

Guidelines for Efficient Internal Audit in Organizations in the Industrial Sector in the Digital Era

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Abstract

An effective internal auditing is a tool for building confidence and providing opinions on risk management, internal control, and corporate governance to help ensure efficient and effective operations. Contribute to promoting organizational performance to achieve objectives and goals in order to increase organizational value and sustainable growth. The objective of this research is to study Guidelines for Efficient Internal Audit in Organizations in the industrial sector. Subsequently, this will be developed into a structural equation model. The qualitative research was conducted via in-depth interviews with 9 experts and group discussions of 11 qualified experts. For the quantitative research, a survey of 500 executives responsible for internal auditing of establishments listed on the Stock Exchange of Thailand was conducted using questionnaires analyzed by descriptive and inferential statistics including multivariate statistics. The results of the research revealed guidelines for efficient internal audit in organizations in the industrial sector, with the importance of all four elements arranged as follows: 1) Environmental Study ($\bar{X} = 4.27$) was the most important item including study business processes such as operational processes, administrative and support processes, and various organizational projects. 2) Integration ($\bar{X} = 4.13$) was ranked highly important, including apply risk management principles, internal control, and process analysis to internal audits. 3) Collaboration ($\bar{X} = 4.05$) was also a very important item including collaborate with the auditee to identify the root causes of detected control deficiencies and provide recommendations on how to improve the detected deficiencies. 4) Digital Technology ($\bar{X} = 3.99$) was also a very important item including Implement different levels of access authority for detailed data to ensure data security and it establishes procedures for personnel involved in authentication, access control, and usage control of digital technology and information systems. Finally, the hypothesis test results showed that small and medium-sized businesses and large businesses place the importance of guidelines for efficient Internal audit in organizations in the Industrial sector was not significantly difference at 0.05 levels. The results of the analysis of the developed structural equation model (SEM) showed that it passes the evaluation criteria and is consistent with the empirical data with the chi-square probability (CMIN-p) of 0.067, the relative chi-square (CMIN/DF) of 1.138, the goodness of fit index (GFI) of 0.956, and the root mean square error of approximation (RMSEA) of 0.017.

Keywords: Structural Equation Modeling, Internal Audit, Internal Control, Digital Technology, Organizations in the Industrial Sector.

Introduction

Business management operates in a complex, highly competitive, and rapidly changing environment currently. Although organizations are established with the primary goal of maximizing shareholder benefits and creating long-term value, operations that fail to consider the consequences of their actions often lead to decline, resulting in both monetary and intangible damages (Yanyong Thammathatcharee, 2006). Furthermore, business operations are subject to various risks, including economic risks, competitive risks, operational risks, and risks related to compliance with laws and regulations. These risks in industrial businesses can have a significant impact on operations, potentially leading to damage, leakage, or even loss of assets. For example, over the past decade, several major global events have had widespread and severe economic consequences. In 1995, two significant events occurred: the Barings Bank crisis in Singapore and the Daiwa Bank crisis in New York City, USA. These were followed by the Enron and WorldCom crises, along with many others between 2001 and 2005 (Stock Exchange of Thailand, 2006). One cause is the lack of transparency in accounting records, financial statements, and internal control systems, as well as poor oversight in internal management. These issues stem from ethical shortcomings on the part of executives (Silaporn Srijanpet, 2008). In Thailand, the economic crisis of 1997, which began with the bankruptcy of Bangkok Commercial Bank and the closure of over 50 financial institutions, was analyzed as having resulted from corruption among senior executives, a lack of transparency, indiscipline in financial reporting, insufficient disclosure of information, and the bankruptcy of related businesses. Furthermore, the "Shining a Light on Fraud: Economic Crime Survey in Thailand," conducted by PwC Thailand's Forensic Services division, revealed that nearly half, or 48%, of companies in Thailand were victims of fraud and economic crime. This is significantly higher than the 2016 survey, which found that only about 25% of Thai companies admitted that fraud had occurred within their organizations. The survey also showed that asset misappropriation remains the most common type of fraud in Thailand, accounting for 62%, which is significantly higher than the global average of 45%. Similarly, business misconduct accounted for 40%, higher than the global average of 28%. This reflects loopholes in organizational anti-fraud policies, creating opportunities for the exploitation of gray areas or ambiguities in such policies (Somchai Suphatthada, 2020). Moreover, Transparency International (2025) released its 2024 Corruption Perceptions Index report, showing that Thailand scored 34 points, a decrease from the previous year, ranking 107th globally. This index reflects Thailand's performance from 2017 to 2024. Additionally, there have been instances of businesses operating improperly and violating regulations and laws, such as those related to fair customer service (market conduct) under the supervision of the Bank of Thailand (BOT). Several financial institutions have violated these criteria, resulting in fines imposed by the BOT. To date, seven financial service providers have been penalized or fined by the Bank of Thailand for violating market conduct standards (bangkokbiznews.com, 2022). In addition to the impact of various business risks, internal auditing faces several challenges, including core structural problems such as corporate governance that prioritizes rules and procedures over the substance and spirit of good governance practices; outdated internal control systems that rely on legal authority for control and auditing, which, although necessary, are ineffective in creating quality or value from audits; a limited number of internal auditors who believe that internal auditing can add value to the organization by partnering with or advising management; issues related to knowledge and experience; a lack of a holistic and comprehensive perspective; insufficient training at all levels; audits that neglect systems, resulting in high costs but minimal outcomes; and audit processes that do not utilize technology to improve efficiency. Due to the aforementioned problems, organizations in the business and industrial sectors must implement good corporate governance, risk management, and internal control systems to address potential risks. Internal auditing is an independent activity that fosters confidence and provides objective advice. This activity is designed to add value to the organization and improve operational practices, enabling businesses to identify and assess potential risks. Effective internal auditing practices help organizations achieve their goals by systematically evaluating and improving the effectiveness of risk management, control, and corporate governance processes.

