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Applying fuzzy Delphi approach for diagnosis and determination effective factors on information technology internal audit

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Abstract

This research was conducted to present a model of information technology acceptance in internal auditing using the fuzzy Delphi approach. In this study, a sample of 15 financial managers, internal auditors from companies, and audit experts was utilized, employing a non-random and judgmental sampling method. The fuzzy Delphi method was employed for screening the factors. Accordingly, the factors were initially identified as 38 factors for the experts, and through the fuzzy Delphi approach, they were reduced to 12 factors in three stages. Subsequently, a structural interpretive model was used to determine the significance and prerequisites of the validated factors. Ultimately, a four-level model of factors influencing the acceptance of information technology in internal auditing was identified. Considering that each category of factors consisted of a set of variables that were examined, the analysis of the data determined their order. The variables for the first to fourth levels are as follows: Level 1: Specialized training, management awareness, management support and encouragement, auditor's trust in technology adoption, and audit report quality. Level 2: Specialized training, management awareness, management support and encouragement, and audit report quality. Level 3: Specialized training for auditors, management support and encouragement. Level 4: Specialized training for auditors. Finally, based on the findings of the research, recommendations were provided for management and employees, as well as suggestions for other researchers.

Keywords: information technology acceptance, internal auditing, organizational factors, Delphi approach
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1 Introduction

Internal audit adds value to organizations by providing insights and recommendations, providing assurance in various business aspects and providing objective information to officials for decision-making [2]. These value-added activities are very important to help organizations achieve their goals. However, internal audit functions (IAF) on the board are currently facing talent shortages as well as skills gaps, thus making it difficult for their organizations to meet ever-changing needs [3]. As Bose [4] stated, greater use of audit technology indicates a strong commitment to internal audit quality; therefore, internal auditor functions may increase their use of audit technology in their audit

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performance to better meet the ever-changing needs of their organization. Using technology, this function realizes the advancement of skill in the delivery of internal audit and provides additional perspectives to the organization, as well as increasing its credibility and value communication. Demonstrating how internal auditor functions add value to the organization is critical to management and the board, as audit activities typically do not have as much direct impact on the organization's core policy as other departments' activities [4]. This research examines what factors separate organizations that heavily use audit technology, and provides empirical evidence related to internal auditor practices. The investigated factors are related to organizational characteristics, internal auditor and audit committee functions. Previous research on internal audit investment, factors related to internal audit budgeting [5, 12] and staffing [4, 5, 8, 10, 16]. Brazel and Dang [5] found that US public company internal audit budgets are related to firms' risk, audit characteristics, and ability to pay for monitoring. Granlund and Malmi [12] found that US public company internal audit budgets are related to various audit committee characteristics. Brazel and Dang [5] found that during major US accounting scandals in the early 2000s, internal audit budgets and staffing levels of US public companies increased, and Bose [4] showed that US public and private companies, the size of the internal auditor's functions are related to the different activities of the internal auditor's functions, as well as the characteristics of the functions of the internal auditor and the audit committee. Hyvönen et al. [16] examined large German companies and found that company size, capital market importance, scope of audit work to cover and decentralization of internal auditor functions are drivers of the size of internal auditor functions. Gbosbal and Kim [10] found that the size of the internal auditor's performance is related to the ownership of management shares, the proportion of independent board members and the company's control environment. Finally, Gbosbal and Kim [10] found that among companies listed on the Kuwait Stock Exchange, the size of internal auditor functions is related to financial sector companies, the presence of a risk management committee, and the size of the audit committee. This study extends previous internal audit investment research by looking beyond the determinants of budget and addressing the increasing importance of technology in today's audit environment. Examining the extent of an organization's investment in audit technology reflects "the pervasive influence of information technology on organizations, which in turn forces internal auditors to upgrade their knowledge and skills of information technology and adjust the way they do their work" [4]. In addition, this study was motivated by findings from the Global Audit Executive Survey, which indicated that internal audit functions must enhance their information technology (IT) tools and skills to meet their stakeholders' expectations and increase the impact of their performance on the organization [15]. However, in most internal studies, this issue has been neglected and there is an empty space in the information technology and auditing literature for research on this issue, which is the motivation for conducting the present research. Therefore, the current research seeks to investigate the factors related to investment in internal audit technology on the amount of use of information technology systems in companies. The findings of the research, while contributing to the development of theoretical literature in the field of auditing and information technology as an economic-technological factor, can lead to a better understanding of investors, capital market legislators and other users of information technology systems about the impact of information technology adoption among internal auditors. It should be helpful in making investment decisions in this area.

2 Research background

Chenhall and Morris [7] conducted a study entitled new frontiers for internal audit research. The current research showed that internal audit provides useful and valuable services to organizations, and academic research has determined its importance in improving corporate governance. However, the body of internal audit research is still relatively small. In fact, there are many emerging and lesser-known topics and doctors are willing to help. The main focus of this article is to provide specific recommendations for future research based on surveys, interviews and discussions with clinicians. We identify three broad areas for additional academic research: IT innovation, staff and personnel development, and agile auditing. In each area, we describe current practices and discuss the relevant accounting literature, noting gaps where additional research is needed. We also provide a list of testable research ideas to help inform academics on practice-relevant research questions that not only add to the academic literature but also benefit clinicians seeking guidance. We hope this article will inspire more academic research that examines important internal audit questions.

In their study, Garven and Scarlata [9] examined factors related to investment in internal audit technology. They used a sample of 213 senior auditors from both government and private companies. The results of their study indicate that several factors studied are associated with investment in the internal audit function and are combined together. Additionally, the findings suggest that internal audit performance does not fully utilize information technology tools and techniques.

Mir Ashrafi [18] conducted a study to investigate the factors influencing IT internal auditing in a sample bank. Their findings indicated that information technology plays an important role in internal auditing and the implementation of internal controls within organizations. They also showed that information technology leads to increased quality

and efficiency of auditing through automated auditing, the elimination of certain manual auditing methods, and the enhancement of information and knowledge transfer capabilities.

