions, particularly regarding ethical governance and sustainability. It aims to understand how the integration of sustainable technologies and the establishment of ethical frameworks influence institutional performance, competitiveness, as well as stakeholder trust and loyalty.

Methodology: A mixed-methods approach was adopted, combining quantitative and qualitative methods. A quantitative survey was conducted with 300 respondents from 50 Moroccan institutions across four sectors: energy, ICT, water management, and public services. Statistical analyses, including Structural Equation Modeling (SEM) and multiple regression techniques, are utilized to validate the conceptual framework and hypotheses related to the benefits of sustainable technologies. Semi-structured interviews and a netnographic analysis of online discussions are conducted to capture the perceptions of institutional actors regarding sustainable technology adoption and ethical governance. The qualitative data are analyzed thematically using NVivo software, providing insights into the challenges and opportunities associated with responsible innovation.

Results: The findings confirm that the adoption of sustainable technologies improves institutional performance, enhances competitiveness, and builds stakeholder trust. Ethical governance is identified as a crucial lever for gaining trust and retaining stakeholders. The study also reveals that stakeholder satisfaction acts as a mediating role between ethical governance and institutional performance.

Implications: Moroccan institutions should prioritize the adoption of sustainable technologies and strengthen ethical governance to enhance their performance and competitiveness. Public policymakers are encouraged to implement incentive policies, such as grants and training, to facilitate this transition towards responsible innovation.

Value: This research contributes to the literature by adapting global concepts of responsible innovation to the Moroccan context, highlighting the unique challenges of the country in terms of technological sustainability and ethical governance. It also introduces stakeholder satisfaction as a key mediator in the relationship between ethical governance and performance.

Keywords: Responsible innovation, Technological sustainability, Ethical governance, Sustainable technologies, Institutional performance, Ecological transition, social responsibility

Résumé

Objectif : Cette étude explore l'impact de l'innovation responsable au sein des institutions marocaines, en particulier sous l'angle de la gouvernance éthique et de la durabilité. Elle vise à comprendre comment l'intégration de technologies durables et la mise en place de cadres éthiques influencent la performance institutionnelle, la compétitivité ainsi que la confiance et la fidélité des parties prenantes.

Méthodologie : Une approche mixte a été adoptée, combinant méthodes quantitatives et qualitatives. Une enquête quantitative a été menée auprès de 300 répondants issus de 50 institutions marocaines réparties sur quatre secteurs : l'énergie, les technologies de l'information et de la communication (TIC), la gestion de l'eau et les services publics. Des analyses statistiques, incluant la modélisation par équations structurelles (SEM) et des techniques de régression multiple, ont été utilisées pour valider le cadre conceptuel et les hypothèses relatives aux bénéfices des technologies durables. Des entretiens semi-directifs ainsi qu'une analyse netnographique des discussions en ligne ont été réalisés afin de saisir les perceptions des acteurs institutionnels concernant l'adoption de technologies durables et la gouvernance éthique. Les données qualitatives ont été analysées de manière thématique à l'aide du logiciel NVivo, fournissant des éclairages sur les défis et opportunités associés à l'innovation responsable.

Résultats : Les résultats confirment que l'adoption de technologies durables améliore la performance institutionnelle, renforce la compétitivité et consolide la confiance des parties prenantes. La gouvernance éthique est identifiée comme un levier essentiel pour instaurer la confiance et fidéliser les parties prenantes. L'étude révèle également que la satisfaction des parties prenantes joue un rôle médiateur entre la gouvernance éthique et la performance institutionnelle.

Implications : Les institutions marocaines devraient prioriser l'adoption de technologies durables et renforcer la gouvernance éthique afin d'améliorer leur performance et leur compétitivité. Les décideurs publics sont encouragés à mettre en œuvre des politiques incitatives, telles que des subventions et des programmes de formation, pour faciliter cette transition vers l'innovation responsable.

Valeur ajoutée : Cette recherche contribue à la littérature en adaptant les concepts globaux de l'innovation responsable au contexte marocain, tout en mettant en lumière les défis spécifiques du pays en matière de durabilité technologique et de gouvernance éthique. Elle introduit également la satisfaction des parties prenantes comme médiateur clé dans la relation entre gouvernance éthique et performance institutionnelle.

Mots-clés : Innovation responsable, durabilité technologique, gouvernance éthique, technologies durables, performance institutionnelle, transition écologique, responsabilité sociale.

Introduction

Technological innovation has become a strategic lever for institutions, especially in a global context marked by increasing concerns about ethics and sustainability. For years, technological advancements within organizations were often driven by efficiency and competitiveness imperatives, sometimes overlooking their social and environmental implications. However, as issues related to data protection, carbon footprint, and the social impact of technologies gain prominence, a new approach to innovation is emerging: responsible innovation. This approach emphasizes the development and use of technologies that, while meeting institutional needs, adhere to ethical principles and support the transition to a sustainable future (Brammer, Hojmosse & Marchant, 2012).

In addition to enhancing institutional performance, responsible innovation in institutional technologies plays a crucial role in the global landscape of international marketing and supply chain management (SCM). With the rapid growth of globalization, technologies such as blockchain, artificial intelligence, and platform ecosystems are transforming how institutions interact with international partners and optimize supply chains. This transformation not only ensures transparency and efficiency but also enables firms to target and penetrate international markets more effectively, creating a seamless integration between sustainable practices and global competitiveness.

In this context, ethics and sustainability are central to the design of institutional technologies. Businesses and administrations are increasingly required to adopt technologies that not only optimize their operations but also reduce their negative environmental impact and protect individual rights. For instance, the growing adoption of green technologies and eco-friendly digital solutions reflects this trend, as does the integration of ethical principles into data governance, artificial intelligence, and automated systems (Floridi et al., 2018).

In Morocco, this dynamic is also gaining momentum. The country, engaged in a digital transformation process, is witnessing the emergence of initiatives aimed at reconciling technological progress with sustainability. In 2023, the penetration rate of information and communication technologies (ICT) reached 93%, reflecting the growing importance of digital solutions in both public and private sectors (ANRT, 2023). However, this rapid digitization raises questions about the ethics of data management and minimizing the environmental impacts of technologies used by institutions. Indeed, as highlighted by the OCP Policy Center (2022), although Morocco is advancing in its sustainable innovation initiatives, many challenges remain, particularly regarding the financing of green technologies and integrating these innovations into public policies. These challenges are counterbalanced by significant opportunities, such as the potential for green growth and the mobilization of international partnerships to strengthen local capacities in sustainable technologies.

In summary, responsible innovation, focused on ethics and sustainability, is becoming a major issue for Moroccan institutions. They are called upon to play a key role in the transition to a more inclusive and sustainable development model, where technology serves collective well-being while respecting ecological limits. This study explores how these institutions can integrate these principles into the use of technologies, considering the specific challenges and opportunities of the Moroccan context. Recent Moroccan research confirms that institutions

integrating sustainability and ethical responsibility into their innovation processes achieve higher stakeholder trust and long-term competitiveness (Benkirane, 2022).

Research Problem:

How can the principles of responsible innovation be operationalized within Moroccan institutions to ensure ethical and sustainable technology governance while enhancing performance and stakeholder trust?

To address this research question, a mixed-methods approach was adopted, combining both quantitative and qualitative analyses. The quantitative phase involved a survey of 300 respondents across 50 Moroccan institutions from key sectors such as energy, ICT, water management, and public services, analyzed using Structural Equation Modeling (SEM) and multiple regression techniques. Complementarily, semi-structured interviews and a netnographic analysis were conducted to capture institutional perceptions of ethical governance and sustainable technology adoption.

Through an analysis of emerging practices and concrete results achieved by local actors, this paper aims to shed light on responsible technological innovation and its transformative potential for organizations in Morocco.

The remainder of this paper is structured as follows. The first section reviews the main theoretical foundations of responsible innovation, technological sustainability, and ethical governance. The second section presents the conceptual framework and the research hypotheses. The third section details the mixed-methods methodology used to collect and analyze data. The fourth section discusses the main quantitative and qualitative findings. Finally, the paper concludes with a discussion of the theoretical and practical implications, limitations, and avenues for future research.

