

COMPETENCY AND GUIDELINE FOR ASSESSING READINESS TO BE AN INFORMATION TECHNOLOGY AUDITOR IN THAILAND

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ABSTRACT

In the digital era, the role of the IT auditor has become even more critical due to the increased reliance on digital technologies, the proliferation of data, the growing complexity of IT systems, and the growth of computer crime. To be a qualified IT auditor, the IT auditor must have good competencies that will result in quality audit work and results as determined by the organization. IT audit competency influences audit quality. Currently, there is a shortage of IT auditors, with many interested people needing more guidelines to become IT auditors. Therefore, this research aimed to develop a list of essential IT Audit competencies and guidelines for assessing such competencies in Thailand to help produce a new generation of qualified IT auditors. The research was divided into 3 parts: 1) Competency synthesis by in-depth interviews with 10 experts and sending online questionnaires to auditing professionals, with 400 responses. Statistics were used for analysis, including mean, standard deviation, and exploratory factor analysis, using KMO (Kaiser-Meyer-Olkin) statistics and Bartlett's Test of Sphericity 2) Development of competence indicators by holding focus group meetings with 10 experts. 3) Development of an IT auditor competency assessment system, which was evaluated for suitability and satisfaction by 10 experts and 30 users. The evaluation results were excellent.

Keywords: *IT audit, IT auditor, IS Audit, IS Auditor, IT Audit competence, IT Audit Competency Assessment System.*

1. INTRODUCTION

IT auditors have become even more critical due to the increased reliance on digital technologies, the proliferation of data, the growing complexity of IT systems, and the growing computer crime. For instance, in July 2024, our world experienced a massive problem in information technology, with some Windows users around the world encountering the "Blue Screen of Death (BSOD)" caused by a software update to third-party cybersecurity company CrowdStrike's Falcon platform, affecting businesses around the world such as financial institutions, telecommunication companies and airlines [1-4]. We have encountered problems like this many times, where the root cause of the problem comes in many forms, such as inappropriate information technology controls, cybercrime, etc. Every organization should be aware of and control such risks to a level that the organization can accept.

Control is currently needed to improve performance and significantly impact users of information systems, especially to promote business focus on information systems [5]. Therefore, an information technology auditor (IT Auditor) is one of the critical points in driving the organization to help assess and control information technology risks to help the organization benefit from using information technology systems. The organization eventually moves towards its goal [6-8]. IT auditor helps diagnose threats that affect the proper functioning of computer-aided accounts and the security of the data contained in them [9-14].

According to [7,15], an increase in the need for qualified IT auditors and a lack of support from existing IT audit frameworks are also problems in modern IT audits. Currently, there is a need for more IT auditors [16,17].

To be a qualified IT auditor, the IT auditor must have good competencies that will result in quality

audit work and results as determined by the organization. IT audit competence influences audit quality [18-21]. Currently, there is a shortage of IT auditors, with many interested people needing more guidelines to become IT auditors. Therefore, this research aimed to develop a list of essential IT Audit competencies and guidelines for assessing such competencies in Thailand to help produce a new generation of qualified IT auditors.

2. LITERATURE REVIEW

'Information Technology/ Systems audit' collects and evaluates evidence to determine whether a computer system is designed to maintain data integrity, safeguard assets, allow organizational goals to be achieved effectively, and use resources efficiently [22,23].

'IT governance' is the structure of relationships and processes controlling the organization to achieve its goals. The goals are achieved by adding value to the business while balancing the risk versus return over IT and the related processes. IT governance results in an efficient and effective enhancement of the organization's processes. IT governance is important for ensuring that the investment in IT generates value rewards, reduces the risks, and avoids failure. A successful governance framework ensures that IT investments align with organizational goals [22].

'Competency' is the hidden personality traits of an individual that can drive that individual to produce good performance or meet specified criteria in the job for which he or she is responsible [24]. The competency consists of knowledge, skills, and attributes [25-27].

'Competence' refers to having the intelligence, education, and training to add value to an organization through performance. Internal audit competence emanates from long and intensive instruction preparation in the principal knowledge, skills, methods, and scholarly principles. When hiring internal auditors, organizations should look for attributes such as education, experience, professional certification, and computer and communication skills. Internal auditors ought to have technical, analytical, appreciative, interpersonal, and organizational skills, as well as keeping up to date with industry and regulatory changes and developments in professional standards. The level of experience and skills of internal

auditors, thus, demonstrates the quality of their audits [28].

Aligning competencies with organizational priorities will improve the delivery of quality audit services. The competency indicator describes competencies based on various proficiency levels. It outlines a collection of desired and observable motives, traits, and behaviors when executing or carrying out the task. It serves as a tool to guide employee performance evaluations [29].