Razegi Jahromi et al. [20] researched the impact of information technology on internal auditing in private companies in Ahvaz. They used a sample of 30 internal auditors. The findings suggested that information technology is generally used in various stages of internal and private audits, including executing content examination in the operational review process and conducting substantive and detailed testing of account balances and key operations.

3 Research method

The research method used in this study is descriptive in nature. Descriptive research comprises a set of methods aimed at describing the conditions or phenomena under investigation. The execution of descriptive research can be solely for the purpose of gaining a better understanding of existing conditions or aiding the decision-making process. The primary data collection tool in this study is a questionnaire. It should be noted that, based on the nature of the criteria, verbal variables have been used to explain and measure the variables. Therefore, the questionnaire used is fuzzy in nature. Another data collection tool in this research is interviews with managers and experts. In this regard, the fuzzy Delphi method has been employed to gather the opinions of professors, experts, and specialists in the field of accepting information technology in internal auditing, as well as academic environments. The implementation steps of the fuzzy Delphi method, which is a combination of the Delphi method and performing analyses on information using the definitions of fuzzy set theory, are as follows:

1. Selection of experts and presenting the problem to them: In this stage, a group of experts who possess opinions and knowledge in the specific field are selected. The problem at hand is then described to them so that they can provide the best possible decisions with a clear understanding of the problem.
2. Preparation of the questionnaire and its distribution among the experts: After presenting the problem, a questionnaire is designed, consisting of questions related to the problem. This questionnaire is sent to the experts to gather their opinions and perspectives regarding the problem.
3. Obtaining expert opinions and analyzing them: In this stage, the questionnaire is sent to the panel of experts, and they assign ratings to each of the components or provide suggested modifications and recommendations. Based on the questionnaire items and the linguistic variables defined within the questionnaire, the fuzzy averages of each component are calculated using specific relationships [6].

$$A^{(i)} = (a_1^{(i)}, a_2^{(i)}, a_3^{(i)}, a_4^{(i)}), \quad i = 1, 2, 3, ..., n \tag{3.1}$$

$$A_{ave} = (m_1, m_2, m_3, m_4) = \left(\frac{1}{n} \sum_{i=1}^{n} a_1^{(i)}, \frac{1}{n} \sum_{i=1}^{n} a_2^{(i)}, \frac{1}{n} \sum_{i=1}^{n} a_3^{(i)}, \frac{1}{n} \sum_{i=1}^{n} a_4^{(i)} \right) \tag{3.2}$$

   In relation (3.1), it represents the perspective of expert i, and in relation (3.2), A_{ave} it represents the average of expert opinions. a_1, a_2, a_3, a_4 Both relations indicate a trapezoidal fuzzy number. A trapezoidal fuzzy number is a fuzzy membership function that is visually represented as a trapezoid or triangle shape. This type of membership function is used to represent uncertainty in data and evaluate expert opinions.
4. In this step, the previous viewpoints of each individual and the difference between their viewpoints and the average opinion of others are collected. Along with that, the next round questionnaire is sent again to the experts.
5. After conducting the new round of surveys, considering the opinions provided in the first step and comparing them with the results of the new round, if the difference between the two stages is less than the threshold of 0.2, the survey process is stopped. The threshold is calculated using the following equation:

$$\text{Threshold} = \text{Maximum difference}/5 \tag{3.3}$$

   Note: The specific equation for calculating the maximum difference may vary depending on the methodology or criteria used in the fuzzy Delphi method.

$$s(A_{m2}, A_{m1}) = \left| \frac{1}{4}[(a_{m21} + a_{m22} + a_{m23} + a_{m24}) - (a_{m11} + a_{m12} + a_{m13} + a_{m14})] \right| \tag{3.4}$$

   If the difference between the two stages exceeds the threshold, we go back to step 4 and repeat the process.
6. If the difference between the two stages is less than the threshold, the fuzzy Delphi process is concluded.

After collecting opinions, each of the indicators that gained the approval of experts and specialists was included in a pairwise comparison questionnaire. Experts and specialists were once again asked for their opinions on the impact of information technology acceptance indicators in internal auditing. Then, using the Interpretive Structural Modeling (ISM) method, the final model of the indicators' impact based on the collected opinions was designed.

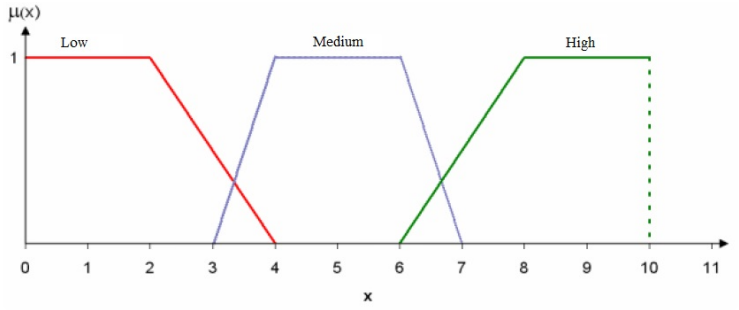
The statistical population of this research consists of 15 finance managers, internal auditors of companies, and experts in the auditing sector who have direct relevance to the subject of the present research and possess sufficient knowledge and awareness. They were selected using non-random judgmental sampling method.

To identify the most influential indicators on information technology acceptance in internal auditing, the relevant sources and articles were studied. Then, a questionnaire was developed based on the research literature, which included 38 initial indicators extracted from the reviewed sources. This questionnaire was then sent to the members of the expert group. Through three rounds of Delphi method, these 38 indicators (Table 1) were eventually reduced to 11 final indicators, as shown in Table 7.

