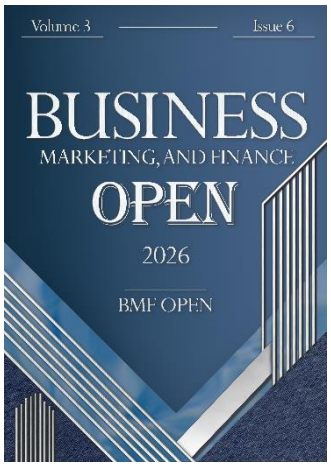
Identifying Key Factors and Drivers Affecting Sustainable Auditing Based on Sustainability Reporting

Morteza Habibizadeh[1], Masoud Taherinia [2,*], Azar Moslemi [3] and Mehdi Khorramabadi [4]

[1] Department of Accounting, Khom.C., Islamic Azad University, Khomein, Iran;
[2] Professor, Department of Accounting, Lorestan University, Khorramabad, Iran;
[3] Department of Accounting, Khom.C., Islamic Azad University, Khomein, Iran;
[4] Assistant Professor, Department of Accounting, Payame Noor University, Tehran, Iran;

* Correspondence: taherinia.m@lu.ac.ir



Citation: Habibizadeh, M., Taherinia, M., Moslemi, A., & Khorramabadi, M. (2026). Identifying Key Factors and Drivers Affecting Sustainable Auditing Based on Sustainability Reporting. *Business, Marketing, and Finance Open*, 3(6), 1-15.

Received: 01 January 2026
Revised: 20 May 2026
Accepted: 27 May 2026
Initial Publication: 08 June 2026
Final Publication: 01 November 2026

Abstract: The present study aimed to identify the key factors and strategic drivers affecting sustainable auditing within the framework of sustainability reporting. This applied research was conducted using a descriptive-survey methodology with a futures studies approach. The study employed a paradigmatic qualitative model as the foundation for hypothesis development and cause-and-effect analysis. Data were collected using a researcher-made questionnaire distributed through block random sampling among experts and specialists in auditing, accounting, and futures studies. The cross-impact analysis method (MICMAC) was applied to analyze the relationships among variables and identify influential and dependent components. An 8×8 matrix was completed by six experts who evaluated the degree of influence among variables using a four-point scale ranging from no impact to strong impact. The research process also incorporated Delphi rounds and scenario analysis to identify possible future states of sustainable auditing. The findings demonstrated that uncertainty, social trust, and auditor independence were classified as linkage and risk variables with high influence and dependence, while technology emerged as the strongest influential variable in the system. Stakeholder pressure was identified as an autonomous variable, whereas institutional challenge, auditor role, and sustainability linkage were classified as dependent variables. MICMAC analysis revealed a matrix fill rate of 87.5%, indicating a highly interconnected system among the identified components. Strategic variables affecting the future of sustainable auditing included technology, uncertainty, social trust, and auditor independence. Furthermore, four future scenarios were extracted: symbolic auditing, trust-regulating institution, reactive-minimal auditing, and predictive and strategic auditing. The results indicated that the future evolution of sustainable auditing depends significantly on technological advancement, regulatory maturity, professional competencies, stakeholder pressure, and the intelligent use of artificial intelligence and ESG-based analytical systems. The study concluded that sustainable auditing is evolving from a traditional compliance-oriented activity toward a future-oriented institutional mechanism for trust creation and strategic governance. The integration of technology, sustainability legitimacy, auditor independence, and uncertainty management plays a critical role in shaping the effectiveness of sustainable auditing systems. The proposed framework provides a comprehensive basis for policymakers, regulators, and professional auditing bodies to improve sustainability assurance practices and strengthen organizational accountability in response to environmental, social, and governance challenges.

Keywords: Sustainable Auditing, Sustainability Reporting, ESG, MICMAC Analysis, Futures Studies, Auditor Independence, Social Trust, Technology Drivers

1. Introduction

In recent decades, sustainability has evolved from a peripheral organizational concern into a central strategic imperative influencing economic, environmental, and social dimensions of business performance. Organizations are increasingly expected to demonstrate accountability not only in financial reporting but also in environmental stewardship, social responsibility, governance quality, and ethical decision-making. This transformation has intensified the importance of sustainability reporting as a mechanism through which organizations communicate their sustainable performance to stakeholders, investors, regulators, and society at large. Sustainability reporting has consequently become a critical component of corporate transparency, legitimacy, and long-term value creation. However, the effectiveness and credibility of sustainability disclosures depend substantially on the existence of reliable auditing and assurance mechanisms capable of verifying the accuracy, completeness, and integrity of disclosed information [1, 2].

The rapid expansion of sustainability reporting frameworks has increased the complexity of auditing practices and has generated new professional expectations for auditors and assurance providers. Traditional financial auditing approaches are no longer sufficient to address multidimensional sustainability-related risks, environmental obligations, governance concerns, and social accountability requirements. Consequently, organizations and regulatory institutions have increasingly emphasized the development of sustainable auditing systems capable of integrating financial and non-financial dimensions of reporting into a coherent assurance framework [3, 4]. Sustainable auditing has therefore emerged as a strategic process aimed at evaluating organizational sustainability performance, enhancing stakeholder trust, and supporting long-term institutional resilience. Unlike conventional auditing models that primarily focus on financial accuracy and compliance, sustainable auditing encompasses broader dimensions such as ESG performance, environmental responsibility, social legitimacy, and strategic governance.

The growing relevance of sustainable auditing has been reinforced by global environmental crises, climate change concerns, resource scarcity, and increasing societal demands for responsible business conduct. Organizations are under mounting pressure from governments, investors, civil society, and consumers to adopt sustainable operational strategies and disclose the impacts of their activities on the environment and society. In response to these developments, sustainability auditing has increasingly become a mechanism for reducing information asymmetry and strengthening stakeholder confidence in sustainability disclosures. Research has demonstrated that credible sustainability assurance contributes significantly to organizational legitimacy, competitive advantage, and sustainable performance outcomes [5, 6]. Furthermore, environmental auditing and sustainability assurance have been identified as effective tools for monitoring organizational compliance with environmental standards, improving waste management practices, and supporting sustainable economic development.