1. Literature Review

Responsible innovation is a concept that has gained importance in recent years due to the growing challenges related to technological ethics, institutional sustainability, and governance. With the rise of digital technologies and disruptive innovations, both public and private institutions face the necessity to adopt more sustainable and ethical technological practices (Von Schomberg, 2013). In this context, this literature review aims to explore key concepts related to responsible innovation and examine how institutional technologies can be used in a manner that respects ethical principles while meeting sustainability requirements.

Responsible Innovation: Key Concepts: Responsible innovation is defined as the development of new technologies and practices that not only enhance institutional efficiency but also consider their social, ethical, and environmental impacts (Von Schomberg, 2013). Unlike traditional innovation, which primarily targets economic growth and competitiveness, responsible innovation incorporates dimensions such as social justice, equity, privacy protection, and transparency. In this study, responsible innovation is analyzed primarily through its institutional mechanisms — namely ethical governance, stakeholder trust and satisfaction, and their combined effect on institutional performance — which together form the core framework of the research. In the institutional framework, responsible innovation

involves conscious decisions regarding the use of technologies, whether it be artificial intelligence, blockchain, or big data, while adhering to sustainability criteria (Grunwald, 2011). The concept of sustainability, derived from the Brundtland Report (1987), plays a key role in this approach, focusing on reducing institutions' ecological footprint, managing data ethically, and holding stakeholders accountable.

Technological advancements such as blockchain, smart contracts, and digital platforms have revolutionized both international marketing and global supply chain management (SCM). These institutional technologies enhance supply chain visibility, ensuring real-time tracking of goods and transactions, which strengthens transparency and trust between global partners (Gligor et al., 2022). Moreover, blockchain and smart contracts allow firms to automate key processes, reducing transaction costs and minimizing delays in cross-border trade (Chen et al., 2021). By integrating these innovations, businesses can coordinate activities across borders more efficiently, ensuring that supply chains are agile and responsive to dynamic global markets (Min et al., 2019). In the realm of international marketing, these technologies enable more personalized, data-driven marketing campaigns, enhancing customer engagement and allowing firms to tailor their offerings to diverse global audiences (Davenport et al., 2020). This interplay between marketing and SCM provides a competitive edge in global commerce, fostering both ethical governance and operational sustainability, as companies are able to demonstrate compliance with environmental and ethical standards more transparently (Vergne, 2020; Gölgeci & Kuivalainen, 2020).

Technological Ethics in Institutions: Technological ethics is a crucial area in responsible innovation. It primarily concerns issues of data protection, privacy, transparency in algorithms, and fairness in access to digital services (Floridi et al., 2018). As institutional technologies expand, ethical concerns increase, particularly with the adoption of artificial intelligence and big data, which can pose risks to privacy and data security. Institutions need to establish robust technological governance frameworks to ensure that technologies are used ethically. This includes adopting data protection policies, managing information technologies responsibly, and ensuring transparency in decision-making processes. Globally, organizations such as the World Economic Forum and the OECD have advocated for stricter regulation of technology use, especially in public institutions, to prevent potential abuses.

Institutional Sustainability and Ecological Transition: The ecological transition is at the heart of concerns related to responsible innovation. For institutions, sustainability goes beyond reducing carbon emissions and involves adopting ecological practices in the daily management of technologies. Green technologies and eco-friendly digital solutions have become essential tools for reducing institutions' environmental impact. Case studies from emerging countries with socio-economic contexts similar to Morocco, such as South Africa or India, show that adopting sustainable technologies in public and private institutions can significantly improve resource management and energy efficiency (Geels, 2002). In Morocco, initiatives such as smart cities and the digitization of administrative services aim to promote sustainability. However, these efforts need to be strengthened to meet national environmental goals, as outlined in the Green Morocco Plan and the commitments of the Ministry of Environment.

Social Responsibility of Institutions: Responsible innovation cannot be separated from the social responsibility of institutions. This responsibility entails that institutions must not only comply with laws and regulations but also adopt proactive practices that enhance social and

economic well-being. Institutional technologies can play a decisive role by enabling greater transparency, increased citizen participation, and ethical process management (Porter & Kramer, 2006). In the Moroccan context, the social responsibility of institutions takes on a special dimension, as the country faces significant socio-economic challenges, such as unequal access to digital services in rural areas and the management of electronic waste (OCP Policy Center, 2022). Moroccan institutions, both public and private, must therefore integrate sustainability and ethics principles into their strategies to better address the population's needs while minimizing their environmental impact.

The Moroccan Context and Regional Specificities: In Morocco, the adoption of institutional technologies is part of a rapid digitization and modernization of infrastructure. However, these transformations come with unique challenges related to governance and sustainability. The internet penetration rate, which reached 93% in 2023 (ANRT, 2023), illustrates the country's potential to leverage institutional technologies but also raises questions about ethical data management and digital inclusion. Reports such as those from the OCP Policy Center (2022) highlight Morocco's efforts to integrate sustainable technologies into strategic sectors such as energy and agriculture. According to the latest national reports, Morocco's ICT penetration reached 96.5% in 2024, while mobile Internet usage exceeded 47 million subscriptions, reflecting a rapid digitalization of both public and private institutions (ANRT, 2024). However, the same report highlights persistent challenges in cybersecurity and data protection, reinforcing the urgency of effective ethical governance mechanisms.

These findings align with empirical studies demonstrating that ethical governance and digital trust are positively correlated with institutional performance and user engagement (Culnan & Williams, 2009; Lins, Servaes & Tamayo, 2017). Such evidence strengthens the causal logic underlying this research, positioning ethical governance as a key determinant of stakeholder trust and institutional success within Morocco's ongoing digital transition.

However, one of the main challenges remains the gap between urban and rural areas in terms of technology access and digital infrastructure. Education and awareness on technological ethics must therefore be central to Moroccan public policies to ensure that technological innovations benefit all segments of the population.

2. Conceptual Framework and Hypotheses

Responsible Innovation and Sustainability Principles

This research is based on two major theoretical frameworks to explore the integration of ethics and sustainability in the use of institutional technologies: the theory of responsible innovation (Von Schomberg, 2013) and the concept of sustainable development proposed by the Brundtland Report (1987). The theory of responsible innovation emphasizes that innovation should not be limited to technological advancements but should also consider social, ethical, and environmental implications. In other words, it ensures that innovation benefits society as a whole while minimizing potential risks. The concept of sustainable development, on the other hand, highlights the need to meet present needs without compromising the ability of future generations to meet their own. These two frameworks provide a basis for analyzing how institutions, particularly in Morocco, can use technologies in an ethical and sustainable manner in a context where environmental and social challenges are increasingly pressing (OCP Policy Center, 2022).

This research also draws on Stakeholder Theory (Freeman, 1984), which posits that organizational performance depends on the institution's ability to manage relationships with its diverse stakeholders. Within this framework, ethical governance acts as a catalyst that fosters stakeholder trust and satisfaction, which in turn enhances institutional legitimacy and long-term performance. Integrating this mediating logic clarifies how responsible innovation mechanisms translate ethical principles into measurable outcomes such as loyalty and competitiveness.

Technological Sustainability in Institutions

The introduction of new technologies within institutions can have a significant impact on their efficiency as well as on the environment and society. Institutions adopting a responsible approach to technology use aim to minimize these negative impacts while maximizing social benefits. Literature shows that adopting sustainable technologies, such as renewable energy sources or low-energy computing systems, has a positive effect not only on the institution's image but also on long-term operational cost reduction (Geels, 2002). In the Moroccan context, efforts to adopt sustainable practices have increased, particularly in agriculture, energy, and water sectors (OCP Policy Center, 2022). However, rapid digitization and heavy reliance on imported technologies pose challenges in waste management and energy consumption.

Hypothesis 1 (H1): The integration of sustainable technologies in institutions positively affects their operational performance and public image.

