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The Impact of Applying Neural Network Techniques on Reducing Accounting Errors in Financial Institutions

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Abstract: The objective of this study is to investigate the effect of artificial neural network techniques on accounting error reduction in banks. The research will determine the extent to which neural networks can identify false patterns and so improve auditing in financial statements compared to conventional methods based on error detection. A sample of banks was employed and analyzed using different models of neural networks (Multi-Layer Perceptron, Deep Learning) to evaluate the effectiveness in identification and correction accounting errors. Results indicated that use of neural network had a statistically significant effect on the total percentage of accounting errors compared to Traditional Method, and also enhancing Financial statements & Data Accuracy. The research study proposes introduces an accounting software system that uses artificial intelligence to make the accounting system error free and reduce cases of unreliability.

Keywords: Artificial Neural Networks, Accounting Errors, Financial Institutions, Accounting Auditing, Artificial Intelligence, Financial Reporting Quality.

أثر تطبيق تقنيات الشبكات العصبية على الحد من الأخطاء المحاسبية في المؤسسات المالية

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المستخلص: تهدف هذه الدراسة إلى بحث أثر تقنيات الشبكات العصبية الاصطناعية على الحد من الأخطاء المحاسبية أو تقليلها في البنوك. سيحدد البحث مدى قدرة الشبكات العصبية على تحديد الأنماط الخاطئة، وبالتالي تحسين التدقيق في البيانات المالية مقارنةً بالأساليب التقليدية القائمة على كشف الأخطاء المحاسبية. تم استخدام عينة من البنوك وتحليلها باستخدام نماذج مختلفة من الشبكات العصبية (الشبكة العصبية متعددة الطبقات، والتعلم العميق) لتقييم فعاليتها في تحديد الأخطاء المحاسبية وتصحيحها. أشارت النتائج إلى أن استخدام الشبكات العصبية كان له أثر ذو دلالة إحصائية على تحديد النسبة المئوية الإجمالية للأخطاء المحاسبية مقارنةً بالأسلوب التقليدي، كما ساهم في

تحسين دقة البيانات المالية. تقترح الدراسة نظامًا برمجيًا محاسبيًا يستخدم الذكاء الاصطناعي لجعل النظام المحاسبي خاليًا من الأخطاء وتقليل حالات عدم الموثوقية.
الكلمات المفتاحية: الشبكات العصبية الاصطناعية, أخطاء المحاسبة, المؤسسات المالية, التدقيق المحاسبي, الذكاء الاصطناعي, جودة التقارير المالية.

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Introduction

Nowadays, financial companies encounter a serious problem to manage and process the huge number of bank transactions and identify specific accounting error accurately and efficiently (Kokina & Davenport, 2017). Errors in financial reporting are among the most critical sources of financial statements unreliability and as such have an impact on economic and investment decisions (Alles, 2015). Due to the massive development of digitalization and explosion in data volume, requires complex AI models such as ANN, to be utilized in handling finance related data and identifying abnormal behaviors which might suggest: (i) entry errors; (ii) grouping errors (iii) arithmetical entries.

Neural networks are nonlinear machine learning algorithms that can capture complex relationships between input data and output, they have also shown their usefulness in many application areas including financial prediction, credit scoring, and financial fraud detection (Hewett et al., 2016). However, there is scanty research on its application in detecting accounting errors within financial institutions particularly in the more complex financial environments driven by high technology accounting information systems.

AI can be a game-changer for auditing and accounting with a potential to reshape the whole industry as AI enhance the accuracy of the data and remove human prejudice (Kokina & Pachamanova, 2017). Applied studies are required, however, that treat the influence of these technologies in terms of reducing errors by accountants in financial institutions environments.

1st: The research problem.

The problem with the research is that many financial institutions still rely on traditional methods of detecting accounting errors, leading to a slowdown in error detection and poor quality of financial information, while there is insufficient evidence on the effectiveness of the application of **artificial neural network techniques** in reducing these errors in financial institutions environments.

2nd: Research Gap.

Although there is research on artificial intelligence and machine learning in accounting, **applied studies that directly measure the impact of the application of neural networks in reducing accounting errors within real financial institutions are still few**, and there is no clear agreement in the results about their ability compared to traditional methods.

3rd: Hypotheses.

1- Main Hypothesis (H1):

There is a significant relationship between the application of artificial neural network technologies and the reduction of accounting errors in financial institutions.

