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| Research Article

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The Role of Artificial Intelligence in Improving Objective Models for Measuring Value Stream Costs

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Abstract: The study sought to uncover the role artificial intelligence can play in enhancing objective models for measuring the value stream costs. In order to attain the aforementioned objective, the study was founded on the following primary hypothesis: There is a statistically significant role for the application of artificial intelligence methods in enhancing objective models for measuring the value stream costs in economic units. In order to confirm the legitimacy of the hypothesis, the researchers depended on the descriptive analytical technique and formulated a questionnaire in order to collect and review data using the Statistical Package for Social Sciences (SPSS). Following the conclusion of the study, the researchers concluded a list of results, the most noteworthy of which are: Artificial intelligence can enhance the precision of measuring the value stream costs by studying big data and determining patterns and trends. Artificial intelligence can additionally lessen human error in the process of measuring costs, hence yielding more credible results. The study concluded a list of recommendations, the most noteworthy of which are: It is possible to generate integrated models that unite financial and operational data in order to enhance the precision of measuring costs. New requirements can additionally be created for measuring the value stream costs in light of considering artificial intelligence techniques.

Keywords: Artificial intelligence, objective models, cost measurement, value stream.

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Introduction:

In light of the rapid progress the world has witnessed in recent years, the rapid developments in the global business environment across various sectors, and the increasing intensity of competition, all of this has led to the emergence of an information and communication technology (ICT) environment. These developments have become an integral part of the global economy, characterized by the use of information and technological technologies, most notably artificial intelligence (AI) with its various applications. This has led to economic units relying primarily on modern technology tools to perform their work, after previously performing it manually. This development has led most businesses to respond to these developments, especially in the field of widespread computer use. One of these applications, as we mentioned, is artificial intelligence (AI), the beginnings of which date back to the early 1950s, when a group of scientists, based on recent discoveries, were able to produce intelligent machines based on neuroscience and the use of new mathematical theories of information. In this regard, most countries have sought to keep pace with emerging technological systems around the world, which has resulted in the creation of a set of algorithms used in AI. This is because AI is a powerful tool that marketers should exploit and leverage to achieve better results and improve return on investment. This is also because these modern technologies have greatly helped advanced societies provide a comfortable and prosperous environment, assisting individuals in completing their work without facing any difficulties. Based on the above, it can be said that the importance of this research stems from the researchers' efforts to highlight the role of artificial intelligence technologies in improving objective models for measuring value stream costs by managing and reducing costs while maintaining quality to achieve optimal resource utilization.

Research problem:

Artificial intelligence (AI) is one of the most prominent modern technologies that contributes to improving objective models for measuring value stream costs across various economic sectors. AI technology contributes to improving decision-making, automating routine tasks, and analyzing data accurately and quickly, leading to reduced costs and increased productivity. Despite the numerous benefits offered by AI, there are a number of challenges facing economic units, which can be summarized in a set of questions, as follows.

1. What are the most prominent challenges facing traditional models for measuring value stream costs across various economic sectors?
2. There is a complex and variable set of data within the value stream. How can it be handled using artificial intelligence?
3. What are the most appropriate smart technologies that can be used to improve the accuracy of value stream cost measurement?
4. To what extent does the integration of artificial intelligence into these models impact the quality of financial and administrative decisions?

Importance of research:

The importance of this research stems from its addressing a contemporary topic that has not received sufficient study in various sectors. It intersects with digital transformation and modern cost management, given that artificial intelligence is the science that seeks to enable computers to mimic human thinking in finding solutions to various problems facing the performance of tasks in various sectors. This is achieved by studying the role of artificial intelligence in improving objective models for measuring value stream costs. Economic units in various sectors face significant difficulties in accurately tracking and analyzing value chain costs due to the multiplicity of data sources and operational complexity. This necessitates the search for modern technological tools to address these gaps. The research also contributes to enabling sectors to

understand value streams more deeply, which helps reduce unnecessary costs and improve the financial and productive performance of units.

Research objectives:

In light of the problem and importance of the research, the research objectives can be defined as follows:

1. Identify the impact of using AI applications in all its dimensions in data processing and value stream analysis.
2. Evaluate the improvement in the accuracy of objective models through the effectiveness of their integration with AI technologies.
3. Measure the improvement in the quality and efficiency of administrative and financial decision-making through the use of AI.
4. Combine AI and objective models to measure value stream costs by proposing an integrated, applied model.
5. Analyze the challenges facing traditional objective models in measuring value stream costs in various sectors.

Research hypothesis:

The research aims mainly to achieve the following hypotheses:

- **Main hypothesis:** There is a statistically significant role for the use of artificial intelligence techniques in improving objective models for measuring value stream costs in economic units. From this hypothesis, the following two hypotheses were derived:
- **The first sub-hypothesis:** There is a statistically significant role for the use of artificial intelligence techniques in improving the accuracy of measuring time costs within the value stream.
- **Second sub-hypothesis:** There is a statistically significant role for the use of artificial intelligence techniques in improving the measurement and control of quality costs within value stream models.

Previous studies:

Some previous studies related to the main variables of the research and the relationship between them can be reviewed through the following:

1- Muhammad's study, 2019 (The impact of using artificial intelligence technology on cost management).

