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Presenting the acceptance model of computer-based auditing tools and techniques with the ISM technique

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Abstract

The objective of this study is to introduce a model for assessing the acceptance of computer-based audit tools and techniques using the ISM technique, and to assess its effectiveness through structural equations. The study follows a mixed research approach and employs a survey-cross-sectional design for data collection. The research methodology is primarily exploratory in nature. Conducting two-stage exploratory studies allows for the qualitative findings from the first stage to inform and enhance the results and analysis of the quantitative phase. The target population for the qualitative portion consists of accounting experts and professionals. This study utilized the viewpoints of 20 accounting experts and professors. The surveyed community is primarily composed of professionals, including auditors who hold a bachelor's degree in accounting and auditing. Additionally, these auditors have achieved at least the rank of senior auditor within auditing institutions. Therefore, given the unlimited number of professionals in the quantitative sector, Cochran's formula was employed for unlimited sampling, resulting in the consideration of a certain 384 number of individuals. To explore the theoretical aspects and review the existing literature on the research topic, written information and articles were utilized. In the qualitative phase, data collection involved conducting library studies and expert interviews. For the quantitative research phase, a questionnaire was employed as a tool to gather data. The qualitative data was analyzed using the thematic analysis method. The research findings revealed that the research model comprised of a comprehensive theme, three constructive themes, and twelve primary themes. Subsequently, the research model was presented based on the final categories. Interpretive structural modeling were employed to identify and design the pattern of relationships among indicators.

Keywords: Audit tools and techniques, computer-based audit, environmental factors, organizational factors
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1 Introduction

Today, information technology is a crucial driver of global development, and many countries prioritize its advancement as a fundamental infrastructure for their progress. Within a short span, these technologies have become integral to the fabric of modern societies. Currently, numerous nations strive to comprehend information technology and acquire essential skills and concepts in this field. Experts assert that, similar to how the steam engine's invention and the

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industrial revolution profoundly transformed work and personal lives, the communication revolution has also ushered in significant changes to human existence [29]. These changes occur as a result of implementing new business methods, introducing fresh varieties and entertainments, and fostering new forms of art. Information technology encompasses subjects related to computer science, technology, the creation, development, installation, and implementation of information systems and software. It focuses on the design and utilization of computers and communication for solving diverse problems. It is worth noting the fascinating fact that computers manufactured half a century ago are now extensively utilized in numerous large organizations [13].

Despite the significant advancement of new technologies, certain organizations have completely disregarded the need to adopt these technologies or are moving very slowly in making decisions about their implementation. While some managers strive to utilize the best available technologies in the business world, it appears that many of them overlook the human and organizational impacts of these technologies [1]. Although these new technologies are comprehensive and possess considerable potential, they can also be seen as a potential weakness. For instance, managers' inability to effectively utilize these technologies puts them at a disadvantage compared to their competitors, or they may miss out on opportunities arising from these technologies. To address this issue, it is essential to comprehend the capabilities of these technologies, their suitability for business, the potential for leveraging their advantages, and to strive towards adopting a new management mindset [29]. The increasing influence of information technology has led to a heightened complexity in the auditing landscape. As a result, the American Association of Certified Public Accountants released Auditing Standards Statement No. 48 titled "Subsequent Events Review and Its Standards" in 1984.

Computer-based auditing methods and tools are utilized to automate auditing procedures. This means that computer-based audit methods (CATTs), as well as computer-based audit methods and tools, involve the utilization of practical organizational software like spreadsheets, word processors, text editing programs, as well as advanced software such as statistical analysis systems and intelligent business tools within the field of auditing. Although CAATTs (Computer-Assisted Audit Techniques and Tools) have been recognized for their significance in reducing audit costs, enhancing audit quality and productivity [5, 6, 18], and their prevalent usage in developed countries [15], their utilization remains limited in developing nations [16, 17, 31]. The repercussions of this restricted adoption of CAATTs are inefficiently conducted audits or, even worse, audits lacking the expected level of quality. Further investigation is required to provide a comprehensive understanding of the reasons behind the lack of acceptance of CAATTs.

Acceptance is a complex concept that encompasses various factors like perceptions, opinions, attitudes, and personal attributes of individuals, along with their level of engagement with technology. User acceptance refers to the noticeable willingness within a group to utilize information and communication technologies for accomplishing tasks aligned with their intended purposes [4]. Embracing information technology as an integral component of the digital landscape has been extensively studied, exploring its connections with other concepts and variables. The theory of information technology acceptance has undergone significant transformations [29]. Researchers in the field have proposed various theories and models to understand the acceptance and use of information technology, including the technology acceptance model, guided behavior theory, innovation diffusion theory, confirmation expectation model, integrated theory of technology acceptance and use, and fit model. These theories examine the relationship between individuals and technology, among other aspects. Numerous surveys have employed different models and methodologies worldwide to investigate factors influencing information technology acceptance. Among them, the Technology-Organization-Environment (TOE) model stands out as the most reliable approach. In this research, the technology-organization-environment (TOE) framework is utilized.