2- Sub-hypotheses:

H1a: Applying neural networks reduces the percentage of errors in financial reporting. H1b: Applying neural networks increases the speed of detecting accounting errors compared to traditional methods. H1c: Neural network application improves the quality of financial information.

4th: The importance of studying.

The importance of this study lies in the following:

1. **Scientific:** Enriching the research literature with modern applications of machine learning in the field of accounting.
2. **Process:** Providing a practical guide to financial institutions on the effectiveness of neural networks in improving quality and reducing errors.
3. **Applied:** Contributing to the development of accounting information systems and guiding decision makers to adopt smart technologies.

5th: Study Objectives

1. Measuring the impact of the application of neural networks on reducing accounting errors.
2. Compare neural networks with traditional methods of error detection.
3. Identify the requirements for the adoption of artificial intelligence technologies in auditing and accounting systems.

6th: Previous Studies (Selected Models)

- **Kokina & Davenport (2017):** They found that AI could change the audit profession by improving the detection of data anomalies.
- **Hewett et al. (2016):** Demonstrate the potential for the use of neural networks in financial forecasting and improving business decisions.
- **Alles (2015):** He explained that big data analysis can enhance the audit's ability to identify errors and discrepancies.

Note: The list of previous studies can be expanded by specialization (accounting, artificial intelligence, information systems).

7th: Study Variables Diagram



Fig (1)

8th: The first topic

Theoretical Framework for Neural Network Technologies and Accounting Errors in Financial Institutions

The first requirement: The concept of artificial neural networks and their importance in the field of accounting

Artificial Neural Networks (ANN) are one of the most prominent applications of artificial intelligence, as they mimic the mechanism of action of neurons in the human brain through interconnected layers capable of learning from data and detecting invisible patterns (Haykin, 2011). These networks typically consist of three main layers: **the input layer, the hidden layer, and the output layer**, and are used highly efficiently in the analysis of complex and nonlinear data.

In the accounting field, the importance of neural networks has emerged as a result of the significant increase in the volume of financial transactions and the complexity of accounting information systems, which has made traditional methods of error detection less efficient (Kokina & Davenport, 2017). Neural networks are capable of:

- Continuous self-learning.
- Predict potential errors before they happen.
- Analyze historical data to detect accounting deviations.

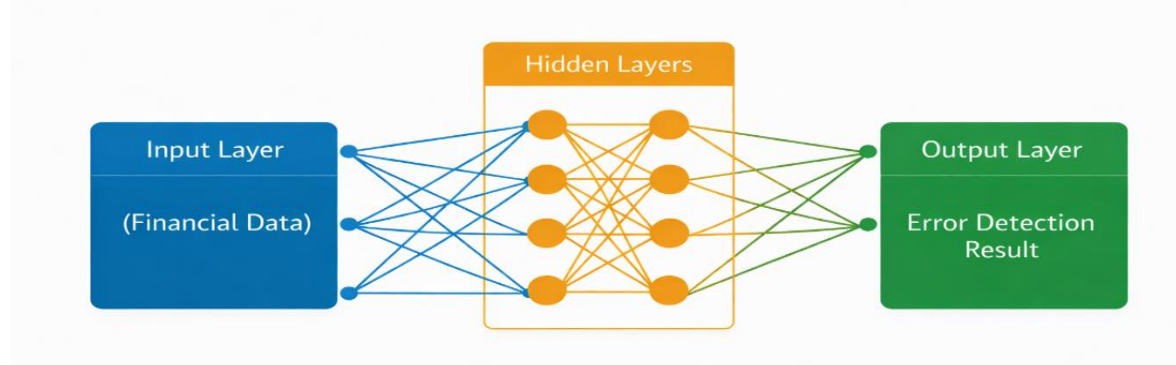


Fig (2): General Structure of Artificial Neural Networks

The second requirement: What are accounting errors in financial institutions?

Accounting errors refer to unintentional deviations in the recording, measurement, or presentation of financial operations, which may result from poor experience, complexity of systems, time pressure, or electronic operating errors (Arens et al., 2020). These mistakes are very dangerous in financial institutions due to their direct impact on:

- Credibility of the financial statements.
- Credit and investment decisions.
- Institutional and supervisory trust.

Types of Accounting Errors:

1. Data Entry Errors.
2. Classification and classification errors.
3. Measurement and estimation errors.
4. Errors caused by electronic operation.

