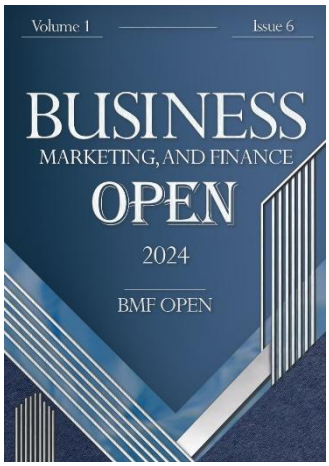
Design and Validation of a Native Conceptual Model for Evaluating and Improving Internal Audit Performance in the Iranian Petrochemical Industry Using a Mixed-Methods Approach



Mozhgan Heidari [1], Ali Akbar Chaharmahali [2,*] and Mehran Matinfard [3]

[1] Ph.D. student in Accounting, Department of Accounting, North Tehran Branch, Islamic Azad University, Tehran, Iran;
[2] Assistant Professor, Department of Accounting, North Tehran Branch, Islamic Azad University, Tehran, Iran;
[3] Assistant Professor, Department of Accounting, North Tehran Branch, Islamic Azad University, Tehran, Iran;

* Correspondence: chaharmahali@iau.ac.ir

Abstract: This study was conducted with the aim of designing and validating a native conceptual model for evaluating the performance of internal auditing in the Iranian petrochemical industry and identifying existing gaps. In the qualitative phase, using meta-synthesis and a systematic review of 157 studies published between 2000 and 2024, a total of 25 selected studies were coded. In the quantitative phase, data were collected from 100 petrochemical complexes and analyzed using structural equation modeling and paired t-tests. The results indicated that the input, process, and output dimensions have a significant effect on internal audit quality, and a considerable gap exists between the current and the desired state. The largest gap was observed in independence and objectivity, and the smallest gap in training and development. The innovation of this study lies in presenting a native model tailored to the structure and conditions of the Iranian petrochemical industry, which can serve as a foundation for the continuous improvement of internal audit units.

Keywords: Native model for evaluating internal audit performance, mixed-methods approach, Iranian petrochemical industry, meta-synthesis, structural equation modeling

Citation: Heidari, M., Chaharmahali, A. A., & Matinfard, M. (2024). Design and Validation of a Native Conceptual Model for Evaluating and Improving Internal Audit Performance in the Iranian Petrochemical Industry Using a Mixed-Methods Approach. *Business, Marketing, and Finance Open*, 1(6), 184-195.

Received: 04 September 2024
Revised: 21 November 2024
Accepted: 24 November 2024
Published: 10 December 2024

1. Introduction

Internal auditing has evolved into a critical pillar of organizational governance, risk management, and performance assurance in contemporary industries. As global competition intensifies and organizations operate in increasingly complex regulatory and technological environments, internal audit functions must not only ensure compliance but also contribute to strategic decision-making, process optimization, and value creation. In this context, internal auditing has shifted from a narrow compliance-focused role toward a risk-based, advisory, and performance-oriented discipline, reflecting broader shifts in corporate governance, regulatory expectations, and industry dynamics [1]. This evolution has been particularly pronounced in industries with high operational complexity and capital intensity, such as energy,

petrochemicals, and large-scale manufacturing, where internal auditors face multifaceted challenges associated with risk exposure, technological adoption, and stakeholder expectations.

A substantial body of international literature emphasizes that the effectiveness of internal audit functions depends on a constellation of organizational, professional, and contextual drivers. Arena and Azzone (2009), for instance, demonstrated that factors such as auditor competence, organizational support, communication quality, and independence significantly shape internal audit effectiveness [2]. Their findings highlight that internal audit performance cannot be viewed merely as the output of isolated auditing activities; instead, it reflects a systemic interaction among organizational structures, cultural factors, and audit team capabilities. Subsequent research across different geographical and industrial contexts has reinforced this systemic perspective. Chan and Wan (2023) showed that in emerging Asian markets, corporate governance mechanisms—particularly audit committee strength and board oversight—play a decisive role in enhancing internal audit quality [3]. These studies collectively underscore the growing recognition that internal audit performance is a multidimensional construct requiring context-specific evaluation models.

