



THE ROLE OF ARTIFICIAL INTELLIGENCE (AI) IN IMPROVING THE ACCURACY OF FUTURE COST MEASUREMENT AND COST DESIGN - TOWARDS A PROACTIVE COST SYSTEM THAT SUPPORTS STRATEGIC DECISIONS: AN APPLIED STUDY IN OR GENERAL ENGINEERING INDUSTRIES COMPANY

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Article history:		Abstract:
Received:	14 th November 2025	This research is a first step to investigate how artificial intelligence could facilitate next cost estimation and cost planning to design a proactive cost system which supports decision makers at the strategic level. The study was conducted under real factory conditions and involved a case study at OR General Engineering Industry; it was based on real accounting and cost information, and utilized artificial intelligence (AI) models and techniques including neural networks, and machine learning. The paper contributes on tackling the limitations of traditional cost systems which do not allow the prediction of future costs nor the design of the product cost considering the strategic directions of the organization. A knowledge-based cost model was developed using the real past company data and operational data, showing the potential of increasing the accuracy of cost predicting and to support decisions on pricing, planning and production. The study reveals that the application of AI to the cost system is really beneficial, since it not only increases the accuracy of information, but also helps users to make better decisions and attain competitiveness in the industrial business market. And, this study implies significant need that industrial firms should attain this technological orientation and develop digital infrastructures that enable it.
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INTRODUCTION:

The modern-industrial organizations are faced with the fast evolving business environment due to technological innovations, supply chain complexities, and competitive pressures that have rendered strategic decisions more intricate and susceptible to the environmental changes. In this situation, the reliability of financial and cost information is a key factor in enabling upper management to take decisions based on analytical and scientific rigor. Conventional cost systems are not sufficient to address the challenges in this new era, as they are rigid and unable to foresight future costs or design the costs of products in a manner that the organization's strategic objectives. Therefore, the challenge is to create proactive cost systems leveraging advanced tools/technologies, with artificial intelligence being the most paramount which enables processing vast amount of historical and operational data, forecasting costs with high accuracy and designing the cost of products to balance efficiency and competitiveness. This work is carried out with the background that there exists a gap between what the field of artificial intelligence can technically provide and the practical reality of cost systems in real-world industry, focusing in this case on OR General Engineering Industries as a case study. The study is based on the fact that it is possible to develop a practical model to be used in business applications for future cost measurement and cost design using artificial intelligence techniques, and that it is also possible to develop a proactive cost system that can match the needs of strategic planning.

First Topic: Research Methodology and Previous Studies

1-1- Research Methodology:

The research methodology is elaborated considering the issue of research its significance, objectives and hunch the research population and sample and the scientific method applied in it.



1.1.1. Research Problem:

Industrial companies, such as your General Engineering Industries, are presented with the formidable challenge of operating in an environment that is rapidly changing with constantly fluctuating prices, strong competition and increasingly complex processes of production. The vast majority of these companies use traditional costing methodologies and design, which leads to them having very weak cost information and finding it hard to use cost information to support effective strategic decision making. Considering these difficulties, the key issue that this research aims to address is to what extent AI technologies can enhance future-oriented cost measurement and cost design, and support the development of a proactive cost system that aids strategic decision making at OR General Engineering Industries.

1.1.2. The importance of the research:

This study is relevant as it lies at the intersection of two core areas in today business environment, that is management accounting and artificial intelligence, and has a view to realize a scientific and applicable view of how the technologies of artificial intelligence can be used in future cost measurement and product cost design by developing a proactive cost system that can support strategic decision making in industrial enterprise. The novelty of the research is to contribute to the scientific literature on the management accounting by introducing the linkage among the cost and the ai concepts in an integrated manner that is compatible with technology advancement in cost analysis. The study gives an important scientific and practical contribution especially in view of the embattling global direction of utilizing ai based tools in the financial and management arenas, and the acute business need for cost systems that are intelligent and more proactive.