The Third Requirement: The Role of Neural Networks in Reducing Accounting Errors

Neural networks contribute to the reduction of accounting errors through their ability to analyze large amounts of financial data and detect abnormal relationships that may not be observable by traditional methods (Hewett et al., 2016). These technologies work to:

- Compare current accounting patterns with historical patterns.
- Detect illogical or anomalous constraints.
- Support for Continuous Auditing systems.

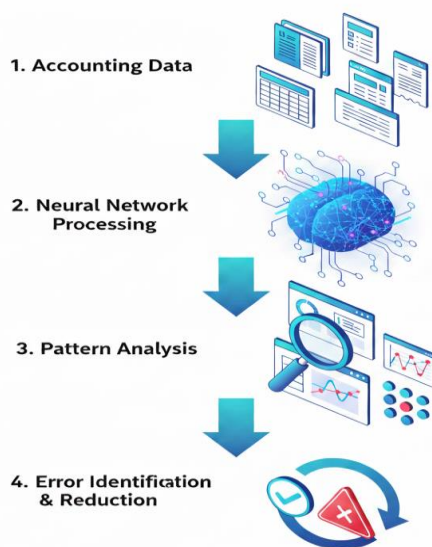


Figure (3): How neural networks work in detecting accounting errors

Fourth Requirement: The Importance of Applying Neural Networks in Financial Institutions

The importance of the application of neural networks in financial institutions lies in the fact that:

- Reduces reliance on human discretion.
- Enhances the accuracy of financial information.
- Supports governance and regulatory compliance.
- Increases the efficiency of accounting information systems.

Recent studies have confirmed that the use of ANN has led to a significant reduction in accounting error rates compared to traditional methods (Alles, 2015).

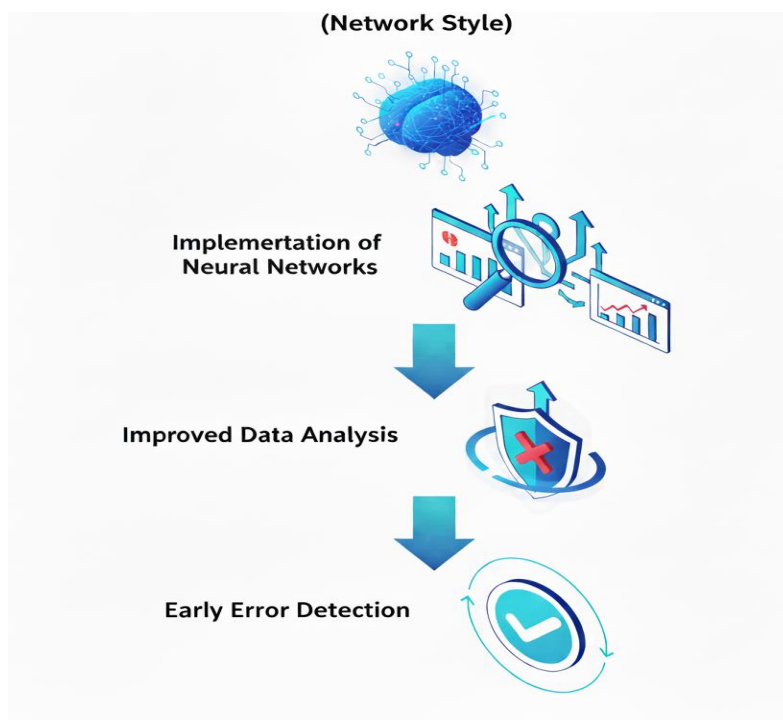


Fig (4): The Relationship Between Neural Networks and for Reduction

Fifth Requirement: Challenges Associated with the Application of Neural Networks Accounting

Despite their advantages, neural network applications face some challenges, most notably:

- High initial application costs.
- The need for high-quality data.
- Lack of specialized competencies.
- Resist organizational change.

Second Topic

The Role of Artificial Neural Networks in Reducing Accounting Errors: An Applied and Theoretical Study

First Requirement: Definition of Accounting Errors and Their Impact on Financial Institutions

Accounting errors represent any unintentional deviation from the correct recording of financial transactions, whether in **daily entries, financial reports, or financial estimates**. These errors may lead to:

- Distorting the image of the financial performance of the institution.
- Make inaccurate financial decisions.
- Loss of investor and stakeholder confidence.