In parallel with global developments, scholarly attention to internal auditing within Iran has grown considerably in recent years. The Iranian energy and petrochemical sectors, due to their strategic importance and economic scale, have become focal points for empirical investigations into internal audit effectiveness. Ahmadi and colleagues (2023) proposed a performance evaluation model tailored to internal audit units in the Iranian energy industry and argued that the intricacy of sectoral operations necessitates specialized, contextually grounded assessment frameworks [4]. This aligns with insights from Zarei and Esfandiari (2020), who identified a series of organizational and environmental factors—including staffing quality, training adequacy, technological infrastructure, and managerial support—that shape internal audit effectiveness in the Iranian energy sector [5]. Their study emphasized that internal auditing in Iran cannot be effectively evaluated using generic global models, given distinctive contextual challenges such as governance structures, regulatory conditions, and operational risk profiles.

In this regard, Iranian petrochemical organizations face a combination of sector-specific risks that magnify the importance of strong internal auditing practices. These risks include volatile global market conditions, high sensitivity to technological disruptions, safety and environmental concerns, and complex supply chain dynamics. Vazifedar and Ahmadi (2023) examined internal audit quality in the Iranian petrochemical industry and found a positive association between audit quality and improvements in financial reporting accuracy, underscoring the strategic relevance of internal auditing in this domain [6]. Their work suggests that internal auditing must be conceptualized not merely as a monitoring tool but as an enabler of broader organizational performance, transparency, and accountability.

A growing stream of research further stresses that independence and objectivity are central determinants of internal audit quality. Ghasemi and Alipour (2022) demonstrated that internal audit independence contributes significantly to improved financial reporting quality in Iranian organizations [7]. Similarly, Okoduwa et al. (2019) found that independence, competence, and organizational support represent the most influential drivers of internal audit effectiveness in service organizations across Nigeria [8]. Although their study was conducted in a different national context, the emphasis on independence and competence resonates strongly with Iranian research findings, suggesting a cross-contextual pattern in internal audit performance determinants.

In addition to independence, auditor competencies and continuous professional development have been highlighted as crucial enablers of audit quality. Zarfash et al. (2020) studied the Iranian energy industry and

identified training, technological capability, and auditor skill enhancement as core factors that elevate internal audit performance [9]. These findings are corroborated by international literature. For example, Ode and Onwadi (2016) emphasized the need for internal auditors to embrace advisory roles, supported by advanced analytical techniques, to contribute meaningfully to process improvement [10]. Such studies underscore that traditional auditing skills must now be supplemented with competencies in risk assessment, data analytics, digital technologies, and strategic communication.

Technological developments—particularly the emergence of artificial intelligence (AI), automation, and advanced analytics—are also transforming internal audit processes and reshaping expectations regarding audit performance. Zare et al. (2024) examined the effect of AI adoption on audit quality and demonstrated that the integration of AI tools enhances the accuracy, speed, and analytical depth of financial statement audits [11]. Their findings highlight the transformative potential of digital technologies and the necessity for internal audit models to account for technological readiness and capability as integral components of performance. The growing reliance on technology within auditing unveils new dimensions of performance evaluation, such as system interoperability, data governance, and algorithmic accountability, which traditional frameworks may fail to address.

Similarly, concerns related to governance structures and external oversight remain pivotal in shaping internal audit performance. Sem and Hastuti (2024) emphasized that the strength of audit committees, the robustness of internal control systems, and the overall quality of auditing practices are central determinants of financial reporting reliability [12]. Their research, although grounded in the finance sector of the Indonesian Stock Exchange, parallels the governance challenges faced by Iranian petrochemical firms, where audit committees often play a decisive role in enabling or constraining audit unit effectiveness.

The influence of auditor characteristics on audit outcomes is another important aspect highlighted in emerging literature. Shaban Khamseh and Bokharaeian Khorasani (2024) found that the personal and professional attributes of audit partners—including experience, risk orientation, and judgment quality—significantly affect audit fees and audit outcomes [13]. While their study focused on external auditing, the implications for internal audit performance are clear: human capital quality—including expertise, ethical orientation, and decision-making ability—constitutes an indispensable dimension of audit effectiveness.

Given the prevailing gaps in training, technological adoption, independence, and structural support within Iranian industries, Lee et al. (2022) proposed a structural equation model for internal audit performance evaluation in manufacturing settings, demonstrating that performance must be analyzed through dynamic interactions among input factors, process quality, and output outcomes [14]. Their model underscores the necessity of multi-faceted performance evaluation frameworks that can capture complexity, interdependency, and context-specific factors affecting audit functions.