Technological transformation has also profoundly influenced the future trajectory of sustainable auditing. The integration of artificial intelligence, digital intelligence, big data analytics, blockchain systems, and advanced information technologies into auditing processes has altered the traditional structure of assurance activities. Emerging digital technologies provide auditors with enhanced capabilities for data analysis, predictive assessment, fraud detection, and real-time monitoring of sustainability indicators. As a result, digital transformation has become one of the most influential drivers shaping the future of sustainable auditing ecosystems [7, 8]. The growing adoption of AI-based auditing systems has improved the efficiency and quality of audit processes while

simultaneously increasing the capacity of organizations to evaluate sustainability-related risks and long-term strategic performance [9]. Similarly, national audit systems and public-sector auditing institutions are increasingly utilizing digital technologies to support regional sustainable development and strengthen governance structures [10].

Despite these advancements, sustainable auditing continues to face numerous institutional, professional, and operational challenges. One of the most significant concerns relates to the credibility and reliability of sustainability disclosures. Since sustainability reports frequently involve qualitative judgments, future-oriented information, and non-financial performance indicators, auditors often encounter difficulties in assessing the objectivity and verifiability of reported information. These challenges become more pronounced in contexts characterized by weak regulatory systems, limited sustainability standards, and insufficient professional competencies. In many developing economies, sustainability assurance practices remain fragmented and inconsistent due to the absence of integrated regulatory frameworks and institutional support mechanisms [2, 11]. Consequently, concerns regarding greenwashing, symbolic reporting, and superficial compliance have intensified in recent years, thereby increasing the need for more robust and strategic auditing frameworks.

Another major issue influencing the effectiveness of sustainable auditing concerns auditor competence and professional expertise. Sustainable auditing requires auditors to possess interdisciplinary knowledge encompassing environmental management, ESG reporting standards, data analytics, strategic risk assessment, and ethical governance. The complexity of sustainability-related information and the integration of digital technologies into audit practices necessitate the development of new professional competencies and analytical capabilities among auditors. Empirical evidence indicates that auditor competence, experience, and professional judgment significantly influence audit quality and sustainability-related decision-making processes [12]. Similarly, the effectiveness of internal auditing systems and sustainability assurance mechanisms is strongly affected by sustainable innovation, technological adaptation, and institutional learning capabilities [13]. These findings highlight the importance of developing educational programs, professional training systems, and technological infrastructures capable of supporting future-oriented sustainable auditing practices.

The relationship between audit quality and sustainable organizational performance has also attracted increasing scholarly attention. Studies indicate that high-quality auditing contributes positively to organizational transparency, operational efficiency, and sustainable growth. Sustainable auditing enhances accountability mechanisms, improves governance quality, and reduces uncertainty among investors and stakeholders. Moreover, organizations with effective sustainability assurance systems are more likely to achieve sustainable economic performance, strengthen stakeholder confidence, and maintain competitive advantages in dynamic market environments [3, 14]. In addition, sustainable revenue generation, financial stabilization, and institutional sustainability have become important strategic objectives for both public and private organizations, thereby further emphasizing the importance of integrated sustainability assurance systems [15].

The evolution of sustainability auditing has additionally expanded into specialized areas such as energy auditing, sustainable banking, anti-money laundering systems, and public-sector governance. Research on energy efficiency auditing demonstrates that environmental auditing practices can significantly reduce energy waste, improve environmental performance, and contribute to sustainable development objectives [6]. Likewise, sustainable banking models increasingly rely on sustainability assurance mechanisms to strengthen accountability, improve financial performance, and support responsible investment practices [16]. In the financial sector, internal auditors are also assuming broader responsibilities related to forensic accounting, customer due diligence, and anti-

money laundering procedures, reflecting the expanding strategic role of auditing within modern sustainability-oriented governance systems [17].

In parallel with these developments, integrated auditing approaches have become increasingly relevant in the evaluation of sustainable development programs and ESG-related initiatives. The integration of sustainability considerations into organizational strategy and auditing frameworks allows institutions to align long-term economic objectives with environmental and social responsibilities. Studies examining integrated audit approaches within state-owned enterprises and sustainable development programs indicate that strategic auditing significantly improves organizational adaptability, governance effectiveness, and policy implementation processes [18]. This integration also facilitates the transition from reactive compliance-oriented auditing toward predictive and strategic auditing models capable of supporting future-oriented organizational decision-making.

Although previous studies have extensively examined sustainability reporting, audit quality, digital transformation, environmental auditing, and sustainable performance, limited research has focused on identifying the key strategic drivers and structural variables influencing the future of sustainable auditing within the broader context of sustainability reporting. Existing studies often examine isolated dimensions of sustainability assurance, such as technological adaptation, auditor competence, or ESG disclosure quality, without providing a comprehensive structural analysis of the interrelationships among institutional, technological, professional, environmental, and strategic factors. Moreover, the majority of prior research has concentrated on current auditing practices rather than adopting a futures studies perspective capable of exploring alternative scenarios and strategic uncertainties affecting the evolution of sustainable auditing systems.

Given the increasing importance of sustainability reporting, digital transformation, ESG accountability, and stakeholder expectations, there is a pressing need to identify the strategic variables, future scenarios, and structural relationships shaping the future of sustainable auditing. Understanding these factors can contribute significantly to the development of more effective sustainability assurance frameworks, policy mechanisms, professional competencies, and governance systems capable of supporting sustainable organizational development in complex and uncertain environments. Therefore, the present study aims to identify the key factors and strategic drivers affecting sustainable auditing based on sustainability reporting through a MICMAC-based futures studies approach.

2. Methodology

The present study was conducted as an applied research project using a descriptive-survey design with a futures studies approach. The research was developed based on a paradigmatic qualitative model extracted during the qualitative phase of the study, which served as the conceptual foundation for identifying the key drivers and factors affecting sustainable auditing based on sustainability reporting. The study adopted a cause-and-effect perspective to formulate and examine the relationships among the identified concepts, categories, and variables. Considering the exploratory and strategic nature of the research topic, the study also incorporated foresight methodologies to analyze future-oriented dimensions of sustainable auditing and sustainability assurance. The statistical population of the study consisted of academic experts, professional auditors, accounting specialists, and researchers in the fields of sustainability reporting and futures studies. Participants were selected through purposive and expert-based sampling procedures to ensure that respondents possessed sufficient professional knowledge and practical experience related to auditing, sustainability reporting, ESG issues, and strategic foresight. In the implementation phase, questionnaires were distributed in blocks using a completely random distribution process based on time-

space allocation procedures until the required number of completed responses was achieved. In addition, expert panels and Delphi rounds were conducted with specialists in accounting, auditing, and futures studies in order to identify, refine, and validate the principal components and strategic variables of the proposed model.