Objectives of the Research

- 1) To study the structure and operational characteristics of effective internal auditing in industrial business organizations.
- 2) To study the components of effective internal audit practices in industrial business organizations in the digital age.
- 3) To develop a structural equation model for effective internal audit approaches in industrial business organizations in the digital age.

Scope of the Research

1. This research employed a mixed-methods approach, incorporating qualitative research through in-depth interviews, quantitative research through surveys, and qualitative research through focus group discussions.

2. Variables used in quantitative research can be divided into two types:

2.1 Independent Variable: Large industrial businesses versus medium and small industrial businesses.

2.2 Dependent Variable: The structure and operational characteristics of industrial businesses and their impact on effective internal auditing. Observed Variables: Variables obtained from collecting data on effective internal auditing practices in industrial business organizations. Latent Variables or Component Variables: Variables whose data are collected from observed variables. These are divided into two types which are: Exogenous Latent Variable: Integration component. Endogenous Latent Variables: Environmental study component, collaboration component, and digital technology component.

3. Period for collecting quantitative data in this research: The project will be conducted from March to July 2025.

Research Hypothesis

H1: The collaboration component directly influences the environmental study component.

H2: The collaboration component directly influences the integration component.

H3: The collaboration component directly influences the digital technology component

H4: The environmental study component directly influences the integration component.

H5: The digital technology component directly influences the integration component.

H6: The overall importance of effective internal audit practices in business organizations, when categorized by business size, does not differ significantly.

Research Conceptual Framework

This research is inductive research employed using a mixed-methodology approach, comprising three components which are: qualitative research through in-depth interviews, quantitative research through survey data collection, and qualitative research through focus group discussions to validate the research model.

Population and Sample

1) Qualitative research was conducted using in-depth interview techniques. Nine key informants, who were experts, were selected through purposive sampling. The expert qualifications were based on the criteria set by the Doctor of Business Administration program in Industrial Business Administration, Faculty of Business Administration, King Mongkut's University of Technology North Bangkok. The experts were divided into three groups: three entrepreneurs or business executives; three representatives from the government and related agencies; and three academics.

2) Quantitative research: The population used in this research consisted of executives responsible for internal auditing in 921 listed companies on the Stock Exchange of Thailand (SET, 2024), divided into small and medium-sized enterprises (SMEs) and large industrial enterprises. The sample size was determined based on the criteria for factor analysis or structural equation modeling, with a minimum of 500 samples (Thanin, 2024). A probability sampling method using the lottery technique was employed (Thanin, 2024: 64), as shown in

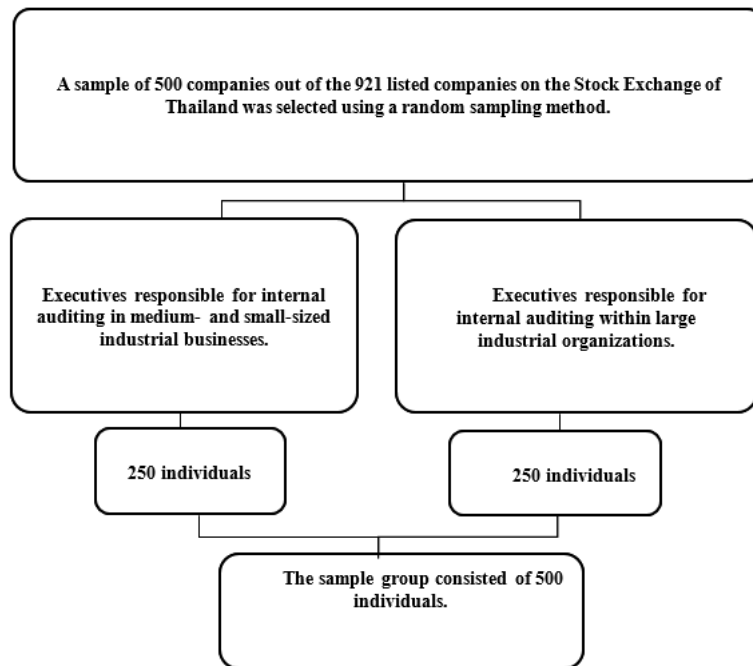


Figure 1.

Figure 1: Determination of the sample size used in the research.

3) Qualitative research using focus group discussion techniques was conducted to validate the model. The sample group used in this research consisted of 11 experts, selected through purposive sampling. The qualifications of the experts were determined by the Doctor of Business Administration program in Industrial Business Administration, Faculty of Business Administration, King Mongkut's University of Technology North Bangkok.

Research Tools

1. In-depth interviews: A structured interview format was used, with the researcher establishing four components: environmental study, collaboration, digital technology, and integration.

2. The questionnaire is divided into four sections as follows:

Part 1: is a questionnaire about the general status of business and industrial organizations. The questionnaire consists of a checklist of 4 questions and one open-ended question.

Part 2: is a questionnaire on the structure and operational characteristics of internal auditing in the business and industrial sectors. The questionnaire is in the form of a checklist consisting of 20 items.

Part 3: A questionnaire on effective internal audit practices in industrial business organizations. The questionnaire uses a five-point Likert scale for evaluation, consisting of 100 items (Thanin, 2024).

3. Focus group discussion: The research tool used was a focus group recording form.

Data Collection.

1. In-depth interviews: Obtain a letter of recommendation from the Faculty of Business Administration, Doctor of Business Administration Program in Industrial Business Administration, King Mongkut's University of Technology North Bangkok. Contact experts to request their assistance and cooperation in providing information. Conduct interviews with experts according to the established structure. During the interviews, the researcher must record data throughout. Transcribe the in-depth interviews and conversations verbatim. Group meanings into themes, interpret or assign meaning, analyze the data, and compile it into rating scale questions for use in quantitative research.

