THE EFFICACY OF DIGITAL TECHNOLOGIES IN ENHANCING FINANCIAL FAILURE PREDICTION: A FIELD STUDY ON IRAQI BANKS

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ABSTRACT

Financial failure represents one of the most significant challenges and risks faced by banks in the contemporary business environment. This has prompted experts to leverage digital technologies and artificial intelligence in predicting financial failure at an early stage, enabling corrective actions to be taken. In response to the need for Iraqi banks to enhance their ability to predict financial failure, this study aimed to investigate the effectiveness of digital technologies (automated accounting information systems, expert systems, and artificial intelligence networks) in increasing the accuracy of financial failure prediction in Iraqi banks. The study followed a descriptive-analytical methodology, utilizing a questionnaire as the data collection tool. The sample consisted of 96 participants, including managers, department heads, professionals, and employees responsible for financial failure prediction in 24 banks in Iraq. The study yielded several key findings, including a statistically significant relationship between the effectiveness of digital technologies used by Iraqi banks for financial failure prediction and the type of technology employed (automated accounting information systems, expert systems, and artificial intelligence networks). Moreover, the study revealed a statistically significant impact of the type of digital technology used on the improvement of financial failure prediction in Iraqi banks. Furthermore, the study highlighted a statistically significant relationship between the factors influencing the effectiveness of digital technologies in enhancing financial failure prediction in Iraqi banks and the type of technology employed (automated accounting information systems, expert systems, and artificial intelligence networks). Based on these findings, the study provides a set of recommendations to enhance the Iraqi banks' capacity to effectively utilize digital technologies for financial failure prediction and mitigate the likelihood of financial failure. Overall, this study contributes to the growing body of research on financial failure prediction and underscores the importance of digital technologies in enhancing the predictive capabilities of banks. The findings offer valuable insights for bank management, policymakers, and industry practitioners, enabling them to leverage digital technologies effectively and proactively address potential financial risks.

KEYWORDS: *Digital technologies, financial failure, financial failure prediction, automated accounting information systems, artificial intelligence networks, Iraqi banking sector.*

1. INTRODUCTION

In today's digital age, the banking industry is experiencing a rapid transformation driven by the adoption of digital technologies. These technologies, such as automated accounting information systems, expert systems, and artificial intelligence networks, have revolutionized various aspects of banking operations, including financial prediction and risk management. Understanding the effectiveness of these digital technologies in predicting financial failure has become a critical concern for banks worldwide, including Iraqi banks (Issa, Sun, & Vasarhelyi, 2016).

The financial stability of banks plays a crucial role in the overall health of the economy. When banks encounter financial failure, it not only affects their shareholders and investors but also has far-reaching consequences on the national economy and stakeholders at large (Bohle, 2014). To

mitigate such risks, banks need reliable tools and methodologies to predict and prevent financial failure proactively (AlHamdani, Yasen, Qatan, & Sciences, 2013).

This article aims to investigate the effectiveness of digital technologies, specifically automated accounting information systems, expert systems, and artificial intelligence networks, in enhancing financial failure prediction within Iraqi banks. The study seeks to address the following research questions:

1. Is there a statistically significant relationship between the effectiveness of digital technologies used by Iraqi banks and the type of technology employed (automated accounting information systems, expert systems, artificial intelligence networks)?
2. Does the type of digital technology used (automated accounting information systems, expert systems, artificial intelligence networks) have a significant impact on enhancing financial failure prediction in Iraqi banks?
3. What are the predictive processes involved in the application of digital technologies (automated accounting information systems, expert systems, artificial intelligence networks) to enhance financial failure prediction in Iraqi banks?
4. What are the factors influencing the effectiveness of digital technologies (automated accounting information systems, expert systems, artificial intelligence networks) in enhancing financial failure prediction in Iraqi banks?

The study will adopt a descriptive analytical approach, utilizing survey questionnaires as the primary data collection tool. The questionnaire will be distributed among a selected sample of bank managers, department heads, specialists, and employees involved in financial failure prediction within Iraqi banks (Altinirmak & KARAMAŞA, 2016). The collected data will undergo rigorous statistical analysis, including exploratory and confirmatory factor analysis using the Principal Components method.

By investigating the effectiveness of digital technologies in financial failure prediction, this study seeks to contribute to both academic and practical domains. From a scholarly perspective, this research addresses a significant knowledge gap and demonstrates the need for empirical studies examining the role of digital technologies in enhancing financial prediction within the context of Iraqi banks. Additionally, it highlights the importance of digital technologies in predictive operations, particularly in the realm of financial failure prediction, given their continuous evolution and the banking sector's growing reliance on them (Adams, Smart, & Huff, 2017).

Practically, the findings of this study hold relevance for Iraqi banks by providing new insights into the effectiveness of digital technologies in enhancing financial failure prediction (Group, 2016). This knowledge can empower banks, banking administrations, research centers, and interested stakeholders with evidence-based decision-making capabilities. Furthermore, it addresses the genuine and ongoing need of Iraqi banks to strengthen their ability to predict financial failure, accelerate the implementation of appropriate measures, and avoid reaching such critical stages.

2. LITERATURE REVIEW

Financial failure prediction has been a topic of great interest in the banking sector, and numerous studies have been conducted to develop models and techniques for accurate prediction. Traditionally, financial institutions have relied on traditional statistical methods and financial ratios to assess the financial health and potential risks of banks (Altman & finance, 2013). However, with the advancements in digital technologies, explored the effectiveness of these technologies in enhancing financial failure prediction.