Despite the abundance of research, several limitations characterize current scholarly work on internal audit performance evaluation in Iran. First, most prior studies have relied on descriptive or correlation-based methodologies, offering limited insight into causal and structural relationships among performance determinants. Second, only a handful of studies have addressed the petrochemical industry directly, despite its strategic and operational complexity. Third, very few attempts have been made to integrate qualitative synthesis with quantitative modeling to develop a holistic, empirically grounded, and context-sensitive performance evaluation model. This methodological gap is notable given the rapidly evolving institutional, technological, and governance environments in Iran.

Furthermore, existing research often examines individual determinants—such as independence, governance structures, skill levels, or technological readiness—in isolation. Comprehensive models that incorporate inputs, processes, and outputs within a unified conceptual structure remain scarce. This gap is particularly problematic for the petrochemical sector, where internal audit units must address multifaceted risks, comply with international standards, support strategic decision-making, and maintain resilience in the face of global market fluctuations.

The need for a context-specific internal audit performance evaluation framework is therefore both theoretically and practically urgent. Such a model should incorporate the full range of organizational, professional, technological, and governance-related factors highlighted in previous research. It should also reflect the realities of Iranian petrochemical firms—organizations characterized by large-scale operations, complex risk structures, extensive regulatory obligations, and heavy reliance on technological systems. This aligns with the arguments made by Zarfash et al. (2020) regarding technology and training [9], by Vazifedar and Ahmadi (2023) regarding performance impacts [6], by Zarei and Esfandiari (2020) regarding sectoral characteristics [5], and by Ahmadi et al. (2023) concerning the unique needs of Iran's energy industries [4].

In addition, scholarly evidence indicates that internal audit performance cannot be effectively evaluated without considering external pressures, technological transformations, and governance dynamics [2, 3, 10, 12]. The convergence of these factors in the petrochemical sector necessitates the development of a tailored conceptual model that is grounded in both global best practices and local contextual realities.

Considering these gaps and the need for a rigorous evidence-based framework, this study seeks to contribute to the literature by integrating meta-synthesis and structural equation modeling to construct and validate a native conceptual model of internal audit performance for the Iranian petrochemical industry.

The aim of the study is to design and validate a context-specific conceptual model for evaluating internal audit performance in the Iranian petrochemical industry.

2. Methodology

This study employed an exploratory mixed-methods approach to achieve its objectives. This approach enables the researcher to obtain a more comprehensive and in-depth understanding of the phenomenon under investigation by integrating qualitative and quantitative methods. The qualitative phase of the study began with the identification and classification of key factors through the meta-synthesis method, the steps of which are described below.

In the qualitative phase, meta-synthesis was used. This method aims to synthesize and integrate qualitative findings from multiple studies. The seven-step model of Sandelowski and Barroso (2007) was adopted for conducting the meta-synthesis:

1. **Defining the research question:** The main qualitative question was: "What factors influence the performance of internal auditing in the Iranian petrochemical industry?"
2. **Systematic search:** Studies related to internal audit performance evaluation, internal audit effectiveness, as well as research associated with the petrochemical industry, were searched in reputable domestic databases (such as Magiran and SID) and international databases (such as Web of Science, Scopus, and Google Scholar) between 2000 and 2024. Search keywords included "internal auditing," "performance evaluation," "petrochemical industry," "effectiveness," "corporate governance," "modeling," "qualitative-quantitative," "mixed-methods," "meta-synthesis," and their English equivalents.

3. **Study selection:** After removing duplicate and irrelevant studies, 157 preliminary studies were reviewed. Inclusion criteria included relevance to the topic, publication in scientific–research journals or reputable conferences, and provision of qualitative or quantitatively synthesizable findings. Ultimately, 25 studies with the highest overlap and relevance to the research question were selected for analysis.
4. **Data extraction and coding:** Key information from each selected study (such as findings, concepts, influential factors, and results) was extracted and coded using MAXQDA software. Recurrent and similar themes in the codes were identified and categorized.
5. **Analysis and synthesis:** The key themes derived from coding were systematically compared and integrated to identify overarching patterns and fundamental concepts. This stage included identifying relationships between concepts and developing an initial conceptual framework.
6. **Validation of findings:** The qualitative findings were validated through re-reviewing the studies and, where possible, conducting preliminary interviews with several petrochemical industry experts (who were later included in quantitative data collection).
7. **Presentation of findings:** The qualitative results were presented in the form of dimensions and components influencing the evaluation of internal audit performance in the Iranian petrochemical industry.