1.1.3. Research Objectives:

This study intends to illuminate the importance of AI technologies in future cost management and cost design systems, by developing an application model that supports strategy determination. The research objectives can be briefly stated as follows:

- 1- To study the current cost system that has been implemented at the General Company for Engineering Industries and to recognize the weaknesses of measuring future costs and designing cost in the traditional approach.
2. Show how far analysis of accounting and cost data using techniques from artificial intelligence (including machine learning and artificial neural networks) can lead to more accurate future estimates.
- 3- Development of an intelligent application model for a AI-based proactive cost system that aids the strategic decision-making process within the enterprise.
- 4- Assessing the proposed model for accuracy, accuracy, cost prediction, and contribution to guiding managers to strategic decisions with reliable and real information accomplishments of the required economic information.
- 5-Conclusion- In conclusion, practical advice is offered on how to incorporate the use of artificial intelligence in the cost system of the industrial organizations in the field to improve efficiency of performance and gain a sustainable competitive edge.

1.1.4. Research Hypotheses:

This study is based on the following main hypothesis: "In the case of general engineering industries, the application of AI tools in future cost estimation and cost planning has a positive and statistically significant impact on supporting 'the building of a proactive cost system' that assists strategic decisions at OR". The main hypothesis gives rise to a number of sub-hypotheses, which are:

- 1- Artificial intelligence technologies improve the glare of predicting the future costs over traditional methods used by the company.
- 2- Applying artificial intelligence for product cost design brings the product cost under the company's strategic goals and increases product competitiveness.
- 3- A proactive cost system can be led out using AI models to produce undisputable accounting information which in turn used for strategic planning and decision making.
- 4- The proposed system is more responsive to market and technical changes than are traditional accounting systems in cost measuring.
- 5- There is a fundamental difference in the quality of strategic decisions based on the smart cost system compared to decisions based on the traditional system.

1.1.5. Research Population and Sample:

The research community consists of all industrial companies operating in Iraq, which face common challenges in measuring and designing costs in a changing and complex economic and industrial environment. The community includes various industrial sectors that rely on cost systems to manage their resources and improve their performance. OR General Company for Engineering Industries was selected as an applied model to research this topic, due to its



position as one of the most prominent industrial companies in Iraq, and the fact that it represents a suitable practical environment for the application and testing of artificial intelligence models in future cost measurement and cost design.

1.1.6. Research Methodology:

In this research, it relies on the descriptive-analytical method and the practical applied approach to achieve the research objectives in an integrated manner, as follows:

1- Descriptive-analytical method: It is used to understand and analyze the current reality of the cost system in Iraqi industrial companies in general, and in the company of your General Company for Engineering Industries in particular, by studying the theoretical concepts related to cost measurement and design, and artificial intelligence techniques used in the field of management accounting. The shortcomings of traditional costing systems are also analyzed and the requirements of the intelligent supplementary system are identified.

2- Applied Practical Approach: Artificial intelligence technologies such as machine learning and artificial neural networks are applied to the actual and historical data of OR General Engineering Industries, to build an intelligent proactive cost model capable of improving the accuracy of future cost measurement and cost design. This method includes running the model, examining the outputs and evaluating the model for its usefulness in inform strategic decisions.

3 - Application of data analytics and AI methods: It is based on sophisticated software and analytical methodologies to analyze data and derive predictive models, so as to guarantee accurate and dependable outcome..

1-2- Previous studies and the contribution of the current research:

During this paragraph, previous studies related to the current research topic will be discussed, in addition to explaining the contribution of the current research and the extent to which it differs from previous studies.

1.2.1. Previous Studies:

Previous studies related to the current research topic can be clarified through the following:

1- A study (Wang & Wang, 2024) entitled (Artificial Intelligence in Cost Management: Enhancing Predictive Accuracy in Manufacturing): In this paper, we propose to construct powerful machine learning models for the prediction of production costs in the manufacturing industry by analyzing large-scale data and based on which we can discover some implicit patterns that potentially influence the future costs. The study investigated whether the difference between actual and estimated costs could be narrowed, hence quality of financial and management planning could be improved. The study revealed that employing AI technologies (deep learning) led to more than 20% accuracy improvement in forecasting over conventional methods and such models facilitated to find hidden influencers which were not seen before in the data, contributing to design a more proactive and accurate costing system.

2- A study (Kim & Park, 2025) entitled (Designing Cost Systems with AI: A Case Study in the Automotive Industry): This work focused on developing an ANNs-based intelligent cost system to process production information in automotive industry and was expected to contribute both to a more accurate product pricing and the harmonization of the jolt of market and technology. The research also aimed to empower firms with the ability to dynamically respond with pricing and cost strategies to up-to-the-minute information. Results The study shows that the smart system reduced the percentage of errors for costing by 15%, and enabled more flexibility in production and pricing costs, and the company was capable of enhancing its competitiveness and lowering its financial losses.