2. Quantitative research: The researchers will contact the sample group to request responses to the questionnaires. If face-to-face meetings are not convenient, the questionnaires will be distributed and collected via postal mail and electronic means. The completed questionnaires will be checked for accuracy and completeness. The data will then be coded numerically and recorded in a computer for statistical analysis.

3. Focus group discussions: Focus group recording forms will be used, with a moderator introducing discussion topics to encourage participants to generate ideas and express their opinions on the issues or discussion approaches extensively. The data obtained from the discussions will be collected from the experts for further analysis.

Statistics Used in Data Analysis.

1. In-depth interviews were analyzed using content analysis, resulting in a framework for effective internal auditing in digital-era industrial organizations, categorized by component.

2. Quantitative research: General baseline data were analyzed using descriptive, inferential, and multivariate statistical methods, employing SPSS (Statistical Package for the Social Sciences) and AMOS (Analysis of Moment Structures).

3. Focus group discussion: Content analysis was used to summarize the opinions and suggestions obtained from the focus group discussions.

Results

1. Qualitative research results from in-depth interviews.

An analysis of effective internal audit practices in digital-era industrial organizations revealed four key components: 1) environmental study, 2) collaboration, 3) digital technology, and 4) integration. The results are as follows:

1. Environmental Study Components:

1.1 Study the organization's goals, mission, and objectives to determine audit guidelines.

1.2 Study business processes, such as operational processes, administrative and support processes, and various organizational projects.

1.3 Study corporate governance, covering accountability, checks and balances, transparency, integrity, responsibility for performance, and competitiveness.

1.4 Study legal information, regulations, and the economic, social, and political environment, as well as various government policies related to the organization.

1.5 Collect various risk factors in selecting the auditee, such as organizational structure, location, monetary value, complexity of work or methods, quality of internal control systems, significant personnel changes, expansion of computer use within the organization, and the time elapsed since the last audit.

2. Collaboration Component:

2.1 Hold joint meetings between the internal audit team, senior management, and the organization's board of directors to discuss strategies for selecting auditees.

2.2 Seek collaboration from senior management and auditees regarding factors such as the complexity of work or methods, level of management, and operational lifecycle.

2.3 Obtain information and guidelines from the risk assessment process from various sources, such as management, the executive board, and auditees, to identify risk factors for effective and efficient audit planning.

2.4 Seek collaboration from personnel within the audited unit who have no vested interest in the audited work to participate as part of the audit team when auditing complex processes, thereby enhancing audit efficiency and the acceptability of audit results.

2.5 Hold meetings for joint planning and problem-solving between auditees and internal auditors, which will support effective problem resolution and management.

3. Digital Technology Components

3.1 Utilize an internal audit computer system with data analytics capabilities and the ability to connect to risk management tools or other financial systems.

3.2 Integrate the internal audit system with various organizational systems using modern technology to facilitate collaboration between departments.

3.3 Establish a cybersecurity risk prevention system to protect against data disruption, breaches, theft, or destruction.

3.4 Develop internal audit workflows that align with big data management systems to enhance audit efficiency.

3.5 Acquire electronic devices capable of connecting and transmitting data via the Internet (Internet of Things (IoT)), along with appropriate security systems.

4. Integration Components:

4.1 Coordinate various audit approaches, such as management-oriented auditing, risk-based auditing, participative auditing, and proactive and constructive auditing.

4.2 Utilize the COSO Internal Control – Integrated Framework to develop internal audit plans, providing internal auditors with comprehensive and complete audit guidelines.

4.3 Integrate general internal auditing with information systems auditing, including audit strategies and processes, within the same audit project to define a more complete and comprehensive audit scope and to cover risks more thoroughly.

4.4 Apply risk management principles, internal controls, and process analysis in internal auditing.

4.5 Analyze processes for developing and monitoring the implementation of strategic plans to ensure they are appropriate and consistent with the organization's characteristics.

2. Results of the data analysis on the general status of business and industrial organizations.

The study found that the size of industrial business organizations, equally categorized into medium- and small-sized industrial businesses (with fixed assets not exceeding 200 million baht) and large industrial businesses (with fixed assets exceeding 200 million baht), accounted for 50.00% each. The most common business type was the financial industry (25.00%), followed by the service industry (17.20%). The most common investment structure was Thai-owned companies (80.80%), followed by joint ventures between Thai and foreign investors (15.20%). The primary location of the organizations was Bangkok and its surrounding areas (88.60%), with the remainder located in other provinces (11.40%). Most organizations had been in operation for over 30 years (54.00%), followed by those operating for 10–20 years (21.20%).

3. Analysis of data on the structure and operational characteristics of internal auditing in the industrial sector.

The most common organizational structure found was the hierarchical structure (44.60%), followed by the functional structure (36.00%). For the internal audit unit, the most common structure involved reporting directly to the Audit Committee or the Board of Directors (73.40%), followed by independent structures (14.40%). The most important subcommittee for internal audit work was the Audit Committee (86.20%), followed by the Risk Management Committee (7.60%). The most common number of personnel in the internal audit unit was more than 15 (39.80%), followed by fewer than 5 (34.80%). The most common characteristics of internal audit planning are long-term plans (longer than one year) and annual plans, accounting for 51.60%, followed by annual plans alone at 45.60%. Regarding the development of knowledge for internal audit personnel, the most common approach is defining 25–40 hours per year (32.20%), followed by more than 40 hours per year

(28.00%). The most common type of organizational risk is operational risk (59.00%), followed by strategic risk (13.80%). The most frequently used internal audit method is random sampling (66.80%), followed by interviews (20.40%).

The most common professional qualification among personnel in the internal audit unit is Certified Internal Auditor of Thailand (CPIAT), at 43.80%, followed by Certified Internal Auditor (CIA) at 30.40%. The most frequently used form of information technology in organizational internal auditing is the application of Microsoft programs, such as Microsoft Excel, in internal audit work (67.20%), followed by the development of internal audit system programs by the internal audit unit (12.00%).