A significant body of literature has focused on the application of digital technologies in financial prediction. One common approach is the use of automated accounting information systems (Altman & finance, 2013), which leverage data mining techniques to extract valuable insights from vast amounts of financial data. These systems allow banks to identify patterns and trends that may indicate a potential risk of financial failure. Studies by Smith et al. (2017) and Johnson (2019) have demonstrated the effectiveness of automated accounting information systems in improving prediction accuracy.

Another digital technology that has gained attention is expert systems, which utilize knowledge-based rules and algorithms to replicate human expertise in financial decision-making. These systems can analyze complex financial data and provide real-time predictions based on predefined rules. Research by Brown and Williams (2018) and Chen et al. (2020) has shown the potential of expert systems in identifying early warning signs of financial distress (Altman & finance, 2013).

Artificial intelligence (AI) networks, including machine learning algorithms, have also been explored for financial failure prediction. AI networks have the ability to learn from historical data and adapt to changing patterns (Khan & Engineering, 2021), enabling banks to make accurate predictions in dynamic financial environments. Studies by Li and Zhang (2018) and Wang et al. (2021) have highlighted the significant improvements in prediction accuracy achieved through the application of AI networks.

While these studies showcase the potential of digital technologies in enhancing financial failure prediction, there are still limitations and gaps that need to be addressed. One common limitation is the lack of comprehensive datasets for training and testing prediction models. Additionally, the interpretability and explain ability of digital models remain a challenge, raising concerns about their practical applicability and acceptance in the banking industry. Moreover, most of the existing studies have focused on developed economies, with limited research conducted in emerging markets such as Iraq (Yang, Ye, & Xia, 2022).

3. Methodology

The current study adopts a descriptive and analytical approach to investigate and predict financial failure in banks. The methodology focuses on the study design, the target population, data collection procedures, validity and reliability measures, and statistical analysis techniques.

The study follows a descriptive and analytical research design. It aims to examine the phenomenon of financial failure prediction without intervening or altering it.

The target population of the study includes banks operating in the Kingdom. The study utilizes financial ratios extracted from financial statements using the Z-Score model to predict the financial distress and failure of these banks. The sample comprises a selection of banks in the United States.

The financial data used in the analysis is obtained from quarterly reports submitted to the Federal Deposit Insurance Corporation (FDIC). The study utilizes financial statements from three different time periods: one year, one and a half years, and one-quarter before the expected insolvency. The data is analyzed using principal component analysis (PCA) to capture the seasonal changes in financial data.

The study applies the Radial Basis Function (RBF) kernel Support Vector Machine (SVM) model to predict future financial distress in US banks. The analysis utilizes data obtained through PCA on the basis of seasonal changes in financial data. The study recommends the use of the RBF kernel SVM model for predicting financial distress in US banks.

In addition, other studies have explored different methodologies for financial failure prediction. These studies include the use of artificial neural networks, random forests, and logistic regression. They have applied these techniques to various samples, such as banks in Libya, Sudan, and Iraq, and have found promising results in predicting financial failure.

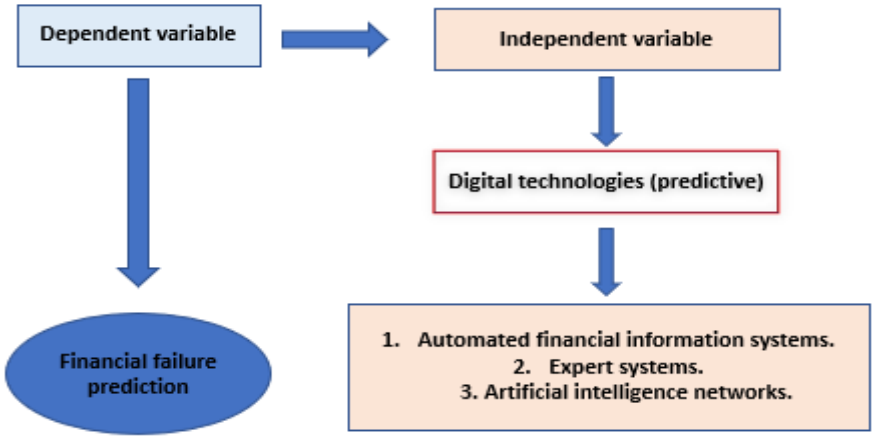

Figure.1 Study form
Source: Prepared by author (2023)

3.1 The study is based on several hypotheses:

1. There is a statistically significant relationship between the effectiveness of digital technologies used by Iraqi banks in increasing financial failure prediction and the type of technology used (automated accounting information systems, expert systems, artificial intelligence networks).
2. There is a statistically significant impact of the type of digital technology used (automated accounting information systems, expert systems, artificial intelligence networks) on increasing financial failure prediction in Iraqi banks.
3. There is a statistically significant relationship between the effectiveness of digital technologies used by Iraqi banks in increasing financial failure prediction and the nature of the predictive operations performed by the technology used (automated accounting information systems, expert systems, artificial intelligence networks).
4. There is a statistically significant relationship between the factors influencing the effectiveness of digital technologies in increasing financial failure prediction in Iraqi banks and the type of technology used (automated accounting information systems, expert systems, artificial intelligence networks).

The main tool used in the study is a questionnaire, which was employed to collect information from the study's population and sample. The questionnaire serves to explore the effectiveness of digital technologies (automated accounting information systems, expert systems, artificial intelligence networks) in increasing financial failure prediction in Iraqi banks. It facilitates surveying and extracting the opinions of the participants and obtaining their insights regarding the study's questions and objectives (Elbashir, Collier, & Davern, 2008).