The rapid evolution of Information Communications Technology (ICT) necessitates a corresponding speed of development in the skill sets and knowledge based on the current ICT workforce. Competency refers to the knowledge, skills, and attitudes (KSAs) associated with exceptional job performance. It plays a role in discerning between high, average, and low performance, signifying desirable qualities or behaviors and functions as performance. Thus, competency indicators are divided into three levels: low, medium, and high [30].

Competency is the ability of an individual to perform a job or task properly. It is a set of defined knowledge, skills, and behavior. Competency levels can help organizations or auditors identify gaps or weaknesses in auditor competence so that they can develop it to meet the organization's goals [31-33]. Audit competence influences audit quality [34-37].

3. METHODOLOGY

This research methodology uses a qualitative approach by emphasizing the data analysis. The methodology in this research comprises three parts: 1) Synthesize a list of essential IT audit competencies, 2) Develop IT auditor competency indicators, and 3) Develop IT auditor competency assessment system.

3.1 Synthesize a list of essential IT audit competencies

The method of synthesizing a list of essential IT audit competencies is as follows [38]:

Firstly, a theory study, literature review, and in-depth interviews with experts will be used to synthesize the critical elements of the IT Auditor competencies.

Secondly, develop a questionnaire on IT Auditor competencies. The questionnaire's content

validity was determined by the Index of item objective congruence (IOC), and Cronbach's alpha was used to examine reliability.

Finally, data were analyzed using mean, standard deviation, and exploratory factor analysis by KMO (Kaiser-Meyer-Olkin) analysis and Bartlett's Test of Sphericity statistics by SPSS.

3.2 Develop IT auditor competency indicators

The method of developing IT auditor competency indicators is as follows:

Firstly, from the above IT audit competency items, further studies from theories and research papers [29-30], [39-47] were conducted to synthesize the IT audit competency indicators. Reference details from related theories and research are shown in Table 1.

Table 1: Reference Details From Related Theories And Research To Synthesize IT Audit Competency Indicators

IT Audit Competency Item	Reference
1. Knowledges	
1.1 Basic knowledge of information technology	
1.1.1 Basic components of an information technology system include hardware, software, operating system, database management system, network, and application.	[29,39]
1.1.2 Information technology system environment such as network zone, system development zone (Dev, Test, Prod), etc.	[30,40]
1.1.3 Data center operation	[41,42]
1.1.4 System development process	[30]
1.1.5 Information/Cyber security	[30]
1.2 Basic knowledge of the information technology auditing process	
1.2.1 IT Audit process	[43]
1.2.2 Risk and controls	[44]
1.3 Nature of Business	
1.3.1 Nature of business and goals of the organization	[46]
1.4 IT Governance	
1.4.1 IT Laws	[47]
1.4.2 IT Regulations	[47]
1.4.3 IT Standards	[44]
1.5 Disruptive Technology	
1.5.1 Disruptive Technology	[30]
2. Skills	
2.1 Risk management skill	[44,45]
2.2 Data analytics skill	[30]
2.3 Communication skill	[29,30]

IT Audit Competency Item	Reference
2.4 Project management skill	[30]
2.5 Analytical thinking skill	[46]
2.6 Collaborative and Teamwork skill	[30]
3. Attributes	
3.1 Honesty	[46]
3.2 Objectivity and Independence	[44]
3.3 Professional	[46]
3.4 Proactive	[46]
3.5 Like to learn	[46]

The table above shows that relevant theory and research are used to create the indicators of each IT audit competency item.

Finally, the appropriateness of the IT audit competency indicators drafted by the advisor and 10 experts (focus group) should be considered, and the adjustments should be made according to their recommendations.

3.3 Develop IT auditor competency assessment system

The method of developing an IT auditor competency assessment system is as follows:

Firstly, an IT audit competency assessment system should be developed using the above requirements, consisting of IT competency items and indicators.

Secondly, evaluate the system's suitability with experts in the following areas: functional requirement test, functional test, usability test, performance test, and security test.

Finally, evaluate the system's satisfaction by sampling 30 users using the Technology Acceptance Model (TAM) in the following areas: Perceived Usefulness (PU), Perceived Ease of Use (PE), Attitude Toward Using (AU), and Behavioral Intention (BI).

4. DATA ANALYSIS AND DISCUSSION

4.1 IT audit competency items

From literature reviews and in-depth interviews with 10 auditing experts, it was found that an IT Auditor's competency consists of 3 main components: knowledge, skills, and attributes, with 24 sub-components, as illustrated in Table 2 [38].

Regarding the items mentioned above, a questionnaire survey was developed and distributed through email and Google Forms to the people working in the audit field in Thailand, including IT Auditors, Financial Auditors, Internal Auditors, Compliance Auditors, and Special Auditors.