The adoption of Computer-Assisted Audit Tools and Techniques (CAATT) differs from the adoption of other technologies commonly found in traditional industries like retail and manufacturing. There are three environmental factors unique to the external audit environment. These factors encompass several elements: the intricacy of the Accounting Information Systems (AIS) environment, the competitive pressure faced by audit firms to adopt Computer-Assisted Audit Tools and Techniques (CAATT), and the level of support from professional accounting bodies for CAATT adoption. Firstly, clients with complex AIS tend to engage larger audit firms that possess adequate capabilities and investments in IT resources and expertise [2, 15]. Secondly, the pressure to adopt CAATT within the audit industry is more intricate compared to other sectors. Audit firms face significant pressure to secure funding [8] and must gather sufficient evidence and deliver competitive audits within budgetary constraints and time limitations [2]. Lastly, the audit industry operates under the regulations set forth by professional accounting bodies (PABs), whose support plays a crucial role in influencing audit firms to embrace CAATT. Building upon previous research on technology acceptance, this study aims to address the question of what constitutes an acceptance model for computer-based auditing tools and techniques.

2 Literature review

Various models have been utilized for the implementation of information technology. Some of these models are grounded in theory, while others have been derived from literature reviews, observations, and experiences. Theoretical models are primarily based on theories of change or behavioral theories in general. They propose that the adoption and integration of new technology are influenced by attitudes, behavioral intentions, or actual behaviors that result in embracing change [23]. To identify the factors that impact technology utilization within an organization, several models will be discussed subsequently.

2.1 Technology-Organization-Environment (TOE) model

This particular model is employed to comprehend the crucial factors that impact the adoption of new information technology within an organization. This framework encompasses three primary factors: organizational, technological, and environmental, which collectively influence the process of utilizing technological innovation. The technology-organization-environment framework highlights these three foundational aspects of an organization that shape the acceptance and utilization of information and communication technology within the organization [7].

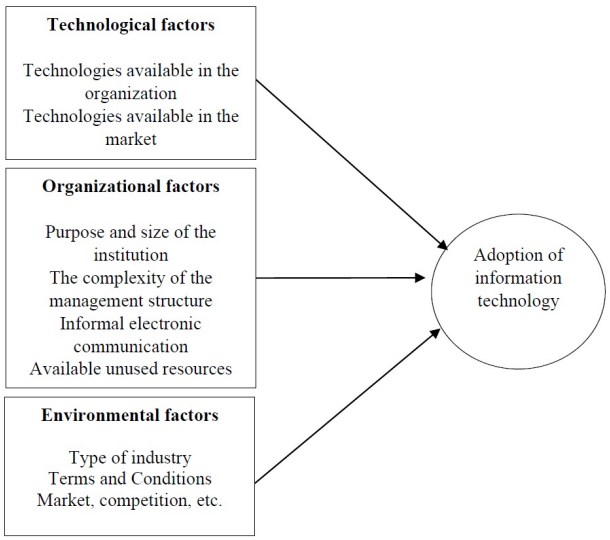

Figure 1: Technology-Organization-Environment framework [12]

The technological background encompasses both internal and external technologies that are suitable for the organization. The organizational background comprises various factors, such as the organization's goals and size, informal electronic communications and relationships, the availability of unused resources within the organization, as well as the centralization, formality, and complexity of its management structure. Additionally, the environmental context defines the industrial situation in which the organization operates, including the type of industry, level of competition, market stability and instability, government transactions, laws, and regulations. Collectively, these three factors significantly influence the organization's decisions regarding the adoption of technological innovation [23].

2.2 Factors adapted from TOE and DOI models used in the research model

2.2.1 Technological factors

Technological factors encompass both established and emerging technologies that are associated with an organization. In simpler terms, these factors comprise the internal and external technologies within the organization, and many of them will influence future technologies [22]. Tornatzky and Fleischer [28] have defined technological factors as observable characteristics linked to a technology.

Relative advantages

Rhodes explains comparative advantage as the degree to which a new innovation is seen as improved and superior compared to previous ideas. It is logical for organizations to assess the relative benefits of a technology before adopting it [22]. Organizations that can comprehend the advantages of a technology in comparison to others are more inclined to embrace it [7].

Financial costs

The cost of a technology is among the key factors that impact the choice to adopt it at the organizational level. According to Rhodes [24], organizations are more likely to embrace technologies that are more affordable, as they tend to be adopted more quickly. Organizations aim for the benefits derived from adopting a new technology to align with the costs associated with its adoption [22].