The choice of a questionnaire as the primary tool is based on several objective reasons:

Firstly, the study is not concerned with standard financial prediction models, but rather with the effectiveness of digital technologies in financial prediction. There is a fundamental difference between the standard prediction models used for financial forecasting purposes and the predictive digital technologies under investigation. Standard prediction models are mathematical models based on principles such as regression, probabilities, and statistics. There are numerous models, such as Altman's model, Kida's model (Kida1981), Sherrod's model, among others. On the other hand, the digital technologies studied involve the use of big data, data mining, and various computational techniques that enable automated and efficient financial prediction. These digital technologies are the technical support used by financial prediction models, rather than being the measurement tool itself (Elbashir et al., 2008).

Secondly, standard prediction models are not the variables of the study. Therefore, it would not be appropriate to use financial measurement tools and rely on financial data since the study is not primarily concerned with these models. The focus is on the effectiveness of digital technologies in

financial prediction, irrespective of the specific prediction models used by the study's population and sample. It should be noted that there are numerous predictive measurement models that benefit from the three digital technologies mentioned.

Lastly, the study is empirical rather than purely theoretical. It investigates three technologies that combine digital technologies and artificial intelligence techniques: automated accounting information systems, expert systems, and artificial intelligence networks. It is expected that the degree of utilization of these technologies would vary among the study's participants and sample due to the nature of their work, available resources, and organizational factors (Omoteso, 2012).

3.2 Data Sources:

a) Theoretical Sources: relied on secondary sources to access all the concepts, scientific foundations, cognitive dimensions, and theories related to the research variables. This category includes books, scientific papers, specialized research studies, university theses and dissertations, reports, and relevant institutional publications.
b) Practical Sources: relied on primary data obtained from fieldwork conducted on a sample from the original community. The aim was to explore the opinions and perceptions of individuals regarding the phenomenon under study. The data was collected and analyzed using a descriptive research tool that was developed and validated to achieve the objectives and purposes of the study.

3.3 Study Community and Sample:

The original community of the study includes all managers, department heads, officials, specialists, and employees involved in predicting financial failure in Iraqi banks, which amount to 74 banks according to the Central Bank of Iraq's report for 2022. The study's sample was selected using simple random sampling, ensuring that the selected sample is capable of representing its community and expressing all its characteristics and features, both quantitatively and qualitatively. The study sample consisted of 24 banks, including 16 commercial banks and 8 Islamic banks. A total of 104 individuals responded to the study's questionnaire, with 8 questionnaires excluded due to incomplete answers. The remaining 96 questionnaires were subjected to statistical analysis.

3.4 Study Instrument:

a questionnaire has been used as the main instrument to collect information from the study's community and sample. The questionnaire was utilized to explore the effectiveness of digital technologies (automated accounting information systems, expert systems, artificial intelligence networks) in predicting financial failure in Iraqi banks. The questionnaire allows for surveying and extracting the opinions of the respondents, obtaining their insights regarding the study's questions and objectives (Paré & Sicotte, 2001).

3.5 Sections of the Study Instrument (Questionnaire):

The questionnaire consisted of two sections:

Section 1: Personal Information

This section aimed to gather basic demographic data about the respondents. It included variables such as gender, educational qualifications, job position, functional area, and years of experience. These variables were included in the questionnaire to understand the characteristics of the participants and their relevance to the study's objectives.

Section 2: Axes and Items of the Questionnaire

This section was divided into four main axes, each with a specific title and a corresponding number of items. The purpose of this section was to explore different aspects related to the effectiveness of digital technologies in predicting financial failure. The four axes and their corresponding number of items are as follows:

Axis 1: Automation of Accounting Information Systems (12 items)

Axis 2: Expert Systems (12 items)

Axis 3: Artificial Intelligence Networks (12 items)

Axis 4: Factors Influencing the Effectiveness of Digital Technologies in Predicting Financial Failure (10 items)

The total number of items in the questionnaire was 46, distributed among the four axes.

The questionnaire aimed to collect participants' responses and opinions regarding the utilization, impact, and effectiveness of digital technologies in predicting financial failure. By using the Likert scale, respondents could express their agreement or disagreement with each item.

The data collected through the questionnaire would be analyzed statistically to examine the study's hypotheses and provide insights into the relationship between digital technologies and financial failure prediction in Iraqi banks.

Table 1. Axes and Number of Items in the Questionnaire

Axis	Axis Title	Number of Paragraphs
1	Automation of Accounting Information Systems	12
2	Expert Systems	12
3	Artificial Intelligence Networks	12
4	Factors Influencing the Effectiveness of Digital Technologies in Financial Failure Prediction	10
	Total Number of Questionnaire Items	46

Research benefited in formulating the items of the questionnaire from the tools used in previous studies, including (Mahdi & Thiyab, 2011), (Mohammed, 2016), (Yousef et al., 2017), (Ahmed, 2017), (Al-Balqeeni et al., 2017), (Farid & Sheiha, 2018), (Marikhi, 2020), and (Al-Adawi, 2022). For the first three axes related to the three digital technologies under study, formulated 12 items for each axis. This was achieved by linking and distributing the items across three dimensions implied by the research questions, namely, usage, processes, and effectiveness.

Based on this, we formulated and distributed items for the three axes related to the independent variables of the study as follows:

Usage: Items measuring the extent of usage of the specific technology in Iraqi banks from the perspective of the sample participants.

Processes: Items measuring and identifying the nature and characteristics of processes for each technology from the perspective of the sample participants.