Data collection in this study was carried out using a researcher-developed questionnaire designed specifically in accordance with the conceptual framework and qualitative findings of the research. The questionnaire included targeted and structured items aimed at evaluating the relationships among the identified variables and assessing their influence on sustainable auditing and sustainability reporting processes. The development of the instrument was grounded in the categories extracted from expert interviews and qualitative coding procedures, which initially generated a large number of conceptual indicators and primary codes. Following multiple rounds of expert review and Delphi analysis, the variables were refined and categorized into eight major dimensions, including institutional challenges, uncertainty and sustainability information risk, auditor role evolution, social trust, stakeholder pressure, technology, auditor independence, and sustainability linkage with organizational strategy. The questionnaire utilized a four-point unipolar scale ranging from zero to three to evaluate the degree of influence among variables, where zero represented no influence and three indicated a strong influence. In addition to the questionnaire, expert panel discussions and Delphi-based consultations were employed to enhance the validity and comprehensiveness of the identified components and to facilitate the extraction of future scenarios and strategic variables. The use of both qualitative and quantitative tools enabled the researchers to obtain a comprehensive understanding of the structural relationships among the variables affecting sustainable auditing.

The collected data were analyzed using both qualitative and quantitative analytical approaches with an emphasis on futures studies techniques and cross-impact analysis. Initially, qualitative analyses, including coding procedures and Delphi-based expert evaluations, were conducted to identify the main concepts, categories, and strategic dimensions influencing sustainable auditing. Subsequently, the MICMAC (Matrix of Cross Impact Multiplications Applied to Classification) method was employed to analyze the influence and dependence relationships among variables. An 8×8 cross-impact matrix was formed and completed by experts who evaluated the intensity of direct and indirect relationships among the identified variables. The analysis process involved multiple matrix rotations within MICMAC software to achieve an optimal level of validity and stability in the system structure. Variables were then classified into influential, dependent, autonomous, and linkage categories according to their penetration power and dependence degree. Scatter plots and influence-dependence maps were generated to determine the stability of the system and identify strategic variables affecting the future of sustainable auditing. Furthermore, scenario analysis was conducted to develop possible future scenarios based on the identified strategic drivers and uncertainties. Through expert collaboration, several future-oriented scenarios for sustainable auditing were extracted and interpreted in relation to policy, professional, and educational implications. The integration of MICMAC analysis, Delphi methodology, and scenario planning enabled the study to construct a comprehensive structural model for understanding the future dynamics of sustainable auditing within the context of sustainability reporting.

3. Findings and Results

Cross-impact analysis is a graphical and structural method used to identify and evaluate variables according to their degree of influence and dependence within a system. In this method, variables are positioned in a coordinate system divided into four quadrants based on their penetration power and dependence level. The analytical framework of MICMAC is formed through the interaction between the influence exerted by variables and the extent

to which they are influenced by other variables. Accordingly, the most important variables in the system are first identified and then entered into a cross-impact matrix in order to determine the intensity and direction of their relationships. In this matrix, variables located in the rows act as influencing variables, whereas variables located in the columns are considered influenced variables.

The cross-impact matrix in the present study was developed using the MICMAC technique as a combined qualitative–quantitative analytical approach. An expert panel consisting of six operational and academic specialists in auditing, accounting, and futures studies participated in the completion of the matrix. The matrix was designed as an 8×8 structure, and the experts evaluated the degree of influence among variables using a four-point scale ranging from 0 to 3, where 0 represented no influence and 3 represented a strong influence. After data collection, the matrix-based questionnaire was entered into MICMAC software for structural analysis and identification of strategic variables.

Following two rounds of matrix rotation in MICMAC software, the system reached 100% desirability, indicating a high degree of validity and coherence among the variables. Out of 64 possible relationships in the matrix, 56 relationships were identified as meaningful, resulting in a fill rate of 87.5%. This finding indicates that more than 88% of the identified variables exert influence on one another, demonstrating a highly interconnected and dynamic system. The results of the initial structural analysis of the cross-impact matrix are presented in Table 1.

Table 1. Initial Analysis of Cross-Impact Matrix Data (Structural Analysis)

Fill Rate	Total Relationships	High Impact (3)	Medium Impact (2)	Weak Impact (1)	No Impact (0)	Number of Iterations	Matrix Size
87.5%	56	37	19	0	8	2	8×8

As previously explained, eight principal variables were identified as the main components of the system and were incorporated into the decision-making model. These variables formed the dimensions of the cross-impact matrix and represented the fundamental categories influencing the future of sustainable auditing based on sustainability reporting. Each expert assessed the impact of one variable on another through the four-point influence scale. Following completion of the questionnaires, the collected data were analyzed using MICMAC software in order to determine the structural relationships among variables.

Identifying the principal components constituted one of the most important stages of the modeling process. Through interviews conducted with nine experts, 59 initial codes were extracted and subsequently condensed into eight fundamental categories. In the next stage, five experts and specialists participated in analytical evaluations and Delphi rounds to refine and validate the identified categories. Fuzzy Delphi analysis was employed to increase the precision and reliability of the categorization process. Ultimately, the eight core process variables influencing the future of sustainable auditing were identified and classified as shown in Table 2.

Table 2. Trends and Important Components of the Future Study of Sustainable Auditing Based on Sustainability Reporting

Row	Long Component Description	Short Component Description	Component Code
1	Institutional Challenges of Sustainable Auditing	Institutional Challenge	R1
2	Uncertainty and Risk of Sustainability Information	Uncertainty	R2
3	The Evolution of the Auditor Role	Auditor Role	R3
4	Legitimacy and Social Trust	Social Trust	R4
5	Stakeholder Pressure and the External Environment	Stakeholder Pressure	R5
6	Technology and the Future of Auditing	Technology	R6
7	Ethics, Independence and Conflicts of Interest	Auditor Independence	R7
8	Linking Sustainability to Organizational Strategy	Sustainability Link	R8

The distribution of variables within the MICMAC scatter plot reflects the degree of system stability or instability. In stable systems, the distribution of variables resembles an "L-shaped" pattern in which some variables demonstrate high influence while others exhibit high dependence. Under such conditions, the role and position of each factor can be clearly interpreted. Conversely, unstable systems are characterized by variable dispersion around the diagonal axis, where most variables simultaneously possess moderate influence and moderate dependence. Such systems are considerably more complex because the strategic importance of variables becomes difficult to distinguish.