Lack of knowledge

Rhodes' theory suggests that possessing knowledge and comprehension of an innovation is likely to result in its adoption [14]. Numerous organizations have postponed the adoption of innovations due to challenges in developing the necessary skills and understanding of the technology. Research indicates that having specialized knowledge about an innovation within an organization enhances the motivation to adopt it [7].

Security concern

If there is any violation in the information carriers, it will lead to severe repercussions for the organization. These consequences include financial losses, incorrect decision-making, loss of public confidence, inability to carry out important tasks, increased expenses, and disruptions in services [22]. In addition, the organization's reputation can be damaged and result in business losses, legal issues, a decline in stock value, loss of trust from investors, acquisition of competitors' information through internal knowledge, loss of customers, and future employment problems due to the loss of the organization's data. This perspective underscores the significance of information security within the organizational context. Another rationale for the need to conduct research in the field of information security is the complexity and vastness of knowledge in this domain, which necessitates extensive exploration on its practical application [14].

2.2.2 Organizational factors

Organizational factors are related to the attributes of the organization. Key characteristics of an organization encompass its size, level of concentration, formality, intricacies of management structure, competence and knowledge of personnel, as well as access to internal and external resources [22]. The organization's structure and processes can either hinder or support the adoption of technology. As a result, organizational factors have the most significant influence on the acceptance of technology.

Senior management support

The backing from top-level management in an organization is a crucial factor that assists in the implementation of new technologies within the organization. It has been found that there is a positive correlation between senior management support and technology adoption [22]. Numerous studies have demonstrated that the support of senior management plays a significant role in the acceptance and spread of innovations within the organization. By providing support and demonstrating a positive attitude, senior management can establish an environment conducive to embracing innovation and technology.

Company size

While large organizations possess the required resources and infrastructure to embrace innovation, small organizations encounter constraints stemming from factors like financial limitations, a scarcity of expert professionals, and notably, the short-term outlook of senior management [22].

2.2.3 Environmental factors

Tornatzky and Fleischer [28] provided a definition for environmental factors, stating that the organization's environment encompasses its industry, competitors, government, and customers. Each of these factors influences the company's decisions and business policies based on their level of influence [14].

Competitive pressure

Competitive pressure has been recognized as a significant factor influencing the adoption of information technology. When competition intensifies and businesses strive to expand their market share, certain organizations may opt for new technologies to gain a competitive edge [14]. By leveraging information technology, productivity can be enhanced and performance can be improved through timely access to relevant information. Conversely, in industries where competition is high, the likelihood of technology adoption by organizations tends to increase [22].

Support from government resources

Information technology is a crucial aspect of government reforms, and it is anticipated that the government will

have a significant role in promoting the adoption of technology for effective governance in the future [22]. Over the past ten years, information technology has played a key role in policy changes, government institutions, performance management, simplifying bureaucratic processes, and re-engineering [22]. In his book "Social Dimensions of Information Technology," Norris concludes that information technology can greatly enhance government, society, education, and the quality of political processes [14].

Support for government supervision

To achieve the research goals, the following questions have been formulated and examined based on the principles of good government supervision as described in previous studies. These principles include an open and inclusive policy-making process, professionalization of the bureaucracy, responsive government, and active participation of civil society in public affairs [22]. Additionally, government supervision involves leveraging electronic information, ensuring equal access to services, reducing discrimination, increasing citizen engagement in policy-making through online interactions with policymakers, bridging the digital divide, and addressing social inequalities. These ideals are frequently mentioned in approaches to good governance [32].

How do audit firms adopt computer-assisted audit tools and techniques (CAATTs)?