By identifying the three main dimensions—input, process, and output—and their related codes, the qualitative findings served as the foundation for designing the quantitative questionnaire. This questionnaire assessed both the current and desired conditions of each component, and its data analysis is presented in the quantitative section.

In the quantitative phase, with the aim of empirically testing the conceptual model derived from the qualitative phase and identifying the gap between current and desired conditions, a survey method and structural equation modeling were used.

• **Statistical population:** All active petrochemical complexes in Iran. According to the Iranian Petrochemical Industry Association, the number of such complexes at the time of the study was approximately 100 units.

• **Sample and sampling method:** Using the snowball sampling method, participants were selected from among managers, supervisors, and senior experts of internal audit units. The selection targeted individuals most familiar with internal audit processes in this industry.

Sample size: 245 participants.

Demographic characteristics of respondents:

Gender: 71% male, 29% female

Average work experience: 12.4 years

Education: 16% bachelor's degree, 62% master's degree, 22% PhD

Job position: 28% internal audit managers, 39% audit supervisors, 33% senior audit experts

• **Data collection instrument:** The main data collection instrument was a researcher-developed questionnaire. This questionnaire was developed based on the qualitative findings and literature review and consisted of two parts:

o Part one: Questions assessing the current status of identified factors in various dimensions (input, process, output).

o Part two: Questions assessing the desired status of these factors.

A five-point Likert scale was used to measure respondents' attitudes toward each item. The validity and reliability of the questionnaire were confirmed using exploratory and confirmatory factor analyses on a pilot sample and by calculating Cronbach's alpha for reliability assessment.

• **Data analysis method:** The collected data were analyzed using AMOS and SPSS software. Analytical methods included:

o **Confirmatory factor analysis (CFA):** To confirm the factor structure of the proposed model and examine its fit with the data. Fit indices such as AGFI, RMSEA, TLI, CFI, GFI, and Chi-square/df were evaluated.

o **Structural equation modeling (SEM):** To test the relationships among identified dimensions and their impact on internal audit quality.

o **Paired t-test:** To examine the presence of a performance gap between the current and desired status across each identified factor and dimension, the mean scores of the two conditions were compared using paired t-tests. The results showed significant mean differences across all dimensions and components ($p < 0.05$). The greatest difference was related to "independence and objectivity," and the smallest difference was in "training and development." Detailed mean differences and implications for management are presented in the quantitative findings section.

3. Findings and Results

The thematic analysis derived from the meta-synthesis of 25 studies led to the identification and classification of factors influencing internal audit performance in the Iranian petrochemical industry across three main dimensions:

• **Input dimensions:** These dimensions refer to the resources and prerequisites required for conducting internal audit activities. The key components identified in this dimension include:

o *Human resources:* encompassing knowledge, skills, experience, and professional expertise of internal auditors.

o *Training and development:* the extent of investment in specialized training and continuous knowledge updating of auditors.

o *Independence and objectivity:* the degree of freedom of the internal audit unit from managerial influence and its ability to provide unbiased reports.

o *Support from senior management and the audit committee:* the level of backing and attention from top management to internal audit activities.

o *Budget and financial resources:* adequacy of financial resources allocated to the internal audit unit.

• **Process dimensions:** These refer to the methods, procedures, and tools used in carrying out internal audit duties. Key components identified include:

o *Audit methods and tools:* quality of planning, execution of audit tests, and use of advanced auditing techniques.

o *Documentation and reporting:* accuracy, comprehensiveness, and clarity of audit documentation and reports.

o *Risk management:* attention of internal auditors to identifying and assessing organizational risks.

o *Stakeholder communication:* quality of interaction with other units, management, and the audit committee.