Ethics and Technology Governance

Another fundamental aspect of responsible innovation is ethics in technology governance. With the rise of artificial intelligence (AI), big data, and automated systems, institutions must adopt governance frameworks that ensure ethical use of these technologies. Literature highlights that transparency, data protection, and accountability are essential pillars to ensure that AI and other digital technologies are used responsibly (Floridi et al., 2018). In Morocco, digital governance reforms are progressing, with particular attention to personal data protection and cybersecurity, notably through Law 09-08 on personal data protection.

Hypothesis 2 (H2): The implementation of ethical and governance frameworks in the use of institutional technologies enhances stakeholder trust and reduces risks associated with technological innovation.

Institutional Technologies and Ecological Transition

The ecological transition largely depends on adopting technologies that contribute to reducing carbon emissions and using natural resources efficiently. Both public and private institutions play a key role in this transition by integrating green technologies into their processes. In Morocco, initiatives such as the National Strategy for Sustainable Development (SNDD) aim to promote a green economy and encourage environmentally friendly practices across all sectors (Ministry of Environment, 2021). Technologies such as renewable energy, smart irrigation systems, and high-energy-efficiency buildings are concrete examples of how Moroccan institutions can contribute to this effort.

Hypothesis 3 (H3): The adoption of ecological technologies by Moroccan institutions accelerates the transition to a sustainable economy while enhancing their market competitiveness.

Social Responsibility and Stakeholder Loyalty

One of the benefits of responsible innovation is its positive impact on stakeholder loyalty, including employees and service users. Institutions that adopt ethical and sustainable practices are perceived as more credible and trustworthy, which strengthens stakeholder engagement. Studies show that socially responsible companies benefit not only from a better reputation but also from greater loyalty from their clients and partners (Porter & Kramer, 2006). In Morocco, where rapid digitization offers new opportunities to engage stakeholders, institutions can leverage digital platforms to transparently communicate their social responsibility initiatives.

Hypothesis 4 (H4): The adoption of responsible practices by Moroccan institutions enhances stakeholder loyalty by strengthening trust and engagement.

Drawing on these theoretical frameworks, this research aims to analyze the impacts of ethics and sustainability in the use of institutional technologies in Morocco. The analysis will focus on key variables: institutional performance, ethical governance, ecological transition, and stakeholder loyalty. This conceptual framework will assess how responsible innovation can contribute to more sustainable and ethical practices in Moroccan institutions, while identifying specific challenges in this emerging context.

The conceptual model therefore focuses on the causal chain linking ethical governance to stakeholder trust and satisfaction, which in turn enhances institutional performance. The broader discussions on marketing and SCM are treated as sectoral implications rather than central components of the theoretical framework.

3. Methodology

3.1 Mixed-Methods Approach: Quantitative and Qualitative Methods

This study adopts a mixed-methods approach to analyze the adoption of sustainable institutional technologies in Morocco, combining quantitative methods to measure the impact of these technologies and qualitative methods to explore institutional actors' perceptions regarding ethics and sustainability issues.

3.2 Quantitative Method

Objective: The main goal of the quantitative method is to analyze the impact of adopting sustainable institutional technologies on the performance of Moroccan institutions, while considering ethical governance and ecological transition. The method aims to empirically test the hypotheses formulated within the conceptual framework using robust statistical techniques.

Sampling The quantitative sample consists of 300 respondents from 50 Moroccan institutions across four sectors: energy, information and communication technologies (ICT), water

management, and public services. These institutions were selected based on their involvement in sustainability initiatives, such as adopting green or eco-friendly technologies. Respondents include technology directors, environmental project managers, and public decision-makers.

Although the initial data collection yielded 350 completed responses, 50 of them were excluded due to missing or inconsistent information across key demographic variables. The final dataset therefore comprises 300 valid and complete responses from 50 Moroccan institutions, ensuring adequate representativeness across the four targeted sectors (energy, ICT, water management, and public services). This adjustment guarantees the internal consistency and statistical validity of the quantitative analyses, particularly for Structural Equation Modeling (SEM) and regression testing.

Selection criteria for institutions are based on their documented commitment to sustainable technological projects and their contribution to local and international sustainability initiatives (e.g., the Green Morocco Plan). The sample size (300 respondents) ensures statistical representativeness of the results.

Sample Size Justification:

To ensure the statistical validity of the results, a power analysis was conducted using a medium effect size (Cohen's $d = 0.3$), a significance level (alpha) of 0.05, and a statistical power of 0.80. The results indicate that a minimum sample of 175 respondents is required to detect a real effect with an 80% probability.

With a sample of 300 respondents, our study exceeds this requirement, ensuring greater statistical precision and reliability. Additionally, for Structural Equation Modeling (SEM), a sample size between 200 and 400 is generally recommended depending on the complexity of the model, particularly the number of latent and observed variables. Therefore, the size of our sample is fully justified, ensuring the robustness of the analyses and the validity of the hypotheses tested.

Data Collection Data were collected using an online structured questionnaire measuring the following variables:

- Institutional energy consumption
- Reduction of CO₂ emissions
- Efficiency of natural resource management (water, waste)
- Institutional performance (cost reduction, stakeholder satisfaction)

A 5-point Likert scale was used to measure respondents' perceptions of the adoption of sustainable technologies and their impact on institutional performance, ethical governance, and ecological transition.

Measurement and Validation Each construct was measured using multi-item scales adapted from validated sources in prior literature. Items were translated into French using the back-translation method (Brislin, 1986) and pre-tested with 15 respondents to ensure clarity and contextual accuracy. All items were rated on a five-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree).

- ❖ Sustainable Technologies (4 items): adapted from Geels (2002) and OCP Policy Center (2022) — e.g., “Our institution uses energy-efficient and eco-friendly technologies.”
- ❖ Ethical Governance (4 items): adapted from Floridi et al. (2018) and OECD (2020) — e.g., “Our institution promotes transparency and accountability in digital decision-making.”
- ❖ Stakeholder Trust and Satisfaction (5 items): adapted from Freeman (1984) and Porter & Kramer (2006) — e.g., “We trust our institution to act ethically in the use of technologies.”
- ❖ Institutional Performance (4 items): adapted from Min et al. (2019) — e.g., “The use of sustainable technologies improves our institution’s operational performance.”

A confirmatory factor analysis (CFA) was conducted using AMOS 26 to assess the measurement model. All standardized loadings (λ) exceeded 0.70 ($p < 0.001$). Reliability and validity indices for each construct are summarized below.

The measurement items were adapted from validated scales in previous studies, including Hair et al. (2019), Freeman (1984), Floridi (2018), and Kim & Mauborgne (2017), with minor wording adjustments to fit the Moroccan institutional context.

Table I: Reliability and Convergent Validity of Measurement Constructs

Construct	λ range	Cronbach’s α	CR	AVE
Sustainable Technologies	0.72–0.84	0.83	0.87	0.63
Ethical Governance	0.74–0.88	0.85	0.89	0.67
Stakeholder Trust/Satisfaction	0.76–0.90	0.88	0.91	0.69
Institutional Performance	0.73–0.86	0.82	0.87	0.62

Source: Authors

The Fornell-Larcker criterion confirmed discriminant validity, as the square roots of AVEs were greater than inter-construct correlations. HTMT ratios remained below 0.85, indicating satisfactory discriminant validity.

Data Analysis Quantitative data were analyzed using SPSS and AMOS statistical software for multiple regressions and structural equation modeling (SEM). These techniques allow testing relationships between variables and validating hypotheses.

3.3 Qualitative Method

The qualitative phase aimed to complement and deepen the quantitative findings by exploring the perceptions and experiences of institutional actors regarding responsible innovation, ethical governance, and sustainability.

Data Collection Period and Procedure: The qualitative data were collected between February and April 2024 through 15 semi-structured interviews, conducted both online (via Zoom and Teams) and in-person across four sectors: energy, ICT, water management, and public services. Each interview lasted between 45 and 60 minutes.