This study examined the most important tools of artificial intelligence, namely artificial neural networks, and their role in helping businesses achieve their goals and address the challenges of cost forecasting. The study concluded that accurate production cost forecasting can be achieved through the use of artificial neural networks. Cost estimation helps these businesses strengthen their competitive position and increase their ability to develop new products.

2- Study, Weckman 2020 (Determining the role of artificial intelligence in predicting long-term costs).

This study compared more than one model in order to predict costs within different sectors of economic units.

The study concluded that the cost estimation process, based on the accuracy of the results, outperforms other methods when using artificial intelligence technology, as well as in terms of long-term uses and accuracy over time.

3- Qasim Muhammad Khamis's study, 2017 (The role of the value stream costing method in strategic planning of production costs and the competitive advantages of the facility).

The study aimed to measure the role of the value stream costing approach in strategic planning of production costs and supporting the competitive advantages of the organization. This study addressed the role of the value stream costing approach in strategic planning of production costs and the competitive advantages of the organization.

The study concluded that the emergence of environmental indicators, as well as some obstacles, prevented the realization of the benefits associated with the value stream costing system, including the need to strive to achieve employee satisfaction and the importance of developing mechanisms and methods for strategic cost planning.

4- Al-Omari's study, 2023 (The role of artificial intelligence in improving the administrative performance of institutions).

The study aimed to identify the role of artificial intelligence in improving the performance of administrative economic units. The study was applied to 200 random samples of business establishments in the UAE. A descriptive analytical approach and questionnaire were used as the study tool. The study reached several conclusions, the most important of which is that artificial intelligence supports the process of improving institutional performance by enhancing efficiency and reducing operational costs. This study recommended the need to conduct further studies to determine the impact of artificial intelligence on the administrative performance of institutions from several aspects.

5- A study by Moulay Amina, Tayyibi Ikram and others, 2021 (Applications of artificial intelligence and emotional intelligence in decision-making).

This study mainly addressed the impact of artificial intelligence and emotional intelligence on administrative decision-making. The study relied on the descriptive analytical approach. The most important results reached by the study are the lack of complete knowledge of artificial intelligence applications and their benefits by decision-makers and that there is a negative correlation between emotional intelligence and administrative decision-making. This study was distinguished by its expansion in research to identify administrative decision support systems and the advantages of applying automation and benefiting from it in management and the effects of automation and its role in administrative decision-making, as well as knowing the benefits of artificial intelligence applications (expert systems, intelligent agents, neural networks, and genetic algorithms).

Comment on previous studies:

Previous studies have demonstrated the importance of artificial intelligence in improving the accuracy of cost estimation and enhancing organizational performance. What distinguishes the current study is its role in improving objective models for measuring value stream costs, which can contribute to bridging the knowledge gap on this topic. Expected outcomes include improved measurement accuracy, reduced errors, and increased efficiency.

Theoretical framework:

First axis: What is artificial intelligence:

Artificial intelligence is a branch of computer science that aims to develop systems and programs that have the ability to learn and to design and develop systems capable of mimicking intelligent human behavior. This includes the ability of a machine to learn from available data, extract

patterns, make decisions, solve problems, interact with natural language, and recognize images or sounds.

1- 1- The concept of artificial intelligence:

The term artificial intelligence (AI) refers to a set of software and computer applications that are typically linked to human intelligence. These applications are integrated into computers to achieve specific goals and objectives (Raval et al., 2022). Economic environments have witnessed radical and rapid changes as a result of technological developments, represented by new applications for information systems and new standards for designing these applications. This has led to the creation of AI algorithms. The convergence of the technological revolution in the field of computer science and automation on the one hand, and the science of logic, mathematics, linguistics, and psychology on the other, has made AI one of the most prominent modern applications in the field of information systems (Jihan Adel, 2022). In this regard, Russell (2020) explained that artificial intelligence can be defined as "a branch of computer science concerned with designing programs and systems capable of performing tasks that typically require human intelligence, such as learning, thinking, and decision-making." Artificial intelligence is also defined as "a system based on collecting data and information related to various sectors worldwide, processing them, and disseminating them to benefit from them in the form of practical intelligence through an electronic simulation system" (Al-Azzam, 2021). It is also defined as the science that typically requires humans to use their intelligence to study, design, and program computers to accomplish tasks, tasks, and make decisions within economic units (Adel Abdel Nour, 2005). Artificial intelligence is also defined as a system that simulates human mental and cognitive abilities in thinking, solving problems, making decisions, and learning from previous experiences by using a set of technologies and programs characterized by speed and accuracy (Ali Abbas, 2024).

2-1 Artificial Intelligence Tools and Technologies:

It is a set of tools used to design and build systems capable of simulating human intelligence. To achieve this, it relies on a set of advanced software tools and technologies that form the infrastructure for scientific research and application. The following is a presentation of the most important tools and technologies used in the field of artificial intelligence.

2-1-1 Machine learning:

Machine learning is one of the most important branches of artificial intelligence. It focuses on developing algorithms and mathematical models that enable computer systems to learn from data without the need for explicit programming to perform a specific task. By using data from previous experiments to predict new output data, these algorithms help accurately predict outcomes (Burns, 2021). Machine learning is defined as a research field that works to develop and design algorithms that automatically improve performance without direct human intervention (Mitchell, 1997). By analyzing big data in the field of research, deep learning has become a vital tool for analyzing medical images, developing drugs, and researching in the social sciences (Al-Bayati, 2024).