4. Analysis results on the structure and operational characteristics, classified by the size of the industrial sector.

The study found that the organizational structure of the internal audit unit does not depend on the size of the business or industry (p -value = 0.52). However, the organizational structure of the internal audit unit does depend on the size of the business or industry (p -value = 0.01). For medium- and small-sized businesses, the most common organizational structure of the internal audit unit was reporting directly to the Audit Committee or the Board of Directors (68.00%), followed by being independent (not reporting to any other unit) (16.00%). For large businesses, the most common organizational structure of the internal audit unit was reporting directly to the Audit Committee or the Board of Directors (78.80%), followed by being independent (not reporting to any other unit) (12.80%).

The establishment of subcommittees within organizations that are crucial to internal audit work is not dependent on the size of the business or industry (p -value = 0.69). For medium- and small-sized businesses, the largest number of personnel in the internal audit unit was fewer than 5 people (44.40%), followed by 5–10 people (24.40%). For large businesses, the largest number of personnel in the internal audit unit was more than 15 people (56.40%), followed by fewer than 5 people (25.20%).

The characteristics of internal audit planning do not depend on the size of the business or industry (p -value = 0.15).

The characteristics of knowledge development for personnel in internal audit units depend on the size of the business or industry (p -value = 0.00). For small and medium-sized enterprises (SMEs), the most common level of knowledge development for internal audit personnel was 12–24 hours per year (34.40%), followed by 25–40 hours per year (33.20%). For large businesses, the most common level of knowledge development for internal audit personnel was more than 40 hours per year (39.60%), followed by 25–40 hours per year (31.20%).

The percentage and chi-square values of organizational risk types are independent of the size of the business or industry (p -value = 0.17).

The internal audit methodologies used in organizational audits are not dependent on the size of the business or industry (p -value = 0.20).

The professional qualifications of personnel in internal audit units are independent of the size of the business or industry (p -value = 0.09).

For small and medium-sized enterprises (SMEs), the individuals or organizations that most frequently assess the quality of their internal audit units are the audit committees (36.00%), followed by external individuals or organizations that provide specialized internal audit quality assessment services (24.80%). For large businesses, the individuals or organizations that most frequently assess the quality of their internal audit units are external individuals or organizations that provide specialized internal audit quality assessment services (43.20%), followed by the audit committee (28.80%).

The patterns of information technology usage in organizational internal auditing depend on the size of the business and industry (p -value = 0.00). For medium- and small-sized businesses, the most common use of information technology in internal auditing was the application of Microsoft programs, such as Microsoft Excel, in internal audit work (76.40%). This was followed by the development of internal audit system programs by the organization's IT department (8.00%). For large businesses, the most common use of information technology in internal auditing was the application of Microsoft programs, such as Microsoft Excel, in internal audit work (58.00%). This was followed by the development of internal audit system programs by the internal audit department (16.80%).

5. Analysis of the level of importance of effective internal audit principles in business and industrial organizations in the digital age.

Overall, the findings indicated a high level of importance, with an average score of 4.11. A detailed analysis of each aspect revealed that all aspects were highly important, ranked from highest to lowest as follows:

- 1) The Environmental Study component has a mean score of 4.27. An analysis of individual items shows mean scores ranging from 4.63 to 3.89, with 4 items at the highest level and 25 items at a high level.
- 2) The Integration component has a mean score of 4.13. An analysis of individual items shows mean scores ranging from 4.44 to 3.65, with all 25 items at a high level.
- 3) The Collaboration component has a mean score of 4.05. An analysis of individual items shows mean scores ranging from 4.40 to 3.45, with 24 items at a high level and 1 item at a medium level.
- 4) The Digital Technology component has a mean score of 3.99. An analysis of individual items shows mean scores ranging from 4.51 to 3.63, with 1 item at the highest level and 24 items at a high level.

6. Analysis of the level of importance, categorized by industry size.

Small and medium-sized enterprises (SMEs) found that effective internal audit practices in industrial organizations in the digital age are, overall, highly important, with an average score of 4.09. An analysis of the importance of each aspect showed that all aspects were highly important, ranked from highest to lowest as follows:

- 1) The Environmental Study component had a mean score of 4.26 with a standard deviation of 0.49. For individual item analysis, the mean scores ranged from 4.58 to 3.89, with 2 items at the highest level and 23 items at a high level.
- 2) The Integration component had a mean score of 4.14 with a standard deviation of 0.60. For individual item analysis, the mean scores ranged from 4.45 to 3.67, with all 25 items at a high level.
- 3) The Collaboration component had a mean score of 3.99 with a standard deviation of 0.52. For individual item analysis, the mean scores ranged from 4.39 to 3.30, with 20 items at a high level and 5 items at a medium level.
- 4) The Digital Technology component had a mean score of 3.96 with a standard deviation of 0.74. For individual item analysis, the mean scores ranged from 4.48 to 3.56, with all 25 items at a high level.

Large businesses found that effective internal audit practices in industrial organizations in the digital age are, overall, highly important, with an average score of 4.13. An analysis of the importance of each aspect showed that all aspects were highly important, ranked from most to least important as follows:

- 1) The Environmental Study component had a mean score of 4.29 with a standard deviation of 0.49. For individual item analysis, the mean scores ranged from 4.67 to 3.88, with 4 items at the highest level and 21 items at a high level.
- 2) The Integration component had a mean score of 4.13 with a standard deviation of 0.67. For individual item analysis, the mean scores ranged from 4.44 to 3.63, with all 25 items at a high level.
- 3) The Collaboration component had a mean score of 4.10 with a standard deviation of 0.49. For individual item analysis, the mean scores ranged from 4.43 to 3.59, with all 25 items at a high level.
- 4) The Digital Technology component had a mean score of 4.02 with a standard deviation of 0.84. Individual item analysis showed mean scores ranging from 4.54 to 3.62, with 1 item at the highest level and 24 items at a high level.