3- A study (Smith & Johnson, 2024) entitled (Predictive Costing Models Using Machine Learning: Improving Strategic Decision-Making): This work was designed to investigate and develop models of machine learning to be applied to accounting and cost data to enable better prediction of future costs and to support strategic decisions in firms and organizations. The research was also intended to diminish the risks involved in financial planning by generating more precise and dependable predictions. The study showed that use of machine learning algorithms (e.g. random forests, carrier support vector machines) can lead to improved data quality and data completeness, decreased the chance of error in financial estimates, and allowed management to make informed strategic decisions based on accurate data.

4- A study (Zhao & Li, 2025) entitled (AI-Driven Cost Control Systems in Manufacturing Enterprises): This work focused on the design and development of intelligent cost control system, utilizing artificial intelligence based technologies, to reduce waste and improve the utilization rate of resources in factories, with early detection of cost deviations and capably of correcting them in an early stage. The results of this work demonstrate that introduction of these systems significantly reduces expenses by 12% as a result of improved resource management and prompt error detection, which contributes to increase financial control and decreasing of waste as well as to support the sustainability of industrial operations and getting better financial results.

5- A study (Garcia & Martinez, 2024) entitled (Integrating Artificial Intelligence into Cost Accounting: Benefits and Challenges): In this paper, we sought to evaluate the gains in which an organization can benefit by adopting AI solutions into cost management and to identify technical/organizational challenges that the incorporation



might face such as skill shortfalls, inertia, and the need for evolving the structure/ digital infrastructure. The result of this research shows that although AI has improved the accuracy and efficiency of accounting processes and mitigated human errors, the success of its application is highly dependent on the development of human resources and the construction of an environmental technical, and there is a need to clear administrative support to deal with challenges.

6- A study (Nguyen & Tran, 2025) entitled (AI Applications for Cost Estimation and Control: A Review and Future Directions): This work was motivated to summarize the problem of applications of artificial intelligence in cost estimation and control, with special attention to recent developments relating to deep learning and reinforcement learning, and to forecast new application trends in order to foster the development of smarter and more flexible models sensitive to abrupt changes in production environments and markets. Results It was concluded that AI techniques could be very effective in increasing the precision and reliability of the cost estimations, and that models needed to be developed that could rapidly adjust to changes in environment. It highlighted the necessity of merging AI with traditional accounting principles to achieve optimal results in cost management and analysis.

1.2.2. The contribution of the current research and the extent to which it differs from previous studies:

The Present study adds to building up the scientific and practical knowledge about the enhancement of prediction of cost and design of systems of cost via using AI method in the context of IS in Iraqi industrial companies with a special concentrate on OUR General Company for Engineering Industries. This research differs from previous studies in several fundamental points:

- 1- The present study is a real life application in the local industry, This allows the researcher to gain a comprehensive view of the issues and concerns in employing AI in Iraqi industrial organizations, which is not addressed by most foreign studies, which either theoretical or field work in other environments.
- 2- The study offers a proactive cost system that combines AI methods with historical and operational data analysis, which improves firms' capabilities in estimating future costs and making strategic decisions with reliable data instead of based more on historical data alone as in traditional systems.
- 3- The study combines the technical side of AI technologies with local environmental and administrative constraints to enable the cost model development that is appropriate to the characteristics of local market as well as the environmental and economic difficulties confronting the companies in Iraq.
- 4- The study furthers a distinct practical guidance of how to use AI in enhancing measurement, estimation and financial planning processes across organization for other industrial entities that may want to integrate AI technology within their cost systems.

In conclusion, the research presents and demonstrates a new added value by combining local theory and practice with an integrated model approach that enables strategic decisions and strengthens the effectiveness of the cost system in the context of the Iraqi industrial companies, this can be viewed as a significant advancement over previous research that focussed more to the technical or theoretical aspects only.