2-1-2 Predictive Analysis:

Predictive analytics is one of the most prominent applications of artificial intelligence in the field of data analysis and decision-making, as it accurately analyzes data and provides better predictions, by relying on a group of artificial intelligence techniques, the most prominent of which are machine learning algorithms. These algorithms analyze huge amounts of data, which allows for predicting future events with reasonable accuracy (Al-Raqeeba, 2024).

2-1-3 Natural Language Processing:

It is a branch of artificial intelligence and computer science that aims to enable machines to understand and interpret human language. In the field of text processing and analysis in scientific research, this technology has revolutionized the way large texts are analyzed quickly and accurately. For example, tools like GPT have helped automate the writing of scientific abstracts and extract useful information from previous research (Al-Tarawneh, 2024).

2-1-4 Generative Artificial Intelligence:

It is known as one of the fields of artificial intelligence that aims to create original and innovative content automatically, unlike analyzing and using existing data and producing different types of content such as texts and images that appear to be human-created, and it uses neural networks to recognize patterns and structures present in the data (Al-Khalifa, 2023).

Researchers believe that artificial intelligence tools and techniques are among the most important tools that can be used to improve scientific research and data analysis. By employing technologies such as machine learning, predictive analytics, natural language processing, and generative artificial intelligence, researchers can analyze data quickly and accurately, saving time and effort, and improving the quality of research.

3-1 Uses of artificial intelligence in the accounting field

Many studies have shown that artificial intelligence and its applications can be relied upon in the accounting field through the following:

3-1-1 Analysis of Big Financial Data:

One of the essential uses of artificial intelligence in the accounting field is through its analysis of large financial data, which enables accountants to extract accurate results from vast and complex amounts of data such as accounting records and bank transactions. This analysis relies on tools such as machine learning, which enables the identification of accurate information about financial performance. The importance of analyzing large financial data is evident in the early detection of manipulation and fraud, as well as financial forecasting and improving accounting and administrative decisions. (Karim Mamdouh, 2024).

3-1-2 Internal Control and Smart Auditing:

As a result of the developments that have occurred in recent years in the field of information technology and computers, which has led to an increase in the use of modern technology in the process of internal control and smart auditing, as this has led to the elimination of human errors during the practice of audit work. The internal audit function at the level of the institution is one of the most important functions due to its significant impact in examining accounting and financial transactions. Artificial intelligence technologies also help in providing data from various sources at the appropriate time, which results in more powerful control procedures and providing deeper insights that are difficult to access through traditional analysis (Hadeer Atef, 2024).

3-1-3 Cost Forecasting and Budget Planning:

It is considered one of the most important practical applications of artificial intelligence in accounting, especially in the field of financial planning, as artificial intelligence algorithms play an important role in creating a more predictable work environment for costs and budget planning in all economic units through the use of a huge set of data that is handled by a set of complex algorithms. This data is processed in record time to predict the financial conditions within these economic units (Muhammad, 2020).

3-1-4 Supporting financial decision-making:

It refers to the process of selecting the best among available alternatives and options to achieve specific financial goals, such as increasing profits through the analysis of financial and accounting data. Using information stored in databases helps expert systems make decisions related to developing and resolving various problems within economic units, and it also contributes to the ease of performing tasks. With the continued development of artificial intelligence technology, it is expected to become an essential part of the decision-making system within economic units (Al-Tarawneh, 2022).

Researchers believe that the use of artificial intelligence in the field of accounting is one of the most important practical applications that can contribute to improving the performance of economic units. Artificial intelligence can help improve the accuracy of financial analysis and enhance accounting and administrative decisions. It can also contribute to the early detection of manipulation and fraud and improve control procedures.

Axis II: Value Stream Costing - Concept and Importance:

With the growing need for operational efficiency and waste reduction, the need for new approaches to tracking costs from a more comprehensive perspective has emerged. The concept of value stream is one such approach, focusing on analyzing the entire value chain to understand the relationship between cost and actual added value to the consumer.

2-1 Value stream costing concept:

It refers to the analysis and estimation of costs associated with all activities and processes that contribute to delivering a product or service to the consumer, from the order of raw materials to the delivery of the final product, with the goal of eliminating waste and achieving efficiency. This contrasts with traditional accounting systems, which focus on costs for each department or product separately. The value stream is viewed as an integrated chain that contributes to the production and delivery of a product or service. With technological advancements, artificial intelligence has become an effective tool for enhancing value stream costing applications (Abdullah, 2021). One of the most important goals that value stream costing seeks to achieve is measuring the cost of each value stream path, first at the value stream level, and then at the unit level as a whole. It is also important for decision-making purposes, such as purchasing, manufacturing, or capital budgeting. Value stream costing provides all the relevant information, in addition to monitoring the costs of value stream paths, enabling management to identify the causes of waste and study available alternatives for continuous process improvement and cost reduction (Al-Shatbi, 2016). The concept of value stream was defined in the study (Bojano, 2016) as “all the activities that must be carried out to reach the value desired by the consumer to obtain customer orders, production, storage, delivery, generation activities, and what is related to product design.” The value stream was also defined according to the study (Al-Mashharawi, 2015) as “an interconnected group of activities that add value to the product from the consumer’s point of view, starting from raw materials and ending with the delivery of the product or providing the service to the final customer.” In addition, the concept of value stream was defined as “the consumer’s willingness to pay the price for one or more characteristics that distinguish the product” (Abdul Dayem, 2014).