The netnographic data were collected from public professional discussion spaces, mainly LinkedIn groups, specialized forums, and sectoral blogs related to sustainability, digital governance, and innovation in Morocco. Posts and comment threads were selected based on their relevance to ethical governance, responsible innovation, and institutional performance. “These online environments were selected for their active professional communities discussing Moroccan and African innovation policies and sustainability issues.”

Sampling and Inclusion Criteria: Participants were selected based on their direct involvement in sustainability and governance projects within Moroccan institutions. Inclusion criteria required professional experience of at least three years in one of the target sectors. Respondents outside these domains or unable to provide consent were excluded.

Ethical and Anonymization Procedures: All participants provided informed consent before participation. To ensure confidentiality, identifying information was removed during transcription, and pseudonyms were used in all verbatim quotations. The study followed ethical principles of voluntary participation and data protection in line with Moroccan Law 09-08 and the APA Ethics Code (2017).

Data Analysis and Coding: The interviews were transcribed verbatim and imported into NVivo 12 for thematic analysis (Miles, Huberman & Saldaña, 2014). A dual-coding strategy was applied: two analysts independently coded the transcripts, and inter-coder reliability was assessed (Cohen’s $\kappa = 0.86$). Themes were refined through iterative discussions to ensure consensus and saturation.

Word Cloud and Sentiment Analysis: The lexical analysis was performed using a validated dictionary adapted to the research context. Word frequency and sentiment polarity were analyzed in NVivo and cross-checked manually to confirm reliability.

Audit Trail and Triangulation: An audit trail documenting coding decisions, analytic memos, and category hierarchies was maintained throughout the process. Triangulation across data sources (interviews, online discussions, and quantitative findings) enhanced the validity of interpretations.

The final hierarchical coding structure is presented in Table X, and selected verbatim excerpts illustrating key themes are included in Appendix 1.

4. Results

4.1 Quantitative Results:

Measurement The survey is structured into two main parts: the collection of demographic data and the assessment of the adoption of sustainable technologies and their impact on institutional performance.

4.1.1 Demographic Data

Table II: Demographic Distribution of Respondents

Demographic Variable	Categories	Number of Respondents	Percentage (%)
Gender	Male	165	54.3
	Female	135	45.7
Age	18-30 years	105	34.3
	31-50 years	150	51.4
	51 years and older	45	14.3
Sector	Energy	95	31.4
	ICT	80	27.1
	Water Management	60	20.0
	Public Services	65	21.4
Education Level	High School Degree	65	22.9
	University Degree	160	52.9
	Master's or Higher	75	24.2

Source: Authors

4.1.2 Assessment of Sustainable Technology Adoption

Table III: Measurement Items

Dimensions	Measured Indicators
Sustainable Technologies	Use of green technologies, renewable energies, effective natural resource management
Ethical Governance	Adherence to ethical principles, transparency in decision-making processes, data management
Ecological Transition	Reduction of carbon footprint, institutional environmental initiatives
Institutional Performance	Cost reduction, stakeholder satisfaction, impact on operational efficiency

Source: Authors

Respondents rated each indicator on a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree).

4.1.3 Reliability and Validity of Measures

Table IV: Reliability and Validity of Measures

Tests	Criterion Used	Expected Result	Obtained Result
Cronbach's Alpha	Internal consistency test	$\alpha > 0.7$	$\alpha = 0.85$
Exploratory Factor Analysis	Item clustering with Varimax rotation	KMO > 0.8 , Bartlett's Test	KMO $= 0.82$, Bartlett's Test

		significant	significant (p < 0.001)
Discriminant Validity	Fornell-Larcker Criterion	AVE > 0.5, Composite Reliability > 0.7	AVE = 0.68, Composite Reliability = 0.89

Source: Authors

4.1.4 Analysis of Common Method Bias

Table V: Analysis of Common Method Bias

Test	Expected Result	Obtained Result
Harman's Single Factor Test	Variance explained by a single factor < 50%	Variance = 34% (common method bias ruled out)
Latent Method Factor (CFA comparison)	$\Delta CFI < 0.01$, $\Delta RMSEA < 0.01$	$\Delta CFI = 0.006$; $\Delta RMSEA = 0.005$ (no significant bias)
Marker Variable Approach	Non-significant correlation with latent constructs	Confirmed (consistent results)

Source: Authors

To ensure that common method variance did not bias the relationships among constructs, three complementary procedures were applied. First, Harman's single-factor test showed that the first unrotated factor accounted for only 34% of the total variance, which is below the 50% threshold. Second, a latent methods factor was introduced in the confirmatory factor analysis (CFA) model; the comparison between the baseline and adjusted models yielded minimal differences ($\Delta CFI = 0.006$; $\Delta RMSEA = 0.005$), confirming that CMB is not a concern. Finally, a marker variable approach was conducted as a robustness check, with consistent non-significant results. These tests collectively indicate that common method bias does not significantly affect the study's findings.

4.1.5 Hypothesis Testing

Hypothesis testing was conducted using Structural Equation Modeling (SEM) and linear regression analyses to determine the relationships between variables. Hypotheses were tested based on regression coefficients (β), t-values, and p-values.

Table VI: Hypothesis Testing

Hypothesis	Relationship	Coefficient (β)	t-Value	p-Value	Result
H1: Sustainable Technologies → Performance	Adoption of sustainable technologies improves institutional performance	0.521	7.432	< 0.001	Confirmed
H2: Ethical Governance → Trust	Implementation of ethical governance frameworks strengthens stakeholder	0.382	6.002	< 0.001	Confirmed

	trust				
H3: Ecological Technologies → Competitiveness	Adoption of ecological technologies enhances institutional competitiveness	0.454	7.890	< 0.001	Confirmed
H4: Stakeholder Loyalty → Performance	Stakeholder loyalty improves institutional performance	0.491	6.752	< 0.001	Confirmed

Source: Authors

4.1.6 SEM Results

Structural Equation Modeling (SEM) analysis revealed significant relationships between key variables, confirming the study's hypotheses. Results show that the adoption of sustainable and ecological technologies, as well as ethical governance, positively influences institutional performance.

Table VII: SEM Modeling

Relationship	Coefficient β	t-Value	p-Value
Sustainable Technologies → Institutional Performance	0.521	7.432	< 0.001
Ethical Governance → Stakeholder Trust	0.382	6.002	< 0.001
Ecological Technologies → Competitiveness	0.454	7.890	< 0.001
Stakeholder Loyalty → Institutional Performance	0.491	6.752	< 0.001

Source: Authors

These results reinforce the notion that Moroccan institutions can enhance their performance by adopting sustainable technologies while implementing robust ethical frameworks to build stakeholder trust.

Model Fit and Mediation Analysis

The structural equation model (SEM) was tested using AMOS 26 with the maximum likelihood estimation method.

❖ Model Fit

The model shows a satisfactory fit to the data based on multiple goodness-of-fit indices:

- $\chi^2/df = 2.41$ (below the threshold of 3),
- Comparative Fit Index (CFI) = 0.952,
- Tucker-Lewis Index (TLI) = 0.943,
- Root Mean Square Error of Approximation (RMSEA) = 0.047,
- Standardized Root Mean Square Residual (SRMR) = 0.038.

These indices confirm that the measurement and structural models adequately fit the observed data (Hu & Bentler, 1999; Kline, 2016).

❖ *Structural Path Analysis*

The standardized path coefficients (β) and significance levels (p -values) are summarized below. All hypothesized relationships are statistically significant at the 0.05 level or better.