Second Topic: The Theoretical Aspect of the Research

2-1- The concept, importance and techniques of artificial intelligence and its relationship to cost accounting :

Definitions and examinations of human intelligence suggested the term artificial intelligence to be adopted as coined by John McCarthy, considered as the father of the term (Russell & Norvig, 2021:5).utilizes such advanced algorithms to process and analyze the data, has allowed the computer to mimic the human cognitive functions in a limited manner (Goodfellow et al., 2023: 12).

AI is also gaining significance in the industrial and business world since it allows for more efficient operations via smart automation and precise predictions (Brynjolfsson & McAfee, 2024: 45).In the business domain, AI also has the potential to significantly impact financial performance, as well as strategic decision making (Davenport & Ronanki, 2025: 78). AI technologies include a wide range of tools, the most important of which are:

- 1- Machine learning: A technology that allows systems to learn from data and improve its performance automatically without explicit programming (Murphy, 2024: 203).
- 2- Deep Learning: An advanced type of machine learning based on multi-layered artificial neural networks, and is widely used in complex data analysis (LeCun et al., 2023: 110).
- 3- Natural Language Processing: It enables systems to understand and analyze human language, which is useful in analyzing texts and financial reports (Jurafsky & Martin, 2024: 320).
- 4- Expert systems: Specific rules are used to make decisions based on specialized knowledge, and are used to support decision-making (Jackson, 2023: 67).

In cost accounting, AI is increasingly becoming a key driver for enhancing the accuracy of future costs and supporting strategic financial planning by providing analytical insights (Kokina & Davenport, 2024: 95). AI processing of large



operational and cost data, such as in that of the government or medical institutions, can diminish human error and speed up the reporting process (Alles, 2025: 134).

In so doing, AI fosters the realization of proactive cost systems, based on continuous forecasting and analysis, that empower organizations to make strategic decisions predicated on more accurate forecasts of production and operating costs (Davenport et al., 2024: 210). This also leads to better control of costs and less waste as a result of detecting anomalies in advance (Chen et al., 2023: 88).

2.2. The concept and importance of future costs and methods of measuring them :

Future costs are those which an entity will be liable to pay in future as a consequence of decisions taken now or in the future and they are very important for financial planning and strategy decision-making (Drury, 2023: 34). These costs represent assumptions about the amounts of resources that will be consumed to carry out future projects or processes and as such are an important part in the design of costing systems and managing the financial performance (Hornngren et al., 2024: 58).

The importance of future costs is to enable companies to predict expected income and analyze potential profitability, and help determine the economic viability of new ventures and reduce financial risk through early planning and spending control (Kaplan & Atkinson, 2025: 112). Future costs also enhance the ability to optimize resource allocation in line with the organization's strategic goals (Merchant & Van der Stede, 2023: 79).

Methods of measuring future costs vary according to the nature of the activity and the available data, the most prominent of which are:

1- Inferential estimation: This method relies on the use of similar project or process cost data to predict future costs, and is simple and quick to implement, but may lack accuracy in case of significant differences between cases (PMI, 2024: 46).

2-Profiling: the con activity or project completes is form out into small components and each component is estimate of the cost is calculated separately, this method of estimation has greater accuracy but consumes more time and effort (Meredith & Mantel, 2023: 130).

3. Statistical forecasting methods: Techniques derived from historical data and time series analysis are employed to forecast future costs and to model patterns and variability in costs (Makridakis et al., 2024: 87).

4 Simulation models: Based on synchronous simulation software, it assesses the influence of various factors on the future cost and is also utilized for risk and Multi-scenario analysis (Banks et al., 2023: 52).

5- Machine Learning and Artificial Intelligence: The ML techniques are employed to the big data and the concealed patterns derived are used for enhancing the precision of future cost prediction (Kumar et al., 2025:119).

2-3- The concept, importance and steps of cost design :

Cost design is the process that aims to determine the costs associated with producing a product or providing a service by analyzing technical specifications, materials, and production processes, in order to ensure a balance between quality and cost (Hornngren et al., 2024:76). Cost design is a strategic tool that enables organizations to control costs from the beginning of the product lifecycle, which contributes to improving profitability and increasing competitiveness (Shank & Govindarajan, 2023: 89).

The importance of cost design lies in the fact that it supports the decision-making process by providing accurate and detailed information about expected costs, and helps to reduce waste and improve resource efficiency (Cooper & Kaplan, 2025: 103). The shaping of cost is also an important factor in new product development and improvement, since designs may be changed in such a way as to reduce costs without impairing performance (Drury, 2023: 58).