• **Output dimensions:** These refer to the results and outcomes of internal audit activities. The key components identified include:

o *Reporting quality:* accuracy, timeliness, and provision of practical recommendations in audit reports.

o *Stakeholder satisfaction:* level of satisfaction of management, the audit committee, and other users of audit reports.

o *Value added:* the extent to which internal auditing improves processes, internal controls, and the overall performance of the organization.

o *Risk and fraud reduction:* the role of internal auditing in preventing and identifying noncompliance and misconduct.

Figure 1 illustrates the qualitative findings, providing a comprehensive depiction of the factors influencing the evaluation of internal audit performance in the Iranian petrochemical industry.

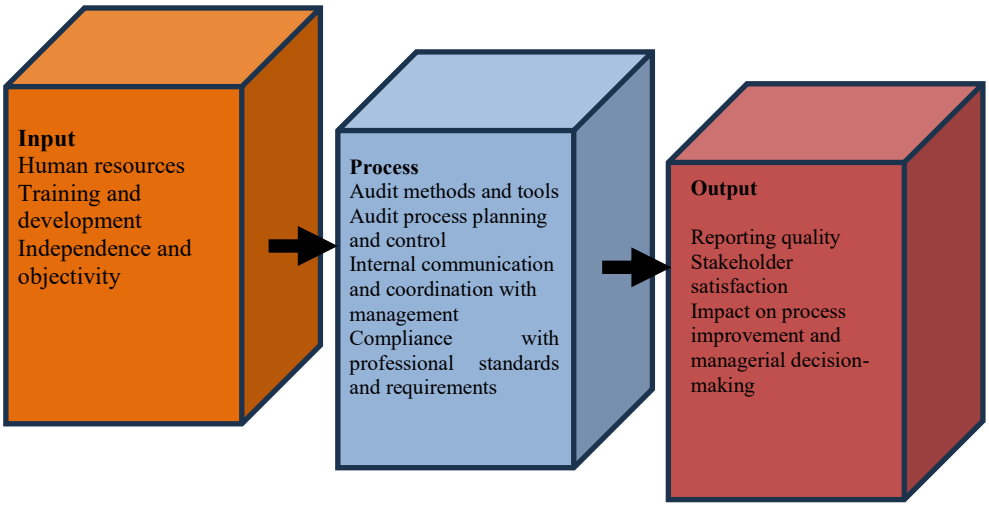


Figure 1. Conceptual Model

Table 1. Main Codes and Subcodes Extracted from the Meta-Synthesis of Studies Related to Internal Audit Performance Evaluation in the Iranian Petrochemical Industry

Dimension	Main Code	Subcodes	Number of Supporting Studies
Input	Human resources	Knowledge, skills, and experience of internal auditors; professional expertise and valid certifications	15
Input	Training and development	Continuous specialized training; knowledge updating programs; organizational investment in skills enhancement	14
Input	Independence and objectivity	Structural separation from executive management; no CEO interference in auditor selection; formal audit charter	12
Process	Audit methods and tools	Comprehensive planning; execution of internal control tests; use of modern auditing technologies	20
Process	Audit planning and process control	Setting precise objectives and timelines; continuous monitoring and improvement	13
Process	Internal communication and coordination with management	Effective interaction with the audit committee and operational units; smooth reporting flow	18
Process	Compliance with professional standards	Full alignment with IIA standards; participation in external assessments	18
Output	Reporting quality	Clarity of language; inclusion of actionable recommendations; follow-up on corrective actions	18
Output	Stakeholder satisfaction	Increased satisfaction of management and audit committee; acceptance of recommendations	16
Output	Contribution to process improvement & managerial decision-making	Enhanced decision transparency; reduced operational risk; creating added value	15

After extracting and categorizing key factors from the qualitative phase, this section presents the empirical testing of the conceptual model and the relationships between identified dimensions using quantitative methods.

The fit indices of the final model indicate a good overall fit with the data. The model fit indices are as follows:

$\chi^2/df = 2.35$ (below 3; indicating good fit)

GFI = 0.91 and AGFI = 0.88 (above 0.85; satisfactory)

CFI = 0.94 and TLI = 0.92 (above 0.90; very good)

RMSEA = 0.061 (below 0.08; acceptable)

SRMR = 0.047 (below 0.05; excellent)

Given these values, the model demonstrates strong fit (CFI and TLI above 0.90; RMSEA below 0.08). These results confirm that the proposed three-dimensional structure aligns well with the data, and the observed variables adequately explain the latent constructs.