7. Comparison of differences in the importance, classified by business and industrial size.

The study found that, overall, there was no significant difference in the importance of effective internal audit principles in industrial organizations in the digital age when categorized by business size. However, when analyzing differences by specific aspects categorized by industry size, no statistically significant differences were found in Environmental Study, Digital Technology, or Integration. Nevertheless, statistically significant

differences were observed in 10 aspects of Collaboration, with large businesses placing greater importance on effective internal audit principles in the digital age than medium- and small-sized businesses.

8. Hypothesis testing results on differences in the importance, categorized by industry size.

H6: The overall level of importance of effective internal audit principles in business and industrial organizations in the digital age does not differ significantly when categorized by business size (p-value = 0.31).

9. Analysis of data on opinions and suggestions regarding effective internal audit practices in industrial business organizations in the digital age.

1. Additional approaches to enhance effective internal auditing in industrial organizations include: 1) utilizing technology and AI in internal auditing; 2) developing the skills, knowledge, and capabilities of internal auditors; and 3) improving internal audit processes.

2. Organizations seek support from government agencies or other entities to develop effective internal audit practices in the digital age. This includes: 1) training and development of knowledge and skills in internal auditing; 2) development of digital technologies for internal auditing; and 3) clear legal requirements, regulations, and oversight for internal auditing.

3. The major obstacles to effective internal audit practices in industrial organizations in the digital age are as follows: 1) insufficient internal audit resources, such as personnel and time; 2) changes in digital technology; and 3) lack of support from senior management.

10. Results of the SEM analysis before the model improvement.

The results of the structural equation modeling analysis of effective internal audit approaches in industrial business organizations, in both unstandardized estimate and standardized estimate modes, before model modification, are shown in Figures 2 and 3.

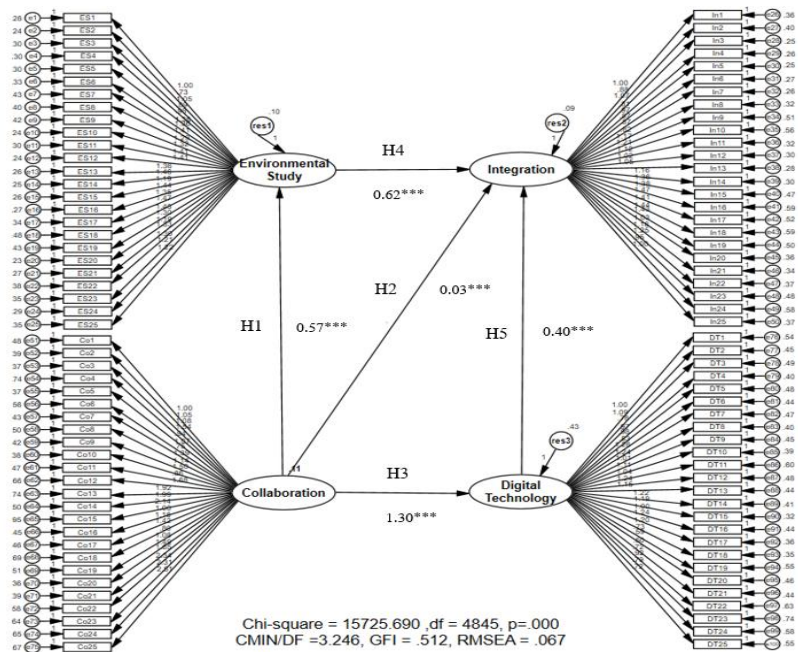


Figure 2: SEM unstandardized estimate mode before model refinement.

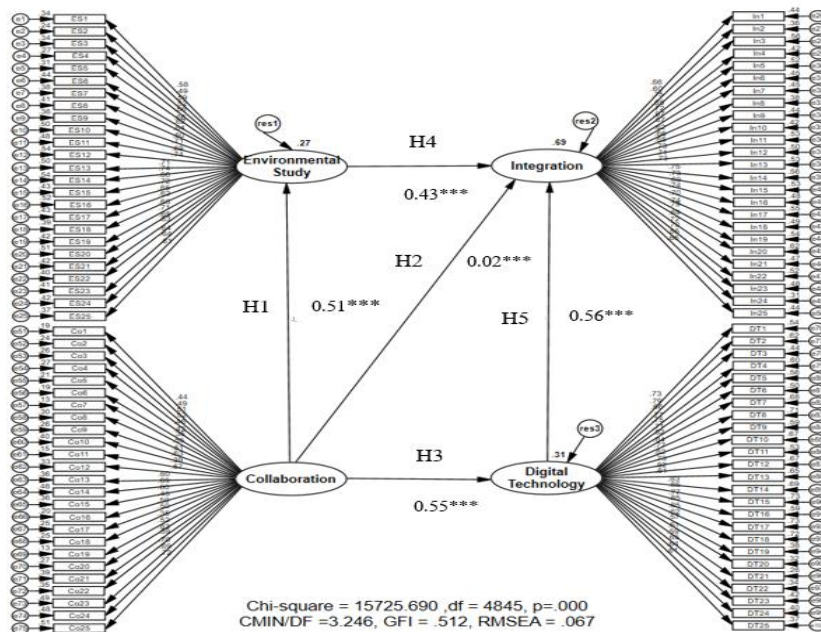


Figure 3: SEM standardized estimate mode before the model improvement.