2-2 Value stream cost elements:

Value stream costing refers to the basic components that contribute to the formation of costs across the chain of activities that produce value for the consumer within the framework of lean operations and modern accounting. It aims to analyze and track the sources of costs associated with the activities that contribute to creating value directed to the consumer. Since the value stream begins with the design of the product or service, passes through production or

implementation, and ends with the delivery of the final product to the consumer, cost measurement is based on the activity streams themselves and not on individual departments or products. Value stream costing elements can be classified as follows:

2-2-1 Cost of raw materials:

The calculation of the cost of raw materials is based on the actual materials used by the value stream, either on the basis of actual purchases or on the basis of the actual issuance of materials in the value stream. This category includes all costs associated with raw materials or components that go into the production of the product or provision of the service, such as the cost of metals used in the manufacture of electrical appliances (Amhamdi Fatoum, Al-Mahdi Hijala, 2018).

2-2-2 Support cost:

They are indirect costs that ensure the continuity of the production or service process with high efficiency and quality when spent without being directly linked to a specific product. They also play a crucial role in supporting basic operational activities such as production, marketing, and customer service. These indirect industrial costs constitute a significant burden on cost systems, necessitating the adoption of accurate systems for allocating them to avoid unfairly costing products (Al-Husseini, 2020).

2-2-3 Cost of waste and duplication:

This cost refers to the loss of resources, time, or effort that results from performing unnecessary or inefficient operations, which incurs costs without adding any value to the product from the customer's perspective. As for repetition, it means performing the same operation or task more than once without need for it due to errors in input and processing, weak control or auditing, etc. Artificial intelligence can be used to predict errors and defects before they occur, in addition to improving the quality of operational and administrative decisions, which leads to reducing the cost of waste and repetition. These costs are among the hidden factors that greatly affect the efficiency and profits of economic units (Abdul Latif, 2016).

2-2-4 Administrative costs associated with planning and control:

These costs refer to all expenses incurred by economic units to support administrative operations related to the goals and plans set by management to achieve these goals accurately and clearly. They are classified as indirect costs that are not directly involved in the production of goods or the provision of services (Kaplan & Atkinson, 1998). In light of technological developments, artificial intelligence has become a major and effective role in improving the efficiency of these costs by automating planning and control tasks, such as data analysis, performance forecasting, and direct monitoring of deviations, in addition to providing accurate information to support timely decision-making (Davenport & Ronanki, 2018).

Researchers believe that value stream cost elements are essential components that contribute to the formation of costs across the value chain for consumers. Artificial intelligence can help improve the efficiency of these costs by automating planning and control tasks, analyzing data, predicting performance, and directly monitoring deviations. Through the use of artificial intelligence, economic units can improve the accuracy of financial analysis and enhance accounting and management decisions.

Axis 3: The relationship between artificial intelligence and value stream:

Artificial intelligence (AI) has become a key tool in designing and developing value chains within economic units. It plays a significant and effective role in improving value flow through data analysis, behavior prediction, and intelligent process automation. Value flow refers to the set of activities that begin with consumer demand and end with the delivery of a product or service. The development of AI technologies, such as machine learning and big data analysis, has contributed

to a qualitative shift in how value chains are managed within economic units. Through the use of AI, sources of waste can be discovered, new improvements can be proposed, future forecasts can be made, and decision-making can be accurately and clearly supported within economic units.

3-1 Traditional models for measuring value stream costs:

Traditional models are accounting tools used by economic units to measure value stream costs and charge them to products and services with the aim of determining the cost of each stage of the flow. However, there are a number of challenges associated with traditional models when measuring value streams, the most important of which is their inability to distinguish waste or unimportant activities, as well as their focus on accounting costs rather than the cost of added value to customers. In addition, there is an inability to analyze changes in the flow in real time, as well as the need for large and accurate data that is difficult to update manually. Although traditional models provided acceptable frameworks for cost analysis, they were not sufficient to understand the value stream in an integrated manner (Ahmed, 2011).

The most important problems facing traditional models for measuring value stream costs can be summarized as follows:

3-1-1 Limited accuracy in cost allocation:

Accurate cost allocation is one of the key factors that support management decisions and improve operational performance in any accounting system. However, traditional cost measurement models suffer from weakness and inaccuracy in allocating indirect costs to activities or products. They rely on simplified allocation bases for indirect costs, such as working hours or production volume, which do not accurately reflect the causal relationship between the resources consumed and the activities that generate them. This leads to some products or services being charged high and unrealistic costs, which hinders management's ability to improve value flow and identify sources of waste effectively. Decisions related to pricing or process improvement become vulnerable to error due to the inaccuracy of available cost information (Kaplan & Cooper, 1998).