The scale used in this questionnaire was a 5-point Likert-type scale, with point 1 representing 'strongly disagree' and point 5 representing 'strongly agree'. The questionnaire survey consists of two parts. The first part identifies respondents' information regarding their careers and organizations (e.g., type of organization, position, work experience, etc.). The second part is composed of statements representing the items mentioned above. A panel of five experts examined the content validity, and item-objective congruence (IOC) was then calculated. Internal consistency reliability was assessed using Cronbach's alpha coefficient. The overall test item-objective congruence (IOC) was acceptable (0.90), as shown in Table 2. The overall questionnaire Cronbach's alpha (α) coefficients were good (0.96), as shown in Table 3. Our study's result proved that the questionnaire was a valid and reliable tool for synthesizing IT Auditor competencies. Results were obtained from 400 questionnaire responses (N=400). The highest responders were those with more than 10 years of auditing experience (39.25%), and 65.5% of the respondents were supervisors or above. The questionnaire summary is shown in Tables 4 and 5, respectively.

Table 2: IT Audit Competency Items And IOC

IT Audit Competency Items	IOC	Meaning
1. Knowledge		
1.1 Basic knowledge of information technology		
1.1.1 Basic components of an information technology system include hardware, software, operating system, database management system, network, and application.	1.0	Agree
1.1.2 Information technology system environment such as network zone, system development zone (Dev, Test, Prod), etc.	0.8	Agree
1.1.3 Data center operation	0.8	Agree
1.1.4 System development process	1.0	Agree
1.1.5 Information/Cyber security	1.0	Agree
1.2 Basic knowledge of the information technology auditing process		
1.2.1 IT Audit process	1.0	Agree
1.2.2 Risk and controls	1.0	Agree
1.3 Nature of Business		

IT Audit Competency Items	IOC	Meaning
1.3.1 Nature of business and goals of the organization	1.0	Agree
1.4 IT Governance		
1.4.1 IT Laws	0.8	Agree
1.4.2 IT Regulations	1.0	Agree
1.4.3 IT Standards	1.0	Agree
1.5 Disruptive Technology		
1.5.1 Disruptive Technology	0.8	Agree
2. Skills		
2.1 Risk management skill	1.0	Agree
2.2 Data analytics skill	1.0	Agree
2.3 Communication skill	1.0	Agree
2.4 Project management skill	0.8	Agree
2.5 Analytical thinking skill	0.8	Agree
2.6 Collaborative and Teamwork skill	1.0	Agree
3. Attributes		
3.1 Skepticism	0.4	<u>Disagree</u>
3.2 Honesty	0.8	Agree
3.3 Objectivity and Independence	1.0	Agree
3.4 Professional	0.8	Agree
3.5 Proactive	0.8	Agree
3.6 Like to learn	0.8	Agree
Average	0.9	

The results found that out of 24 items, 23 received values greater than 0.5 (IOC > 0.5), of which only one item did not pass, namely 'Skepticism', with a value of 0.4. Therefore, from the results, 3 critical elements with 23 sub-items are important components of the competency of an IT Auditor.

Table 3: Internal Consistency Reliability

Domain	Internal consistency reliability (Cronbach's alpha) (n=30)
Knowledge	0.96
Skills	0.98
Attributes	0.94
Total	0.96

The overall questionnaire Cronbach's alpha (α) coefficients were good (0.96). Our study's result proved that the questionnaire was a valid and reliable tool for synthesizing IT Auditor competencies.

Table 4: Demographic Data And Experiences Of The Respondents

	Number (N=400)	Percentage (%)
Gender		
Male	153	38.30
Female	247	61.70
Number of years of working experience		
< 1 Year	42	10.50
1 – 5 Years	112	28.00
5 – 10 Years	89	22.25
> 10 Years	157	39.25
Education		
Under bachelor's degree	8	2.00
Bachelor's degree	149	37.30
Master's degree	234	58.50
Doctoral's degree	9	2.20
Audit field		
IT Auditor	115	28.75
Financial Auditor	151	37.75
General Auditor, e.g., Operation auditor, and compliance auditor, etc.	89	22.25
Other/Special auditor	45	11.25
Position level in the organization		
Staff	138	34.50
Supervisor or Senior or Ass. Manager	93	23.25
Manager or Sr-Manager or Director	90	22.50
C-level, Partner or Owner	79	19.75

Results were obtained from 400 questionnaire responses (N=400). The highest responders were those with more than 10 years of auditing experience (39.25%), and 65.5% of the respondents were supervisors or above.