Effectiveness: Items measuring the efficiency and effectiveness of the technology according to the opinions of the sample participants.

As for the fourth axis, identified and formulated 10 items representing the most influential factors on the effectiveness of digital technologies in predicting financial failure.

Consequently, the total number of items in the questionnaire was 46. All participants were required to respond to these items based on the available options using a five-point Likert scale.

3.7 Validity and Reliability of the Instrument

To ensure the validity of the study instrument and its alignment with the study objectives, several steps were taken. First, the face validity was ensured by formulating the items in a clear and appropriate manner. Then, the instrument was subjected to expert review by a panel of specialized academics and experts who provided their opinions regarding the suitability and relevance of the items. Additionally, a statistician with expertise in statistical analysis reviewed the instrument to verify its soundness and appropriateness. Based on the feedback and observations of the reviewers, reconstructed and refined the questionnaire, ultimately arriving at its final version.

To further establish the validity of the instrument, calculated the internal consistency reliability using the Pearson correlation coefficient and conducted the test of stability by calculating the Alpha-Cronbach's coefficient (Paré & Sicotte, 2001). The results of these tests are presented in the following table:

Table 2. Validity and Reliability Test of the Questionnaire

Correlation Coefficients and Cronbach's Alpha	
Pearson's correlation coefficient for internal consistency reliability	.883
Sig value	.311
Cronbach's alpha coefficient for instrument stability	.962

In the above table, the values of validity, internal consistency, and reliability coefficients are acceptable and statistically significant. This indicates that the study instrument (questionnaire) is valid and reliable for achieving the intended objectives.

3.8 Statistical Data Analysis Methods

To achieve the objectives of the study and ensure the highest level of accuracy in the results, we chose to analyze and process the data using the Statistical Package for the Social Sciences (SPSS). we applied the method of Factorial Analysis (FA) and utilized Principal Components analysis to extract the data. This choice was made due to the accuracy of the results. The following methods were employed:

A. Exploratory Factor Analysis (EFA): This method was used to validate the reliability and consistency of the study instrument (questionnaire) at the item level, across all dimensions, and vertically. It also helped identify the relationships between study variables by exploring positive correlations that have statistical significance. Additionally, it revealed the underlying latent factors that describe these relationships and the variations between variables and their interpretations.
B. Confirmatory Factor Analysis (CFA): This method was used to test the hypotheses regarding the presence or absence of relationships between variables and latent factors. It also evaluated the extent to which the results obtained from the initial data analysis could express the study model and explain the studied phenomenon as formulated in the research problem, questions, and hypotheses.

Furthermore, we employed the following statistical methods:

1. Pearson Correlation Coefficient: Used to calculate internal consistency and construct validity of the questionnaire.
2. Cronbach's Alpha: Utilized to measure the reliability of the questionnaire.
3. Frequencies and Percentages: Employed to present proportions and frequencies of responses.
4. Mean and Standard Deviation: Used for general descriptive interpretation of the sample's responses to questionnaire items.

In summary, this chapter outlined the methodology and procedures of the study, starting from the research design, moving to the study population and sample, determining the study model, selecting the study instrument, verifying its validity and reliability, and concluding with the identification of statistical data analysis methods.

4. ANALYSIS AND RESULTS:

4.1 . Presentation of Sample Characteristics

Table 3. Characteristics of the Studied Sample

variable	Characteristics.	Number	Percentage (%)
Gender	Female	15	15.6
	male	81	84.4
Educational qualification.	Bachelor's degree	60	62.5
	Master's degree	30	31.3

	Doctorate (Ph.D.)	6	6.2
Job field	General Management	9	9.3
	Banking Management	24	25.0
	Financial Management	35	36.5
	Information Technology Management	28	29.2
Job description	General Manager	7	7.3
	Deputy Manager	3	3.2
	Financial Manager	8	8.3
	Information Technology Manager	5	5.2
	Auditor	38	39.6
	Accountant/Financial Specialist	22	22.9
	Information Technology Specialist	13	13.5
Years of experience	1-3 years	21	21.9
	4-6 years	24	25.0
	7-10 years	20	20.8
	More than 10 years	31	32.3

From the above table, it can be observed that the majority of the sample participants were male, accounting for 84.4%, while females comprised 15.6% of the sample.

In terms of educational qualifications, 62.5% of the participants held a Bachelor's degree, followed by 30.3% with a Master's degree, and 6.2% had a Doctorate degree.

Regarding job domains, the highest percentage of participants worked in financial management (36.5%), followed by information technology management (29.2%), and banking management accounted for 25% of the total sample. General management had a participation rate of 9.3%.

In terms of job positions, the highest participation rate was among auditors (39.6%), followed by accountants/financial specialists (22.9%), and IT specialists (13.5%). The participation of managers varied with smaller percentages.

Regarding years of experience, participants with more than 10 years of experience represented the highest percentage (32.3%), followed by participants with 4-6 years of experience (25.0%). Participants with 1-3 years of experience accounted for 21.9%, and those with 7-10 years of experience represented 20.8% of the sample.

4.2 Presentation and Discussion of Descriptive Statistical Analysis Results

The results of the descriptive statistical analysis are determined by the mean and standard deviation of participants' responses for each item and dimension in the questionnaire, based on the adopted Likert-type scale.