The results of the present study indicated that most variables were concentrated around the diagonal axis of the scatter plot, suggesting a semi-unstable and interactive system structure. Only a limited number of variables demonstrated exceptionally high influence power, whereas the remaining variables displayed relatively similar structural positions with differences primarily in the intensity of their impacts.

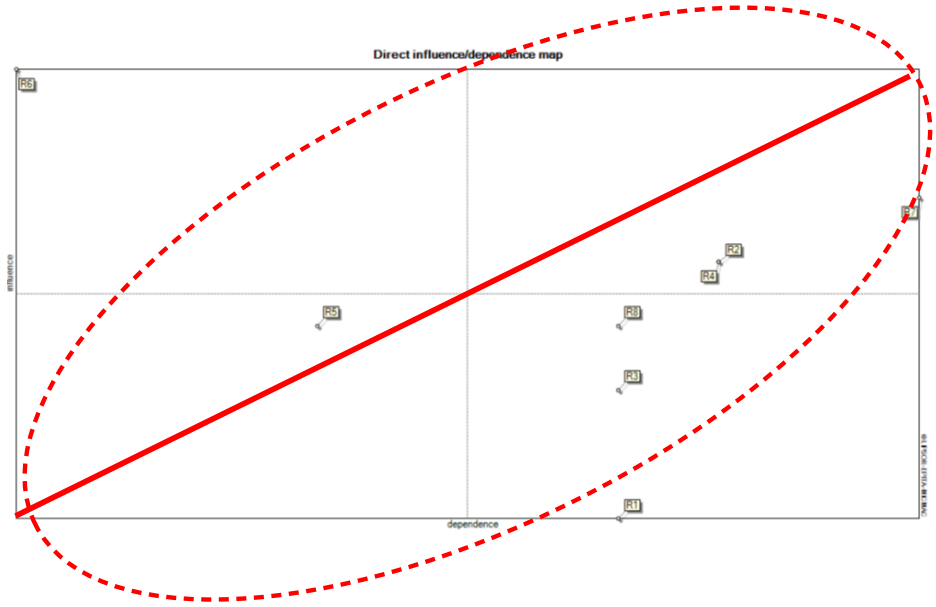


Figure 1. Scatter Map of Variables and Their Position on the Direct Influence–Dependence Axis

The MICMAC software measured both direct and indirect effects of variables through two rounds of analysis, thereby identifying the position of each variable within the influence–dependence diagram. This analytical procedure enabled the researchers to examine the strategic role and systemic scope of each variable more accurately, particularly through the assessment of indirect relationships among factors.

Table 3. Influence and Dependency of Components

Row	Components	Category Indicator	Penetration Rate	Degree of Dependence	Boundary of Influence and Dependence	Variable Type
1	Institutional Challenge	R1	14	18	5	Effective
2	Uncertainty	R2	18	19	5	Two-sided
3	The Role of the Auditor	R3	16	18	5	Effective
4	Social Trust	R4	18	19	5	Two-sided
5	Stakeholder Pressure	R5	17	15	5	Autonomous
6	Technology	R6	21	12	5	Influential
7	Auditor Independence	R7	19	21	5	Two-sided
8	Sustainability Link	R8	17	18	5	Effective

In MICMAC analysis, variables are classified into four major groups, including autonomous variables, dependent variables, linkage variables, and influential variables. Linkage variables are characterized by high influence and high dependence simultaneously, making them unstable but strategically important components of the system. The analysis demonstrated that uncertainty, social trust, and auditor independence belonged to the category of two-sided or linkage variables, indicating that these factors both influence and are influenced by other variables. Technology emerged as the strongest influential variable in the system, while stakeholder pressure was classified as an autonomous variable with relatively lower systemic dependence.

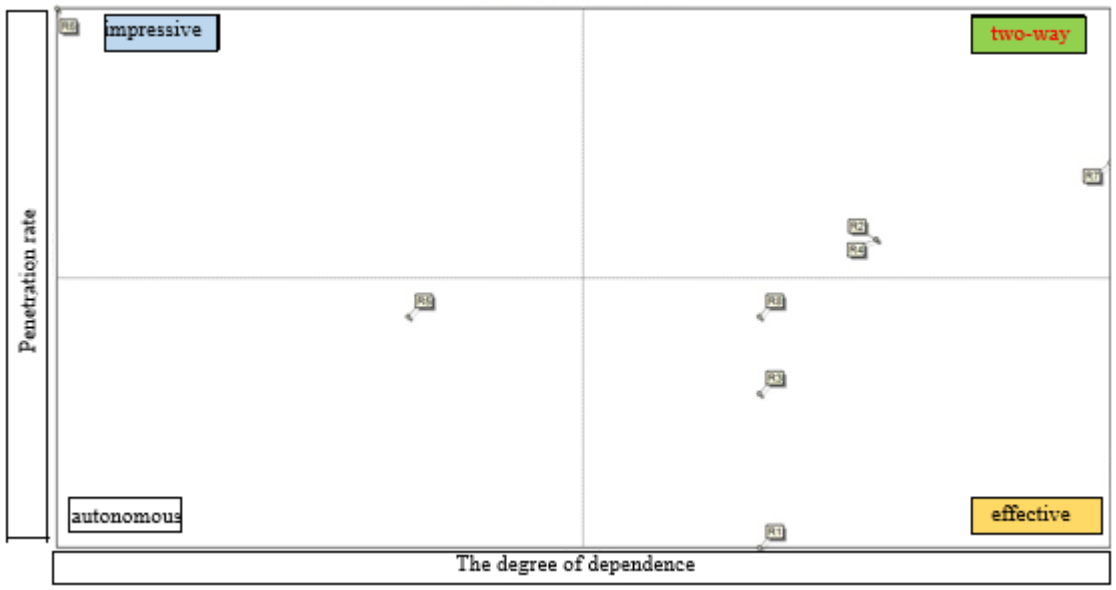


Figure 2. MICMAC Results

Strategic variables are those variables that can significantly influence the dynamics and future transformation of the system while also remaining manageable and controllable by policymakers and organizational actors. Variables with high influence power and relatively high dependence are generally considered strategic because they simultaneously shape the system and respond to systemic changes. Based on the influence–dependence map and the distribution of variables within the scatter plot, the strategic variables affecting the future of sustainable auditing based on sustainability reporting were identified as technology, uncertainty, social trust, and auditor independence.