Table 5: Descriptive Statistics (N=400)

	\bar{x}	S.D.
1. Knowledges		
1.1 Basic knowledge of information technology		
1.1.1 Basic components of an information technology system include hardware, software, operating system, database management system, network, and application. [IT1]	4.31	0.74
1.1.2 Information technology system environment such as network zone, system development zone (Dev, Test, Prod), etc. [IT2]	4.18	0.76

	\bar{x}	S.D.
1.1.3 Data center operation [IT3]	4.14	0.81
1.1.4 System development process [IT4]	4.21	0.80
1.1.5 Information/Cyber security [IT5]	4.37	0.77
1.2 Basic knowledge of the information technology auditing process		
1.2.1 IT Audit process [IT6]	4.36	0.75
1.2.2 Risk and controls [IT7]	4.42	0.72
1.3 Nature of Business		
1.3.1 Nature of business and goals of the organization [IT8]	4.15	0.72
1.4 IT Governance		
1.4.1 IT Laws [IT9]	4.16	0.77
1.4.2 IT Regulations [IT10]	4.19	0.77
1.4.3 IT Standards [IT11]	4.26	0.78
1.5 Disruptive Technology		
1.5.1 Disruptive Technology [IT12]	4.25	0.72
2. Skills		
2.1 Risk management skill [SK1]	4.33	0.69
2.2 Data analytics skill [SK2]	4.26	0.71
2.3 Communication skill [SK3]	4.31	0.70
2.4 Project management skill [SK4]	4.16	0.72
2.5 Analytical thinking skill [SK5]	4.38	0.70
2.6 Collaborative and Teamwork skill [SK6]	4.35	0.68
3. Attributes		
3.1 Honesty [AT1]	4.55	0.56
3.2 Objectivity and Independence [AT2]	4.55	0.56
3.3 Professional [AT3]	4.52	0.56
3.4 Proactive [AT4]	4.43	0.60
3.5 Like to learn [AT5]	4.49	0.60

Statistics obtained from the questionnaire responses of 400 people found that the respondents gave the highest level of agreement ($\bar{x} > 4$) on every question.

Tables 6, 7, and 8 show the results of factor analysis of the extracted factors, respectively.

Table 6: KMO And Bartlett's Test Of 'Knowledge'

	Value	
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.94	
Bartlett's Test of Sphericity	Approx. Chi-Square	5244.39
	df	66.00
	Sig.	0.00

KMO measure of sampling adequacy was 0.94, indicating sufficient intercorrelations, while

Bartlett's Test of Sphericity was significant (Chi square= 5244.39, Sig.= 0.00).

Table 7: KMO And Bartlett's Test Of 'Skills'

		Value
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.92
Bartlett's Test of Sphericity	Approx. Chi-Square	2217.95
	df	15.00
	Sig.	0.00

KMO measure of sampling adequacy was 0.92, indicating sufficient intercorrelations, while Bartlett's Test of Sphericity was significant (Chi square= 2217.95, Sig.= 0.00).

Table 8: KMO And Bartlett's Test Of 'Attributes'

		Value
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.88
Bartlett's Test of Sphericity	Approx. Chi-Square	2068.40
	df	10.00
	Sig.	0.00

The KMO measure of sampling adequacy was 0.88, indicating sufficient intercorrelations, while Bartlett's Test of Sphericity was significant (Chi-square = 2068.40, Sig. = 0.00).

Tables 9, 10, 11, and 12 show the results of the extracted factors using the principal component analysis and variable rotation method, respectively.

Table 9: Component Matrix Of All Items

Variables	Component		
	1	2	3
IT1-Basic of IT Components	0.83		
IT2-IT Environments	0.81	0.32	
IT3-Data Center Operations	0.83		
IT4-System Development Process	0.84	0.33	
IT5-IT/Cyber Security	0.83		
IT6-IT Audit Process	0.78		
IT7-IT Risks and Controls	0.72	0.34	
IT8-Nature of Business	0.40	0.50	0.34
IT9-IT Laws	0.57	0.50	
IT10-IT Regulations	0.60	0.51	0.30
IT11-IT Standards	0.74	0.42	
IT12-Disruptive Technology	0.61	0.46	
SK1-Risk management skill	0.43	0.69	

Variables	Component		
	1	2	3
SK2-Data analytics skill	0.34	0.76	
SK3-Communication skill	0.32	0.77	0.32
SK4-Project management skill	0.36	0.80	
SK5-Analytical thinking skill	0.35	0.78	
SK6-Collaborative and Teamwork skill	0.39	0.70	0.34
AT1-Honesty			0.88
AT2-Objectivity and Independence			0.88
AT3-Professional			0.86
AT4-Proactive			0.80
AT5-Like to learn			0.79
Extraction Method: Principal Component Analysis			
Rotation Method: Varimax (Only one component was extracted. The solution cannot be rotated.)			