The SEM results are highly consistent with the qualitative findings. The positive and significant effects of the input and process dimensions on internal audit quality empirically confirm the importance of components such as independence and objectivity, staff competencies, and audit execution methods identified in the qualitative phase.

The results of the paired t-test showed significant differences between the current and desired status across all components ($p < 0.05$), indicating a meaningful gap across all identified dimensions and components.

Greatest gap: *Independence and objectivity* — mean difference = 1.34

Smallest gap: *Training and development* — mean difference = 0.64

These findings indicate that strengthening independence and objectivity in internal audit units is a higher priority compared to other dimensions.

The final model of this study is a comprehensive conceptual model that introduces the three main dimensions—Input (human resources, training and development, independence and objectivity), Process (audit methods/tools, audit planning and control, internal communication and managerial coordination, compliance with professional standards), and Output (reporting quality, stakeholder satisfaction, contribution to process improvement and managerial decision-making)—as key factors influencing internal audit quality in the Iranian petrochemical industry. This model, integrating both theoretical and context-specific empirical findings, provides an operational framework for evaluating and improving internal audit performance in this industry.

4. Discussion and Conclusion

The findings of this study demonstrate that the performance of internal audit units in the Iranian petrochemical industry is significantly influenced by a set of interrelated input, process, and output dimensions. The results from the structural equation modeling reveal that the input dimension—which includes human resource competencies, training and development, independence and objectivity, managerial support, and financial resources—exerts a strong and meaningful impact on internal audit performance. This aligns closely with earlier research showing that internal audit effectiveness is fundamentally shaped by organizational resources and structural supports. For instance, Arena and Azzone (2009) argued that internal audit quality is a function of organizational drivers such as competence, independence, and interaction quality [2]. The present study reinforces these conclusions by empirically demonstrating similar patterns in the Iranian petrochemical context, where human expertise, auditor autonomy, and adequate resourcing emerged as central determinants of audit performance.

A particularly significant finding is the large performance gap identified in the "independence and objectivity" component, which registered the highest mean difference between current and desired conditions. This finding is strongly aligned with the literature, which consistently emphasizes the fundamental role of independence in ensuring audit quality. Ghasemi and Alipour (2022) found that the independence of internal auditors directly contributes to higher-quality financial reporting and enhances the reliability of organizational controls [7].

Similarly, the study by Okoduwa et al. (2019) identified independence, competence, and organizational support as core determinants of audit effectiveness in service organizations, reinforcing the cross-contextual relevance of independence as a primary audit quality driver [8]. Taken together, these findings indicate that despite growing recognition of internal auditing's strategic role, the petrochemical sector still faces structural challenges related to governance, reporting lines, and auditor autonomy.

The comparatively small gap observed in the "training and development" component suggests that most petrochemical organizations have already institutionalized some level of skill development and professional training for internal auditors. This observation is consistent with the research of Zarfash et al. (2020), who found that training, technology use, and ongoing skills development significantly enhance internal audit performance in Iran's energy industries [9]. While the current study indicates that training activities exist to some extent, the persistence of performance gaps in other areas suggests that training efforts may not be sufficiently aligned with emerging audit challenges such as advanced analytics, digital auditing, and integrated risk management.

The results also highlight the crucial influence of process-related factors, particularly audit methods, documentation quality, risk identification, and communication with stakeholders. These findings are supported by previous research emphasizing the importance of methodological rigor and process quality. Ode and Onwadi (2016) documented that internal auditors contribute meaningfully to organizational improvement when they adopt advanced auditing techniques and assume advisory roles [10]. Likewise, the findings of Chan and Wan (2023) in emerging Asian economies underscore that robust governance structures, effective communication, and strong audit committee engagement strengthen internal audit quality [3]. This study's results parallel these insights by showing that interaction quality, methodological thoroughness, and alignment with professional standards are critical to internal audit effectiveness in petrochemical organizations.

Furthermore, the confirmatory factor analysis demonstrated strong statistical support for the three-dimensional conceptual model of internal audit performance. This provides empirical backing for a structural approach similar to the model proposed by Lee et al. (2022), who developed a performance evaluation framework based on input, process, and output dimensions for manufacturing industries [14]. The convergence of these results indicates that integrated, multi-dimensional evaluation frameworks are well-suited for high-risk, technically complex industries such as petrochemicals.