Table 4. Strategic Variables Affecting the Future of Sustainable Auditing Based on Sustainability Reporting

Row	Strategic Variables	Strategic Variable Code
1	Technology	R6
2	Uncertainty	R2
3	Social Trust	R4
4	Auditor Independence	R7

Using these strategic variables and with the collaboration of four experts, the researchers developed several possible future scenarios for sustainable auditing. These scenarios illustrate different future trajectories depending on the maturity of regulations, technological advancement, professional competence, and institutional support.

Table 5. Possible Future Scenarios for Sustainable Auditing

Row	Scenario Title	Scenario Components	Characteristics	Outcome	Status
1	Symbolic Auditing	Formal reporting, widespread greenwashing, undermining public trust	Sustainability auditing reduced to checklist verification and apparent legitimacy	Reduction of sustainable auditing to a public relations instrument	Weak standards + weak auditors
2	Trust-Regulating Institution	Mandatory sustainability reporting, ESG auditing standards, technology and AI integration	Transparent regulations with conservative auditing approaches and limited innovation	Formal trust without strategic value creation	Strong standards + weak auditors
3	Reactive–Minimal Auditing	Professional auditors and audit control systems	Professional competence without institutional support, high legal risk, and quality differences	Progressive but unstable auditing structure	Weak standards + strong auditors
4	Predictive and Strategic Auditing	Integration of auditing with organizational strategy and long-term risk management	Scenario-based auditing, corporate governance integration, and future-oriented trust building	Institutionalization of sustainable auditing as a strategic decision-making pillar	Strong standards + capable auditors

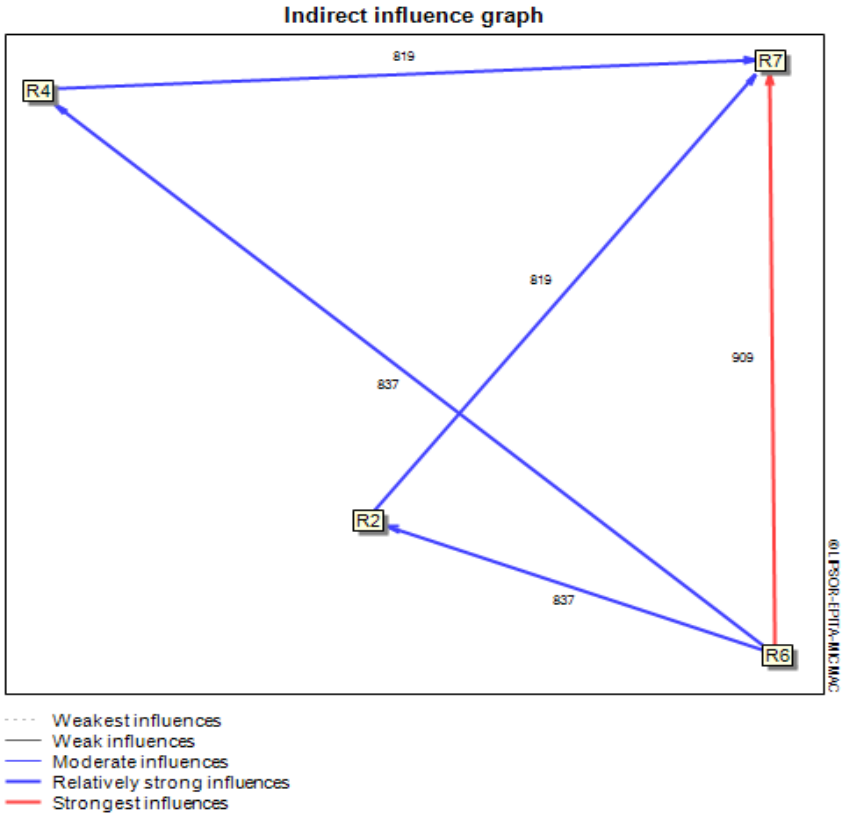
The scenario analysis demonstrated that sustainable auditing is likely to evolve from a conventional control-oriented process into a future-oriented institution focused on trust creation, strategic governance, and long-term sustainability management. This transition is highly dependent on the maturity of auditing standards, technological innovation, institutional support, and the development of professional competencies among auditors.

Table 6 illustrates the policy, professional, and educational implications associated with each future scenario. The results indicate that the successful realization of advanced sustainable auditing scenarios requires synergy among institutional reforms, professional development, and educational transformation.

Table 6. Comparative Scenario–Implications Analysis

Future Scenario	Policy Implications	Professional Implications	Educational Implications
Symbolic Auditing	Government intervention, minimum mandatory requirements, non-financial audit monitoring systems	Redefinition of auditor roles and strengthening ethical standards	Emphasis on ethics, legitimacy, and critical thinking
Trust-Regulating Institution	Empowering regulations and professional innovation policies	Strengthening professional judgment and ESG risk analysis	Interdisciplinary ESG and non-financial reporting education
Reactive–Minimal Auditing	Institutional support and interim guidance frameworks	Professional learning networks and risk management	Training auditors for uncertainty and futures studies
Proactive and Strategic Auditing	Integration of sustainability auditing into corporate governance and policymaking	Development of scenario-based auditing and strategic advisory roles	Specialized training in data mining, foresight, and long-term risk analysis

In the final stage of the analysis, the researcher developed the structural model with the assistance of four experts by considering the key variables and strategic drivers identified in the MICMAC analysis. The structural model was generated based on the indirect effects matrix using an impact coefficient of 3 and a graphing threshold level of 10%. Through expert consensus regarding the intensity of relationships among variables, the final structural network was established. In the resulting model, directional arrows indicate the existence and direction of influence between variables, thereby illustrating the hierarchical and structural relationships within the system.