From the above table, it can be concluded as follows: the members of component 1 ("Knowledges") are IT1 – IT12, the members of component 2 ("Skills") are SK1 - SK6, and the members of component 3 ("Attributes") are AT1-AT5. The results are consistent with items obtained from theory studies, literature reviews, and expert interviews.

Table 10: Community And Component Matrix Of 'Knowledge'

Variables	Component	Community
	1	
IT1-Basic of IT Components	0.84	0.71
IT2-IT Environments	0.86	0.75
IT3-Data Center Operations	0.87	0.76
IT4-System Development Process	0.88	0.78
IT5-IT/Cyber Security	0.88	0.78
IT6-IT Audit Process	0.86	0.75
IT7-IT Risks and Controls	0.84	0.71
IT8-Nature of Business	0.68	0.47
IT9-IT Laws	0.82	0.66
IT10-IT Regulations	0.84	0.71
IT11-IT Standards	0.88	0.78
IT12-Disruptive Technology	0.81	0.65
Extraction Method: Principal Component Analysis		
Rotation Method: Varimax (Only one component was extracted. The solution cannot be rotated.)		

Twelve items including 'Basic of IT Components', 'IT Environments', 'Data Center Operations,' 'System Development Process',

'IT/Cyber Security', 'IT Audit Process', 'IT Risks and Controls', 'Nature of Business', 'IT Laws', 'IT Regulations', 'IT Standards', and 'Disruptive Technology' can be arranged in one component, it cannot divide into subgroups, meaning that all variables in this set can be classified into the same group named 'Knowledges'.

Table 11: Commuality And Component Matrix Of 'Skills'

Variables	Component	Commuality
	1	
SK1-Risk management skill	0.87	0.75
SK2-Data analytics skill	0.87	0.76
SK3-Communication skill	0.90	0.82
SK4-Project management skill	0.90	0.80
SK5-Analytical thinking skill	0.91	0.83
SK6-Collaborative and Teamwork skill	0.90	0.78
Extraction Method: Principal Component Analysis		
Rotation Method: Varimax (Only one component was extracted. The solution cannot be rotated.)		

Six items, including 'Risk management skill', 'Data analytics skill', 'Communication skill', 'Project management skill', 'Analytical thinking skill', and 'Collaborative and Teamwork skill', can be arranged into one component; it cannot be divided into subgroups, meaning that all variables in this set can be classified into the same group named 'Skills'.

Table 12: Commuality and Component Matrix Of 'Attributes'

Variables	Component	Commuality
	1	
AT1-Honesty	0.92	0.86
AT2-Objectivity and Independence	0.94	0.88
AT3-Professional	0.93	0.87
AT4-Proactive	0.88	0.78
AT5-Like to learn	0.87	0.75
Extraction Method: Principal Component Analysis		
Rotation Method: Varimax (Only one component was extracted. The solution cannot be rotated.)		

Five items, including 'Honesty', 'Objectivity and Independence', 'Professional', 'Proactive', and 'Like to lean', can be arranged into one component; it cannot be divided into subgroups, meaning that all variables in this set can be classified into the same group named 'Attributes'.

4.2 IT audit competency indicators

From the above IT audit competency items, further studies from theories and research papers [29-30], [39-47] were conducted to synthesize IT audit competency indicators; it was found that the IT audit competency indicators were divided into 3 levels, i.e., primary, intermediate and advanced. Considering the appropriateness of the IT auditor competency indicators draft by the advisor and 10 experts (Focus group), it was found that the advisor and all experts agreed with all of the indicators. However, experts have expressed their opinions to make minor adjustments, such as specifying more details of the indicators to be clearer and merging or switching the levels of the indicators, etc. An example of the steps of synthesis of IT audit competency indicators is as follows:

Firstly, the sample IT audit competency item of 'Knowledge' is 'Basic components of an information technology system include hardware, software, operating system, database management system, network, and application' [29,39]. The sample IT audit competency item of 'Skills' is 'Analytical thinking skill' [46]. And the sample IT audit competency item of 'Attributes' is 'Objectivity and Independence' [44], the IT audit competency indicators are shown in Table 13.

Table 13: Example Of IT Audit Competency Indicators Synthesized From Relevant Theories And Research

Basic	Intermediate	Advanced
1. Knowledges		
1.1 Basic knowledge of information technology		
1.1.1 Basic components of an information technology system include hardware, software, operating system, database management system, network, and application. (Example indicator 1)		
1) You must have basic knowledge of computers, software, hardware, operating systems, database management systems, mobile devices, cloud computing, etc. 2) You must have basic knowledge about backup and restoration. 3) You must have basic knowledge of	1) You must always be knowledgeable about new and emerging digital technologies. 2) You must know how to use applications such as word processing, spreadsheet, and presentation programs.	1) You must know about applying and leveraging emerging digital technologies and tools. 2) You must know about online collaboration and how to use digital media creation programs. 3) You must know how to use digital safely.