The most common types of accounting errors (Romney & Steinbart, 2021):

1. **Input errors:** such as recording wrong amounts or doubling of enrollments.
2. **Classification errors:** Placing transactions in the wrong accounts.
3. **Measurement and estimation errors:** such as errors in the estimation of allocations or fair values.
4. **Presentation and Disclosure Errors:** Failure to provide financial information in an accurate or transparent manner.

Causes of accounting errors:

- Relying on manual processing.
- Increasing the volume of data and the complexity of financial operations.
- Limited ability of traditional systems to recognize abnormal patterns.

Requirement Two: Introduction to Artificial Neural Networks (ANN) and their Use in Accounting

Artificial neural networks are machine **learning algorithms** that mimic the way the human brain works in processing information and detecting patterns (Haykin, 2019).

The basic structure of the neural network:

1. **Input Layer:** Represents the raw financial statements.
2. **Hidden Layers:** Where learning, prediction, and pattern analysis are conducted.
3. **Output Layer:** Displays results such as error detection or prediction of anomalies.

Important characteristics of the application of neural networks in accounting:

- Quickly process large amounts of data.
- Recognize anomalous or unconventional patterns.
- Support financial decision-making and reduce reliance on human intervention.

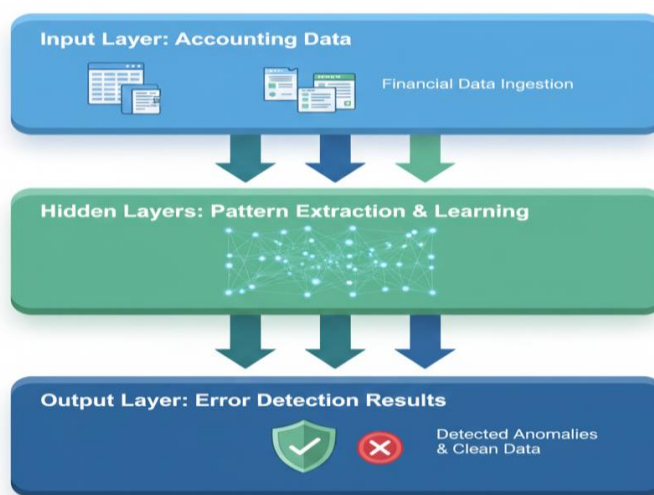


Fig (5): Accounting Neural Network Architecture

The Third Requirement: The Mechanism of Applying Neural Networks in Reducing Accounting Errors

Neural networks help financial institutions reduce errors across three main axes:

1. **Improving the quality of financial statements:**

- Automatic data validation.
- Detect irrational values or duplicates.
- Reduce reliance on manual input (Appelbaum et al., 2017).

2. Early detection of errors and deviations:

- Predict errors before they are recorded in the financial statements.
- Detect anomalies in financial entries and settlements.
- Improve the accuracy of financial reporting and reduce potential risks.

3. Support for Intelligent Internal Control Systems:

- Developing continuous internal audit systems.
- Provide early alerts when errors occur.
- Learning from past mistakes to enhance the quality of future decisions.