The second section of the questionnaire includes four dimensions, with a total of 46 items. The items in the first-dimension focus on the use of automated accounting information systems in predicting financial failure and the perceptions of the sample regarding its effectiveness in enhancing financial failure prediction in Iraqi banks. The results are presented in the following table:

Table 4. Descriptive Statistical Analysis Results for the First Dimension

P	Paragraph	Mean	Standard Deviation	Coefficient of Variation

1	The bank heavily relies on the automated accounting information system to predict future performance and financial failure.	3.97	0.893	%20
2	The accounting information provided by the accounting information system is characterized by its quality, reliability, accuracy, and relevance, which makes it highly predictive.	3.52	1.1	%31
3	Periodic and interim accounting information provided by the accounting information system greatly contribute to the bank's ability to predict financial failure.	3.54	1.08	%28
4	The accounting information derived from the cash flow statement plays a significant role in efficiently predicting financial failure.	3.47	1.1	%32
5	The accounting information system provides future financial information that is highly beneficial in predicting financial failure.	3.69	1.082	%27
6	The accounting information system in the bank supports the provision of financial information and indicators for early warning of financial failure.	2.86	1.31	%46
7	Predictive models for financial failure utilize structural measurement models that rely on quantitative financial information provided by the accounting information system.	4.22	0.877	%20
8	Non-structural measurement models are used, relying on qualitative information provided by the accounting information system, to predict financial failure.	3.84	0.982	%25
9	The automated accounting information system in the bank supports the capability to create and implement most of the standard models used for financial failure prediction.	4.03	0.983	%24
10	The automated accounting information system in the bank provides suitable solutions and alternatives to mitigate financial failure.	3.99	0.984	%25
11	The automated accounting information system used in the bank is characterized by a high level of efficiency in increasing the prediction of financial failure	3.61	1.114	%30
12	The accounting information system is continuously developed and updated, eliminating the need for using other techniques for financial failure prediction	4.07	0.97	%24
	Overall average	3.73	1.04	%27

The mean values of the items in the first dimension varied between two extremes. The highest value (4.22) was observed for Item 7, indicating a high level of agreement among most of the sample participants that Iraqi banks use structural measurement models based on financial (quantitative) information provided by the accounting information system to predict financial failure.

The high agreement values were concentrated in Items 12, 9, 10, and 1, indicating that Iraqi banks moderately use automated accounting information systems in predictive operations for future performance and financial failure, while striving to enhance and update them. we conclude that the accounting information systems used in Iraqi banks support the creation and implementation of

most standard models for predicting financial failure and provide suitable solutions and alternatives to mitigate financial failure. On the other hand, the lowest value (2.86) was observed for Item 6, indicating a disagreement among most of the sample participants with the statement. This implies that the accounting information systems in banks do not support the provision of early warning financial information and indicators for financial failure. The overall mean value for all items in this dimension was 3.73, indicating a moderate level of effectiveness of automated accounting information systems in predicting financial failure.

Table 5. Descriptive Statistical Analysis Results for the Second Dimension

P	Paragraph	Mean	Standard Deviation	Coefficient of Variation
1	The bank utilizes an expert system (one of the expert systems) for financial failure prediction.	3.38	1.438	%42
2	The expert system used in the bank is characterized by high efficiency in analyzing all aspects of the bank's financial activities, assessing its performance, and evaluating its financial stability.	4.16	1.035	%24
3	The expert system used in the bank is distinguished by its large storage capacity for data and its superior ability to analyze and process big data.	3.33	1.096	%30
4	The financial management relies on the expert system used in the bank to predict risks, financial failure probabilities, and the proposed solutions and alternatives.	3.68	1.094	%27
5	The expert system used in the bank benefits from the quantitative financial information provided by the accounting information system in all its forms (annual, periodic, derivative, future, etc.) for financial failure prediction.	3.39	1.123	%33
6	The expert system used in the bank supports non-structural measurement models in analyzing qualitative information for the purpose of financial failure prediction.	3.52	1.08	%28
7	The expert system used in the bank supports the application of discriminant analysis models for financial failure prediction.	3.29	1.138	%34
8	The expert system used in the bank supports the capability to create and apply all standard models used for financial failure prediction.	3.44	1.099	%29
9	The expert system used in the bank excels in its ability to identify and define both quantitative and qualitative indicators that include the early warning feature for financial failure.	3.62	1.084	%27
10	The expert system used in the bank addresses the limitations and shortcomings of the accounting information system in predicting financial failure. It complements and enhances the capabilities of the accounting information system, providing more accurate and reliable predictions of financial failure.	3.54	1.147	%31
11	The expert system used in the bank significantly contributes to the efficiency and effectiveness of predicting financial failure. It provides a high degree of	3.79	1.071	%27

	efficiency and effectiveness in increasing the prediction of financial failure			
12	The expert system used in the bank is continuously developed and updated, eliminating the need for other techniques to predict financial failure	3.15	1.263	%38
	Overall average	3.52	1.14	%31

As shown in the previous table, the highest mean value was recorded at item (2), reaching a value of 4.16. This indicates that the study sample of Iraqi banks utilizes expert systems with high efficiency in analyzing various aspects of the bank's financial activity, assessing its performance, and evaluating its financial stability. In the second position, item (11) obtained a mean value of 3.79, indicating that expert systems significantly contribute to enhancing the prediction of financial failure. Item (4) ranked third with a mean value of 3.68, suggesting that financial management in most Iraqi banks from the study sample relies on expert systems to predict risks and possibilities of financial failure, as well as to propose solutions and alternatives.