Basic	Intermediate	Advanced
web browsers, search engines, email, social media, communication tools, online transactions, etc.		
2. Skills		
2.1 Analytical thinking skill (Example indicator 2)		
1)Able to break down problems into simple lists without prioritizing them. 2)Able to plan work by breaking down issues into parts or activities. 3)Able to identify cause and effect in each situation and identify the pros and cons of various issues.	1)Able to plan work by arranging tasks or activities according to their priority or urgency. 2)Able to plan work by defining activities and procedures that involve multiple parties efficiently and can anticipate problems or obstacles that may occur. 3)Able to connect the complex factors of each situation or event.	1)Understand the issue at a level where you can distinguish the complex interconnected factors in detail and analyze the relationship of the problem to a particular situation. 2)Able to plan complex work by defining activities and procedures involving multiple departments or parties, including anticipating problems, and obstacles, and preparing preventive and corrective measures in advance. 3)Able to use various analytical techniques to find alternative solutions, including considering the pros and cons of each option.
3. Attributes		
3.1 Objectivity and Independence (Example indicator 3)		
1)Describe the importance of independence in audit activities and identify elements that affect independence. 2)Describe the importance of objectivity in an audit and be able to identify factors that may or appear to	1)Detect potential deficiencies in the independence of the audit and their potential impact. 2)Detect potential deficiencies in the impartiality of the audit and their potential impact.	1) Address any potential impairments to internal audit independence to achieve conformance with the Standards; communicate the impact of any remaining impairments. 2)Develop and maintain policies that govern

Basic	Intermediate	Advanced
undermine objectivity.		objectivity and recommend strategies to promote objectivity.

The information in the above table is synthesized from related theories to determine the indicators at each level consisting of basic, intermediate and advanced.

Secondly, consider the appropriateness of the above IT audit competency indicators by the advisor and 10 experts (focus group). After the review, the advisor and experts provided the following recommendations for Example indicator 1: 1) there should be a score of "No competency" as well because some people may not have any knowledge or skills in that area and there is no space to fill in the information 2) basic level should increase knowledge about network devices and network security devices 3) the knowledge of using 2 application programs, word processing, and spreadsheet, should be more fundamental level and add presentation programs to this topic 4) advance levels may add the use of analytical tools to help with audit work 5) basic knowledge should be about computer usage, in addition to Backup & Restoration and 6) it should be increased to know safe digital usage from the intermediate level as well.

The advisor and experts provided the following recommendations for Example indicator 2, there should be a score of "No competency" as well because some people may not have any knowledge or skills in that area and there is no space to fill in the information.

The advisor and experts provided the following recommendations for Example indicator 3: 1) There should be a score of "No competency" as well because some people may not have any knowledge or skills in that area and there is no space to fill in the information 2) Basic level: please describe more detail of objectivity 3) Intermediate level: should be clarify the word of "Detect".

Table 14: Examples Of Improved IT Audit Competency Indicators Based On Recommendations From Advisor And Experts

No competency	Basic	Intermediate	Advance
1. Knowledges			
1.1 Basic knowledge of information technology			

No competency	Basic	Intermediate	Advance
1.1.1 Basic components of an information technology system include hardware, software, operating system, database management system, network, and application. (Example indicator 1)			
Lack of competence in this area or unclear competence in this area	1) You must have basic knowledge of computers, software, hardware, operating systems, database management systems, mobile devices, network equipment, network security equipment, cloud computing, etc. 2) You must have basic knowledge of computer usage and backup and restoration. 3) You must know how to use applications such as word processing, spreadsheet, and presentation programs. 4) You must have basic knowledge of web browsers, search engines, email, social media, communication tools, online transactions, etc.	1) You must always be knowledgeable about new and emerging digital technologies. 2) You must know how to use digital safely.	1) You must have knowledge of evaluating the use of basic components of an organization's technology system and be able to suggest solutions for improvement. 2) You must know how to apply the benefits of emerging technologies and digital tools, such as analytical tools, to assist in audits (Analytical tools), etc.
2. Skills			
2.1 Analytical thinking skill (Example indicator 2)			
Lack of competence in this area or unclear competence in this area	1) Able to break down problems into simple lists without	1) Able to plan work by arranging tasks or activities according to	1) Understand the issue at a level where you can distinguish