11. Results of the SEM analysis after the model improvement.

The results of the structural equation modeling analysis of effective internal audit approaches in industrial business organizations in the digital age, in both unstandardized estimate and standardized estimate modes after model adjustment, are shown in Figures 5, 6, and Table 1

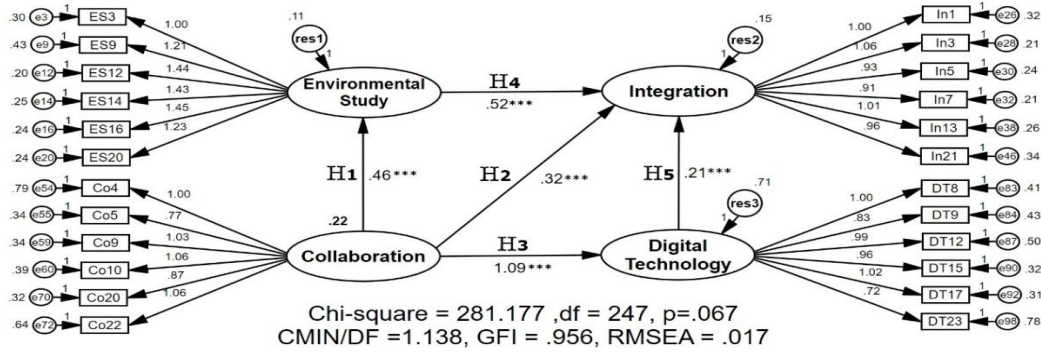


Figure 4: SEM unstandardized estimate mode after the model improvement.

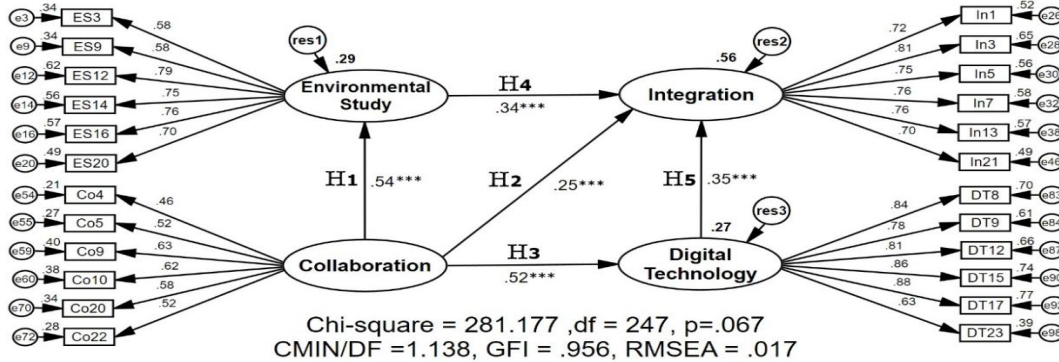


Figure 5: SEM standardized estimate mode after the model improvement.

Table 1: Statistics obtained from the SEM analysis after model improvement.

Variables	Estimate		R ²	Variance	C.R.	P
	Standardized	Unstandardized				
Collaboration				0.22		
Environmental Study	0.54	0.46	0.29	0.11	6.745	***
Integration	0.25	0.32	0.56	0.15	3.794	***
Digital Technology	0.52	1.09	0.27	0.71	7.313	***
Environmental Study						
Integration	0.34	0.52	0.56	0.15	6.169	***
Digital Technology						
Integration	0.35	0.21	0.56	0.15	7.227	***
Environmental Study						
ES3	0.58	1.00	0.34	0.30		
ES9	0.58	1.21	0.34	0.43	10.427	***
ES12	0.79	1.44	0.62	0.20	12.679	***
ES14	0.75	1.43	0.56	0.25	12.305	***
ES16	0.76	1.45	0.57	0.24	12.389	***
ES20	0.70	1.23	0.49	0.24	11.840	***
Collaboration						
Co4	0.46	1.00	0.21	0.79		
Co5	0.52	0.77	0.27	0.34	7.688	***
Co9	0.63	1.03	0.40	0.34	8.469	***
Co10	0.62	1.06	0.38	0.39	8.383	***
Co20	0.58	0.87	0.34	0.32	8.128	***
Co22	0.52	1.06	0.28	0.64	7.721	***
Integration						
In1	0.72	1.00	0.52	0.32		
In3	0.81	1.06	0.65	0.21	17.180	***
In5	0.75	0.93	0.56	0.24	15.932	***
In7	0.76	0.91	0.58	0.21	16.207	***
In13	0.76	1.01	0.57	0.26	16.121	***
In21	0.70	0.96	0.49	0.34	14.885	***
Digital Technology						
DT8	0.84	1.00	0.70	0.41		
DT9	0.78	0.83	0.61	0.43	20.535	***
DT12	0.81	0.99	0.66	0.50	21.744	***
DT15	0.86	0.96	0.74	0.32	23.805	***
DT17	0.88	1.02	0.77	0.31	24.616	***
DT23	0.63	0.72	0.39	0.78	15.208	***

*** Statistical significant at the 0.001 level.

Figures 4, 5, and Table 1 show that the SEM for effective internal auditing in industrial organizations, after model modification, indicates that the Collaboration component has a direct influence on the Environmental Study component, which in turn has a direct influence on the Integration component. Additionally, the Digital Technology component has a statistically significant direct influence on the Integration component.

12. Results of the consistency assessment of the SEM before and after model modification.

After the model improvements were completed, the CMIN-P was found to be 0.067 (greater than 0.05), the CMIN/DF was 1.138 (less than 2.00), the GFI was 0.956 (greater than 0.90), and the RMSEA was 0.017 (less than 0.08). Therefore, it can be concluded that all four statistical values met the evaluation criteria. Thus, the improved structural equation model for effective internal auditing in digital-era industrial organizations is consistent with the empirical data, as shown in Table 2.

Table 2: Statistics for assessing the goodness of fit of the SEM before and after model improvement.

Statistics	Criteria	Before Improvements	After Improvements
1. CMIN-P (Chi-square probability level)	< 0.05.	0.000	0.067
2. CMIN/DF (Relative Chi-Square Value)	> 2.00.	3.246	1.138
3. GFI (Goodness-of-Fit Index)	< 0.90.	0.512	0.956
4. RMSEA (Root Mean Square Error Estimation)	> 0.08.	0.067	0.017

13. Hypothesis testing results for analyzing the causal relationships between latent variables in the SEM.

H1: The collaboration component directly influences the environmental study component, consistent with the research hypothesis. The p-value is 0.001, and the standardized regression weight is 0.54.