Table 1: Extracted indices

Row	Indicator	Row	Indicator
1	Education	20	Labor market balance
2	Motivation	21	Work force participation
3	Production	22	Welfare of the workforce
4	Auditors' satisfaction	23	Competence of auditors
5	Effectiveness of auditors	24	Technology
6	Auditors' skills and experience	25	The relationship between organizational and individual goals
7	Recruiting and adjusting the workforce	26	Organizational culture
8	Competitiveness	27	Individual differences
9	Education of auditors	28	Auditors' perception and attitude
10	Factor share of labor force	29	Security of auditors
11	Wages and payments	30	Commitment and organizational responsibility
12	Auditors' physical and mental health	31	Commitment and organizational responsibility
13	Competence of auditors	32	Working relationships
14	Specialized training	33	Creativity
15	Management Awareness	34	Valuation of auditors according to the application of technology in internal audit
16	Management support and encouragement	35	Change in financial situation as a result of using technology in auditing
17	Internal training of auditing technology	36	The importance of using technology in internal audit Technology upgrade in internal audit job
18	The amount of use of auditing technology	37	Audit report quality
19	The credit of auditors from the acquisition of technology	38	Understanding the quality of audit reports

According to the relationships proposed by Cheng and Lin [6], the average values of the desired indicators for accepting information technology in internal auditing are calculated based on the following relationships. Since experts have different characteristics, they also have different mindsets. Therefore, if the options are answered based on different mindsets, the analysis of variables becomes meaningless. However, by defining the domain of qualitative variables, experts with the same mindset will respond to the questions. Therefore, qualitative variables are defined as trapezoidal fuzzy numbers [6]: Low (0, 0, 2, 4), Medium (3, 4, 6, 7), High (6, 8, 10, 10). Although trapezoidal fuzzy numbers have a more complex computational process compared to triangular fuzzy numbers, they can introduce more ambiguity carriers in linguistic and qualitative variables within the range from b to c, which is defined for trapezoidal fuzzy numbers, while this range is converted to a single point b in triangular numbers.



4 Determination of indices

Based on the proposed options and the definition of linguistic variables, the desired questionnaire was designed. The results of the questionnaire responses are presented in Table 2.

According to the available results in Table 2, the average values of the desired indices for accepting information technology in internal auditing are calculated according to the following relationships [6].

$$A^{(i)} = (a_1^i, a_2^i, a_3^i, a_4^i), \quad i = 1, 2, 3, ..., n \tag{4.1}$$

$$A_m = (a_{m1}^i, a_{m2}^i, a_{m3}^i, a_{m4}^i) = \left(\frac{1}{n}\sum a_1^{(i)}, \frac{1}{n}\sum a_2^{(i)}, \frac{1}{n}\sum a_3^{(i)}, \frac{1}{n}\sum a_4^{(i)}\right) \tag{4.2}$$

At this stage, experts have been asked to select the desired indices as low, high, or moderate options.

Table 2: The average opinions of experts from the first questionnaire

Row	Indicators	Importance of index	De-fuzzified average
1	Education	[8.9, 7.9, 8.7, 8.5]	9.6
2	Motivation	[10, 10, 8, 6]	9.9
3	Productivity	[7.7, 5.8, 4.5, 3.8]	6.2
4	Employee Satisfaction	[9.5, 9.3, 7.3, 5.5]	9.1
5	Employee Effectiveness	[8.4, 7.8, 5.5, 4]	7.3
6	Skills and Experience of Employees	[8.8, 8.4, 6.4, 4.8]	7.4
7	Workforce Recruitment and Adjustment	[7.9, 6.2, 4.7, 3.1]	6.9
8	Competitiveness	[8.4, 7.8, 5.5, 4]	7.3
9	Educational Attainment of Employees	[8.2, 7.1, 5.7, 3.8]	6.8
10	Share of Workforce	[7.7, 5.8, 4.5, 3.8]	6.2
11	Salaries and Compensation	[8.4, 7.8, 5.5, 4]	7.3
12	Physical and Mental Health of Employees	[9.5, 9.3, 7.3, 5.5]	9.1
13	Employee Capability	[9.5, 9.3, 7.3, 5.5]	9.1
14	Labor Market Balance	[7.2, 6.1, 5.2, 3]	6.3
15	Workforce Participation	[8.4, 7.8, 5.5, 4]	7.3
16	Employee Welfare	[8.8, 7.3, 6.5, 4.8]	8.1
17	Employee Competence	[7.9, 6.2, 4.7, 3.1]	6.9
18	Technology	[7.7, 5.8, 4.5, 3.8]	6.2
19	Alignment of Organizational and Individual Goals	[8.8, 7.3, 6.5, 4.8]	8.1
20	Organizational Culture	[10, 10, 8, 6]	9.9
21	Individual Differences	[9.5, 9.3, 7.3, 5.5]	9.1
22	Employee Perception and Understanding	[9.5, 9.3, 7.3, 5.5]	9.1
23	Employee Safety	[7.9, 6.2, 4.7, 3.1]	6.9
24	Organizational Commitment and Responsibility	[10, 10, 8, 6]	9.9
25	Work Relationships	[7.9, 6.2, 4.7, 3.1]	6.9
26	Creativity	[8.4, 7.8, 5.5, 4]	7.3
27	Specialized Training	[8.9, 7.9, 8.7, 8.5]	9.6

28	Management Awareness	[10, 10, 8, 6]	9.9
29	Management Support and Encouragement	[7.7, 5.8, 4.5, 3.8]	6.2
30	Internal Technology Training for Auditing	[9.5, 9.3, 7.3, 5.5]	9.1
31	Utilization of Auditing Technology	[8.4, 7.8, 5.5, 4]	7.3
32	Credibility of Auditors in Technology Acquisition	[8.8, 8.4, 6.4, 4.8]	7.4
33	Value Placed by Auditors on the Use of Technology in Internal Auditing	[7.9, 6.2, 4.7, 3.1]	6.9
34	Financial Status Change as a Result of Technology Application in Auditing	[8.4, 7.8, 5.5, 4]	7.3
35	Importance of Technology in Internal Auditing	[8.2, 7.1, 5.7, 3.8]	6.8
36	Advancement of Technology in the Field of Internal Auditing	[7.7, 5.8, 4.5, 3.8]	6.2
37	Quality of Audit Reports	[8.4, 7.8, 5.5, 4]	7.3
38	Understanding the Quality of Audit Reports	[9.5, 9.3, 7.3, 5.5]	9.1

According to the provided tables 2 and 3, the disagreement of each expert can be calculated using equation (4.3) as described by Cheng and Lin [6]. In fact, based on this equation, each expert can assess their opinion by considering the average of opinions and, if desired, adjust their previous opinions.

$$e = (a_{m1}-a_1^{(i)}, a_{m2}-a_2^{(i)}, a_{m3}-a_3^{(i)}, a_{m4}-a_4^{(i)}) = \left(\frac{1}{n}\sum a_1^{(i)} - a_1^{(i)}, \frac{1}{n}\sum a_2^{(i)} - a_2^{(i)}, \frac{1}{n}\sum a_3^{(i)} - a_3^{(i)}, \frac{1}{n}\sum a_4^{(i)} - a_4^{(i)}\right) \tag{4.3}$$

Using equation (4.3), the disagreements of the experts were calculated and adjusted in a questionnaire. Then, each expert provided their new opinions based on the reassessment of their previous opinions. The results of this stage are presented in tables 3 and 4.