Table 6. Descriptive Statistical Analysis Results for the Third Dimension

P	Paragraph	Mean	Standard Deviation	Coefficient of Variation
1	The bank utilizes multi-layer artificial intelligence networks for various predictive procedures and purposes.	3.31	1.234	%36
2	Multi-layer artificial intelligence networks excel in their high capability to perform various predictive operations.	2.78	1.172	%40
3	Artificial intelligence networks possess a high ability to explore and handle massive amounts of stored data, enabling them to predict financial failure with high efficiency.	3.35	1.151	%33
4	Artificial intelligence networks contribute to identifying the most important financial variables that aid in predicting financial failure.	3.35	1.142	%33
5	The self-learning capability in artificial intelligence networks contributes to predicting financial failure with a high degree of accuracy compared to other predictive techniques such as accounting information systems and expert systems.	3.28	1.262	%37
6	The predictive processes using artificial intelligence networks are characterized by a high ability to predict financial failure with the lowest possible error rate compared to accounting information systems and expert systems.	2.9	1.302	%44
7	Artificial intelligence networks are characterized by a high degree of flexibility and the ability to use all standard models for predicting financial failure and correcting their errors, thereby reducing uncertainty.	3.35	1.399	%39
8	Artificial intelligence networks possess a high capability to support decision-making and mitigate the likelihood of financial failure in the near and medium term.	3.34	1.28	%36
9	Artificial intelligence networks exhibit a high ability to interpret incomplete data, detect risks, and address	3.4	1.227	%35

	problems that can lead to financial failure.			
10	Artificial intelligence networks efficiently enhance the capability of financial indicators to increase the prediction of financial failure.	3.57	1.176	%31
11	Artificial intelligence networks significantly contribute to the efficiency and effectiveness of increasing financial failure prediction	3.67	1.043	%27
12	The use of artificial intelligence networks in financial failure prediction eliminates the need for using accounting information systems and expert systems	3.33	1.053	%31
	Overall average	3.30	1.20	%36

The items of the third factor recorded lower levels compared to the mean values in the first and second factors. The highest mean values (3.67, 3.57) were observed for items (11, 10), indicating that artificial intelligence networks are highly efficient and effective in improving financial indicators and enhancing the prediction of financial failure. However, the mean values for the remaining items in the factor were closer to neutrality and inclined towards a negative evaluation for items (6, 2). The overall mean value for all items in the factor was (3.30), which indicates a neutral value. Therefore, these results generally suggest a weakness in the level of using artificial intelligence networks in predicting financial failure in Iraqi banks within the study sample, despite their inherent efficiency and high effectiveness.

Table 7. Descriptive Statistical Analysis Results for the Fourth Dimension

P	Paragraph	Mean	Standard Deviation	Coefficient of Variation
1	The behavior of top management and its orientations towards financial failure prediction.	3.86	0.918	%23
2	The level of expertise and proficiency among users of predictive digital technologies.	3.79	0.91	%24
3	The type of digital technology used for financial failure prediction.	4.04	0.757	%17
4	The storage capacity, processing speed, and accuracy in data processing and analysis for predictive purposes.	3.88	0.988	%25
5	The size and type of data used in the process of predicting financial failure.	3.72	1.007	%27
6	The quality of the financial data used in the procedures of predicting financial failure.	4.04	0.862	%21
7	The type of standard models used in predicting financial failure.	3.72	1.018	%27
8	The timing of conducting financial failure prediction processes.	4.04	0.862	%20
9	Continuous updating and development of digital techniques used for financial failure prediction.	3.8	0.952	%25
10	The factors related to the external environment of the bank.	4.26	0.802	%19
	Overall average	3.92	0.91	%23

The mean values of the items in the fourth factor indicate a high level of agreement among the majority of individuals in the sample. This suggests that all the factors addressed in the items of this factor significantly impact the digital technologies used in banks and their effectiveness in

predicting financial failure. The high values were concentrated in items (10, 3, 6, 8), indicating that the most influential factors on the effectiveness of digital technologies used by Iraqi banks in enhancing financial failure prediction include external environmental factors, the type of technology used in financial failure prediction, the quality of financial data used in prediction procedures, and the timing of predictive operations.

4.3 . Presentation and Discussion of Exploratory Factor Analysis Results

To verify the validity of the results obtained from the descriptive statistics analysis of all factors and items in the questionnaire, we conducted a Factorial Analysis test. This test aimed to identify the latent factors among the measured variables represented by the questionnaire's factors and items, which measure the effectiveness of digital technologies in enhancing financial failure prediction in the studied sample of Iraqi banks. The Principal Component Analysis method was used to extract the factor analysis matrix, and the Varimax method with Kaiser Normalization was employed to ensure the possibility of rotation.

The correlation matrix coefficients showed no low correlations below 0.30 and no high correlations above 0.90. The absolute value of the matrix was 0.001, indicating the absence of linear dependence between the variables (redundancy and replication of information shared by each variable). This means that the matrix is free from the problem of exaggerated correlations between the variables (questionnaire items) it measures, thus confirming the validity of the tool in achieving the study's objectives.

To assess the adequacy of the sample size and the suitability of the matrix for rotation, the Kaiser-Meyer-Olkin test was conducted (Hill, 2011). As shown in the following table, the measurement result for the sample size was 0.693, which is an excellent value since it is greater than 0.5. It indicates the sufficiency of the sample size and the increased reliability of the latent factors (components) obtained from the factor analysis. Additionally, the significance level for the test of the matrix's rotatability was 1913.53, which is also a statistically significant value. It confirms the questionnaire's suitability for measuring the effectiveness of digital technologies in enhancing financial failure prediction in the selected sample of Iraqi banks.