No competency	Basic	Intermediate	Advance
	prioritizing them. 2) Able to plan work by breaking down issues into parts or activities. 3) Able to identify cause and effect in each situation and identify the pros and cons of various issues.	their priority or urgency. 2) Able to plan work by defining activities and procedures that involve multiple parties efficiently and can anticipate problems or obstacles that may occur. 3) Able to connect the complex factors of each situation or event.	the complex interconnected factors in detail and analyze the relationship of the problem to a particular situation. 2) Able to plan complex work by defining activities and procedures involving multiple departments or parties, including anticipating problems, and obstacles, and preparing preventive and corrective measures in advance. 3) Able to use various analytical techniques to find alternative solutions, including considering the pros and cons of each option.
3. Attributes			
3.1 Objectivity and Independence (Example indicator 3)			
Lack of competence in this area or unclear competence in this area	1) Understand the importance of independence in audit activities, such as no conflicts of interest, etc. 2) Understand the importance of objectivity in the audit, such as	1) If any potential deficiencies are found that could affect the independence of the audit, appropriate recommendations must be made. 2) If any potential deficiencies are found	1) Address any potential impairments to internal audit independence to achieve conformance with the Standards; communicate the impact of any remaining

No competency	Basic	Intermediate	Advance
	accepting different opinions, treating everyone equally, controlling emotions, etc.	that could affect the objectivity of the audit, appropriate recommendations must be made.	impairments . 2)Develop and maintain policies that govern objectivity and recommend strategies to promote objectivity.

IT Audit Competency (If you want to see an explanation of the scoring criteria, click on the competency title and click again to hide the explanation.)	Level of indicator			
	No competency	Basic	Intermediate (Basic level is required)	Advance (Intermediate level is required)
1. Knowledges				
1.1 Basic knowledge of information technology				
1.1.1 Basic components of an information technology system include hardware, software, operating system, database management system, network, and application.	○	○	○	○
1.1.2 Information technology system environment such as network zone, system development zone (Dev, Test, Prod), etc.	○	○	○	○
1.1.3 Data Center Operation	○	○	○	○
1.1.4 System development process	○	○	○	○
1.1.5 Information Security / Cyber security	○	○	○	○

Figure 2: IT Audit Competency Assessment Screen

Finally, the IT audit competency indicators were improved based on advisor and expert recommendations, and the final indicators are shown in Table 14.

4.3 IT audit competency assessment system

This session presents the test results obtained from the developed web-based application of the IT audit competency assessment system. In the first step, the user logs in to the system through the panel, as shown in Figure 1.

Login

Email

Password

[Login](#)

[New Register](#) [Forgot Password](#)

[Privacy Policy](#)

Figure 1: Login Page Of The IT Audit Competency Assessment System

Once the user has logged in, the assessment screen will be displayed according to the IT audit competency items, as shown in Figure 2.

The screen will display the IT audit competency indicator with 4 levels: no competency, basic, intermediate, and advanced. Users can read the meaning of each level by double-clicking on the items, as shown in Figure 3.

IT Audit Competency (If you want to see an explanation of the scoring criteria, click on the competency title and click again to hide the explanation.)	Level of indicator			
	No competency	Basic	Intermediate (Basic level is required)	Advance (Intermediate level is required)
1. Knowledges				
1.1 Basic knowledge of information technology				
1.1.1 Basic components of an information technology system include hardware, software, operating system, database management system, network, and application.	<ul style="list-style-type: none"> • Lack of competence in this area or unclear competence in this area 	<ul style="list-style-type: none"> • Have basic knowledge about computers, software, hardware, operating systems, database management system, mobile devices, network equipment, network security equipment and about computing etc. • Have basic knowledge about computer usage and Backup & Restoration. • Have knowledge of using applications such as word processing programs, spread sheet programs, and presentation 	<ul style="list-style-type: none"> • Always have knowledge of new and emerging digital technologies. • I have knowledge about how to use digital safely 	<ul style="list-style-type: none"> • Have knowledge in evaluating the use of basic components of an organization's technology system and can suggest solutions for improvement. • Have knowledge in applying the benefits of emerging technologies and digital tools, such as the application of analytical tools to assist in audit (Analytic tools), etc.

Figure 3: Meaning Of Each IT Audit Competency Indicator

When the user completes the assessment, the system will display a results screen with an overview of each domain, including knowledge, skills, and attributes, as shown in Figure 4.

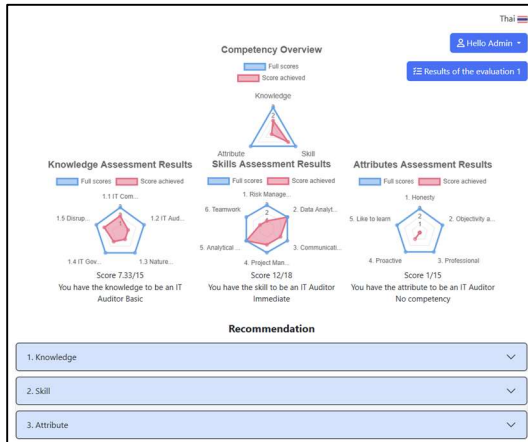


Figure 4 Meaning Of Each IT Audit Competency Indicator

The results screen also shows recommendations for improving competency on each item, as seen in the table at the bottom of the results screen, as shown in Figure 5.