Here are some of the research studies conducted in this field. Taftian and Mojkar [27] conducted a study called "Preparation and Acceptance of Artificial Intelligence Technology in Accounting." This research addresses the significance of preparing for and accepting artificial intelligence technology in the accounting field, which has been overlooked in existing accounting literature. The study focuses on the acceptance of artificial intelligence in accounting and auditing within a company, describing how the diffusion of innovation theory applies to the implementation and promotion of artificial intelligence technology. Etemadi et al. [10] conducted a study titled "Acceptance of Accounting Information Systems Based on Self-Assessment of Wisdom." The findings indicate that all components of the technology acceptance and application model, except for "performance expectation," directly and positively impact the acceptance of accounting information systems. Moreover, it can be stated that the personality traits related to accounting information systems positively impact accountants' level of expertise. Sepasi et al. [25] conducted a study titled "Investigating Factors Affecting the Acceptance of Information Technology from the Perspective of Internal Auditors." The results obtained from the sample of internal auditors revealed that all the examined factors have an effect on the acceptance of information technology among internal auditors. Notably, technological factors were identified as the most influential factor among others. Qalavandi et al. [20] presented a study titled "Factors Affecting the Use of Computers Among Teachers: Testing the Integrated Theory of Acceptance and Use of Technology." The findings indicated that performance expectation and effort, as well as social influence on the decision to use information technology, have a positive and significant impact. Additionally, facilitating conditions and gender also demonstrated a significant positive effect on usage. Fakour et al. [11] conducted a study titled "Examining the Impact of Innovation Diffusion Theory on Internet Banking Acceptance Based on Davis's Technology Acceptance Model." Previous research indicates that the aspects of innovation diffusion theory (observability, relative advantage, testability, and compatibility) influence the adoption of Internet banking, as examined in this study using the Davis model. The dimensions of innovation diffusion theory have a positive and significant impact on the dimensions of the Davis model, including user attitudes towards usage, ease of use, and perceived usefulness. In another study, Drobyshevskaya et.al [9] presented research titled "Primary Approaches to Assessing the Effectiveness of Tax Control and Management in the Context of Digitalization." The authors emphasize the need to enhance the assessment method for evaluating the effectiveness of tax control, which is a crucial task with both scientific and practical significance for shaping government financial policies. Additionally, they conducted a comparative analysis to examine various approaches in developing methods for evaluating the efficiency of tax administration and control processes. In their study titled "Organizational and Environmental Effects on the Adoption of Computer-Aided Auditing Tools and Techniques (CAATTs) by Audit Firms in Malaysia," Siew et al. [26] found that environmental factors such as the complexity of client accounting information systems (AIS) and the perceived support from professional accounting bodies (PAB) influence the adoption of CAATTs.

In their 2019 research, Rahi [21] explored the role of UTAUT and the quality of electronic services in influencing the adoption of Internet banking. The research model was based on technology acceptance theories. Through analysis using a structural equation model, the study found that commitment, reliability, website design, and customer service had a positive and significant impact on the adoption of electronic banking technology. Similarly, in their 2018 research titled "Integrated Theory of Acceptance and Use of Technology," Venkatesh et al. [30]. highlighted the importance of this theory in the field of information technology acceptance. Furthermore, we have examined the most significant studies pertaining to this theory. The research's limitations and unique characteristics have been highlighted. One notable aspect of this theory is its comprehensive evaluation of both quantitative and qualitative methods for assessing information technology acceptance. In a study conducted by Ismaeel Jabouri et al. in [13], titled "Investigating In-

formation Technology Infrastructure on Innovation Performance," the findings suggest that incorporating information technology as a dynamic strategy within an organization is essential and will result in innovation and organizational improvement. Pynoo et al.'s [19] research, titled "Predicting High School Teachers' Acceptance and Use of a Digital Environment based on the UTAUT Model as a Theoretical Framework," operationalized acceptance through four dimensions: attitude, intention, frequency of use, and actual usage observed in recent years. The results indicated that performance expectation and social influence exerted by superiors in promoting the use of the digital learning environment were the primary predictors of acceptance, whereas effort expectation and provision of facilitating conditions played a lesser role.

3 Methodology

This research utilizes an approach that relies on exploratory studies. The objective of conducting two-stage exploratory studies is to use the outcomes and analyses from the initial qualitative method to aid the results and analysis of the subsequent quantitative method. The present study follows a mixed research design as its purpose is to develop a framework for assessing the impact of computer-aided auditing tools and techniques (CAATTs) adoption on organizations and the environment within audit institutions. Additionally, it can be classified as a cross-sectional survey based on the data collection method employed.

The target population for this study consists of individuals who are experts in the field of accounting. Once the operational team is established and decisions are made, experts will be chosen and provided with an explanation regarding the matter. Several key criteria for selecting these experts include their involvement with the topic at hand, their up-to-date knowledge about the issue for collaborative purposes, their willingness to participate in the analysis process, and their perception that the information gained from group consensus will be beneficial to them. In this research, an expert is defined as an individual who:

- Hold a bachelor's degree in accounting and stay updated on the latest trends in the field.
- Possess a minimum of a master's degree.
- Accumulate a minimum of ten years of professional experience in accounting and auditing.
- Acquire at least five years of managerial experience.

Accordingly, the study utilized 20 accounting experts and professors, for analysis. The final part of the study employed interpretive structural model and operational research approaches in a quantitative manner. Consequently, the study focused on professionals within the field, specifically auditors with a minimum of a bachelor's degree in accounting and auditing, holding the rank of senior auditor in auditing institutions. As the number of professionals in the quantitative sector is vast, Cochran's formula was used to determine an unlimited sample size of 384 individuals to be considered.

The research employed two distinct approaches for gathering information: library and field methods. Library methods were utilized to collect information pertaining to the literature and background of the research, while field methods were employed to validate or refute the research hypotheses. In the qualitative phase, both library research methods and expert interviews were utilized. For the quantitative research phase, data collection was conducted through the use of a questionnaire tool. Questionnaire No. 1 was designed for the interpretive structural model stage to identify the causal relationships among the identified indicators, while Questionnaire No. 2 was used in the structural equation technique stage.