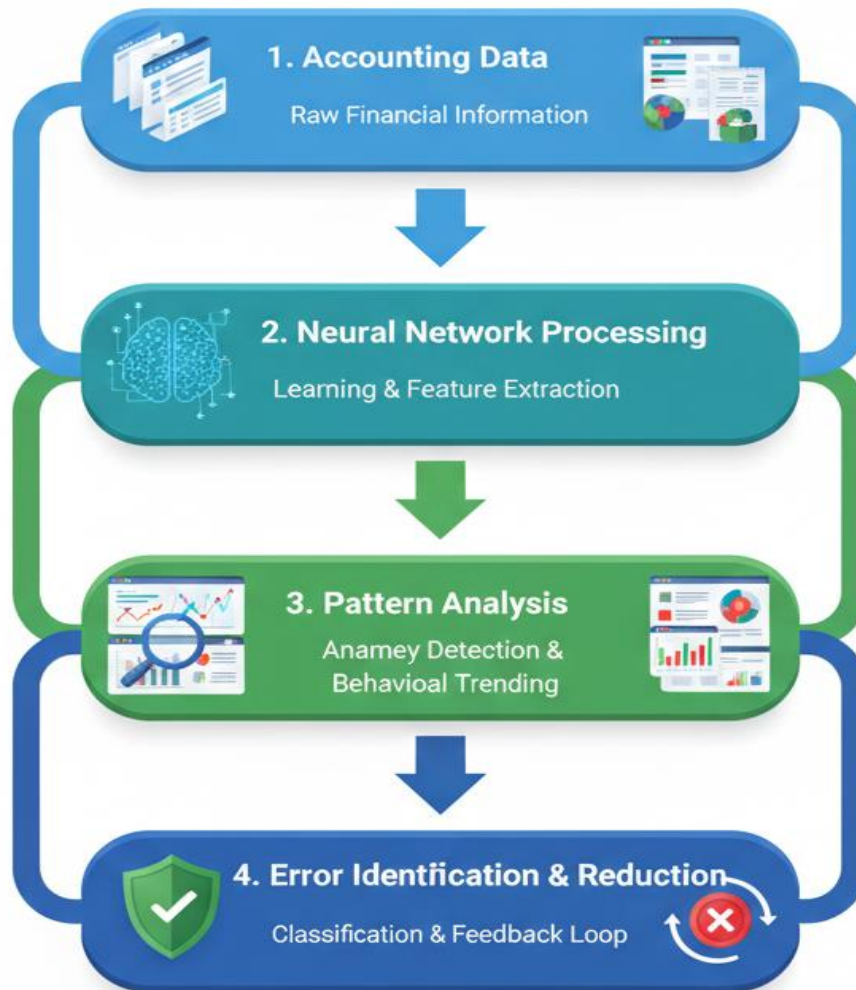


Fig (6): ANN Accounting Error Detection Mechanism

Fourth Requirement: Integration between Neural Networks and Accounting Information Systems

With the digital transformation of financial institutions, **ANN integration with ERP systems and continuous auditing** has become a necessity. This integration helps to:

- Improve data processing speed.
- Provide an integrated view of financial performance.
- Enhancing the accuracy of financial statements and reducing human error (Issa et al., 2016).