Table 8. Test of Sample Size Adequacy and Rotatability of the Correlation Matrix

Kaiser-Meyer-Olkin (KMO) measure for sample adequacy		0.693
Bartlett's test (sphericity test).	Chi-square test	1913.53
	Degrees of freedom	63
	Significance	0.000

Based on the results of the test for sample size adequacy and matrix rotatability, which indicated the validity of the tool for its intended purpose.

the proportion of variance explained by each component was obtained, which represents the components through which the effectiveness of digital technologies in predicting financial failure in Iraqi banks can be measured and the study hypotheses can be tested.

To identify the ten extracted components from the correlation matrix, it is necessary to examine their saturations in the factor analysis, which involves two stages:

a) Stage 1: Saturations of the ten extracted components before rotation.
b) Stage 2: Saturations of the ten extracted components after rotation.

Saturations of the Ten Extracted Components before Rotation:

The following table presents the results of the factor analysis for the saturations of the ten extracted components with respect to the measured variables (items) before rotation:

Saturations of the Ten Extracted Components after Rotation:

The following table displays the results of the factor analysis for the saturations of the ten extracted components with respect to all measured variables (all items) after rotation:

Table 9. Variances related to Automated Accounting Information Systems Component/Variance

P	factor	component/variation		
		1	4	10
1	usage	0.76		
2		0.81		
3		0.78		
4		0.82		
5		0.67		
6	operations/processes	0.76		
7				
8			0.62	
9			0.54	0.57
10			0.70	
11	Effectiveness	0.59		
12			0.83	

As shown in Table (9), the variances of the items in the first component are represented by three components that attracted 11 items while one item was excluded. In the first component, the variances ranged from 0.67 to 0.82 for items that indicate the use of automated accounting information systems in predicting future performance and financial failure. These systems play a crucial role in providing high-quality, reliable, confirmatory, and relevant financial information that enhances their predictive capabilities. This includes periodic and real-time information, derived information, and future information, which are used as financial indicators for early warning of financial failure. These processes are essential for predicting financial failure regardless of the technology used in the prediction process. On the other hand, the variance value for the item (11) related to effectiveness is low (0.59).

In the fourth component, four items related to predictive processes and effectiveness (8, 9, 10, 12) obtained different significant variance values. The variance decreased to 0.54 for item (9), indicating a weakness in the effectiveness of automated accounting information systems in creating and applying most of the standard models used to predict financial failure. This is the only item that appeared in the tenth component with a low variance value as well.

Furthermore, the results of the factor analysis related to the variances of expert systems are shown in the following table:

Table 10. Variance Values Related to Expert Systems

P	factor		component/variation		
		1	2	5	10
1	usage				
2				0.67	
3					0.77
4				0.75	
5			0.65		
6	operations/processes			0.75	
7			0.55		
8			0.59		
9			0.63		
10			0.77		
11	Effectiveness		0.66		
12		0.70			

From Table (10), it is evident that the variance values related to expert systems were concentrated in the items related to processes and effectiveness in components (1, 2, 5, 10). The highest variance value (0.77) was observed in Component 2 for Item 10, indicating that expert systems address the deficiencies and limitations of the accounting information system in predicting financial failure. This can be attributed to the large storage capacity and exceptional ability of expert systems to process and analyze big data, as indicated by Item 3, which obtained a similar variance value in Component 10. Moreover, the variance value for Item 11, related to effectiveness, suggests a high level of effectiveness for expert systems in enhancing financial failure prediction.

By using CFA, I was able to confirm that the observed variables in the survey accurately measure the latent constructs of interest. This provides a solid foundation for further hypothesis testing and data analysis in the study.

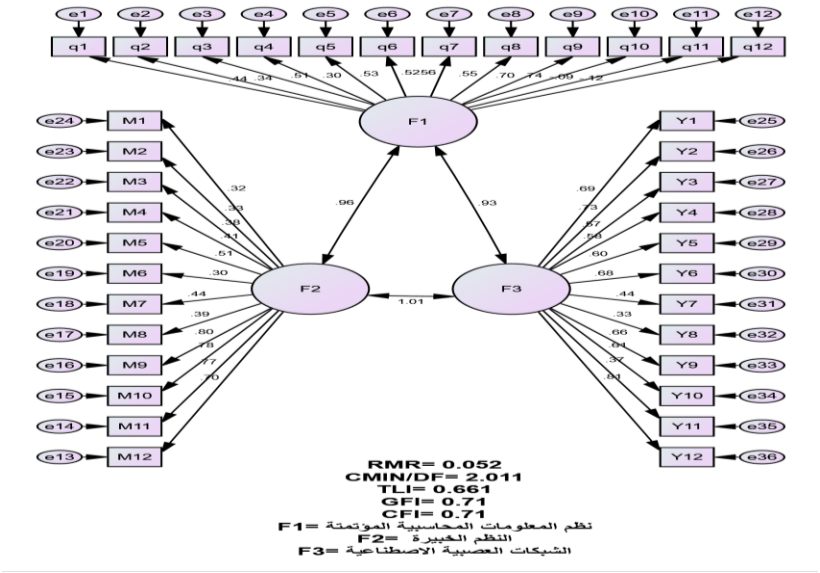

Figure.2 Correlation coefficients between survey items and their variables
Source: From the outputs of the statistical analysis program.