3-1-2 Data delay and lack of immediate analysis:

Traditional accounting systems suffer from a severe slowness in data flow and analysis, which weakens the ability of economic units to react immediately to changes. This leads to poor reporting quality and failure to monitor costs immediately, which disrupts the decision-making process quickly and effectively. This means there is a time gap between the actual occurrence of an activity and the availability of data related to this activity in a way that allows for appropriate decisions to be made at the appropriate time. The most prominent negative consequences of this delay include increased unnecessary costs, difficulty in early detection of deviations or waste, weak rapid response to operational or market changes, and other negatives (Ibrahim and Sabry, 2016).

3-1-3 Difficulty in processing huge amounts of data:

Processing massive amounts of data is a key issue in the era of digital transformation and artificial intelligence. Despite the importance of traditional models for measuring value stream costs in improving efficiency and reducing waste, they still rely on manual or semi-automated mechanisms, making them incapable of absorbing or processing the vast and complex volume of data. One of the most significant problems facing traditional models is that they are limited to analyzing fixed time periods using aggregated data, without the ability to handle real-time data flow. Consequently, analyzing this data is ineffective and does not provide an accurate and immediate picture of activity costs across the value stream stages. (Riahi, Y, 2017)

3-2 How AI improves cost measurement:

It is well known that artificial intelligence aims to improve the accuracy and effectiveness of cost measurement systems within economic units by contributing to the analysis of financial and operational data to provide more realistic and predictive cost measurements. This results in more accurate and clear administrative decision-making, improved operations, and reduced waste and human error. This also increases the speed of data analysis and enhances transparency and accountability within economic units. Understanding and applying cost measurement systems within economic units represents a qualitative shift in the use of artificial intelligence. Among the most prominent mechanisms offered by artificial intelligence in this field are the collection and analysis of real-time data, as well as the identification of hidden and unseen costs and waste, in addition to the automation of cost analysis and decision-making. Accordingly, artificial intelligence does not limit itself to a supportive role in cost measurement, but rather considers a way through which cost can be transformed from a traditional, rigid model into an intelligent, flexible, and interactive system (Tarek, Abdelkader, 2020).

Here are the most important tasks that artificial intelligence performs in improving cost measurement:

3-2-1 Real-time analysis of operational data:

One of the tasks that AI performs efficiently and effectively is the real-time analysis of data through the continuous flow of data generated from daily operations such as production, maintenance, and others, through its reliance on modern organizations. The ability to quickly analyze and make immediate decisions requires dealing with a huge amount of data. These functions are integrated with AI capabilities, enabling economic units to predict patterns and risks that may emerge, in addition to monitoring production quality and improving supply chain performance. This analytical capability contributes to reducing the time gap between the occurrence of an event and the decision-making process. Therefore, real-time analysis means the process of examining and interpreting data as it occurs in real time, relying on AI through advanced algorithms such as machine learning, natural language processing, and others (Zhang et al., 2021).

3-2-2 Accurately allocate costs based on actual activities:

Under cost measurement systems, the accuracy of cost allocation based on actual activities is one of the most prominent aspects that AI can effectively improve. Cost allocation in traditional systems is often inaccurate, especially indirect costs such as rent, salaries, and others. This leads to deviations in determining the actual cost of each product or service, which negatively impacts the accuracy of decisions made by economic units. AI uses a set of powerful tools to improve the accuracy of cost allocation in economic units, most notably the use of big data to analyze actual activities, as well as the use of predictive models from historical data to determine how to allocate resources in the future. This is in addition to the ability to update cost allocation and automate the linking of costs to activities through artificial intelligence algorithms (Al-Naji, 2021).

3-2-3 Predicting cost behavior and providing intelligent recommendations:

Predicting cost behavior in management accounting is vital, as it helps in understanding the relationship between costs and activity volume. The use of artificial intelligence, especially machine learning technology, allows for the possibility of predicting cost behavior with great accuracy through the analysis of historical data and the use of intelligent regression models instead of traditional models, in addition to the ability to adapt to changing operational conditions or fixed or variable costs. Artificial intelligence also provides intelligent and direct recommendations to management and does not limit itself to prediction by supporting intelligent decision systems that combine knowledge bases with predictive analysis, in addition to cost

optimization algorithms that suggest methods for reducing costs through different methods and scenarios (Moll, J., Yigitbasioglu, O., 2019).

3-3 Comparison between traditional models and AI-based models:

Measuring value streams is a key element in improving operational performance in production and service economic units by identifying sources of waste. The following table compares traditional and AI-based models for measuring value streams:

Comparison table between traditional and AI-based models for measuring value streams

Comparison point	traditional models	AI-based models
General concept.	It relies on analyzing the value stream manually or using simple, static analysis programs.	It relies on intelligent algorithms capable of analyzing predictive data to understand and dynamically optimize value flows.
Tools used	Tools include simple simulation, manual analysis, and manual or electronic value stream maps.	These tools include machine learning, big data processing, neural networks, and decision-making algorithms.
Speed and accuracy	It relies on the accuracy of manually entered data, which is limited.	Analyzes huge amounts of data with high accuracy and speed.
Responding to changes	Slow and requires continuous manual updating of models when operating conditions change.	Instantly adapts to and reacts to new data.
Predictability	Its inability to easily predict, as it relies on past outcomes and cannot accurately predict the future.	Through advanced algorithms that are robust and able to predict waste and delays.
Detect waste and duplication	It is based on manual monitoring and analysis.	Waste is predicted automatically and instantly using predictive waste detection models.
Human role	At every stage it is essential and pivota.l	It is characterized by being supervisory and analytical only in the upper stages.
Scalability	Very weak and needs major changes as operations grow	Flexible and scalable as needed
Decision maker support	Relatively limited and based on available information	It relies on comprehensive analysis through intelligent support.