Table 3: Results of Counting the Responses to Questionnaire 2

Row	**Indicators**	**Importance Level**		
		Low	**Medium**	**High**
1	Education	0	0	15
2	Motivation	0	0	15
3	Productivity	4	5	6
4	Employee Satisfaction	0	3	12
5	Employee Effectiveness	0	3	12
6	Skills and Experience of Employees	4	5	6
7	Workforce Recruitment and Adjustment	3	6	6
8	Competitiveness	1	2	12
9	Educational Attainment of Employees	2	3	10
10	Share of Workforce	3	6	6
11	Salaries and Compensation	1	2	12
12	Physical and Mental Health of Employees	0	3	12
13	Employee Capability	0	3	12
14	Labor Market Balance	4	5	6
15	Workforce Participation	1	2	12
16	Employee Welfare	4	5	6
17	Employee Competence	4	5	6
18	Technology	4	3	8
19	Alignment of Organizational and Individual Goals	0	3	12
20	Organizational Culture	0	0	15
21	Individual Differences	0	3	12
22	Employee Perception and Understanding	0	3	12
23	Employee Safety	4	5	6
24	Organizational Commitment and Responsibility	0	0	15
25	Work Relationships	3	6	6

26	Creativity	4	5	6
27	Specialized Training	0	0	15
28	Management Awareness	0	0	15
29	Management Support and Encouragement	4	5	6
30	Internal Technology Training for Auditing	0	3	12
31	Utilization of Auditing Technology	0	3	12
32	Credibility of Auditors in Technology Acquisition	4	5	6
33	Value Placed by Auditors on the Use of Technology in Internal Auditing	3	6	6
34	Financial Status Change as a Result of Technology Application in Auditing	1	2	12
35	Importance of Technology in Internal Auditing	2	3	10
36	Advancement of Technology in the Field of Internal Auditing	3	6	6
37	Quality of Audit Reports	1	2	12
38	Understanding the Quality of Audit Reports	0	3	12

Table 4: Average Perspectives of Experts Obtained from the Second Questionnaire

Row	**Indicators**	**Indicator Importance**	**Normalized Fuzzy Average**
1	Education	[10, 10, 8, 6]	9.9
2	Motivation	[10, 10, 8, 6]	9.9
3	Productivity	[7.2, 6.1, 5.2, 3]	6.3
4	Employee Satisfaction	[9.5, 9.3, 7.3, 5.5]	9.1
5	Employee Effectiveness	[9.5, 9.3, 7.3, 5.5]	9.1
6	Skills and Experience of Employees	[7.2, 6.1, 5.2, 3]	6.3
7	Workforce Recruitment and Adjustment	[7.9, 6.2, 4.7, 3.1]	6.9
8	Competitiveness	[8.4, 7.8, 5.5, 4]	7.3
9	Educational Attainment of Employees	[8.2, 7.1, 5.7, 3.8]	6.8
10	Share of Workforce	[7.7, 5.8, 4.5, 3.8]	6.2
11	Salaries and Compensation	[8.4, 7.8, 5.5, 4]	7.3
12	Physical and Mental Health of Employees	[9.5, 9.3, 7.3, 5.5]	9.1
13	Employee Capability	[9.5, 9.3, 7.3, 5.5]	9.1
14	Labor Market Balance	[7.2, 6.1, 5.2, 3]	6.3
15	Workforce Participation	[8.4, 7.8, 5.5, 4]	7.3
16	Employee Welfare	[7.2, 6.1, 5.2, 3]	6.3
17	Employee Competence	[7.2, 6.1, 5.2, 3]	6.3
18	Technology	[7.7, 5.8, 4.5, 3.8]	6.2
19	Alignment of Organizational and Individual Goals	[9.5, 9.3, 7.3, 5.5]	9.1
20	Organizational Culture	[10, 10, 8, 6]	9.9
21	Individual Differences	[9.5, 9.3, 7.3, 5.5]	9.1
22	Employee Perception and Understanding	[9.5, 9.3, 7.3, 5.5]	9.1
23	Employee Safety	[7.2, 6.1, 5.2, 3]	6.3
24	Organizational Commitment and Responsibility	[10, 10, 8, 6]	9.9
25	Work Relationships	[7.9, 6.2, 4.7]	6.9
26	Creativity	[7.2, 6.1, 5.2, 3]	6.3
27	Specialized Training	[7.2, 6.1, 5.2, 3]	6.3
28	Management Awareness	[7.2, 6.1, 5.2, 3]	6.3
29	Management Support and Encouragement	[7.7, 5.8, 4.5, 3.8]	6.2
30	Internal Technology Training for Auditing	[9.5, 9.3, 7.3, 5.5]	9.1
31	Utilization of Auditing Technology	[10, 10, 8, 6]	9.9
32	Credibility of Auditors in Technology Acquisition	[9.5, 9.3, 7.3, 5.5]	9.1
33	Value placed by auditors on the use of technology in internal auditing	[9.5, 9.3, 7.3, 5.5]	9.1
34	Financial status change as a result of technology application in auditing	[7.2, 6.1, 5.2, 3]	6.3

35	Importance of Technology in Internal Auditing	[10, 10, 8, 6]	9.9
36	Advancement of technology in the field of internal auditing	[10, 10, 8, 6]	9.9
37	Quality of Audit Reports	[7.2, 6.1, 5.2, 3]	6.6
38	Understanding the Quality of Audit Reports	[9.5, 9.3, 7.3, 5.5]	9.1