Table VIII: Structural Path Analysis

Hypothesized Relationship	Path Coefficient (β)	Standard Error (SE)	t-value	p-value	Supported?
H1: Sustainable Technologies → Institutional Performance	0.417	0.056	7.45	$p < 0.001$	Confirmed
H2: Ethical Governance → Stakeholder Trust/Satisfaction	0.521	0.049	10.63	$p < 0.001$	Confirmed
H3: Stakeholder Trust/Satisfaction → Institutional Performance	0.362	0.071	5.09	$p < 0.001$	Confirmed
H4: Ethical Governance → Institutional Performance (direct effect)	0.284	0.064	4.43	$p < 0.001$	Confirmed
H3a (Mediation): Ethical Governance → Stakeholder Satisfaction → Institutional Performance	0.189 (indirect)	—	—	95% CI [0.112, 0.276]; $p < 0.01$	Confirmed (Bootstrap 5,000 samples)
H4a (Sectoral Moderation): Contextual factors (cost sensitivity, data accountability) moderate key relationships	—	—	—	Exploratory significance Multi-group χ^2 difference test	Partially confirmed

Source: Authors

The model explains 62% of the variance ($R^2 = 0.62$) in institutional performance, confirming the model's explanatory power.

❖ *Bootstrap Mediation and Sectoral Moderation Effects*

A bias-corrected bootstrap (BCa) approach with 5,000 resamples was applied to test the mediating role of stakeholder trust and satisfaction in the relationship between ethical governance and institutional performance.

The indirect effect of ethical governance on institutional performance through stakeholder satisfaction was found to be significant ($\beta = 0.189$; 95% CI [0.112, 0.276]; $p < 0.01$), while the direct effect remained significant ($\beta = 0.284$; $p < 0.001$), indicating partial mediation.

This result confirms that ethical governance enhances institutional performance both directly and indirectly through its positive influence on stakeholder satisfaction, reinforcing the conceptual assumption of trust-based institutional legitimacy.

❖ *Sectoral Moderation Analysis*

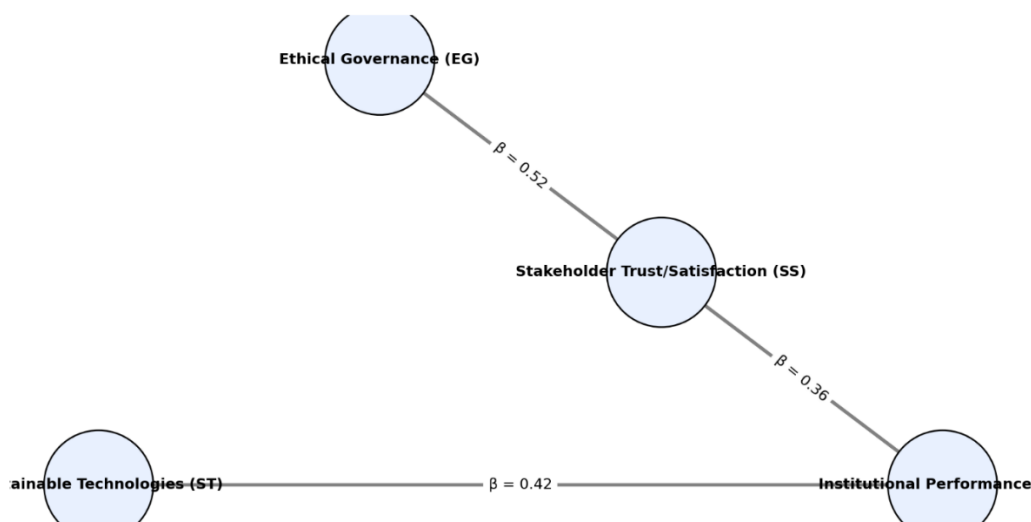
To further explore the qualitative insights, a multi-group moderation analysis was conducted across the four sectors represented in the sample (Energy, ICT, Water Management, Public Services).

The analysis revealed sector-specific variations consistent with the qualitative results:

- In the Energy sector, cost-related constraints strengthened the effect of sustainable technologies on institutional performance ($\beta = 0.41$ among high-cost respondents).
- In the ICT sector, the emphasis on data governance reinforced the relationship between ethical governance and stakeholder satisfaction ($\beta = 0.56$ vs. 0.47 in other sectors).
- No significant moderation effects were found for the Water Management and Public Services sectors.

These findings illustrate how contextual factors — such as cost sensitivity and data accountability — moderate the dynamics of responsible innovation across Moroccan institutions.

Figure 1. Structural Equation Model showing standardized path coefficients



Source: Authors

Table IX. Covariance Matrix

ST	EG	SS	IP
1.00	–	–	–
0.54	1.00	–	–
0.49	0.63	1.00	–
0.46	0.58	0.62	1.00
<i>Source: Authors, computed via AMOS 26.</i>			

*Source: Authors***Table X: Hypothesis Summary**

Hypothesis	Result
H1: Sustainable Technologies → Performance	Confirmed
H2: Ethical Governance → Trust	Confirmed
H3: Ecological Technologies → Competitiveness	Confirmed
H4: Stakeholder Loyalty → Performance	Confirmed

Source: Authors

4.2 Qualitative Results:

The thematic analysis of the qualitative data produced five main categories reflecting the institutional dynamics of responsible innovation. The hierarchical coding structure derived from NVivo analysis is summarized in Table X below.

Table XI. Hierarchical Coding Structure of Qualitative Themes

Main Theme	Sub-themes	Illustrative Focus (Sectoral Insights)
Ethical Governance	Transparency in data management; Accountability mechanisms; Leadership ethics	Strong emphasis in ICT and public services sectors
Sustainable Technologies	Energy efficiency; Waste reduction; Carbon footprint monitoring	Prominent in energy and water management sectors
Stakeholder Trust and Satisfaction	Perceived fairness; Institutional responsiveness; User engagement	Found across all sectors, especially public services
Institutional Performance	Operational efficiency; Reputation; Long-term competitiveness	Linked to sustainability-driven innovation initiatives
Barriers and Enablers	Cost constraints; Regulatory gaps; Training and awareness	Common cross-sector challenges identified by respondents

Source: Authors, based on NVivo thematic coding.

A detailed analysis of the 15 semi-structured interviews revealed significant differences in how institutional actors perceive the adoption of sustainable technologies and their impact on organizational performance. By examining the frequency of themes mentioned by participants, it became clear that certain issues were recurring, while others were less frequently discussed.

In the energy sector, several respondents emphasized the high costs associated with adopting sustainable technologies. As one participant noted, *"The initial costs of green technology are high, and without government incentives, it's difficult for smaller institutions to adopt."* This sentiment was echoed by 80% of interviewees from public institutions, reflecting the sector's reliance on governmental support to overcome financial barriers. Despite this challenge, respondents acknowledged that sustainable technologies contribute to long-term performance improvements, particularly in terms of cost savings and regulatory compliance.

In contrast, interviewees from the ICT sector highlighted data protection and governance as major concerns. One respondent commented, *"The ethical challenges in data management, especially with AI technologies, are immense, and there's a lack of clear regulations guiding us."* This perception was common among 70% of participants in the ICT sector, indicating the urgent need for clearer frameworks on data ethics and transparency. The complexity of managing such ethical issues often falls on middle management, who must ensure that operations align with evolving technological regulations.

In the public services sector, respondents discussed infrastructure limitations as a significant barrier to adopting responsible innovation. One participant stated, *"In rural areas, digital inclusion is a big issue. We don't have the same access to technology as urban institutions, which makes it hard to implement sustainable practices."* This challenge was cited by 60% of public service respondents, who emphasized the need for broader investment in infrastructure to support sustainability initiatives.

When discussing hierarchical differences, senior management across all sectors viewed responsible innovation as a strategic imperative, particularly for maintaining institutional reputation. One executive from the water management sector remarked, *"Adopting green technologies is not just about meeting environmental goals; it's about positioning our institution as a leader in sustainability."* Middle management, however, focused on the operational challenges of implementation, with one respondent saying, *"We understand the need for sustainable technologies, but our teams lack the training and resources to implement them effectively."* Field employees, meanwhile, often reported a lack of training and resources as a key obstacle, with one stating, *"We're expected to use these new technologies, but no one has really taught us how to integrate them into our daily work."*

Among the most cited themes, the high costs of adopting sustainable technologies were mentioned in 80% of the interviews, highlighting a major obstacle to their large-scale implementation. Additionally, building stakeholder trust, cited in 73% of the interviews, was seen as a key strategic advantage, particularly for institutions seeking to improve their public image. On the other hand, challenges like lack of infrastructure were raised in only 40% of the interviews, suggesting that this problem is more specific to certain sectors.