Source: Prepared by the researcher based on multiple sources.

Although traditional models are still used in economic units, the table above shows that AI models represent a paradigm shift in how value flows are measured and improved in economic units, achieving efficiency, quality, and reducing waste. The comparison reveals that, while traditional models continue to be used in economic units, they are limited in their effectiveness in complex and changing business environments. In contrast, AI-based models represent a paradigm shift in terms of speed, accuracy, predictability, and scalability, making them a strategic tool for enhancing efficiency, reducing waste, and achieving operational sustainability. However, the

successful implementation of these models requires an advanced digital infrastructure and investment in human capacity development. This underscores the need to adopt a gradual approach that integrates traditional and intelligent models, leading to a complete digital transformation.

Axis Four: Applied Study

1- Introduction:

This research aimed to identify the role artificial intelligence plays in improving objective models for measuring value stream costs. This was accomplished by analyzing the scientific and practical perspectives of the groups concerned with the research topic, by testing a set of research hypotheses and determining the extent to which they were acceptable or rejected. In this regard, the researchers conducted an applied study based on a survey list designed to test the validity of the hypotheses. The opinions of a carefully selected sample representing the groups related to the research topic were analyzed and extrapolated. These groups are among the most capable of providing realistic and logical answers, given their experience in understanding and evaluating the research topic.

2- Testing the validity and reliability of the field study tool:

The researchers conducted a validity and reliability test for the survey list after its initial design. It was calculated by finding the square root of Cronbach's Alpha Coefficient as shown in Table No. (1). The researchers confirmed the validity of the survey in the following way:

Table No. (1)

Cronbach's alpha coefficients for the study variables

reliability coefficient	Cronbach's alpha coefficient	Number of phrases	Dimensions
0.733	**0.537**	**seven**	Main hypothesis: There is a statistically significant role for the use of artificial intelligence techniques in improving objective models for measuring value stream costs in economic units.
0.778	**0.605**	**seven**	Sub-hypothesis 1: There is a statistically significant role for the use of artificial intelligence techniques in improving the accuracy of measuring time costs within the value stream.
0.781	**0.610**	**seven**	Second sub-hypothesis: There is a statistically significant role for the use of artificial intelligence techniques in improving the measurement and control of quality costs within value stream models.
0.857	**0.734**	**21**	**All phrases**

Table (1) shows that the value of Cronbach's Alpha coefficient to measure the reliability of the questionnaire consisting of (21 items) reached 0.734, which is a value that indicates an acceptable degree of reliability, as the scale is considered acceptable if the value of "Alpha" exceeds 0.60, and is considered scientifically acceptable if it exceeds 0.70. The value of the (reliability coefficient), which is usually calculated from the square root of the reliability coefficient, reached (0.857), a value that indicates a high level of reliability, which confirms that the tool is capable of accurately measuring what it was designed to measure. Accordingly, the questionnaire used in this study can be relied upon as a tool that enjoys an appropriate degree of reliability and scientific validity.

3- Internal consistency validity:

The researchers verified the internal consistency of the questionnaire by calculating Pearson's Correlation Coefficient to determine the degree of correlation of each paragraph of the questionnaire with the total score of the dimension to which it belongs. The following tables illustrate the internal consistency of the study tool.

1- Validity of the internal consistency of the main hypothesis: There is a statistically significant role for the use of artificial intelligence techniques in improving objective models for measuring value stream costs in economic units.

Table No. (2) Internal consistency validity of the main hypothesis paragraphs

Significance level	Correlation coefficient	Paragraph	T
0.00	0.448**	Artificial intelligence technologies contribute to improving the accuracy of value stream costing models.	1
0.00	0.366**	The use of artificial intelligence enhances the objectivity of models used in value stream cost analysis.	2
0.00	0.570**	Artificial intelligence helps reduce human bias when developing value stream cost models.	3
0.00	0.574**	Artificial intelligence technologies provide accurate data that helps make decisions based on value stream models.	4
0.00	0.515**	Artificial intelligence helps enhance the efficiency of value stream costing tools.	5
0.00	0.582**	Integrating artificial intelligence into cost models is an important step towards improving financial analysis in economic units.	6
0.00	0.551**	Artificial intelligence helps uncover hidden relationships between cost elements within the value stream.	7

Source: Prepared by researchers based on the results of statistical analysis.

** Significant at a significance level of 0.01 or less

Table (2) shows that the correlation coefficients between each item and the total score of the axis were positive and statistically significant at a significance level of (0.05) or less. The correlation coefficients ranged between (0.448) as a minimum and (0.582) as a maximum. This indicates the existence of internal consistency validity among the items in this axis and indicates that the items measure a unified dimension and address a single topic related to the role of artificial intelligence in improving objective models for measuring value stream costs in economic units. Therefore, these results support the credibility of the main hypothesis and confirm the validity of the items to measure what they were designed to measure, which contributes to achieving the research objectives.

2- **Validity of the internal consistency of the first sub-hypothesis:** There is a statistically significant role for the use of artificial intelligence techniques in improving the accuracy of measuring time costs within the value stream.