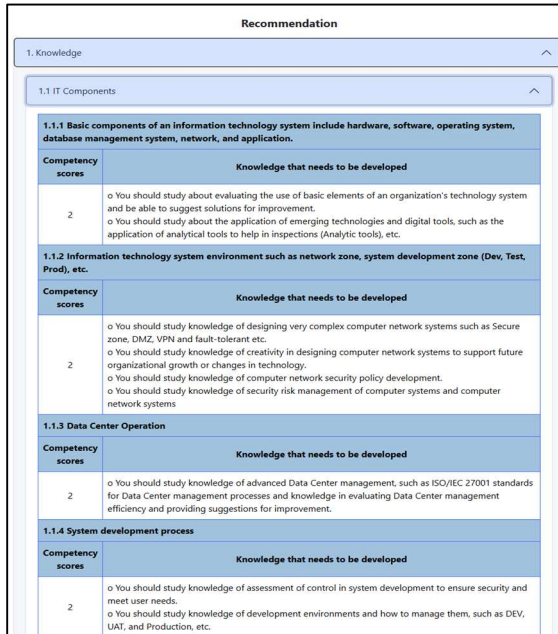


Figure 5: Recommendations

The results of the system suitability assessment by experts are shown in Table 15.

Table 15: The Results Of The System Suitability Assessment By Experts

Evaluation topics	Suitability score (1-5)		
	\bar{x}	S.D.	Explanation
1. User Requirement	4.53	0.49	Most suitable
2. Functional Test	4.72	0.44	Most suitable
3. Usability Test	4.52	0.54	Most suitable
4. Performance Test	5.00	0.00	Most suitable
5. Security Test	4.65	0.47	Most suitable

Experts assessed the system suitability by giving a suitability score (1-5), where 1 is least suitable, 5 is most suitable, the assessment consists of 5 parts, and the results are as follows: 1) User Requirement is most suitable ($\bar{x} = 4.53$, S.D.=0.49) 2) Functional Test is most suitable ($\bar{x} = 4.72$, S.D.=0.44) 3) Usability Test is most suitable ($\bar{x} = 4.52$, S.D.=0.54) 4) Performance Test is most suitable ($\bar{x} = 5.00$, S.D.=0.00) 5) Security Test is most suitable ($\bar{x} = 4.65$, S.D.=0.47). The evaluation found that all topics received the 'Most suitable' evaluation results.

Table 16: The Results Of User Satisfaction Assessment

Evaluation topics	Suitability score (1-5)		
	\bar{x}	S.D.	Explanation
1. Perceived Usefulness (PU)	4.17	0.76	Most satisfied
2. Perceived Ease of Use (PE)	4.33	0.66	Most satisfied
3. Attitude Toward Using (AU)	4.32	0.67	Most satisfied
4. Behavioral Intention (BI)	4.28	0.65	Most satisfied

From Table 16, 30 users assessed the user satisfaction assessment by giving a satisfaction score (1-5), where 1 is least satisfied, 5 is most satisfied, and the assessment consists of 4 parts. The results are as follows: 1) Perceived Usefulness is most satisfied ($\bar{x} = 4.17$, S.D.=0.76) 2) Perceived Ease of Use is most satisfied ($\bar{x} = 4.33$, S.D.=0.66) 3) Attitude Toward Using is most satisfied ($\bar{x} = 4.32$, S.D.=0.67) 4) Behavioral Intention is most satisfied ($\bar{x} = 4.28$, S.D.=0.65). The evaluation results found that all topics received the 'Most satisfied' evaluation results.

5. CONCLUSIONS

As mentioned in the introduction, in this digital age, the role of the IT auditor has become even more critical due to the increasing reliance on digital technologies, the proliferation of data, the increasing complexity of IT systems, and the rise in cybercrime. In addition, current laws and regulations require organizations to have IT auditors, but organizations need help finding qualified personnel in this field. Therefore, this research has synthesized the necessary competencies for being an IT auditor and indicators for organizations or personnel interested in this field. This study synthesized the core components of IT auditor competency using EFA. The results comprised three core competencies, namely 'knowledge', 'skills', and 'attributes' with 23 sub-competencies. It also developed 23 competency indicators of IT auditor competency categorized into 4 levels: 'no competency', 'basic', 'intermediate and 'advanced'. In addition, a system has been developed to assess the competencies of IT auditors, which will provide recommendations for those interested in developing themselves to become a qualified IT auditor.

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