The research conducted in multiple stages and employing various techniques. In this study, the thematic analysis method was utilized to analyze qualitative data and establish a model concerning the factors influencing the acceptance of computer-based auditing tools and techniques. Once the information from thematic analysis is gathered, efforts will be made to analyze and interpret the results and implement the qualitative model. In the quantitative phase, interpretive structural modeling was employed to identify and design the relationship patterns among the indicators.

After variables identification, they are entered in the self-interactive structural matrix (SSIM). The group decision-making rule should be used to get a collective agreement on the relationship between each pair of elements such as A and B. Interpretive Structural Modeling (ISM) logic performs based on nonparametric methods and modes in frequencies. The achievement matrix is obtained by converting its interactive structural matrix to a double value matrix of zero and one. Once the initial achievement matrix is obtained, its internal consistency must be established. One possible strategy for the calculation of different paths of i to j is to obtain the T Achievement matrix.

The T achievement matrix is adapted using the following Boolean laws [33]:

$$\begin{aligned} &0+0=0\\ &0+1=1; \quad 1+0=1\\ &1+1=1 \end{aligned} \tag{3.1}$$

So, to calculate the achievement matrix (T) we have:

$$T=(I+D)^{n-1}; \quad t_{ij}=\begin{cases} 1, & \text{If there is a path from variable 1 to variable 2;}\\ 0, & \text{otherwise.} \end{cases} \tag{3.2}$$

To determine the relationships and level of the criteria, the set of outputs and inputs of each criterion must be extracted from the received matrix.

4 Results

By applying the theme analysis method and following the six-step process, the texts were carefully examined and analyzed, resulting in the identification of primary and secondary themes.

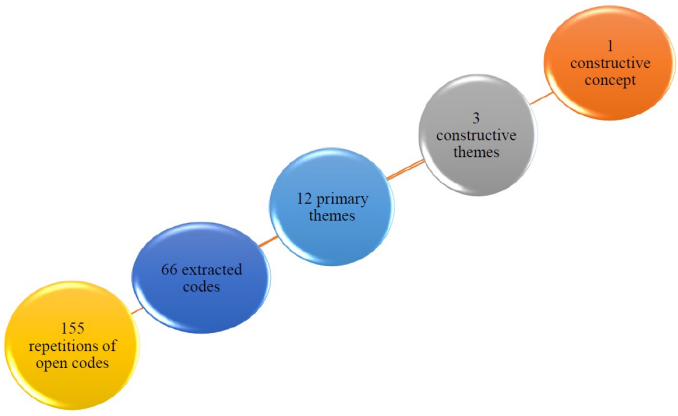

Figure 2: Main and sub-themes

The research model was comprised of one overarching theme, three constructive themes, and twelve primary themes, as indicated by these results. Ultimately, the research model is presented based on the final categories.

Four quantitative measures–Holstein's coefficient, Scott's P coefficient, Cohen's kappa index, and Kruppendorf's alpha–were employed to assess the validity, transferability, verifiability, and reliability. The Holstein coefficient (PAO), also known as the "observed agreement percentage," was calculated to determine the level of correlation among experts' opinions, yielding a significant value of 0.85. Additionally, the P-Scott index was computed to address shortcomings in the Holstein method, resulting in a value of 0.77. Furthermore, Cohen's kappa index, serving as the fourth indicator of validity for qualitative research, stood at 0.76 in this study. Finally, Kerpinderoff's alpha was utilized and obtained an estimated value of 0.79 within this study.

4.1 Structural interpretive modeling

This section presents the results obtained from data analysis. First, the demographic characteristics of the experts participating in the study are presented. Then, the structural self-interaction matrix is formed based on the experts' perspectives. For data analysis, the Interpretive Structural Modeling (ISM) method in MICMAC software version 6 has been used. After the initial accessibility matrix is obtained, by entering transitivity in the relations between variables, the final accessibility matrix is obtained. This is a square matrix in which each cell is one if the element has access to the element through any length, and zero otherwise. The first step in structural-interpretive modeling is to calculate the internal relationships of the indicators. Experts' point of view is used to reflect the internal relationships between indicators. The research components were coded as Table 1.