The findings also suggest that internal audit outputs—namely reporting quality, stakeholder satisfaction, and organizational value added—serve as important outcomes linked to both input and process factors. This aligns with Ahmadi et al. (2023), who found that internal audit performance in the Iranian energy sector is best explained when outputs are considered as the cumulative result of internal audit competencies, structural supports, and methodological rigor [4]. The present study offers further evidence that effective outputs such as clear reporting, executive engagement, and decision-support contributions are contingent upon the strength of the internal audit system as a whole.

The growing role of technology and digital transformation in auditing is another relevant point supported by the findings. Although technology was not the largest performance gap in this study, the literature suggests that petrochemical organizations must increasingly integrate advanced digital auditing tools to remain effective. Zare et al. (2024) demonstrated that artificial intelligence improves the quality and speed of audit processes and enhances auditors' ability to detect irregularities [11]. This resonates with the present findings in which process and methodological components were shown to exert critical influence on audit performance. While the petrochemical

sector has begun investing in training and audit tools, the growing complexity of risks and reliance on digital systems suggests that technology adoption will become an even more vital performance dimension in the future.

Another major theme reflected in both this study and previous research concerns the role of governance structures—particularly audit committees and senior management—in shaping internal audit performance. Sem and Hastuti (2024) demonstrated that strong audit committees and effective internal controls significantly influence financial reporting quality [12]. The present study's findings similarly reveal that support from senior management and audit committees is an important input factor influencing audit quality in Iran's petrochemical sector. The strong alignment between the study results and international evidence indicates that governance support is essential to empower internal audit units, ensure auditor independence, and encourage implementation of audit recommendations.

Additionally, the characteristics of auditors themselves emerged as a meaningful determinant of performance. Shaban Khamseh and Bokharaeian Khorasani (2024) demonstrated that personal and professional attributes of auditors—including their expertise and experience—strongly affect audit outcomes [13]. This study's findings correspond to these results by showing that human resource competencies play a central role in determining internal audit effectiveness. This has implications for recruitment, training, and professional development strategies within petrochemical firms.

The findings also reinforce the need for contextualized audit models that reflect the specific risk landscape and organizational characteristics of petrochemical firms. Zarei and Esfandiari (2020) emphasized that internal audit effectiveness in the Iranian energy sector depends heavily on sector-specific operational risks and environmental conditions [5]. Similarly, Vazifedar and Ahmadi (2023) highlighted the relationship between internal audit quality and financial reporting improvements in the petrochemical industry [6]. The present study adds to this literature by demonstrating that performance gaps persist across multiple audit dimensions, confirming the need for comprehensive, sector-tailored internal audit performance models.

Taken together, the results of this study provide robust empirical evidence that internal audit performance in the Iranian petrochemical industry depends on a holistic, multi-dimensional set of drivers. These findings not only support the insights of foundational studies [1, 2] but also align with contemporary research emphasizing auditor skills, technological adoption, governance structures, and organizational support [3, 9, 11, 12]. By identifying significant gaps between current and desired performance levels—particularly in independence and objectivity—the present study highlights the urgent need for structural and managerial reforms within petrochemical internal audit units. The results demonstrate that even though training efforts have progressed, significant improvements are needed in governance arrangements, resource allocation, audit methodologies, and organizational culture.

The study thus contributes to the internal auditing literature by validating a conceptual model tailored to a high-risk, high-value industrial environment and by integrating qualitative meta-synthesis with robust quantitative modeling to capture the complexity of audit performance determinants.

This study, despite its methodological rigor, has several limitations. The reliance on self-reported questionnaire data may introduce response bias, particularly in evaluating sensitive dimensions such as independence and managerial support. The sample, although drawn from a substantial number of petrochemical complexes, may not fully represent all audit units across the industry due to variations in organizational size, governance structures, and operational complexity. The cross-sectional nature of the data also limits the ability to make causal inferences about changes in audit performance over time. Additionally, while the qualitative phase included an extensive

meta-synthesis, access to unpublished or internal industry documents was limited, which may have constrained the depth of contextual insights.