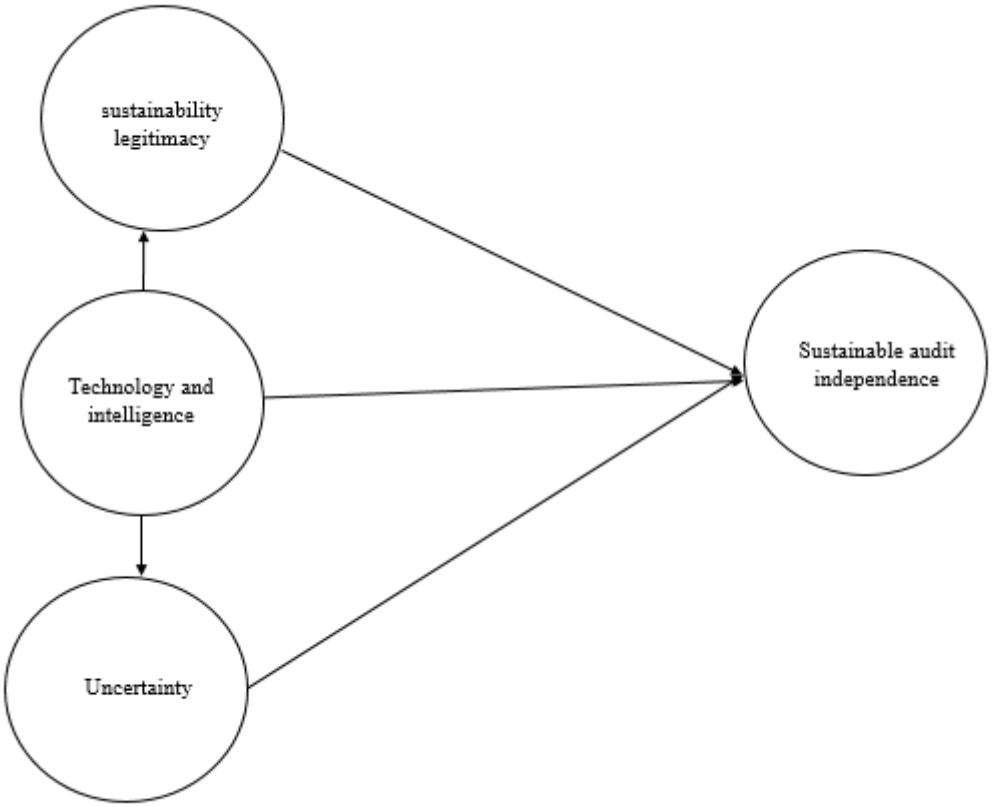


Figure 3. Final Structural Model

4. Discussion and Conclusion

The present study aimed to identify the key factors and strategic drivers affecting sustainable auditing based on sustainability reporting using a futures studies approach and MICMAC structural analysis. The findings demonstrated that the future of sustainable auditing is strongly influenced by several interconnected variables, including technology, uncertainty, social trust, auditor independence, stakeholder pressure, institutional challenges, and the integration of sustainability into organizational strategy. The results revealed that technology emerged as the most influential variable within the system, while uncertainty, social trust, and auditor independence were classified as linkage or two-sided variables with both high influence and high dependence. Furthermore, the study identified four major future scenarios for sustainable auditing, including symbolic auditing, trust-regulating auditing, reactive-minimal auditing, and predictive and strategic auditing. These findings indicate that sustainable auditing is evolving from a conventional compliance-oriented activity toward a strategic and future-oriented institutional mechanism centered on trust creation, ESG governance, and long-term sustainability management.

One of the most important findings of this study was the central role of technology in shaping the future of sustainable auditing. The results demonstrated that technology possesses the highest penetration rate among all identified variables, indicating its powerful influence over the entire sustainability assurance ecosystem. This finding aligns with previous studies emphasizing the transformative role of digital technologies, artificial intelligence, big data analytics, and blockchain systems in improving audit quality and sustainability assurance effectiveness [7-9]. Digital transformation enables auditors to analyze complex ESG-related information more efficiently, increase predictive capabilities, reduce operational risks, and improve transparency in sustainability reporting processes. The findings also support the argument that future auditing systems will increasingly depend on AI-assisted analytical tools and intelligent auditing frameworks capable of processing real-time sustainability information and detecting inconsistencies in non-financial disclosures [10]. In this regard, technological integration not only improves audit efficiency but also enhances the credibility and legitimacy of sustainability reporting systems in increasingly data-driven organizational environments.

The identification of uncertainty as a strategic linkage variable also represents a significant contribution of the present study. Sustainability reporting inherently involves future-oriented, non-financial, and often qualitative information, which increases the complexity and ambiguity of auditing processes. The findings suggest that uncertainty management is one of the primary determinants of sustainable auditing effectiveness because sustainability-related disclosures frequently involve climate risks, environmental obligations, governance uncertainties, and stakeholder expectations. This result is consistent with prior research highlighting the growing complexity of sustainability assurance and the need for auditors to manage information uncertainty and ESG-related risks more effectively [1, 2]. The study further indicates that organizations operating in unstable institutional or regulatory environments may experience greater challenges in implementing reliable sustainability assurance systems due to limited standardization and inconsistent disclosure practices. Therefore, uncertainty management becomes essential for strengthening the strategic role of sustainable auditing and reducing information asymmetry among stakeholders.

Another important finding concerns the role of social trust as a two-sided strategic variable. The results revealed that sustainable auditing significantly contributes to strengthening organizational legitimacy and stakeholder confidence. Social trust emerged as both an influential and dependent factor, suggesting that public confidence in

sustainability disclosures both shapes and is shaped by the quality of sustainability auditing systems. This finding is highly consistent with studies emphasizing the role of sustainability assurance in improving organizational transparency, legitimacy, and accountability [1, 4]. Sustainability auditing serves as an institutional mechanism for reducing skepticism regarding ESG disclosures and minimizing concerns related to greenwashing and symbolic reporting practices. The scenario analysis conducted in the present study further demonstrated that weak auditing standards and inadequate auditor competencies may result in symbolic auditing systems characterized by superficial compliance and diminished public trust. This finding supports the arguments proposed by previous scholars who warn that ineffective sustainability assurance frameworks may undermine organizational legitimacy and reduce stakeholder confidence in sustainability initiatives [5, 11].