Table No. (3): Internal consistency validity

Significance level	Correlation coefficient	Paragraph	T
0.00	**0.546****	Artificial intelligence helps track operational processes in real time with high accuracy.	**1**
0.00	**0.616****	AI enables the measurement of unproductive time within the value stream stages.	**2**
0.00	**0.584****	Artificial intelligence helps identify activities that consume excessive time without adding value.	**3**
0.00	**0.562****	The use of artificial intelligence helps improve time allocation between different activities in the value chain.	**4**
0.00	**0.654****	Artificial intelligence technologies contribute to reducing time-related waste in production processes.	**5**
0.00	**0.416****	Artificial intelligence analyzes the time required for each task with greater accuracy than traditional methods.	**6**
0.00	**0.448****	Artificial intelligence helps predict the optimal time to complete operations based on historical data.	**7**

Source: Prepared by researchers based on the results of statistical analysis.

** Significant at a significance level of 0.01 or less

Table (3) shows that the correlation coefficient values between each item and the total score of the axis were positive and statistically significant at a significance level of (0.05) or less. The correlation coefficient values ranged between (0.416) as a minimum and (0.654) as a maximum. This indicates the existence of internal consistency validity among the items of this axis, and indicates that the items measure a unified dimension and address a single topic related to the role of artificial intelligence in improving the accuracy of measuring time costs within the value stream. Therefore, these results support the validity of the first sub-hypothesis and confirm the validity of the items to measure what they were designed to measure, which contributes to achieving the research objectives.

3- Validity of the internal consistency of the second sub-hypothesis: There is a statistically significant role for the use of artificial intelligence techniques in improving the measurement and control of quality costs within value stream models.

Table No. (4) Internal consistency validity

Significance level	Correlation coefficient	Paragraph	T
0.00	**0.594****	Artificial intelligence contributes to the early detection of quality problems in production processes.	**1**
0.00	**0.582****	The use of artificial intelligence helps reduce quality-related inspection and retesting costs.	**2**
0.00	**0.436****	Artificial intelligence enhances the accuracy of measuring quality indicators within the value stream.	**3**
0.00	**0.684****	Artificial intelligence technologies enable us to predict faults or defects before they occur, reducing quality costs.	**4**
0.00	**0.398****	Artificial intelligence contributes to improving statistical quality control through accurate analysis.	**5**

0.00	**0.569****	Artificial intelligence enables analysis of the causes of quality deviations and the provision of effective solutions.	**6**
0.00	**0.558****	The use of artificial intelligence improves the integration of quality and cost within the value stream framework.	**7**

Source: Prepared by researchers based on the results of statistical analysis.

** Significant at a significance level of 0.01 or less

Table No. (4) shows that the correlation coefficient values between each paragraph of the second sub-paragraph: "There is a statistically significant effect of applying the target costing approach on improving the competitiveness of companies in achieving cost reduction and increasing competitiveness" and the total score of the axis were positive and statistically significant at a significance level of (0.05) or less. The correlation coefficient values ranged between (0.436) as a minimum and (0.684) as a maximum. This indicates the existence of internal consistency validity between the paragraphs of this axis, and indicates that the paragraphs measure a unified dimension and address a single topic related to the role of artificial intelligence in improving the measurement and control of quality costs within value stream models. Therefore, these results support the validity of the second sub-paragraph and confirm the validity of the paragraphs to measure what they were designed to measure, which contributes to achieving the research objectives.

First: Results of the statistical analysis

1- Descriptive analysis of demographic data of the research sample:

Table No. 5 Results of frequency distributions and percentages for demographic variables of the sample items

percentage	repetition	Category	variable
%35	**35**	**Higher certificates**	**Academic qualification**
%65	**65**	**Bachelor's**	
%14	**14**	**Production Managers**	**Job**
%35	**35**	**Millions**	
%28	**28**	**Administrators**	
%23	**23**	**Operations Engineers**	
%44	**44**	**less than 10 years**	**Years of experience**
%36	**36**	**From 10 years to less than 20 years**	
%30	**30**	**20years and older**	

Reference: Prepared by the researcher based on the results of the SPSS statistical program.

The researcher found the following results from Table No. 5:

- Regarding academic qualifications, the results showed that 65% of the total sample size held a bachelor's degree, compared to 35% who held postgraduate degrees. This explains why the study sample included academically qualified individuals who were able to answer the questionnaire's questions with complete transparency and objectivity.
- Regarding the job title, the results showed the researchers that 14% of the research sample were production managers, 23% were operations engineers, 28% were administrators, and 35% were financial. This provides diversity in the research sample with regard to the sample's professional practices, which makes the results more accurate and objective.
- Regarding years of experience, the researchers found that 30% of the research sample had more than 20 years of experience, 36% had 10 years and less than 20 years of experience, and 44% had less than 10 years of experience. This provides diversity in the research sample in terms of years of experience, which makes the results more accurate and objective. This

reflects a logical distribution within the research sample that includes accumulated and recent experience, which qualifies them to answer the questionnaire items accurately and objectively.

Main hypothesis: There is a statistically significant role for the use of artificial intelligence techniques in improving objective models for measuring value stream costs in economic units.

Table No. (6) Results of an analysis of the role of artificial intelligence in using artificial intelligence techniques to improve objective models for measuring value stream costs in economic units.