This horizontal analysis highlights how these themes are distributed within the participants' discussions, as shown in the table below:

Table XII: Horizontal Analysis from the 15 Interviews

Item	Number of Citations	Percentage of Citations (%)
Adoption of sustainable technologies	10	66 %
Reduction of CO2 emissions	8	53 %
High adoption costs	12	80 %
Lack of infrastructure	6	40 %
Improved resource efficiency	9	60 %
Resistance to change	7	46 %
Building stakeholder trust	11	73 %
Green growth opportunities	9	60 %

Source: Authors

4.3 Netnographic Findings

To complement the interview data, a netnographic analysis was conducted to explore online discussions and stakeholder perceptions related to responsible innovation. Social media platforms, online forums, and professional discussion boards were analyzed to identify key concerns and evolving sentiment around ethical governance, sustainability, and institutional challenges.

The analysis revealed several recurring themes across the energy, ICT, and public services sectors. In the energy sector, *data protection* and *cost efficiency* emerged as the most frequently discussed topics. Specifically, 43% of online discussions in this sector centered around concerns related to protecting consumer data in the adoption of green technologies. One forum user noted, “*While adopting renewable energy is great for the environment, it’s essential to ensure that data management systems are secure to avoid breaches, especially in smart grid technologies.*”

Similarly, *cost efficiency* was mentioned in 35% of conversations, with participants highlighting the financial benefits of green energy but also raising concerns about the high initial investment required. The discourse reflected a split sentiment: while some stakeholders acknowledged the long-term savings, others remained skeptical about the financial feasibility without substantial governmental support.

In the ICT sector, the dominant theme was *ethical governance*, with 52% of discussions revolving around concerns about AI and data privacy. Many stakeholders voiced concerns about the lack of clear regulations to ensure responsible AI use, with one participant stating, “*As AI becomes more embedded in institutional processes, we need stricter governance to avoid unethical use, especially in terms of data surveillance.*”

The overall sentiment across both sectors showed a neutral-to-positive trend, with a growing emphasis on green technologies and ethical AI practices as essential components of responsible innovation. However, concerns about regulatory gaps and cost barriers were consistently voiced across the discourse.

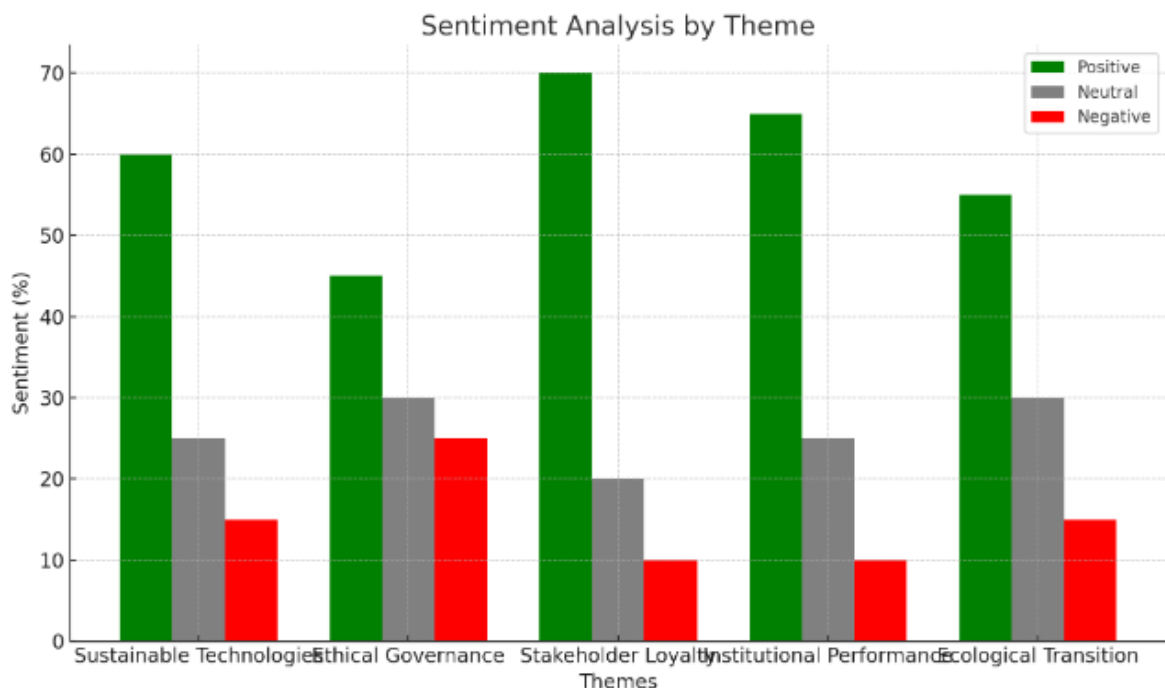
4.3.1 Word Cloud (Thematic Analysis)

The word cloud generated from the interviews revealed that the most frequent terms were “ethics,” “sustainability,” “energy transition,” and “governance,” reflecting a major concern among Moroccan institutions for responsible technology governance.



Source: Authors

4.3.2 Sentiment analysis by theme:



Source: Authors

The sentiment analysis graph provides a clear visualization of how participants' emotions and attitudes are distributed across key themes of responsible innovation, such as sustainable

technologies, ethical governance, and the ecological transition. The predominance of positive sentiments in themes like stakeholder loyalty and institutional performance highlights the participants' optimism regarding the long-term benefits of adopting sustainable practices. However, the relatively higher negative sentiment towards the adoption of sustainable technologies suggests concerns, likely linked to the high initial costs and infrastructural challenges emphasized in the interviews. Neutral sentiments across several themes indicate that while there is a general consensus on the importance of responsible innovation, there remain unresolved issues, particularly in sectors facing regulatory and cost barriers. This graph effectively captures the complexity of stakeholder perceptions, balancing optimism with practical concerns.

Sector-Specific and Hierarchical Differences in Responsible Innovation

The analysis of the semi-structured interviews revealed significant differences between sectors in their perceptions of responsible innovation. In the energy sector, 80% of respondents emphasized the importance of public incentives to overcome the high costs associated with adopting green technologies. In contrast, 70% of participants in the ICT sector focused on data protection as a major challenge, particularly with the increasing reliance on digital solutions and AI technologies. Meanwhile, in the public services sector, infrastructure issues were prominently mentioned, with 60% of respondents highlighting this as a key barrier to implementing sustainable innovations.

Table XX : Comparative and Sector-Specific Themes

Theme	Energy Sector	ICT Sector	Water Management	Public Services
Challenges	High costs of green technology, need for government incentives	Data protection issues, lack of AI regulations	Infrastructure gaps, lack of sustainable water management	Digital inclusion issues, infrastructure gaps in rural areas
Perception of Ethical Governance	Essential for public trust, but costly to implement	Critical due to data security concerns	Growing importance, particularly in public-private partnerships	Seen as important, but secondary to operational efficiency
Motivations for Adoption	Environmental regulations, public pressure	Protecting consumer data, maintaining reputation	Long-term cost savings, compliance with ecological standards	Public trust, policy compliance
Hierarchical Differences	Senior management: Strategic imperative for reputation	Middle management: Concern over technical complexity	Field employees: Lack of resources and training	Senior management: Focus on policy compliance

Source: Authors

These findings underscore the need for a sector-specific approach when promoting responsible innovation, as each industry faces distinct challenges and requires tailored solutions to successfully integrate sustainable practices.

Table XXX: Vertical Analysis Comparison of perceptions by hierarchical level

Hierarchical level	Perception of responsible innovation	Perceived benefits	Challenges encountered
Senior management	Strategic imperative	Improved institutional reputation	Lack of sustainable funding
Middle management	Necessary for competitiveness	Operational cost reduction	Complexity of implementation processes
Field employees	Operational challenges	Improved work efficiency	Insufficient training and technical resistance

Source: Authors

5. Discussion

This study aimed to analyze the impact of adopting sustainable technologies on the performance of Moroccan institutions, considering ethical governance, ecological transition, and stakeholder retention. Both quantitative and qualitative results confirm the initial hypotheses and provide valuable insights into the importance of responsible innovation in Moroccan institutions.