In this stage, the degree of expert consensus is calculated by computing the difference between the averages of two stages 1 and 2 using the fuzzy number distance relations (relation (3.4)).

$$s(A_{m2}, A_{m1}) = \left| \frac{1}{4}[(a_{m21} + a_{m22} + a_{m23} + a_{m24}) - (a_{m11} + a_{m12} + a_{m13} + a_{m14})] \right| \tag{4.4}$$

Table 5: Difference in Average Expert Opinions between the First and Second Questionnaires

Row	**Indicators**	**Average Fuzzy De-fuzzification**	**Average Fuzzy De-fuzzification**	**Opinion Difference**
1	Training	9.6	9.9	0.3
2	Motivation	9.9	9.9	9.9
3	Productivity	6.2	6.2	0.1
4	Employee Satisfaction	9.1	9.1	0
5	Employee Effectiveness	7.3	9.1	1.8
6	Skills and Experience of Employees	7.4	6.3	1.1
7	Workforce Recruitment and Adjustment	6.9	6.9	0
8	Competitiveness	7.3	7.3	0
9	Educational Attainment of Employees	6.8	6.8	0
10	Share of Workforce	6.2	6.2	0
11	Salaries and Compensation	7.3	7.3	0
12	Physical and Mental Health of Employees	9.1	9.1	0
13	Employee Capability	9.1	9.1	0
14	Labor Market Balance	6.3	6.3	0
15	Workforce Participation	7.3	7.3	0
16	Employee Welfare	8.1	6.3	1.8
17	Employee Competence	6.9	6.3	0.6
18	Technology	6.2	6.2	0
19	Alignment of Organizational and Individual Goals	8.1	9.1	1
20	Organizational Culture	9.9	9.9	0
21	Individual Differences	9.1	9.1	0
22	Employee Perception and Understanding	9.1	9.1	0
23	Employee Safety	6.9	6.3	0.6
24	Organizational Commitment and Responsibility	9.9	9.9	0
25	Work Relationships	6.9	6.9	0
26	Creativity	7.3	6.3	1
27	Specialized Training	9.6	9.9	0.3
28	Management Awareness	9.9	9.9	0
29	Management Support and Encouragement	6.2	6.3	0.1
30	Internal Technology Training for Auditing	9.1	9.1	0
31	Utilization of Auditing Technology	7.3	9.1	1.8
32	Credibility of Auditors in Technology Acquisition	7.4	6.3	1.1
33	Value Placed by Auditors on the Use of Technology in Internal Auditing	6.9	6.9	0
34	Financial Status Change as a Result of Technology Application in Auditing	7.3	7.3	0
35	Importance of Technology in Internal Auditing	6.8	6.8	0
36	Advancement of Technology in the Field of Internal Auditing	6.2	6.2	0

37	Quality of Audit Reports	7.3	7.3	0
38	Understanding the Quality of Audit Reports	9.1	9.1	0

Based on the obtained differences, it is evident that consensus has not yet been reached among experts on some indicators, but in most cases, consensus has been achieved. Therefore, indicators with a fuzzy de-fuzzification average of less than 7 and a difference of less than 0.2 are eliminated, while indicators with a fuzzy de-fuzzification average of more than 7 and a difference of less than 0.2 are determined as the final indicators [19]. The table below shows the eliminated and confirmed indicators up to this stage:

Table 6: Results Obtained from the Second Stage

Row	**Indicators**	**Opinion Difference**	**Results**
1	Training	0.3	Next stage
2	Motivation	0	Confirmed
3	Productivity	0.1	Eliminated
4	Employee Satisfaction	0	Confirmed
5	Employee Effectiveness	1.8	Next stage
6	Skills and Experience of Employees	1.1	Next stage
7	Workforce Recruitment and Adjustment	0	Eliminated
8	Competitiveness	0	Confirmed
9	Educational Attainment of Employees	0	Eliminated
10	Share of Workforce	0	Eliminated
11	Salaries and Compensation	0	Confirmed
12	Physical and Mental Health of Employees	0	Confirmed
13	Employee Capability	0	Confirmed
14	Labor Market Balance	0	Confirmed
15	Workforce Participation	0	Confirmed
16	Employee Welfare	1.8	Next stage
17	Employee Competence	0.6	Next stage
18	Technology	0	Eliminated
19	Alignment of Organizational and Individual Goals	1	Next stage
20	Organizational Culture	0	Confirmed
21	Individual Differences	0	Confirmed
22	Employee Perception and Understanding	0	Confirmed
23	Employee Safety	0.6	Next stage
24	Organizational Commitment and Responsibility	0	Confirmed
25	Work Relationships	0	Eliminated
26	Creativity	1	Next stage
27	Specialized Training	0.3	Next stage
28	Management Awareness	0	Confirmed
29	Management Support and Encouragement	0.1	Confirmed
30	Internal Technology Training for Auditing	0	Confirmed
31	Utilization of Auditing Technology	1.8	Next stage
32	Credibility of Auditors in Technology Acquisition	1.1	Next stage
33	Value placed by auditors on the use of technology in internal auditing	0	Confirmed
34	Financial status change as a result of technology application in auditing	0	Confirmed
35	Importance of Technology in Internal Auditing	0	Confirmed
36	Advancement of technology in the field of internal auditing	0	Confirmed
37	Quality of Audit Reports	0	Confirmed
38	Understanding the Quality of Audit Reports	0	Confirmed

According to the final opinions determined in the above table, the fate of 11 indicators is determined in the next stage. Furthermore, out of the 38 indicators determined in this stage, 7 indicators have been eliminated, and 11 indicators have been confirmed. The results of distributing and collecting the questionnaires in the third stage will be

presented next.