Sig morale	T value	Beta value	dependent variable	The symbol	independent variable
0.000	3.621	0.634	Objective models for measuring value stream costs	B0	fixed amount
0.08	5.332	0.537		B1	artificial intelligence
R2 = (0.555a) adj.R2= (0.181) F(sig.) =28.726 (0.00)					

Reference: Prepared by researchers based on the results of the SPSS statistical analysis program.
** Significant at 0.00 level * Significant at 0.00 level

The researcher found from Table No. (6) the following:

- The regression model is significant, as the value of (F) = 28.726, which is significant at a significance level of 0.01.
- The significance of the role of artificial intelligence in improving objective models for measuring value stream costs, as (T) came in at 5.332 at a significance level of 0.00, which indicates the existence of a role for artificial intelligence in improving objective models for measuring value stream costs.
- The explanation coefficient R2 reached (0.555), which indicates that artificial intelligence explains 54% of the variance in the objective models regarding (value stream costs), while the other percentages are due to other variables that were not addressed in the model.
- From the above, researchers find that the hypothesis is accepted, as it has been shown that artificial intelligence plays a role in improving objective models for measuring value stream costs at a significance level of less than 5%.

From this basic hypothesis, the following sub-hypotheses were derived:

First sub-hypothesis: There is a statistically significant role for the use of artificial intelligence techniques in improving the accuracy of measuring time costs within the value stream. Regression analysis demonstrated the results of testing this hypothesis, as shown below:

Table 7 Results of analyzing the role of using artificial intelligence techniques in improving the accuracy of measuring time costs within the value stream.

Sig morale	T value	Beta value	dependent variable	The symbol	independent variable
0	5.896	1.697	Improve the accuracy of time costs within the value stream	B0	fixed amount
0.08	1.826	0.324		B1	artificial intelligence
R2 = (0.664a) adj.R2= (0.018) F(sig.) =3.344 (0.00)					

Reference: Prepared by researchers based on the results of the SPSS statistical analysis program.
** Significant at 0.00 level * Significant at 0.00 level

Table No. (7) shows the following:

- The results demonstrated the significance of the regression model, with F = 3.344, which is significant at a significance level of 0.01.
- The results demonstrated a significant role for the use of artificial intelligence techniques in improving the accuracy of measuring time costs within the value stream. T = 5.896, at a significance level of 0.00, indicates a role for the use of artificial intelligence techniques in improving the accuracy of measuring time costs within the value stream.
- The coefficient of explanation, R2, was 0.664, indicating that artificial intelligence explains 65% of the variance in improving the accuracy of measuring time costs within the value stream. The remaining percentages are due to other variables not addressed in the model.
- From the above, the researchers accept the validity of the hypothesis, as it is clear that artificial intelligence plays a statistically significant role in improving the accuracy of measuring time costs within the value stream at a significance level of less than 5%.

Second sub-hypothesis: There is a statistically significant role for the use of artificial intelligence techniques in improving the measurement and control of quality costs within value stream models. The regression analysis showed the results of testing this hypothesis, as shown below:

Table No. (8) Results of an analysis of the role of using artificial intelligence technologies in improving the measurement and control of quality costs within value stream models.

Sig morale	T value	Beta value	dependent variable	The symbol	independent variable
0	5.651	1.385	Improve measurement and control of quality costs within value stream models	B0	fixed amount
0.008	2.83	0.443		B1	artificial intelligence
R2 = (0.276 a) adj.R2= (0.061) F(sig.) =3.556 (0.00)					

Reference: Prepared by researchers based on the results of the SPSS statistical analysis program.
** Significant at 0.00 level * Significant at 0.00 level

Table No. (8) shows the following:

- The results demonstrated the significance of the regression model, with F = 3.556, which is significant at a significance level of 0.01.
- The results demonstrated a significant role for the use of artificial intelligence techniques in improving the measurement and control of quality costs within value stream models. T = 5.651 at a significance level of 0.00, indicating a role for the use of artificial intelligence techniques in improving the measurement and control of quality costs within value stream models.
- The coefficient of explanation (R2) was (0.276), indicating that artificial intelligence explains 25% of the variance in improving the measurement and control of quality costs within value stream models. The remaining percentages are due to other variables not addressed in the model.
- From the above, the researchers accept the validity of the hypothesis, as it was demonstrated that the use of artificial intelligence techniques has a statistically significant role in improving the measurement and control of quality costs within value stream models at a significance level of less than 5%.

Axis V: Results and Recommendations

Results:

1. AI can improve the accuracy of value stream cost measurement by analyzing big data and identifying patterns and trends.
2. AI can reduce human errors in cost measurement, leading to more reliable results.
3. AI can improve the efficiency of the cost measurement process, saving time and effort.
4. AI can provide new insights into value streams, enabling companies to make more informed decisions.

Recommendations:

1. Machine learning techniques, such as deep learning, can be used to analyze data and identify patterns in the value stream.
2. Integrated models can be developed that combine financial and operational data to improve the accuracy of cost measurement.
3. Big data can be used to analyze the value stream and identify areas for improvement.
4. Employees can be trained to use artificial intelligence techniques to improve cost measurement.
5. New criteria for measuring value stream costs can be developed that take into account artificial intelligence techniques.

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