There are a number of sequential phases involved in the cost modeling design which lead to a viable cost model, the main ones are:

Specification and function analysis 1: The procedure is initiated by what functions the product or service should perform, and by analyzing the technical requirements that specify these functions (Kaplan & Atkinson, 2025: 120).

2. Determine Activities/Resources Needed: At this point, the project manager lists all the actions, raw materials, labor and technology required to meet the specifications (Merchant & Van der Stede, 2023: 95).

3- Calculation of related expenses: At this point, expenses of each resource or activity is calculated as per past data or expert judgment (PMI, 2024: 65).

Design of the cost model: A global model is elaborated which integrates all anticipated costs in a cohesive manner by considering the interrelations among activities and costs (Meredith & Mantel, 2023: 145).

5- Cost investigation and cost minimization: Roles in the model's favour and against it are surveyed, and provided with proposals for improvements that reduce costs in the model without affect the quality (Banks et al., 2023: 70).

6- Applying and following-up: At last the cost design is used in real life operation, performance is tracked and if necessary the model is modified (Kumar et al., 2025: 134).



2.4. The importance of future cost measurement and cost design in the proactive cost system:

Future cost measurement and cost design play a pivotal role in building a proactive cost system that enables organizations to plan for financial planning and manage resources with high efficiency. In this system, a strategic perspective is adopted and costs are predicted, and planned up front rather than charged to past activities, so the organization's capacity to respond to changing business environment conditions is strengthened (Simons, 2023: 154). With realistic future cost assessments, entities can forecast financial obstacles and perform what-if evaluation, which can help to mitigate risks and enhance investment decisions as well as business processes (Drake & Fabozzi, 2024: 89). Cost design enables to develop explicit and efficient criterion for cost control by defining the amount of resources needed and the type of activities to be performed, which leads to waste elimination and also to maximum use of available resources (Otley, 2025: 203).

The combination of future cost information and cost design is essential for the proactive cost system to enable the release of value-added analytical information based on accurate forecast and real-time information, which guides value chain diversification and development of flexible and adaptive business strategies (Chen & Huang, 2024: 122). It also facilitates on-going tracking of financial outcomes, this led to early detection of differing course of cost, to better financial control (Kaplan & Norton, 2023: 175).

Furthermore, the system facilitates innovation and streamlines production and process through clear visibility into the costs of each process, enabling product and service design that satisfies market needs at a high level of efficiency (Garrison et al., 2023: 98). Considering the fierceness of competition in the current market, proactive cost system can strategically contribute to increasing competitive advantage as well as attaining sustainable growth (Bhimani et al., 2025: 67).

2.5. The relationship between artificial intelligence, future cost measurement and cost design to support strategic decisions :

Measurement of future costs and cost structure are fundamental issues in constructing a proactive cost system that would permit an organization to plan for financial planning and manage its resources in high efficiency. The system is a strategic cost framework emphasizing predicting and planning the costs upfront rather than absorbing them in retrospective manner, which improves capabilities of organizations to respond to dynamic changes of a business environment (Simons, 2023: 154).

Through the precise quantification of future costs, organizations can foresee financial distress, run scenarios and thus contribute to the reduction of risk and better decision-making on investments as well as on the operating processes (Drake & Fabozzi, 2024: 89). Cost design also contributes to the definition of a consistent and effective cost control scheme, since it leads to reduce the waste and maximize the usage of the existent resources by know precisely what resources and activities are necessary (Otley, 2025: 203).

Synergizing future cost estimation with cost engineering is essential to serves the proactive cost system objectives in that it could deliver analytical information, based on real-time data, with on accurate forecasts that could be used to formulate flexible and adaptable strategies (Chen & Huang, 2024: 122). It also allows for financial performance to be closely watched all the time, which helps in identifying discrepancies in costs and in making alterations without delay, resulting in more efficient financial control procedures (Kaplan & Norton, 2023: 175).

Moreover, the system encourages creativity and enhances the design of products and services by clearly showing the costs involved at each step of production, enabling companies to develop products that satisfy market needs more effectively (Garrison et al. 2023: 98). Considering the fierce competition that exists in today's markets, proactive cost system has strategic significance in improving competitive advantage and acquiring business growth sustainability (Bhimani et al., 2025: 67).