H2: The collaboration component directly influences the integration component, consistent with the research hypothesis. The p-value is 0.001, and the standardized regression weight is 0.25.

H3: The collaboration component directly influences the digital technology component, consistent with the research hypothesis. The p-value is 0.001, and the standardized regression weight is 0.52.

H4: The environmental study component directly influences the integration component, consistent with the research hypothesis. The p-value is 0.001, and the standardized regression weight is 0.34.

H5: The digital technology component directly influences the integration component, consistent with the research hypothesis. The p-value is 0.001, and the standardized regression weight is 0.35.

14. Analysis of the overall, direct, and indirect influences in the SEM standardized estimate mode after the model improvement.

The study found that the Collaboration component had the highest overall influence, exerting a total effect on the Integration component with a standardized regression weight of 0.61 (0.25 + 0.18 + 0.18). This influence is derived from: 1) A direct effect between the Collaboration component and the Integration component, 2) An indirect effect through the Environmental Study component, which in turn influences the Integration component, and 3) An indirect effect through the Digital Technology component, which in turn influences the Integration component.

15. Pairwise analysis of the relationships between variables related to effective internal audit approaches in industrial business organizations in the digital age after model improvement.

The study found that the relationships between variables in the structural equation model of effective internal audit guidelines in digital-era industrial organizations, after model improvement, consisted of 276 pairs. Of these, 269 pairs were statistically significant at the 0.001 level, 6 pairs were statistically significant at the 0.01 level, and 1 pair was statistically significant at the 0.05 level. The researchers ranked the five strongest relationships from highest to lowest as follows:

1) The relationship between the variable “Developing an internal audit system using digital technology to create a systematic audit process that aligns with international internal audit professional standards (IIA Standards) and best practices” (DT15) and the variable “Developing a system for screening and detecting anomalies and high-risk items based on defined conditions (rule-based) so that relevant departments can take timely corrective action” (DT17) has a value of 0.747.

2) The relationship between the data mining development variable (DT8), which aims to create a comprehensive collection of critical organizational data to establish connections and effectively identify anomalies in transactions, and the variable for developing a system to filter and detect anomalies and high-risk transactions based on defined conditions (rule-based), enabling relevant departments to take timely corrective action (DT17), has a value of 0.746.

3) The relationship between variables related to the provision of artificial intelligence (AI) technology as a tool to help detect anomalies within an organization—such as Natural Language AI, which can listen to, read documents, and learn from information, allowing investigators to specify required information for analysis (DT12)—and the variable for developing a system to filter and detect reports with anomalies and high-risk items based on defined conditions (rule-based), enabling relevant departments to take timely corrective action (DT17), has a value of 0.712.

4) The relationship between the variable “Developing a data mining system to serve as a central repository for all critical organizational data, creating connections, and effectively identifying anomalies in transactions” (DT8) and the variable “Developing a digital internal audit system with a systematic audit process aligned with international internal audit professional standards (IIA Standards) and best practices” (DT15) has a value of 0.707.

5) The relationship between the variable “Utilizing artificial intelligence (AI) technology as a tool to detect anomalies within the organization, such as Natural Language AI, which can listen to, read documents, and learn from data, allowing auditors to specify required data for analysis” (DT12) and the variable “Developing an internal audit system using digital technology to create a systematic audit process aligned with international internal audit professional standards (IIA Standards) and best practices” (DT15) has a value of 0.698.

16. Expert opinions obtained from focus group discussions.

1) The organization should have cybersecurity oversight, with the board of directors playing a direct role in setting policies and closely monitoring and evaluating cybersecurity risks. This responsibility should not be limited to the IT department alone, and such risks should be systematically integrated into the Enterprise Risk Management (ERM) framework and incorporated into other standards, such as ISO standards.

2) Organizations should prioritize third-party risk management, especially when using external service providers or outsourcing, such as external providers for developing computer systems to support business operations. This includes clearly defining access rights to critical data in contracts and regularly monitoring and evaluating performance.

3) Organizations should have a Cyber Incident Response Plan in place, including an early warning system, modern security tools such as Endpoint Detection and Response (EDR), and transparent and appropriate communication guidelines during crises.

4) Organizations should promote a culture of awareness by encouraging personnel at all levels to participate in cybersecurity through training and awareness-raising activities.

5) Organizations should apply artificial intelligence (AI) technology to enhance the efficiency of internal audits by providing data for predicting various risks. However, the

Discussion

1. The research findings indicate that the component with the highest average score is the Environmental Study component, with a mean of 4.27. This empirical evidence demonstrates that the Environmental Study component is crucial for effective internal audit practices in digital-era industrial organizations. This may be because the Environmental Study component involves studying and understanding the business model, control environment, and internal audit environment to assess risks for audit planning. Audit Standard Code 2010, regarding planning, stipulates that internal audit managers must plan based on risk to prioritize internal audit tasks in alignment with the organization's key objectives. Risk assessments should be conducted at least annually, or whenever there are significant changes in the business model, leadership, or external factors such as economic conditions, laws, society, or technology. When such changes occur, a new risk assessment is required, along with the development of appropriate controls. The components of internal control according to the COSO 2013 framework consist of five main elements: the control environment, risk assessment, control activities, information and communication, and monitoring and evaluation. The framework also incorporates 17 principles. Factors to consider when designing an internal control system include the likelihood of risk occurrence, the severity of potential damage, and the cost of preventing or mitigating the risk. This is also consistent with the research findings of Uthit Sueakaew, Panu Chaopreecha, and Chamnien Chuangtrakul (2015) on "A Study of Control Environment Factors Affecting the Internal Control System of Listed Companies on the Stock Exchange of Thailand." The study found that 6 out of 7 control environment factors affected the internal control systems of listed companies on the Stock Exchange of Thailand overall. The factor with the greatest impact was the performance monitoring and auditing mechanism, followed by the determination of authority and responsibility by management. Furthermore, this aligns with the research findings of Bandasak Chusai and Kanoksak Sukwatthanasinit (2018), who studied the components of quality internal audit reports. Their research found that internal audit reports provide opinions aimed at adding value by indicating whether the risk management system and internal controls are appropriate and sufficiently effective for management. This helps ensure the organization's confidence in achieving its set goals and provides guidance for improvement and development to increase value or align with operational practices. Therefore, internal audit reports are essential for management. This is consistent with the research findings of Nattawat Panchanathorn and Porntiva Saengkhaio (2021), who studied the influence of good corporate governance and social responsibility on the business performance of listed companies in the energy and utilities sector on the Stock Exchange of Thailand. The study found that good corporate governance has a statistically significant positive correlation with return on assets and return on equity, particularly in terms of corporate governance assessment rankings and the size of the board of directors.