The findings also emphasized the strategic importance of auditor independence in the sustainable auditing system. Auditor independence was classified as a linkage variable with both high influence and high dependence, indicating that the effectiveness of sustainability assurance heavily relies on the professional objectivity and ethical integrity of auditors. This result is supported by earlier research suggesting that sustainable auditing requires auditors to maintain high ethical standards and professional neutrality in evaluating ESG disclosures and sustainability-related risks [12, 13]. Auditor independence becomes particularly important in sustainability auditing because many sustainability disclosures involve voluntary reporting practices and qualitative judgments that may be vulnerable to managerial manipulation or symbolic presentation. The findings therefore indicate that strengthening professional ethics, institutional oversight, and regulatory independence is essential for ensuring the reliability and credibility of sustainable auditing processes.

The study additionally demonstrated that stakeholder pressure constitutes an important but relatively autonomous variable within the sustainable auditing ecosystem. Although stakeholder demands influence organizational sustainability behavior, stakeholder pressure alone is insufficient to guarantee the effectiveness of sustainability assurance unless accompanied by institutional support, professional competence, and technological advancement. This finding aligns with prior studies indicating that increasing stakeholder expectations regarding ESG accountability have motivated organizations to improve sustainability disclosures and adopt integrated auditing practices [3, 16]. However, the present study suggests that stakeholder pressure functions primarily as an external motivational factor rather than a structurally transformative variable. Consequently, organizations may respond symbolically to stakeholder demands if auditing systems lack robust regulatory frameworks and strategic institutional support.

Another significant contribution of the present study lies in the identification of four future scenarios for sustainable auditing. The symbolic auditing scenario represents a pessimistic future in which sustainability auditing is reduced to superficial compliance and public relations activities. This scenario reflects the risks associated with weak standards, limited auditor competence, and the prevalence of greenwashing practices. Similar concerns have been raised in previous studies discussing the dangers of symbolic sustainability disclosures and the erosion of stakeholder trust in weak assurance environments [2, 11]. In contrast, the predictive and strategic auditing scenario represents a highly developed and future-oriented auditing system characterized by strong standards, technologically capable auditors, and integration between sustainability assurance and organizational strategy. This scenario is consistent with recent research emphasizing the strategic transformation of auditing through digitalization, sustainability innovation, and integrated ESG governance [7, 9]. The findings therefore suggest that the future trajectory of sustainable auditing will largely depend on the interaction between technological maturity, institutional readiness, regulatory development, and professional competencies.

The findings of this study also support the growing body of literature linking audit quality to sustainable organizational performance. Sustainable auditing enhances transparency, strengthens governance systems, improves accountability, and contributes to long-term organizational resilience. This result aligns with evidence demonstrating that high-quality auditing positively affects sustainable growth rates, organizational performance, and economic development outcomes [14, 19]. Moreover, integrated sustainability assurance systems can contribute to sustainable resource allocation, efficient environmental management, and long-term institutional stability. Research on sustainable revenue generation and municipal financial sustainability similarly confirms the importance of strategic auditing mechanisms in promoting stable and sustainable organizational development [15]. The current findings therefore reinforce the notion that sustainable auditing is no longer merely a monitoring tool but rather a strategic governance mechanism capable of supporting organizational sustainability and long-term value creation.

The present study further highlights the importance of interdisciplinary competencies and continuous professional development within the auditing profession. Sustainable auditing requires auditors to possess expertise in ESG standards, environmental accounting, digital technologies, strategic risk analysis, and ethical governance. This finding supports earlier studies emphasizing the role of auditor competence and professional experience in improving audit judgment and sustainable assurance quality [12]. Furthermore, the increasing integration of sustainability concerns into banking systems, energy auditing, anti-money laundering frameworks, and public-sector governance demonstrates the expanding scope of auditing responsibilities in contemporary organizations [6, 17]. Consequently, educational institutions and professional organizations must redesign training programs to prepare auditors for increasingly complex and technology-driven sustainability assurance environments.

The findings additionally suggest that sustainable auditing plays a vital role in supporting sustainable development objectives at both organizational and societal levels. Sustainability assurance contributes to environmental accountability, energy efficiency, responsible governance, and strategic policymaking. Studies examining environmental auditing and sustainable energy programs similarly emphasize the importance of integrated auditing approaches in promoting sustainable development outcomes [6, 18]. The present study therefore confirms that sustainable auditing should be viewed as an essential component of future-oriented governance systems aimed at balancing economic growth with environmental protection and social responsibility.

One limitation of the present study concerns the relatively limited number of expert participants involved in the MICMAC and Delphi analyses, which may restrict the generalizability of the findings across different institutional and geographical contexts. In addition, the study relied primarily on expert judgments and futures studies methodologies rather than empirical longitudinal data, which may affect the external validity of some scenario projections. Another limitation relates to the dynamic nature of technological and regulatory developments in sustainability auditing, which may cause future structural relationships among variables to evolve over time. Furthermore, cultural, institutional, and legal differences among countries were not comparatively examined in this study, potentially limiting the applicability of the findings to broader international contexts.

Future research is recommended to empirically test the structural relationships identified in the present study using quantitative techniques such as structural equation modeling or partial least squares analysis. Comparative international studies could also examine how institutional environments, ESG regulations, and technological infrastructures influence sustainable auditing systems in developed and developing economies. Additional research may further investigate the role of artificial intelligence, blockchain technology, and machine learning in

transforming sustainability assurance practices. Moreover, future studies should explore stakeholder perceptions of sustainability assurance credibility and examine how sustainable auditing influences investor behavior, corporate legitimacy, and organizational trust over time.

From a practical perspective, organizations should strengthen their sustainability auditing systems through greater integration of digital technologies, ESG reporting standards, and strategic governance frameworks. Professional auditing institutions should invest in continuous education and interdisciplinary training programs focused on sustainability assurance, technological competencies, and ethical governance. Policymakers and regulatory authorities should also develop comprehensive sustainability auditing standards and establish effective oversight mechanisms to reduce greenwashing risks and improve stakeholder trust. In addition, organizations should integrate sustainability auditing into strategic decision-making processes in order to enhance long-term resilience, transparency, and sustainable value creation.