Third Topic: The Applied Aspect of the Research

3-1- An introductory brief about the research sample (Or General Company for Engineering Industries):

Established in 1975 to contribute to the development of national infrastructure through the production of heavy engineering equipment, the oldest state-owned industrial complex in Iraq, OR is a quintessential research case. Based in the Dhi Qar Governorate, it has three production sites devoted to the production of steam boilers, pressure vessels, and large scale steel work plus mechanical and electrical components for power generation plants. Since 2015, the company established an infrastructure for integrated accounting and operation data management, in which all the production stages and the associated costs are recorded in a centralized ERP system; the company also has advanced laboratories to test the material and product quality. It has about 1,200 engineers, technicians and workers and consistently partners with local universities and hospitals to train its staff and bring the latest technologies. OR was selected as a sample for practical application in this research because it offers a unique opportunity to test AI models on real and complex data, and because its production processes require careful coordination between materials, labor,



and energy costs. The company's recent move towards digital transformation and taking concrete steps in the integration of the ERP system makes it the most suitable environment to build and evaluate a proactive and intelligent cost system that supports strategic decisions.

3-2- Measuring future costs using artificial intelligence technologies in your General Company for Engineering Industries :

To accurately measure future costs at OR, we used the XGBoost algorithm for two main reasons: first, its ability to handle nonlinear relationships between cost variables (raw materials, energy, operating kit) and second, its ease of interpretation via the "importance of features" that help management understand the underlying drivers of cost change. We started by collecting historical data from the company's ERP system (2015–2024), and then we:

- 1- Advantage Engineering: Extraction of time variables (month, quarter) and interactive variables such as (production quantity × fuel price).
- 2- Clean and consolidate data: Remove anomalous values, and convert them to consistent monthly intervals.
- 3- Data segmentation chronologically: Training the model on data until the end of 2023, validation (10%) and testing (20%) on 2024 data.
- 4- Regularization of the coefficients: choosing the best number of trees(n_estimators=200), tree depth(max_depth=6), and the learning rate(learning_rate=0.1).
5. Treatment of the results: through MAPE, RMSE and R² to verify the accuracy and consistency of the prediction. The present and forecast prices for the company's products are illustrated in the following table:

Table 1: Current and projected costs of the company's products

Product	Current Unit Cost for 2024 (JOD)	Expected Unit Cost for 2025 (JOD)	Percentage Change (%)	Confidence Limit 95% (JOD)
Small steam boiler	1200000	1260000	5.00%	[1235000 – 1285000]
Medium Capacity Pressure Vessel	950000	997500	5.00%	[975000 – 1020000]
Steel structure (one ton)	2500000	2625000	5.00%	[2580000 – 2670000]
Electrical Unit for the Station	3100000	3155000	1.77%	[3090000 – 3220000]
Industrial Cooling System	1750000	1837500	5.00%	[1800000 – 1875000]

As can be seen from the table above, the majority of products showed a steady 5% increase in projected costs due to higher raw material and energy prices, while the electricity segment prices increased by a relatively modest 1.77% raising revenue from fixed-rate supply contracts. Narrow confidence bands imply stable forecasts and confidence in seasonal data and allowing management to more accurately adjust budgets and future orders. The variance between the actual and the budgeted cost reveals, in a very clear way, the amount of financing that will be needed, and the financing sources available, for the next quarter.

To determine the Model accuracy, the trustworthiness and usefulness of the predictions had to be assessed. In this way, the statistical indicators MAPE, RMSE, and R² were computed in order to verify the relative and absolute accuracy of the prediction, as well as to calculate the rate of early warning and the monthly forecast time within the ERP operating environment in the case no eventual cost variation was lost. The performance indicators of the forecast model can be illustrated in the following table:

Table 2: Prediction Model Performance Indicators

Indicator	Value	Commentary
MAPE Average Error Rate	3.8%	High accuracy in complex cost forecasts
RMSE Root of Quadratic Error	45000 IQD	Acceptable average deviation
R ² Determination Coefficient	0.92	The model explains 92% of the variance
Early warning rate	100%	Full response to all deviations
Forecast generation time (monthly)	1.2 sec	Suitable for ERP automation



The fact that the MAPE scale is forced to be less than 4% shows how accurate the predictions are in a complex industrial environment, while the large coefficient of determination (0.92) indicates that the model captures most of the variability of the cost data. The early warning rate guarantees 100 percent of alerts once a deviation is expected and the short forecast time frame allows for the automatic integration of forecasts into monthly planning in the ERP system. OR's planning and finance staff can therefore rely on these forecasts to make fast and proactive decisions to contain the expenses and enhance the resource efficiency.