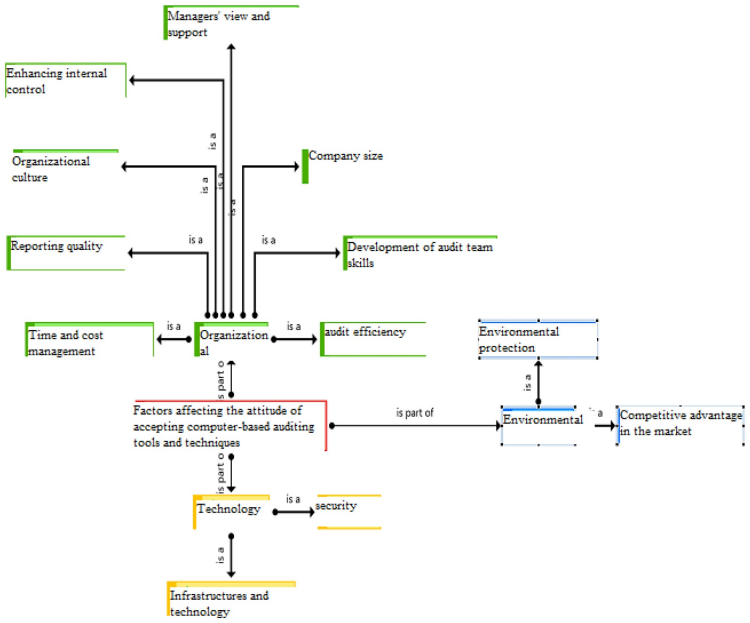

Figure 3: Identification of factors affecting the attitude of acceptance of computer-based audit tools and techniques, quality control analysis, qualitative analysis performed (Atlas T output)

Table 1: Coding of components

Variable	**Symbol**
Enhancing internal control	C1
Audit efficiency	C2
Improving audit team skills	C3
Reporting quality	C4
Environmental protection	C5
Competitive advantage in the market	C6
Technology infrastructures	C7
Time and cost management	C8
Attitudes and support of managers	C9
Organizational culture	C10
Security	C11
Organization size	C12

Table 2: Modes and signs used in expressing the relationship of the identified indicators

O	**X**	**A**	**V**
Absence of relationship	Two-way relationship	Variable j affects i	Variable i affects j

The matrix obtained in this step shows which variables a variable affects and which variables it is affected by. Conventionally, symbols like Table 2 are used to identify the relationship pattern of elements.

The structural self-interaction matrix consists of the dimensions and indicators of study and their comparison using four modes of conceptual relations. The resulting information is formed based on the interpretive structural modeling method of summation and the final structural self-interaction matrix. According to the signs listed in Table 1, the structural self-interaction matrix will be as Table 3.

The received matrix is obtained by transforming the structural self-interaction matrix into a two-valued matrix of zero and one. In the received matrix, the dimensions of the main diameter are equal to one. Therefore, the received matrix of the ISM technique is presented in Table 4.

The method of obtaining the accessibility matrix is by using Euler's theory, in which the adjacency matrix is added to the identity matrix. Then this matrix is raised to the power n if the matrix cells do not change. The following formula shows how to determine accessibility using the adjacency matrix [3]:

Table 3: Structural self-interaction matrix of SSIM

Variable	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
C1		V	V	X	V	V	A	V	A	A	A	A
C2			X	A	V	V	A	A	A	A	A	A
C3				A	V	V	A	A	A	A	A	A
C4					V	V	A	V	A	A	A	A
C5						A	A	A	A	A	A	A
C6							A	A	A	A	A	A
C7								V	V	V	X	V
C8									A	A	A	A
C9										X	A	X
C10											A	X
C11												V
C12												

Table 4: Received matrix of identified indicators

Variable	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
C1		1	1	1	1	1	0	1	0	0	0	0
C2	0		1	0	1	1	0	1	0	0	0	0
C3	0	1		0	1	1	0	0	0	0	0	0
C4	1	1	1		1	1	0	1	0	0	0	0
C5	0	0	0	0		0	0	0	0	0	0	0
C6	0	0	0	0	1		0	0	0	0	0	0
C7	1	1	1	1	1	1		1	1	1	1	1
C8	0	1	1	0	1	1	0		0	0	0	0
C9	1	1	1	1	1	1	0	1		1	0	1
C10	1	1	1	1	1	1	0	1	1		0	1
C11	1	1	1	1	1	1	1	1	1	1		1
C12	1	1	1	1	1	1	0	1	1	1	0	

Determining the final accessibility matrix

$$A + I$$
$$M = (A + I)^n \tag{4.1}$$

where A is the initial accessibility matrix, identity matrix, and final accessibility matrix. The power operation is performed according to Boolean rules (Equation (4.2)).

Boolean rules

$$1 \times 1 = 1; \quad 1 + 1 = 1. \tag{4.2}$$

Therefore, to ensure, secondary relations must be checked. This means that if A leads to B and B leads to C, then A must lead to C. That is, if based on secondary relations, direct effects should have been considered but did not actually occur, the table must be corrected to also show the secondary relation. The final accessibility matrix of the identified indicators is presented in Table 5.