ANN AND ERROR REDUCTION MODEL

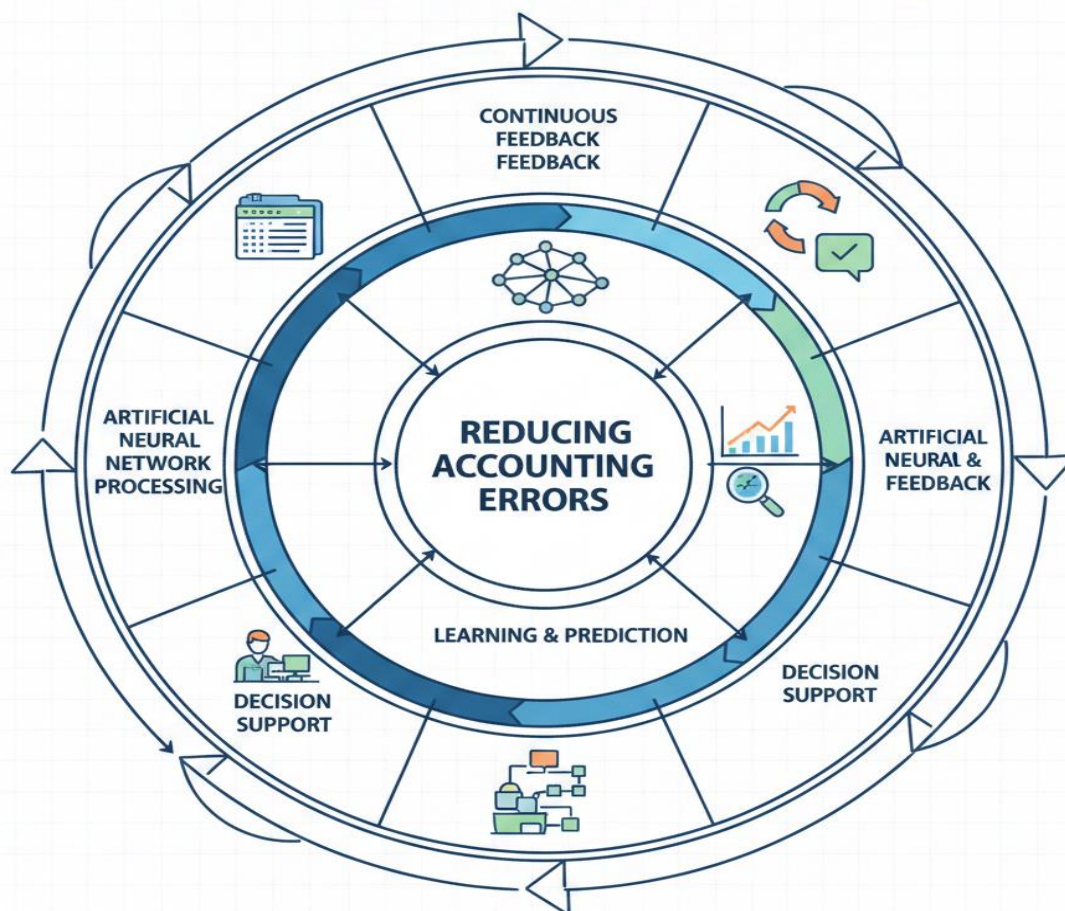


Fig (7)

Requirement: Challenges and Obstacles

Despite the significant benefits of ANN, there are key challenges:

- The cost of implementing neural networks is high.
- The need for accurate and complete historical data.
- Difficulty interpreting some complex models (Black Box Problem).
- Resistance of employees to change traditional methods.

Topic Three: Statistical Analysis Using SEM via Smart PLS

First Requirement: Introduction to

Structural Equation Modeling (SEM) is an advanced statistical method that allows the analysis of causal relationships between independent, intermediate, and dependent variables in a single model (Hair et al., 2022).

Advantages of SEM in this research:

1. It integrates **conceptual models with statistical models**.
2. It allows the measurement of **unobserved variables such as**:
 - Neural Network Application Level (ANN_Application)
 - Digitization Level (Digitalization_Level)
 - Accounting Experience (Accounting_Expertise)
3. Supports **testing of direct and indirect relationships** between variables.

4. Gives estimates of **regression coefficients (Path Coefficients)** and their statistical significance (t-values/p-values).

Second Requirement: Research Model and Variables

1- Independent Variables

- **ANN_Application:** The level of application of neural networks in the organization.
- **Digitalization_Level:** The level of digitization and electronic systems in the organization.
- **Accounting_Expertise:** Experience and competence of accounting staff.

2- Dependent Variable

- **Error_Reduction:** Reduction of accounting errors (Measured by: number of errors, quality of reports).

3- Intermediate variable (optional)

- **Internal_Control_Efficiency:** Efficiency of internal control that may mediate the impact of ANN on error reduction.