Table 7: Results of Counting the Responses to the Third Questionnaire

Row	Indicators	Importance of Indicator		
		Low	Medium	High
1	Training	0	0	15
2	Auditors' Effectiveness	0	3	12
3	Skills and Experience of Auditors	4	5	6
4	Employee Welfare	4	5	6
5	Auditors' Competence	4	5	6
6	Alignment of Organizational and Individual Goals	0	3	12
7	Auditors' Security	3	6	6
8	Creativity	3	6	6
9	Specialized Training	0	0	15
10	Utilization of Audit Technology	0	3	12
11	Auditors' Credibility in Technology Acquisition	4	5	6
12	Understanding the Quality of Audit Reports	0	5	10

Table 8: Average Expert Opinions Obtained from the Third Questionnaire

Row	Indicators	Average Fuzzy Decoupling Opinions	Average Fuzzy Decoupling Opinions	Opinion Difference
1	Training	9.9	9.9	0
2	Auditors' Effectiveness	9.1	9.1	0
3	Skills and Experience of Auditors	6.3	6.3	0
4	Employee Welfare	6.3	6.3	0
5	Auditors' Competence	6.3	6.3	0
6	Alignment of Organizational and Individual Goals	9.1	9.1	0
7	Auditors' Security	6.3	6.2	0.1
8	Creativity	6.3	6.2	0.1
9	Specialized Training	[6,8,10,10]	9.9	0
10	Utilization of Audit Technology	[5.5,7.3,9.3,9.5]	9.1	0
11	Auditors' Credibility in Technology Acquisition	[3,5,2,6,1,7,2]	6.3	0
12	Understanding the Quality of Audit Reports	6.3	6.3	0

Table 9: The average difference of experts' opinions in the second and third questionnaire

Row	Indicators	Average Fuzzy Decoupling Opinions	Average Fuzzy Decoupling Opinions	Opinion Difference
1	Training	9.9	9.9	0
2	Auditors' Effectiveness	9.1	9.1	0
3	Skills and Experience of Auditors	6.3	6.3	0
4	Employee Welfare	6.3	6.3	0
5	Auditors' Competence	6.3	6.3	0
6	Alignment of Organizational and Individual Goals	9.1	9.1	0
7	Auditors' Security	6.3	6.2	0.1
8	Creativity	6.3	6.2	0.1
9	Specialized Training	9.9	9.9	0
10	Utilization of Audit Technology	9.1	9.1	0
11	Auditors' Credibility in Technology Acquisition	6.3	6.3	0

12	Understanding the Quality of Audit Reports	6.3	6.3	0

Based on the fact that the difference in the average of all indicators is less than 0.2, it can be concluded that there is a good consensus among the experts' opinions. There is no need for further referral of the questionnaire, and ultimately the weights of the indicators will be calculated.

5 Findings

In this section, after the necessary information and data have been collected, extracted and classified, we will solve the model and analyze the information. The collected data are meaningless numbers, which are helped by quantitative methods to make them meaningful in order to achieve the goals of the research. Analysis of information as a part of the process of scientific research method is one of the main bases of every study and research by which all research activities are controlled and guided until reaching a result. In other words, in this section, the researcher uses different methods of analysis to answer the formulated problem or questions; Therefore, it is necessary to mention this point that the analysis of the obtained data alone is not enough to find the answers to the research questions, interpretation and interpretation of these data is also necessary. In this chapter, we use a new method in soft operations research called interpretive structural modeling to analyze the extracted indicators that reached the final approval of professors and experts in identifying the influence model of information technology acceptance indicators in internal audit with fuzzy Delphi approach. In the following, the factors identified from research sources that have been approved by experts and experts using the fuzzy Delphi method are introduced.

5.1 Identified factors affecting the acceptance of information technology in internal audit

Using the studies conducted and the analysis of the articles, 12 indicators of the adoption of information technology in internal audit were identified, which are presented as follows:

Table 10: All indicators of information technology acceptance in internal audit

Row	Indicators	Row	Indicators
1	Education	7	Auditor security
2	Effectiveness of auditors	8	Creativity
3	Auditor skills and experience	9	Specialized training
4	Workforce welfare	10	Utilization of audit technology
5	Auditor competence	11	Auditor's credibility in adopting technology
6	Alignment of organizational and individual goals	12	Understanding the quality of audit reports

The sources related to each of the identified variables are presented in the second and third chapters. After the 12 indicators of information technology acceptance plan were identified in the internal audit, using the fuzzy Delphi method, a consensus was reached on 9 indicators in three stages between professors and specialists in discussions related to human resources, the results of which are presented below:

Table 11: Final indicators of information technology acceptance in internal audit

Row	Indicators
1	Specialized Training
2	Management Awareness
3	Management Support and Encouragement
4	Utilization of Audit Technology
5	Auditor's Credibility in Adopting Technology
6	Valuation of Auditors based on the Application of Technology in Internal Audit
7	Importance of Utilizing Technology in Internal Audit
8	Advancement of Technology in the Internal Audit Profession
9	Quality of Audit Reporting

Further, based on the final 9 indicators, an interpretive structural modeling questionnaire whose example is provided in the appendices section was designed and distributed among the experts, and they were asked to determine

the relationship between the indicators according to the method mentioned in the third chapter. According to the definitions, experts had four options to determine the relationship between the factors. First, factor A affects factor B. Second, factor B affects factor A. The third is that both factors affect each other and the fourth is that there is no relationship between the two factors.

5.2 The result of asking experts about the relationship of variables

At this stage, based on the structural interpretive model technique, the following steps have been carried out. After collecting the questionnaires, experts' opinions were gathered. Aggregation of opinions was done based on the frequency of opinions. For this purpose, each of the 4 types of relationship was given a number between 1 and 4. Number 1 is related to no relationship (O), number 2 is related to mutual need and common relationship (X), number 3 is related to column-to-row relationship (A) and number 4 is related to row-to-column relationship (V). Then averaging was done. If the obtained number is between 1 and 2, without relation, between 2 and 3, between 3 and 4, column to row relation and when it is between 4 and 5, row to column relation was considered. Finally, the result of the comments was calculated, which is presented in the following table:

Table 12: The result of polling about the relevance of indicators

1	2	3	4	5	6	7	8	9	
	V	O	V	X	O	O	V	V	1
		X	V	X	A	A	A	X	2
			X	V	A	V	A	X	3
				A	X	X	A	A	4
					O	A	X	V	5
						V	A	X	6
							X	V	7
								A	8
									9

5.3 Formation of the achievement matrix

By converting the relationship symbols of the SSIM matrix to the numbers zero and one according to the following rules, the achievement matrix can be reached. These rules are as follows: a) If the house (i,j) has the symbol V in the SSIM matrix, the corresponding house in the access matrix gets the number 1, and its relative house, i.e. the house (j,i) gets the number zero. b) If the house (i,j) has the symbol A in the SSIM matrix, the corresponding house in the access matrix is assigned zero, and its relative house, i.e. house (j,i), is assigned the number 1. c) If the house (i,j) in the SSIM matrix has the symbol X, the corresponding house in the access matrix gets the number 1 and its relative house, i.e. the house (j,i) gets the number 1. d) If the house (i,j) in the SSIM matrix has the symbol O, the corresponding house in the access matrix gets zero, and its relative house, i.e. house (j,i) also gets zero.