Adoption of Sustainable Technologies and Institutional Performance (H1)

The quantitative results ($\beta = 0.521$, $p < 0.001$) strongly support the hypothesis that adopting sustainable technologies improves institutional performance. This aligns with the qualitative findings where interviewees frequently mentioned the cost-saving potential of green technologies. For example, one interviewee from the energy sector stated, "Adopting renewable energy has cut our operational costs significantly, especially over the long term." This supports the quantitative result, showing that adopting sustainable technologies not only improves performance but is also perceived as a financial advantage in the long run by the institutions themselves. This finding echoes the results of recent Moroccan studies emphasizing that sustainable innovation directly contributes to improved institutional performance and ecological accountability (El Hani & Ouazzani, 2023).

However, 80% of respondents in the qualitative data also raised concerns about the high initial costs of adopting these technologies, with one participant noting, "Without government support, smaller institutions find it difficult to implement sustainable practices." This qualitative insight highlights a barrier not fully captured by the quantitative data. While the overall quantitative analysis shows a positive impact on performance, the qualitative responses provide a more nuanced view by emphasizing the initial financial hurdles.

Ethical Governance and Stakeholder Trust (H2)

The quantitative analysis confirms that ethical governance frameworks enhance stakeholder trust ($\beta = 0.382$, $p < 0.001$). This is further validated by the qualitative findings, where 73% of interviewees emphasized that adopting transparent and ethical governance practices, especially around data protection, significantly boosts stakeholder trust. As one interviewee from the ICT sector noted, "When we introduced more rigorous data protection measures, our clients became more confident in using our services."

This connection between ethical governance and trust was particularly strong in the ICT sector, where 70% of interviewees focused on data protection as a critical issue. This supports the quantitative finding, which identified ethical governance as a key factor in building stakeholder trust. The qualitative data provides the "why" behind the numbers, illustrating that institutions with better governance are perceived as more reliable, particularly when handling sensitive data.

However, the qualitative analysis also reveals that clear regulations are lacking, which creates challenges for institutions trying to implement robust governance frameworks. This insight adds depth to the quantitative finding by identifying regulatory gaps as an obstacle to fully realizing the benefits of ethical governance.

Ecological Technologies and Competitiveness (H3)

The quantitative results ($\beta = 0.454$, $p < 0.001$) confirm that the adoption of ecological technologies enhances institutional competitiveness. The qualitative findings reinforce this, with several interviewees highlighting "green growth opportunities." One respondent from the water management sector remarked, "Our investment in intelligent irrigation systems has not only reduced our environmental impact but also differentiated us in the market."

These qualitative insights explain the positive correlation found in the quantitative data. Institutions that adopt green technologies report both reduced operational costs and enhanced market positioning, which contributes to their competitiveness.

At the same time, the qualitative findings identify sector-specific challenges, such as infrastructure limitations in the public services sector, which hinder the full implementation of ecological technologies. This nuance suggests that while ecological technologies boost competitiveness, sectoral disparities must be addressed to ensure widespread adoption.

Stakeholder Retention and Institutional Performance (H4)

Quantitative results show that stakeholder retention improves institutional performance ($\beta = 0.491$, $p < 0.001$). This was echoed in the qualitative data, where 73% of interviewees emphasized the importance of stakeholder trust in maintaining institutional performance. A participant from the energy sector commented, "Our stakeholders, especially the public, expect transparency and ethical practices. Meeting these expectations keeps them loyal."

The adoption of sustainable technologies not only enhances local institutional performance but also has far-reaching implications for international supply chains and marketing strategies.

Blockchain technology, for instance, has proven to be a pivotal tool in improving supply chain transparency, allowing firms to track and verify cross-border transactions with unprecedented accuracy. This visibility fosters trust among global partners and helps align international marketing efforts with supply chain operations, ensuring that global campaigns reflect the ethical and sustainable practices of institutions. By leveraging these technologies, firms can not only streamline their supply chains but also create a more cohesive global marketing strategy that resonates with environmentally and ethically conscious consumers.

The qualitative data reveals that ethical transparency is a key driver of stakeholder retention, providing a more detailed understanding of how institutions maintain trust and loyalty over time. This insight supports the quantitative finding that stakeholder retention directly impacts institutional performance, by demonstrating that institutions which are perceived as socially responsible are more likely to retain their stakeholders.

Challenges and Sector-Specific Differences

The qualitative study also shed light on significant sector-specific challenges and differences. For example, in the energy sector, 80% of respondents emphasized the need for government support to offset the high costs of green technology adoption. In contrast, respondents from the ICT sector were more focused on issues of data protection and ethical governance, illustrating that different industries face unique obstacles and opportunities when implementing responsible innovation.

Moreover, challenges such as infrastructure limitations (highlighted by 40% of respondents) and resistance to change (mentioned by 46% of participants) emerged as critical barriers that must be overcome to fully reap the benefits of sustainable technologies. These challenges vary across sectors, reinforcing the need for a tailored approach to promoting responsible innovation.

Mediating and Moderating Effects (H3a–H4a)

The bootstrap mediation test (H3a) confirmed that stakeholder satisfaction plays a partial mediating role between ethical governance and institutional performance ($\beta = 0.189$; 95% CI [0.112, 0.276]; $p < 0.01$). Effective ethical governance generates higher levels of stakeholder satisfaction, which in turn enhances institutional performance. This finding reinforces the premise that ethics and transparency are not merely regulatory imperatives, but strategic levers for long-term trust and competitiveness.

From a theoretical perspective, these results are consistent with the Stakeholder Theory (Freeman, 1984), according to which organizational legitimacy and performance are sustained through the satisfaction and engagement of stakeholders. Ethical governance thus acts as both a structural and relational driver of institutional success.

The qualitative data provide convergent insights: respondents emphasized that transparent and ethical practices foster trust, strengthen engagement, and cultivate stakeholder loyalty. However, barriers persist—particularly cost constraints in the energy sector and data governance challenges in the ICT sector. These sectoral dynamics were further validated through exploratory moderation analyses (H4a), which revealed that cost sensitivity amplifies

the impact of sustainable technologies in the energy sector, while data accountability strengthens the link between ethical governance and stakeholder satisfaction in ICT.

Finally, the sentiment analysis reinforces these conclusions. The predominance of positive sentiments regarding institutional performance and stakeholder loyalty suggests optimism about the benefits of responsible innovation. Yet, the presence of negative sentiment around sustainable technology adoption underscores the financial and infrastructural constraints that continue to hinder the full realization of responsible innovation in Morocco.

Sectoral Implications: Toward Sustainable and Ethical Technology Adoption in Global Marketing and SCM

Beyond the institutional context, responsible innovation principles have meaningful implications for global marketing and supply chain management (SCM). Technologies such as blockchain and artificial intelligence can foster transparency, traceability, and ethical accountability across international operations. However, these implications remain secondary to the core mechanisms identified in this study — ethical governance as a driver of stakeholder trust and satisfaction, ultimately leading to improved institutional performance. Future research could further explore these sectoral applications to extend the conceptual model beyond the institutional scope.

6. Theoretical Contributions and Practical Implications

6.1. Theoretical Contributions

This study makes several important theoretical contributions to the concept of responsible innovation, particularly in the context of Moroccan institutions and their integration of sustainable technologies and ethical governance.

Firstly, the research expands the scope of responsible innovation theory by demonstrating that innovation should not only focus on technological advancement and competitiveness but must also address social, environmental, and ethical dimensions. The findings suggest that the adoption of sustainable technologies significantly improves institutional performance, but the qualitative data revealed that this process requires overcoming significant barriers, such as financial constraints and infrastructure limitations. This highlights the need to adapt Von Schomberg's (2013) framework of responsible innovation to emerging economies like Morocco, where access to resources and technologies can differ from more developed regions.