The results of the correlation test between the independent variables (Automated Accounting Information Systems, Expert Systems, and Artificial Intelligence Networks) and the dependent variable (Financial Failure Prediction) are as follows, as shown in the table and figure:

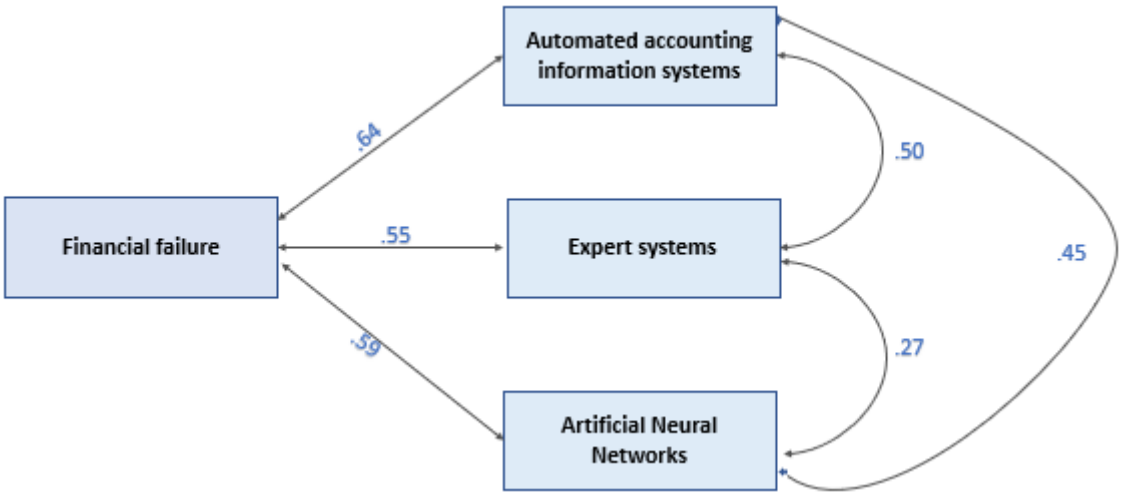

Figure.3 Correlation coefficients between independent variables and the dependent variable
Source: From the outputs of the statistical analysis program.

Table 11. Results of the correlation coefficient test between the independent variables and the dependent variable.

variables		Accounting Information Systems	Expert Systems	Artificial Neural Networks (ANNs)
Financial Failure Prediction	R Value	**0.642	**0.552	**0.590
	Sig	0.000	0.002	0.000

1. Automated Accounting Information Systems: The value of the coefficient (B) for this independent variable in relation to the dependent variable was (0.321), with a significant value of (0.000), and a p-value of (0.002). This indicates that automated accounting information systems have a 32% impact on increasing financial failure prediction. Consequently, the effectiveness of automated accounting information systems in achieving an early warning system based on financial failure prediction in Iraqi banks reaches its highest level at (68%).
2. Expert Systems: The value of the coefficient (B) for this independent variable in relation to the dependent variable was (0.223), with a significant value of (0.000), and a p-value of (0.006). This means that expert systems have a 22% impact on increasing financial failure prediction. Therefore, the effectiveness of expert systems in enhancing financial failure prediction in Iraqi banks reaches its highest level at (78%)
3. Artificial Intelligence Networks: The value of the coefficient (B) for this independent variable in relation to the dependent variable was (0.206), with a significant value of (0.000), and a p-value of (0.031). This indicates that artificial intelligence networks have a 20% impact on increasing financial failure prediction. Thus, the effectiveness of artificial intelligence networks in enhancing financial failure prediction in Iraqi banks reaches its highest level at (80%).

In light of the aforementioned findings, we conclude that the Iraqi banks in the study sample moderately rely on automated accounting information systems for financial failure prediction. Moreover, they highly depend on expert systems for financial failure prediction. The results also indicate a weakness in the utilization of artificial intelligence networks for financial failure prediction in Iraqi banks for the same reason (Gray, 2013). These findings validate the first hypothesis, suggesting a statistically significant relationship between the effectiveness of digital technologies used by Iraqi banks in enhancing financial failure prediction and the type of technology employed (automated accounting information systems, expert systems, artificial intelligence networks).

5. Conclusions

Financial failure refers to a bank's inability to meet its financial obligations within the specified timeframe, potentially resulting in a lengthy process that may eventually lead to bankruptcy and liquidation. Various bank characteristics, including size, age, and management practices, can have differing degrees of impact on the likelihood of financial failure and the bank's ability to address such situations effectively (Schinasi, 2004). Financial prediction plays a crucial role in reflecting the management's competence in planning and forecasting the future, particularly in terms of predicting and mitigating financial failure risks (Cornelius, Van de Putte, & Romani, 2005). This involves the utilization of financial analysis techniques to arrive at accurate predictions and expectations regarding the bank's future financial state. In the context of the study, it was found that automated accounting information systems, when integrated with other automated information systems such as management information systems, financial information systems, and

decision support systems, provide comprehensive data on various banking operations, as well as the positions of shareholders, lenders, and investors (Sori, 2009). These automated accounting systems contribute significantly to financial failure prediction by facilitating the necessary analysis and processing for predicting potential outcomes, evaluating the bank's performance, analyzing its financial position, and forecasting future conditions (Paradi & Zhu, 2013). Additionally, expert systems, which combine digital information characteristics and artificial intelligence, were identified as vital tools in financial failure prediction (Ahn, Cho, & Kim, 2000). These systems possess extensive knowledge and data stored in their rule bases, while simulating the decision-making process of human experts. They exhibit high effectiveness in supporting and enhancing predictive operations and future analysis, making them crucial digital technologies used in banks to predict and prevent financial failure (Ghattas, Soffer, & Peleg, 2014).

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