Future studies should consider adopting longitudinal designs to examine how internal audit performance evolves in response to organizational reforms, technological adoption, or regulatory changes. Mixed-methods research involving direct observation, interviews, and case studies could provide richer insights into the dynamics of audit processes and organizational culture. Expanding the study to include downstream petrochemical industries or related sectors may also help generalize and refine the conceptual model. Future research could further explore digital transformation in auditing, including the adoption of artificial intelligence, advanced analytics, and continuous monitoring systems.

Organizations in the petrochemical sector should prioritize strengthening auditor independence by revising reporting structures and enhancing the authority of audit committees. Capacity-building initiatives must focus on advanced skills such as risk analytics, digital auditing, and strategic communication. Management should invest in modern audit technologies and ensure adequate budget allocation to audit units. Clear mechanisms for monitoring the implementation of audit recommendations would enhance audit impact. Finally, fostering a culture that values transparency, accountability, and professional development will significantly improve internal audit performance across the industry.

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] M. Al-Rjoob and A. Ahmad, "The evolution of internal auditing in large organizations: From compliance to risk-based approach," *Journal of Business Studies,* vol. 9, no. 2, pp. 33-47, 2017.

[2] M. Arena and G. Azzone, "Identifying organizational drivers of internal audit effectiveness," *International Journal of Auditing,* vol. 13, no. 1, pp. 43-60, 2009, doi: 10.1111/j.1099-1123.2008.00392.x.

[3] K. Chan and K. Wan, "Internal audit quality and corporate governance in emerging Asian markets," *Asian Journal of Accounting Research,* vol. 8, no. 2, pp. 115-130, 2023.

[4] M. Ahmadi and et al., "Designing a Performance Evaluation Model for Internal Audit in Iran's Energy Industry," *Financial Accounting Quarterly,* vol. 14, no. 52, pp. 23-40, 2023.

[5] M. Zarei and N. Esfandiari, "Factors affecting the effectiveness of internal audit in the Iranian energy sector," *International Journal of Energy Sector Management,* vol. 13, no. 4, pp. 701-718, 2020.

[6] A. Vazifedar and H. Ahmadi, "The Relationship Between Internal Audit Quality and the Improvement of Financial Reporting Quality in the Petrochemical Industry," *Management Accounting Journal,* vol. 17, no. 3, pp. 101-120, 2023.
[7] Z. Ghasemi and M. Alipour, "The Role of Internal Audit Independence in Enhancing the Quality of Financial Reporting," *Accounting and Auditing Journal,* vol. 6, no. 22, pp. 15-32, 2022.
[8] C. Okoduwa, J. Nwosu, and S. Adewale, "Determinants of internal audit effectiveness in service organizations: Evidence from Nigeria," *African Journal of Accounting, Auditing and Finance,* vol. 8, no. 4, pp. 322-340, 2019.
[9] M. Zarfash, L. Naderi, and R. Soleimani, "Investigating the Role of Training and Technology in Improving Internal Audit Performance in Iran's Energy Industry," *Financial Management and Accounting Quarterly,* vol. 12, no. 45, pp. 75-90, 2020.
[10] E. Ode and A. Onwadi, "Beyond compliance: Advisory roles of internal auditing in process improvement," *Journal of Accounting in Emerging Economies,* vol. 6, no. 3, pp. 257-276, 2016.
[11] H. Zare, Z. Hajjiha, and A. Qeighobadi, "Investigating the Impact of Using Artificial Intelligence in Auditing on the Financial Statement Audit Quality Process," *Professional Auditing Research,* vol. 4, no. 16, pp. 38-65, 2024.
[12] D. V. Sem and T. D. Hastuti, "The Impact of Audit Quality, Audit Committe, and Internal Control Systems on Financial Report Quality (Idx Finance Sector)," *Keunis,* vol. 12, no. 2, p. 120, 2024, doi: 10.32497/keunis.v12i2.5507.
[13] P. Shaban Khamseh and M. Bokharaeian Khorasani, "The Effect of Audit Partner Characteristics on Audit Fees and Audit Quality," in *The Third National Conference on Modern Approaches in Accounting, Auditing, and Finance*, Aliabad, 2024, pp. 1-24.
[14] J. Lee, S. Park, and H. Kim, "Developing a structural equation model for internal audit performance evaluation in manufacturing industries," *Journal of Accounting and Organizational Change,* vol. 18, no. 4, pp. 621-639, 2022.