Authors' Contributions

Authors equally contributed to this article.

Ethical Considerations

All procedures performed in this study were under the ethical standards.

Acknowledgments

Authors thank all participants who participate in this study.

Conflict of Interest

The authors report no conflict of interest.

Funding/Financial Support

According to the authors, this article has no financial support.

References

[1] K. Rawat, "The role of auditors in enhancing sustainability disclosure credibility," *Research in Sustainable Finance,* vol. 10, no. 1, pp. 55-72, 2025.

[2] N. Karina, "Analysis and Audit of Reporting on Sustainable Development for Trade Networks and Directions for Their Improvement," 2023, doi: 10.35784/preko.4032.

[3] S. Abdulameer and N. K. Obaid, "the role of strategic auditing in achieving sustainable performance and its impact on improving the competitive advantage of the product (a practical study in some organizations registered in the iraq stock exchange)," *World Bulletin of Management and Law,* vol. 22, pp. 75-87, 2023.

[4] N. B. A. Akbar and F. S. Mahdi, "The Interest of the Supreme Audit Institution in Sustainable Economic, Social and Environmental Development on the Audit Quality Performance," *International Journal of Professional Business Review,* vol. 8, no. 1, p. 21, 2023, doi: 10.26668/businessreview/2023.v8i1.1164.

[5] H. T. Faieq and K. Cek, "Enhancing Kurdistan's manufacturing companies' sustainable waste management: A norm activation approach to green accounting, CSR, and environmental auditing oversight," *Heliyon,* vol. 10, no. 12, p. e32725, 2024, doi: 10.1016/j.heliyon.2024.e32725.

[6] O. A. Lawal, A. A. Jimoh, K. A. Abdullah, B. A. Bello, and E. D. Awoyemi, "Economic and environmental impact of energy audit and efficiency: A report from a Nigeria household," *Energy for Sustainable Development,* vol. 79, p. 101387, 2024, doi: 10.1016/j.esd.2024.101387.

[7] P. Q. Huy and V. K. Phuc, "Unfolding sustainable auditing ecosystem formation path through digitalization transformation: How digital intelligence of accountant fosters the digitalization capabilities," *Heliyon,* vol. 9, no. 2, 2023.

[8] K. Liović and I. Barišić, "Digital Transformation of the Internal Audit Function - Analysis of Technology Acceptance Factors and Perspectives of Future Development," in *ERAZ Conference - Knowledge Based Sustainable Development: Vol 10. Conference Proceedings*, P. Alexandre Ed., 2024, pp. 147-156.

[9] S. V. Tritama, N. A. Mahaprajna, and B. Leo, "The Role of AI Adoption in Achieving Sustainable Audit Quality," *Journal of Theoretical and Applied Information Technology,* vol. 103, no. 2, 2025.

[10] Y. Zhang, Y. Zhang, and Z. Wang, "Digital transformation of national audits and regional sustainable development: Evidence from China," *Sustainability,* vol. 16, no. 24, p. 10830, 2024, doi: 10.3390/su162410830.

[11] K. NaTaliya and P. L.V, "Audit of Sustainable Development of Electronic Industry Organizations," *Аудитор,* 2023, doi: 10.12737/1998-0701-2023-9-4-9-17.

[12] Z. Hanum and F. Rahmadana, "The Impact of Auditor Competence and Auditor Experience on Audit Judgement, Mediated by Task Complexity, within Public Accounting Firms in the City of Medan," *Journal of Law and Sustainable Development,* vol. 12, no. 1, pp. 1-14, 2024, doi: 10.55908/sdgs.v12i1.1925.

[13] N. Masoud, "Moderating Effect of Sustainable Innovation on Internal Audit Effectiveness and Sustainability Auditing Practices: Evidence from Libya's Public Sector," *International Journal of Financial Studies,* vol. 13, no. 2, p. 69, 2025, doi: 10.3390/ijfs13020069.

[14] H. Nourani and R. Adeli, "The Impact of Audit Quality on Firm Performance Based on Sustainable Growth Rate with an Emphasis on the Role of Product Market Competition," *Accounting and Management Perspective,* vol. 5, no. 68, pp. 32-46, 2022. [Online]. Available: https://www.jamv.ir/article_160328.html.

[15] G. Kordestani and V. Shahbazi, "Examination of sustainable revenue sources for Hamadan Municipality and proposing a sustainable model for revenue resource stabilization and financial resource provision in municipalities: Case study of Hamadan Municipality," *Research in Accounting and Operational Auditing,* vol. 5, no. 2, pp. 81-104, 2025. [Online]. Available: https://jopa.khatam.ac.ir/article_223775_e455f7814385b61628957b5839749674.pdf.

[16] R. Mazraeh Farahani, M. Oshk Sarai, G. R. Mahfouzi, and M. Taleghani, "Sustainable Banking Methods for Improving the Performance of the Banking Industry - A Review of the Literature to a Conceptual Framework," *Journal of Accounting and Auditing Studies,* vol. 12, no. 47, pp. 71-90, 2023.

[17] S. Ismail, R. M. Abdou, and M. S. Ibrahim, "Who is Better in Practicing Customer Due Diligence as an Anti-Money Laundering Tool for Financial Institutions: Can Internal Auditors Be Forensic Accountants? Evidence from MENA Region," in *Sustainable Data Management: Navigating Big Data, Communication Technology, and Business Digital Leadership. Volume 1*, 2025, pp. 11-23.

[18] F. R. Febrianto, F. Amyar, and R. Puspitasari, "Analysis of integrated audit approach in auditing sustainable energy development programs in State-Owned Enterprises," *Jurnal Ilmiah Akuntansi Kesatuan,* vol. 12, no. 6, pp. 487-498, 2024.

[19] E. Aghakhani and M. Khanlari, "Examining the role of financial information transparency and tax auditing in improving tax compliance and its effect on sustainable economic growth," in *First Regional Congress on Current Issues in Intelligent Accounting, Auditing, Financial, and Tax Systems: Challenges and Opportunities*, 2024, pp. 40-53.