2. The research findings indicate that the most important factor for effective internal auditing in digital-era industrial organizations is the study of business processes, such as operational processes, administrative and support processes, and various organizational projects. This factor has a mean score of 4.63, falls within the Environmental Study component, and directly influences the Integration component. This provides empirical evidence that studying business processes is part of understanding business models, the business environment, and the internal audit environment, which comprise corporate governance, organizational risk management, and internal controls. This aligns with the research findings of Sarisa Nanthurat (2020), who studied risk management and the performance of insurance companies listed on the Stock Exchange of Thailand. The research findings indicate that risk management significantly impacts performance. If insurance companies have better risk management, they can better control income volatility, leading to improved company performance. This aligns with the research by Wanida Rakkhamsuk (2019), who studied risk management guidelines and sustainable management of hostel businesses in Chonburi Province. Her study found that the current risk factors for hostel businesses in Chonburi Province include poor economic conditions and high competition. The recommended risk management approach for hostel businesses in Chonburi Province is for operators to periodically assess and analyze risks to prevent and mitigate potential problems or unforeseen events that may affect the business.

3. From the hypothesis testing results, it was found that the collaboration component has a direct influence on the environmental study component, with the highest direct effect and a standardized regression weight of 0.54. This provides empirical evidence that collaboration, as a characteristic of co-creation and teamwork, is consistent with the research findings of Orraphan Saengsiwawet (2018), who studied "Factors Affecting the Effectiveness of Internal Audit Work: The Perspective of Internal Auditors." The study found that management support, as well as monitoring and evaluation, affects the effectiveness of internal audit work. Management support depends on the perceived importance of the internal audit unit, which is reflected in the quality of internal audit work. This is in line with the research findings of Sasithorn Chanthaisong (2019), who studied the internal audit factors affecting the development and improvement of the internal control system at Rajamangala University of Technology Isan. The study found that factors related to control audits, as well as policy setting and support from management or senior executives, had an impact on the development and improvement of the internal control system at Rajamangala University of Technology Isan.

4. From the hypothesis testing results, it was found that the highest overall influence was associated with the Collaboration component, which significantly influenced the Integration component at the 0.001 level of statistical significance, with a standardized regression weight of 0.61. This provides empirical evidence that collaboration, characterized by co-creation, teamwork, and a shared understanding of goals is consistent with the research findings of Orraphan Saengsiwawet (2018), who studied "Factors Affecting the Effectiveness of Internal Audit Work: The Perspective of Internal Auditors." Her study found that management support, as well as monitoring and evaluation, affects the effectiveness of internal audit work. Management support depends on the perceived importance of the internal audit unit, as reflected in the quality of internal audit work. Furthermore, the skills of internal auditors also affect the effectiveness of internal audit work and depend on the specific characteristics of internal audit practices in each organization. This aligns with the research findings of Siridech Kamsuphrom (2018), who studied the components of information systems auditing related to information technology risk assessment. The study found that factors affecting the effectiveness of internal audit work, from the perspective of internal auditors, indicate that current business organizations have shifted their processes for creating competitive advantage from traditional data processing and reporting through print media to modern approaches that emphasize digital content production.

Suggestions

1. Suggestions at the policy level

The Department of Business Development (DBD), Ministry of Commerce, should continuously provide training and knowledge development for entrepreneurs on internal audit standards, risk management principles, internal control, and good corporate governance, appropriate to the context and size of their organizations. And the Revenue Department, Ministry of Finance, should consider a tax relief framework in which the cost of developing digital technology systems for internal auditing is treated as a tax-deductible expense.

2. Suggestions at the operational level

1) Industrial business operators should promote environmental studies within their organizations. This includes studying business processes such as operational processes, administrative and support processes, and various organizational projects. They should also examine legal information, regulations, and rules, as well as the economic, social, and political environment and government policies relevant to the organization.

2) Industrial business operators should promote organizational collaboration. For example, they should cooperate with auditees to identify the root causes of detected control deficiencies and provide suggestions for improving those deficiencies. Meetings should be held to facilitate joint planning for resolving organizational problems between auditees and internal auditors, leading to effective solutions and management practices.

3) Industrial businesses should promote the use of digital technology within their organizations. For example, they should establish different levels of access authorization for data security and define procedures for personnel to authenticate access and control the use of digital technology and information systems. They should also install antivirus systems on the network to detect and prevent the intrusion of all forms of malware and viruses, as well as implement comprehensive cybersecurity protection.

3. Suggestions for future research.

The researchers found inconsistencies in internal audit approaches across multiple sectors. Future research should examine internal audit approaches in different sectors, including the government, private sector, and educational institutions, in order to achieve greater consistency and efficiency in internal audit management across these sectors. Therefore, further research should focus on integrating government internal audit approaches to promote and support internal auditing in business and industrial organizations.

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