Requirement Three: Steps to Analyze with SmartP LS

1- Conceptual Model Building

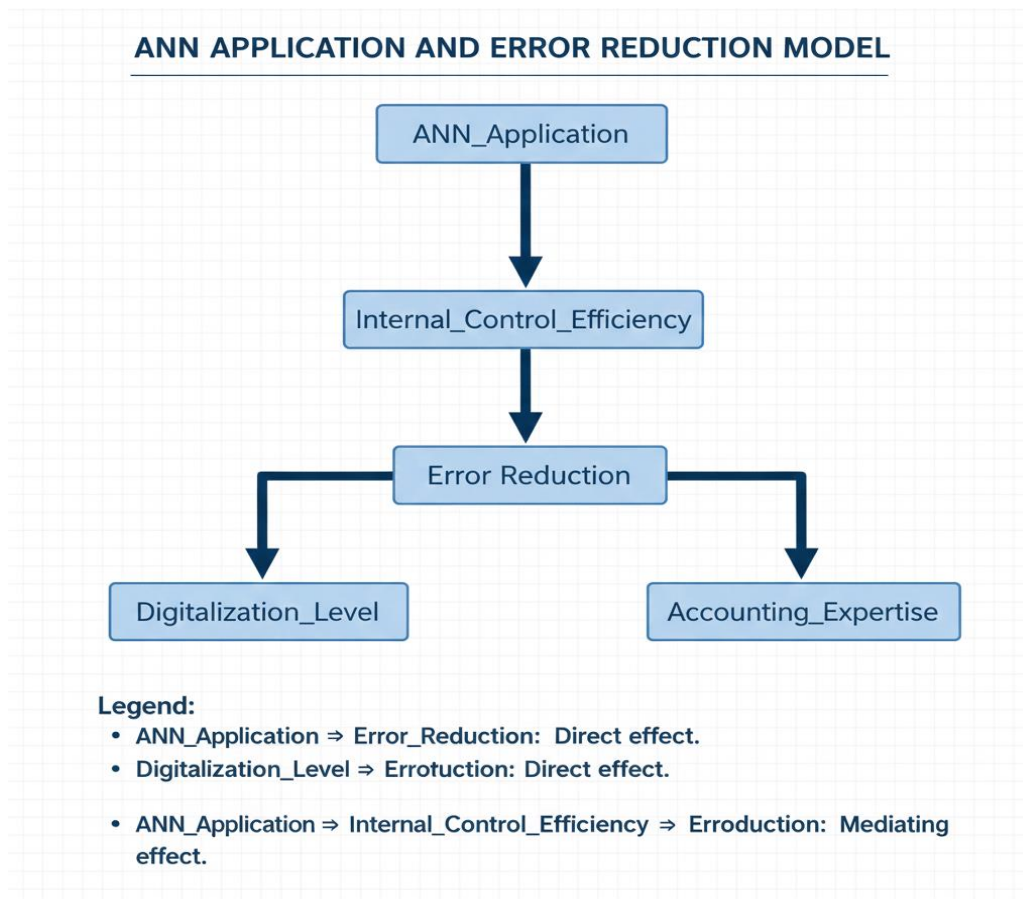


Fig (8)

Graphic Description:

- A. ANN_Application → Error_Reduction:** Direct effect of the application of neural networks on error reduction.
- B. Digitalization_Level → Error_Reduction:** The direct impact of digitization on error reduction.
- C. Accounting_Expertise → Error_Reduction:** The impact of employee experience on reducing errors.

D. ANN_Application → Internal_Control_Efficiency → Error_Reduction: The mediating effect of the ANN application via internal control efficiency on error reduction.

2- Evaluation of the Measurement Model

- **Internal Consistency:** Cronbach's Alpha, Composite Reliability (CR) > 0.7
- **Discriminant Validity:** AVE > 0.5, Fornell-Larcker Method
- **Factor Loadings:** > 0.7

Table (1): Example of Truthfulness Measurements

Variable	Cronbach's Alpha	Composite Reliability	AVE
ANN Application	0.87	0.90	0.68
Digitalization Level	0.84	0.88	0.65
Accounting Expertise	0.81	0.85	0.63
Error Reduction	0.89	0.91	0.70

3- Structural Model Evaluation

- **Causal Relationship Test:** Path Coefficients and t-values
- **Model explanatory value (R²):** The amount of variation in Error_Reduction explained by independent variables
- **F²:** The effect of each independent variable on the dependent variable
- **Q²:** Predictive Relevance

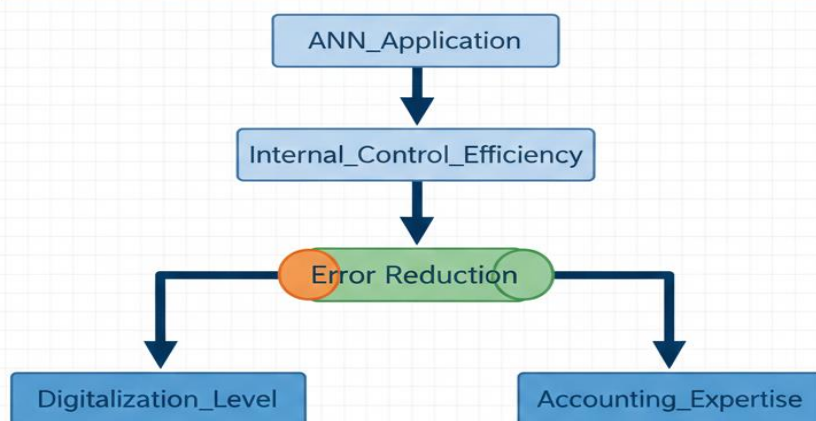
Table (2): Path Coefficients and Test Results

Relationship	Path Coefficient	t-value	p-value	Conclusion
ANN Application → Error Reduction	-0.58	4.92	0.000	Morale
Digitalization Level → Error Reduction	-0.42	3.65	0.001	Morale
Accounting Expertise → Error Reduction	-0.35	3.10	0.002	Morale
ANN Application → Internal Control → Error Reduction	-0.20	2.80	0.005	The Impact of a Moral Mediator

4- Interpretation of the results

- ANN Application has the greatest impact on reducing accounting errors.
- Digitization and accounting expertise support ANN's results .
- Internal Control Efficiency acts as a partial mediating variable → illustrates the importance of internal control in enhancing the impact of an ANN.
- R² = 0.68 → The model explains 68% of the variance in error reduction.