Table 13: formation of the achievement matrix

	1	2	3	4	5	6	7	8	9
1	1	1	0	1	1	0	0	1	1
2	0	1	1	1	1	0	0	0	1
3	0	1	1	1	1	0	1	0	1
4	0	0	1	1	0	1	1	0	0
5	1	1	0	1	1	0	0	1	1
6	0	1	1	1	0	1	1	0	1
7	0	1	0	1	1	0	1	1	1
8	0	1	1	1	1	1	1	1	0
9	0	1	1	1	1	1	0	1	1

5.4 formation of the final access matrix

After the initial acquisition matrix is obtained, its internal consistency should be established. For example, if variable 1 leads to variable 2 and variable 2 leads to variable 3, then variable 1 should also lead to variable 3, and

if this state is not established in the achievement matrix, the modified matrix and the relationships that have been missed should be replaced. In the final matrix, corrections are indicated by *1. For example, 1 is a prerequisite for 3 and 3 is a prerequisite for 7, so 1 must also be a prerequisite for 7; But in the previous table, the number 0 was inserted in the seventh house of the first line. In the next table, this relationship is modified; That is, instead of zero, the number *1 was inserted. In this way, the final access matrix is drawn as follows:

Table 14: Formation of the final access matrix

	1	2	3	4	5	6	7	8	9	penetration
1	1	1	*1	1	1	*1	*1	1	1	13
2	*1	1	1	1	1	*1	*1	*1	1	11
3	*1	1	1	1	1	*1	1	*1	1	14
4	0	*1	1	1	*1	1	1	*1	*1	13
5	1	1	*1	1	1	*1	*1	1	1	13
6	*1	1	1	1	*1	1	1	*1	1	14
7	*1	1	*1	1	1	*1	1	1	1	14
8	*1	1	1	1	1	1	1	1	*1	14
9	*1	1	1	1	1	1	*1	1	1	12
Dependency	13	14	14	14	14	14	14	14	14	

5.5 Determination of model levels

After calculating the final accessibility matrix, the levels of the model should be specified. In this way, the set of inputs and outputs of each factor is determined, and if the outputs and the calculated common set are the same, that factor is related to the same level. Otherwise, it should be moved to the next level. The following are the results of factor leveling:

Table 15: Determination of level 1 factors

Agents	**Output set**	**Input set**	**Common collection**	**level**
Specialized training	1.2.3.4.5.6.7.8.9.10.11.13.14	1.2.3.5.6.7.8.9.10.11.13.14	1.2.3.5.6.7.8.9.10.11.13.14	1
Management awareness	1.2.3.4.5.6.7.8.9.10.11.14	1.2.3.4.5.6.7.8.9.10.11.14	1.2.3.4.5.6.7.8.9.10.11.14	1
Management support and encouragement	1.2.3.4.5.6.7.8.9.10.11.14	1.2.3.4.5.6.7.8.9.10.11.14	1.2.3.4.5.6.7.8.9.10.11.14	1
The amount of use of audit technology	1.2.3.4.5.6.7.8.9.10.11.14	1.2.3.4.5.6.7.8.9.10.11.14	1.2.3.4.5.6.7.8.9.10.11.14	
Credit of auditors from acquiring technology	1.2.3.4.5.6.7.8.9.10.11.14	1.2.3.4.5.6.7.8.9.10.11.14	1.2.3.4.5.6.7.8.9.10.11.14	1
Valuation of auditors according to the application of technology in internal audit	1.2.3.4.5.6.7.8.9.10.11.14	1.2.3.4.5.6.7.8.9.10.11.14	1.2.3.4.5.6.7.8.9.10.11.14	
The importance of using technology in internal audit	1.2.3.4.5.6.7.8.9.10.11.14	1.2.3.4.5.6.7.8.9.10.11.14	1.2.3.4.5.6.7.8.9.10.11.14	
Technology upgrade in the job of internal audit	1.2.3.4.5.6.7.8.9.10.11.14	1.2.3.4.5.6.7.8.9.10.11.14	1.2.3.4.5.6.7.8.9.10.11.14	
Audit report quality	1.2.3.4.5.6.7.8.9.10.11.14	1.2.3.4.5.6.7.8.9.10.11.14	1.2.3.4.5.6.7.8.9.10.11.14	1

According to the obtained results, it is clear that 5 factors are related to the first level (the last level of influence). In this way, these 5 factors are removed from the calculations and the calculations are continued without these factors. The numbers related to these 4 factors are: specialized training (1), management awareness (2), management support and encouragement (3), the quality of the audit report. Thus, by removing the factors related to the first level, the final matrix will be as follows:

Table 16: The final accessibility matrix after removing the first level factors

	1	2	3	9
1	1	1	0	1
2	0	1*	1*	
3*	1*	1*	1	
9*	1	1*	1	

Now, according to the final matrix in hand, we calculate the determination of the level of the remaining factors.