Table 5: Final accessibility matrix of identified indicators

Variable	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
C1	1	1	1	1	1	1	0	1	0	0	0	0
C2	0	1	1	0	1	1	0	1	0	0	0	0
C3	0	1	1	0	1	1	0	0	0	0	0	0
C4	1	1	1	1	1	1	0	1	0	0	0	0
C5	0	0	0	0	1	0	0	0	0	0	0	0
C6	0	0	0	0	1	1	0	0	0	0	0	0
C7	1	1	1	1	1	1	1	1	1	1	1	1
C8	0	1	1	0	1	1	0	1	0	0	0	0
C9	1	1	1	1	1	1	0	1	1	1	0	1
C10	1	1	1	1	1	1	0	1	1	1	0	1
C11	1	1	1	1	1	1	1	1	1	1	1	1
C12	1	1	1	1	1	1	0	1	1	1	0	1

To determine the relations and ranking of criteria, the set of outputs and inputs must be extracted from the received matrix for each criterion.

- Reachability set (row elements, outputs, or outflows): The variables that can be reached through this variable.
- Antecedent set (column elements, inputs, or inflows): The variables through which this variable can be reached.

The output set includes the criterion itself and the criteria it affects. The input set includes the criterion itself and the criteria that affect it. Then, the set of two-way relations between the criteria is identified.

Table 6: Input and output sets (influences) for each variable

Variable	Component	Input	Output
C1	Enhancing internal control	8	7
C2	Audit efficiency	10	4
C3	Improving audit team skills	10	4
C4	Reporting quality	8	7
C5	Environmental protection	11	2
C6	Competitive advantage in the market	12	1
C7	Technology infrastructures	2	12
C8	Time and cost management	8	5
C9	Attitudes and support of managers	5	10
C10	Organizational culture	5	10
C11	Security	2	12
C12	Organization size	5	10

For variable C_i, the reachability set (outputs or influences) includes variables that can be reached through variable C_i. The antecedent set (inputs or dependencies) includes variables through which variable C_i can be reached.

After determining the reachability and antecedent sets, the intersection of the two sets is calculated. The first variable whose set intersection equals the reachability set (outputs) will be level one. Therefore, level one elements will have the most influence in the model. After determining the level, the criterion whose level is known is deleted from the entire set and the input and output sets are re-formed without considering level one variables to obtain the next variable level.

Table 7: Determining the first level in the ISM hierarchy

Symbol	Input	Output	subscription	level
C1	C1-C4-C7-C8-C9-C10-C11-C12	C1-C2-C3-C4-C5-C6-C8	C1-C4	5
C2	C1-C2-C3-C4-C7-C8-C9-C10-C11-C12	C2-C3–C5-C6	C2-C3	3
C3	C1-C2-C3-C4-C7-C8-C9-C10-C11-C12	C2-C3–C5-C6	C2-C3	3
C4	C1–C4–C7-C8-C9-C10-C11-C12	C1-C2-C3-C4-C5-C6-C8	C1-C4	5
C5	C1-C2-C3-C4-C5-C7-C8-C9-C10-C11-C12	C5-C6	C5	2
C6	C1-C2-C3-C4-C5-C6-C7-C8-C9-C10-C11-C12	C6	C6	1
C7	C7-C11	C1-C2-C3-C4-C5-C6-C7-C8-C9-C10-C11-C12	C7-C11	7
C8	C1-C4-C7-C8-C9-C10-C11-C12	C2-C3–C5-C6-C8	C8	4
C9	C7-C9-C10-C11-C12	C1-C2-C3-C4-C5-C6-C8-C9-C10–C12	C9-C10-C12	6
C10	C7-C9-C10-C11-C12	C1-C2-C3-C4-C5-C6-C8-C9-C10–C12	C9-C10-C12	6
C11	C7-C11	C1-C2-C3-C4-C5-C6-C7-C8-C9-C10-C11-C12	C7-C11	7
C12	C7-C9-C10-C11-C12	C1-C2-C3-C4-C5-C6-C8-C9-C10–C12	C9-C10-C12	6

Therefore, variables C7-C11 are level seven variables. After identifying level one variable(s), this variable(s) is deleted and the input and output sets are recalculated without considering level one variables. The common set is identified and variables whose intersection equals the input set are selected as level two variables.

Variables C9-C10-C12 are level six variables.

Variables C1-C4 are level five variables.

Variable C8 is a level four variable.

Variables C2-C3 are level three variables.

Variable C5 is a level two variable.

Variable C6 is a level one variable.

And finally C4 is placed at the outermost level of the model.

The final pattern of the identified variable levels is shown in the figure 4. In this diagram, only the significant relationships of the elements of each level on the elements of the lower level as well as the internal significant relationships of the elements of each row are considered.