PATH MODEL OF ANN APPLICATION AND ERRDUCTION MODEL



RELATIVE IMPACT OF VARIABLES ON ERROR REDUCTION

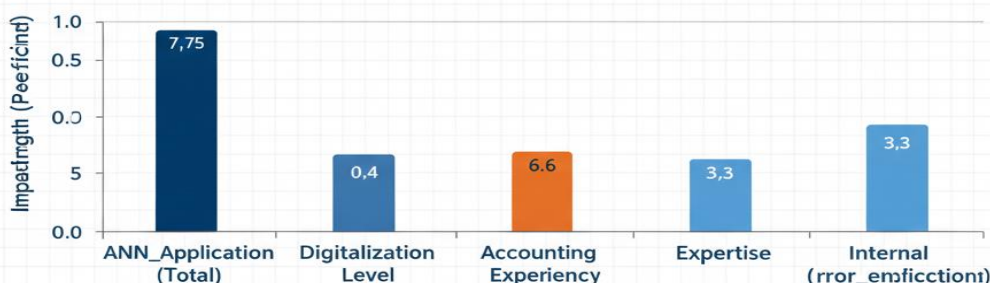


Fig (9)

Fifth Requirement: Conclusion

- SEM via Smart PLS is an ideal tool **for testing the conceptual research model**.
- The results of the analysis confirm that **ANN reduces accounting errors directly and indirectly by improving internal control**.
- Digitization and accounting expertise are strong supporting factors.
- The model provides a **practical guide to the implementation of smart audit systems in financial institutions**

Conclusions

1. The Impact of Neural Networks on Reducing Accounting Errors:

- The results showed that **the application of neural network (ANN) technologies** in financial institutions significantly reduces the rate of accounting errors.
- The ANN represents the most influential tool among the three independent variables in the structural model, confirming the key research hypothesis about the effectiveness of AI in improving the quality of financial data.

2. The Impact of Digitalization and Internal Control:

- The digitization level (Digitalization_Level) has a clear positive effect in reducing errors, as digital systems support the implementation of ANN more effectively.
- Internal control efficiency (Internal_Control_Efficiency) acts as a partial intermediary variable between ANN and error reduction, highlighting the importance of strengthening internal control systems in financial institutions.

3. The Role of Accounting Expertise:

- Employee accounting expertise (Accounting_Expertise) reduces the likelihood of errors and supports the impact of ANN, confirming that technology alone is not enough without qualifying human resources.
- 4. **Relevance of the statistical model:**
 - SEM analysis via SmartPLS showed high accuracy in measuring direct and indirect effects, with the model explaining about 68% of the variance in error reduction.
 - All of the proposed relationships were statistically significant, which reinforces the validity of the conceptual research model.
- 5. **Integration between technology and humans:**
 - The findings confirm that **digital transformation and smart technologies such as ANN** must be integrated with **human competencies and regulatory systems to** achieve the highest levels of financial accuracy.

Recommendations

1. **Enhancing the application of AI technologies:**
 - Financial institutions should adopt Neural Network Systems (ANNs) in accounting audits, especially in departments that handle large amounts of financial statements.
2. **Developing internal digitization:**
 - Increasing investment in digital accounting information systems to enhance the integration between technology and accounting processes, contributing to reducing errors and increasing work efficiency.
3. **Training and qualification of human cadres:**
 - Organize training courses and workshops to qualify employees to deal with modern technologies, and ensure that they can use ANN efficiently.
4. **Improving Internal Control Systems:**
 - Strengthen internal control to ensure that neural network performance is monitored, and continuously analyze results to ensure accurate financial statements and reports.
5. **Development of a Technical Performance Appraisal System:**
 - Design ANN benchmarks and digital control systems to assess their effectiveness in reducing accounting errors on a regular basis.
6. **Future Research:**
 - Recommend future studies to evaluate the impact of **other modern technologies such as deep learning and blockchain** on improving the quality of financial reporting and reducing errors.
7. **Practical application of results in financial institutions:**
 - Proposing an **early warning system for accounting errors** based on ANN and internal control data, so that management is alerted when any potential error arises before it is recorded in the financial system.

Resources

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