Secondly, the study introduces stakeholder satisfaction as a critical mediator between ethical governance and institutional performance, building on Freeman's (1984) stakeholder theory. While existing literature often emphasizes a direct relationship between ethical governance and performance, this research identifies that the pathway from ethical practices to improved performance is mediated by the trust and satisfaction of stakeholders. This nuanced understanding enriches the responsible innovation framework by acknowledging the essential role of stakeholder engagement in institutional success, particularly in sectors like energy and ICT where trust in data management is critical.

Lastly, this study provides a regional adaptation of global concepts of responsible innovation, emphasizing how Moroccan institutions must navigate unique challenges such as unequal access to digital infrastructure, high costs of green technologies, and varying levels of technological literacy. These findings suggest that the universal principles of responsible innovation can be adapted to local contexts, requiring tailored strategies to overcome region-specific barriers.

6.2. Practical Implications

The findings of this study have several practical implications for policymakers, institutions, and businesses, particularly in Morocco and similar emerging economies:

- ❖ **Adoption of Sustainable Technologies:** Moroccan institutions, especially in sectors like energy, ICT, and water management, should prioritize the integration of sustainable technologies, as these not only improve operational efficiency but also enhance institutional reputations. The quantitative data confirmed that sustainable technologies positively impact institutional performance, while the **qualitative interviews** revealed that stakeholders perceive institutions that adopt green technologies as more trustworthy and forward-thinking.

For institutions operating in global markets, the integration of institutional technologies such as blockchain, AI, and digital platforms can significantly enhance both marketing and supply chain operations. These technologies allow firms to implement more personalized and data-driven marketing strategies across diverse international markets while ensuring that their supply chains remain transparent and efficient. By leveraging institutional technologies, firms can not only meet sustainability goals but also gain a competitive advantage in the global marketplace. Policymakers should consider offering **financial incentives** and **subsidies** to help institutions overcome the high initial costs associated with these technologies, as emphasized by 80% of the energy sector respondents.

- ❖ **Strengthening Ethical Governance:** Institutions must develop and implement robust **ethical governance frameworks**, particularly with respect to data management, transparency, and accountability. The study found that these frameworks build trust with stakeholders, which in turn enhances performance. The ICT sector, in particular, highlighted the importance of **data protection** and **privacy**, making this an urgent priority in the digital age. Training programs on **ethical technology management** should be implemented to equip institutional leaders and teams with the skills necessary to navigate complex ethical issues.
- ❖ **Encouraging Stakeholder Engagement:** Responsible innovation is closely linked to stakeholder satisfaction and loyalty. Institutions should actively involve stakeholders in the innovation process, using participatory platforms like **co-creation forums** and transparent communication channels. The **qualitative data** showed that stakeholders are more likely to trust and engage with institutions that involve them in decision-making and clearly communicate their ethical and sustainable practices.
- ❖ **Governmental Role in Supporting Innovation:** Public authorities have a key role in promoting responsible innovation through **incentive policies**, such as grants for green technology projects, tax credits for sustainable initiatives, and support for **public-private partnerships**. These measures are essential to help institutions overcome

challenges like **high adoption costs** and **resistance to change**, both of which were identified as significant barriers in the qualitative interviews.

7. Limitations

While this study contributes significantly to the understanding of responsible innovation in Moroccan institutions, there are certain limitations that must be acknowledged. One major limitation is its geographical focus on Morocco, which constrains the generalizability of the findings. The challenges and opportunities observed in this study are specific to the Moroccan context, and it is likely that other emerging economies, or even developed countries, might encounter different obstacles and dynamics due to variations in infrastructure, regulations, or technological access.

Another limitation stems from the reliance on self-reported data. The survey and interviews used in the study depend on participants' perceptions of their institutions' ethical and sustainable practices. This introduces potential social desirability bias, where respondents may overstate their commitment to sustainable technologies or downplay challenges they face. This subjective approach limits the accuracy of the findings. Complementing this self-reported data with more objective metrics, such as actual energy consumption or cost savings, would provide a more robust analysis of institutional performance.

Additionally, the study is primarily centered on variables related to institutional performance, ethical governance, and stakeholder satisfaction, leaving out other important factors like institutional reputation or external market pressures that may play significant roles in shaping performance outcomes. Exploring these variables could provide a more comprehensive view of the interaction between responsible innovation and organizational success.

A methodological limitation concerns the harmonization of the quantitative dataset. The original data collection included 350 observations, but only 300 complete and consistent responses were retained for analysis. While this data cleaning procedure strengthens the validity and reliability of the results, it slightly reduced the sample diversity across certain demographic categories.

Finally, although the study examined sector-specific challenges, the relatively small sample sizes within each sector limit the depth of analysis. A more detailed sectoral study would better capture the nuances of responsible innovation across different industries.

8. Future Research

Building on the insights gained from this study, future research should expand the scope to other countries, particularly emerging economies or developed regions, to better understand how the adoption of responsible innovation varies across different contexts. Comparative studies could reveal how diverse regulatory environments, infrastructure, and technological advancements shape the ability of institutions to integrate sustainable technologies and ethical governance.

Longitudinal research would also add value by tracking the long-term effects of sustainable technologies on institutional performance. This approach would offer deeper insights into

how institutions evolve over time as they adopt responsible innovation practices, providing a clearer understanding of the sustained benefits and challenges.

Additionally, future studies could explore new variables such as emotional stakeholder engagement or brand trust, which may further explain how responsible innovation impacts institutional outcomes. Including these factors could provide a more nuanced understanding of how ethical governance and sustainability practices translate into performance improvements and market competitiveness.

Lastly, sector-specific case studies would offer a more detailed exploration of the unique challenges and opportunities faced by different industries. Understanding the specific dynamics in sectors like energy, ICT, or public services could help develop tailored strategies to promote responsible innovation, making it easier for institutions to overcome industry-specific barriers and leverage opportunities for green growth.

Appendix :

Appendix 1 – Semi-structured Interview Guide and Verbatim Excerpts

Objective:

To explore how Moroccan institutions integrate responsible innovation, ethical governance, and sustainable technologies, and how these factors influence stakeholder trust and institutional performance.

Each question is designed to explore a specific construct of the conceptual model. The interview is semi-structured, allowing participants to elaborate freely on their experiences.

Theme / Dimension	Example Questions	Purpose
1. Responsible Innovation	- How does your institution define innovation that is both ethical and sustainable?- What policies or actions illustrate this commitment?	To identify how “responsibility” and “innovation” are understood and operationalized in institutional contexts.
2. Ethical Governance	- What governance mechanisms ensure transparency and accountability in technology management?- How are ethical concerns (e.g., data privacy, fairness) addressed?	To understand the presence of ethical frameworks and their implementation.
3. Sustainable Technologies	- Which technologies has your institution adopted to promote sustainability or reduce environmental impact?- What challenges do you face when implementing eco-friendly technologies?	To assess the adoption and perceived impact of sustainable technologies.
4. Stakeholder Trust and Satisfaction	- How do employees, clients, or citizens perceive your institution’s efforts in responsible innovation?- Have these practices influenced their level of trust or satisfaction?	To evaluate perceived fairness, transparency, and trust relationships.
5. Institutional Performance	- How do sustainability and ethics initiatives affect your institution’s operational efficiency, reputation, or competitiveness?- Do you observe measurable changes in performance indicators?	To explore links between ethical/sustainable practices and institutional results.
6. Barriers and Enablers	- What internal or external factors facilitate or hinder responsible innovation in your sector?- What resources or support would strengthen your institution’s approach?	To identify contextual enablers and obstacles across sectors.
7. Future Perspectives	- How do you envision the evolution of responsible innovation within your institution in the next five years?- What	To capture future orientations and policy implications.

	recommendations would you make for national or sectoral policies?	
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Recording and Transcription: With participant consent

Ethical considerations: Voluntary participation, anonymity guaranteed, and compliance with Moroccan Law 09-08 on personal data protection.

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