Table 17: Determination of level 2 factors

Agents	**Output set**	**Input set**	**Common collection**	**level**
Specialized training	1.4.13	1.12.13	1.13	
Management awareness	4.12.13	1.4.12.13	4.12.13	2
Management support and encouragement	1.4.12.13	4.12.13	4.12.13	
Audit report quality	1.4.12.13	1.4.12.13	1.4.12.13	2

According to the obtained results, it is clear that two factors are in the second level. These two factors are the awareness of the company's management (2) and the quality of the audit report (9). These factors are removed from the model and the final matrix is rewritten:

Table 18: The final access matrix after removing the second level factors

1	3	
1	1	0
3	*1	*1

A two-by-two matrix is the result of the calculations up to this part. In the following, the factors of the third level are determined using the same matrix:

Table 19: Determination of level 3 factors

Agents	**Output set**	**Input set**	**Common collection**	**level**
Specialized training	1	1.12	1	3
Management support and encouragement	1.12	1	1	

The only factor related to the third level is auditor qualification training. The number of this factor is 1. As can be seen, one factor remains in the model, which is related to the fourth level of the model. In this way, by identifying all the levels, the final model of the influence levels of the factors affecting the adoption of technology in internal audit is drawn.

5.6 Drawing the final model of the causal levels of factors affecting the adoption of information technology in internal audit

According to the calculations, it was found that there are four levels of influence in the investigation of factors affecting the acceptance of information technology in internal audit. The four identified levels and factors related to each level are:

The first level: specialized training, management awareness, management support and encouragement, auditors' credit from the acquisition of technology and the quality of the audit report.

Second level: specialized training, management awareness, management support and encouragement, and audit report quality

Third level: specialized training of auditors, support and encouragement of managers

Fourth level: specialized training of auditors

6 Discussion

Information technology is the knowledge that examines and studies the use of computers in information and reporting systems and includes a set of tools and methods related to the production, processing and supply of information for the human user. This new knowledge includes technologies related to computer hardware and software for processing, storing, exchanging and transmitting information [14], different patterns of how users accept information technology. It predicts. Among the studies conducted in the group of individual acceptance patterns, Granlund [11], eight patterns include the theory of reasoned action, the technology acceptance pattern, the motivational pattern, the theory of planned behavior, the combined pattern of technology acceptance and planned behavior. They introduced

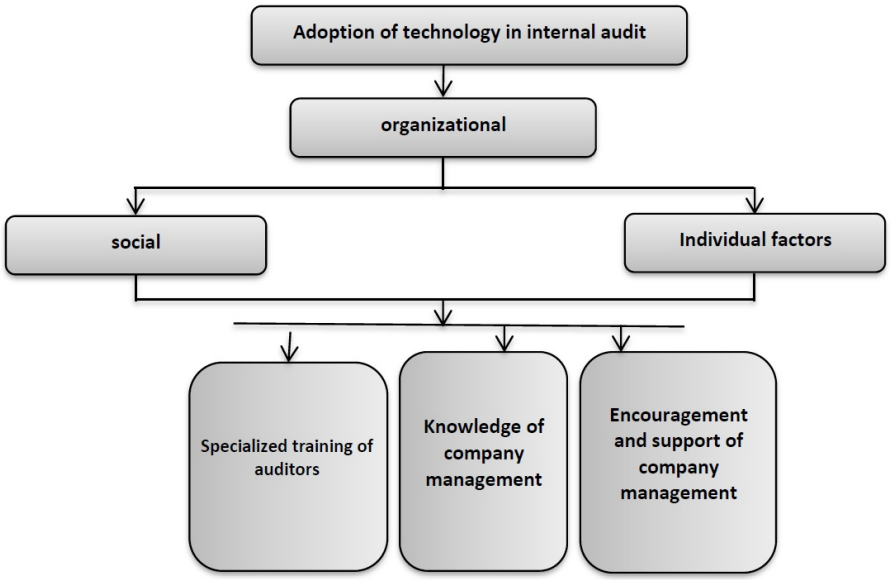


Figure 1: The final four-level model of factors affecting the acceptance of information technology in internal audit

the pattern of using personal computers, the theory of diffusion of innovation and the theory of social cognition as the main patterns [11].

In this research, the factors of presenting the information technology acceptance model in internal audit were investigated with the fuzzy Delphi approach. In order to evaluate the effective factors and examine the views and opinions of internal auditors, a questionnaire was prepared and distributed among a number of financial managers and internal auditors of companies and experts in the distribution audit department, and finally, the effective factors on the acceptance of information technology among internal auditors were identified by means of fuzzy Delphi method analysis. The result indicates that organizational factors are considered as one of the effective factors on the acceptance of information technology among internal auditors. Considering that to evaluate the organizational factors, we have used variables such as the use of specialized and educational instructions, the use of potential and actual benefits, support and encouragement, the amount of training, the result can be interpreted in such a way that with the implementation and use of the factors An organization can increase the acceptance of information technology and information systems among internal auditors, including the use of specialized and training instructions, the use of potential and actual benefits, support and encouragement, the amount of training. Technological factors have a greater impact on the acceptance of technology in the internal audit profession, because they have a significant impact on the use of the system and its perceived usefulness. And also the results are in conflict with the findings of Granlund and Mouritsen [13]. When accepting new information technology, the organizational structure is important for the acceptance of these technologies by internal auditors. If internal auditors are not comfortable using advanced information technology, they are much less likely to use that technology, even when that technology benefits the organization. As a result, information technology training, in addition to its usefulness, should focus on reducing the user's concerns about the use of technology. Considering the fact that to evaluate technological factors, we have used variables such as the importance of using information technology, the relevance of using information technology, the quality and quantity of the outputs used, the results of using information technology, so we carefully and pay more attention to Technological factors, including the importance of using information technology, the relevance of using information technology, the quality and quantity of the outputs used, the results of using information technology, can increase the acceptance of information technology and information systems among internal auditors. Social factors are influenced by users' information technology experience. It is important to identify the relationship between these external variables in professionals and create a suitable balance between external variables to increase the acceptance of internal auditors' technology and create a progressive atmosphere in the internal audit profession. Given that to evaluate the use of the internal audit information technology system, we have used variables such as the use of the internal audit information technology system, the amount of reference to the job description, the amount of time to refer to the job description of the use of information technology. Perceptual factors are considered as one of the factors influencing the acceptance of information technology among internal auditors. This result is in line with the findings of Granlund and Mouritsen [13] and also in terms of the type of relationship and the effectiveness of information technology acceptance with the findings of Lukka [17] and Akhavan and Radfar [1] are aligned.

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