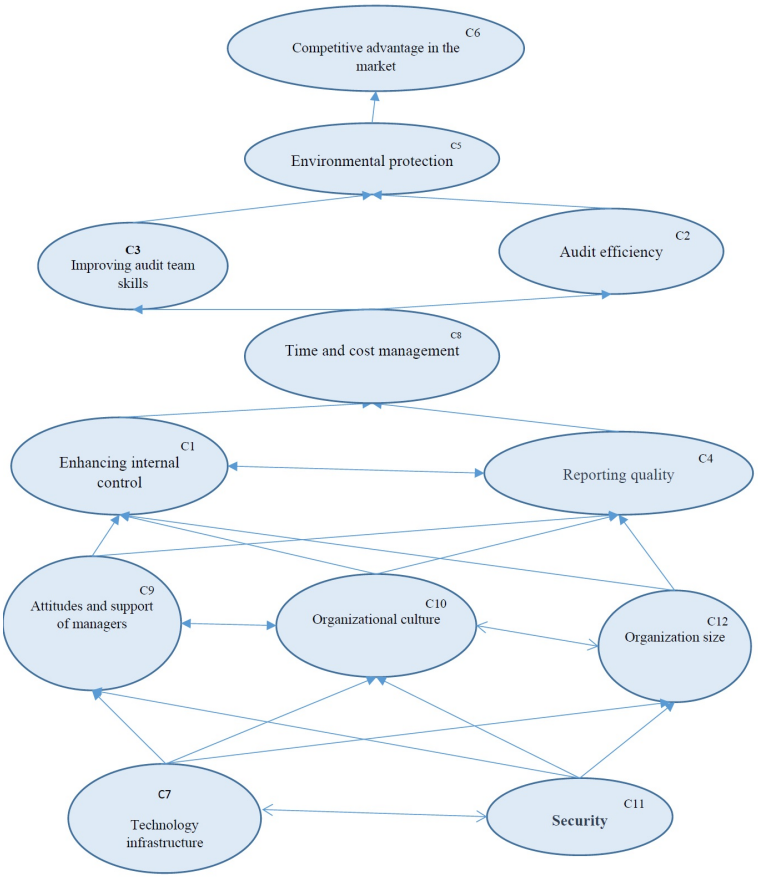

Figure 4: The developed base model using ISM

5 Discussion and conclusion

Based on interpretive structural analysis, a six-level model has been obtained:

The mentioned components play vital roles in promoting audit quality and efficiency, improving resource management, increasing customer trust, and creating a competitive advantage in the market through the adoption of computer-assisted audit tools and techniques (CAATTs) by audit firms. These components improve processes, reduce risks, and enhance audit performance. The role of each of these components in the adoption of CAATTs by audit firms is discussed below:

Enhancing internal control:

- Using CAATTs can help strengthen organizational internal controls and prevent potential risks and fraud.
- This component increases trust in financial information and improves control processes.

Audit efficiency:

- Using CAATTs can help increase efficiency and speed of executing the audit process and reduce time and costs associated with auditing.
- This component improves audit quality and accuracy, enhances customer experience, and increases their satisfaction.

Improving audit team skills:

- Using CAATTs can help develop the IT skills of the audit team and facilitate increasing their expertise and capabilities.
- This component improves audit team efficiency, enhances audit process implementation, and promotes report content and quality.

Reporting quality:

- Using CAATTs can help improve the quality of audit reports and provide more accurate and reliable information to managers and other stakeholders.
- This component increases trust in audit reports and decisions.

Environmental protection:

- Using CAATTs can help reduce paper and natural resource consumption and contribute to environmental protection and reducing environmental impacts associated with auditing.
- This component increases corporate social responsibility and promotes sustainability principles.

Competitive advantage:

- Using CAATTs can help create a competitive edge in the market and distinguish the organization from its competitors.
- This component attracts new customers, retains existing ones, and increases market share.

Technology infrastructure:

- Using CAATTs requires provisioning appropriate technology infrastructure that helps the organization benefit more from audit tools and techniques.
- This component increases the implementation capability of audit systems and provides more advanced capabilities.

Time and cost management:

- Using CAATTs can help improve auditing time and cost management and have more effective performance.
- This component reduces auditing costs, improves planning and resource management.

Attitudes and support of manager:

- Managers' support and positive attitude toward using CAATTs can facilitate and accelerate the adoption process of these tools and promote a technology-use culture in the organization.
- This component increases trust and effective interaction between audit teams and managers.

Organizational culture:

- Using CAATTs can help change the organizational culture toward utilizing technology and promote motivation in audit teams to leverage new tools.
- This component increases organizational flexibility in using technology and improves processes.

Security:

- Using CAATTs requires establishing proper security in provisioning and using data and technology to ensure protection of audit information.
- This component safeguards audit information, reduces security risks, and ensures information security.

Organization size:

- Organization size plays an important role in adopting CAATTs; larger organizations may need more complex technology infrastructures.
- This component helps match the extent of CAATTs use with organizational needs and size.

All these components collectively enable audit firms to improve efficiency, quality, security, and resource management in auditing through using CAATTs and successfully address challenges and opportunities in the auditing industry.

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