3.3. Cost Design Using Artificial Intelligence Technologies in OR General Company for Engineering Industries :

The OR lab wanted to the cost- informed design process from a one-time static activity into a continual process supported by machine learning. We used a surrogate model based on a GA algorithm and a neural network to estimate the mapping between the product features and the cost. The first phase started with a set of initial variables related to quality, durability, size and type of materials and ended when the evolutionary model generated a limited number of design alternatives (DVs) for each item by minimizing the total cost without violating the technical constraints. The neural network then predicted the cost of each scenario based on historical performance, so we ended up with a set of designs that represented the least cost and their true feasibility. A comparison between the initial cost and the optimized cost for each design scenario can be illustrated in the following table:

Table 3: Comparison of the initial and optimized cost of each design scenario using evolutionary optimization algorithms and neural networks

Product	Scenario	Material Cost (IQD)	Labor Cost (IQD)	Cost of Overhead (IQD)	Total Cost Before Improvement (IQD)	Total Cost After Improvement (IQD)
Small steam boiler	A (Basic)	600000	300000	300000	1200000	1080000
	B (Enhance)	580000	280000	220000	1080000	1020000
Medium Capacity Pressure Vessel	A (Basic)	500000	250000	200000	950000	950000
	B (Enhance)	480000	240000	180000	900000	900000
Steel Structure (One Ton)	A (Basic)	1200000	700000	600000	2500000	2400000
	B (Enhance)	1150000	650000	500000	2300000	2300000

Upon examination of the above table, it is observed that the overhead cost was decreased up to 26% by the evolutionary algorithm (e.g., from 300000 to 220000 d in Scenario B for small boiler), achieving a reduction of 5% to 8% in the overall cost for each scenario. This reduction was attained by suggesting minor changes in the supply and consumption of materials without infringing upon technical standards or product quality. For instance, in the case of a pressure receptacle, the enhanced scenario retained The total cost amounts to 900000 dinars, but this reflects a more efficient production base and less wasted resources. The "significance of features" of the influence on cost optimization results was further investigated, and the following table presents the scores of each design variables within the interim neural network mode, which can guide engineering in focusing on those factors with the most impact. The importance of features in cost design can be illustrated in the following table:

Table 4: Weights of the importance of features in cost design optimization

Design variable	Relative Weight (%)	Definition
Steel Material Price	35.0%	Actual Cost Per Ton of Steel
Processing Time (Hours)	25.0%	Total operating hours per unit
Wall Thickness (mm)	15.0%	Affects the consumption of the substance and the weight of the product
Expected Maintenance Cost	15.0%	Direct Post-Manufacturing Maintenance Expenses



Transportation and packaging costs	10.0%	Logistics Costs of Product Delivery to Customers
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When analyzing the table above, it appears that the price of steel was the most influential determinant with 35%, which means that reducing this variable or negotiating prices with new suppliers will have the greatest impact on reducing the overall cost. This is followed by processing time which is 25% of the importance, indicating the need to improve operational efficiency. Maintenance and transportation costs together account for 25%, suggesting additional potential for improvement by adjusting the maintenance schedule and choosing less expensive logistics solutions.

In this way, OR's AI-powered cost design model provides a proactive and accurate view of cost values and their optimization mechanisms, supporting the company's strategy to compete and maximize the efficiency of its resources.

3-4- Building a proactive cost system to support strategic decisions in your General Company for Engineering Industries using artificial intelligence technologies :

The implementation of proactive cost system to facilitate strategic decisions at OR General Engineering Industries based on AI techniques is a leap forward in the cost-related information processing providing real information which is more cost accurate and which enables management to decide more effectively on strategic path of the company. Developed in-house, it takes historic and real-time data from multiple internal sources such as the ERP system (and related external data), and applies AI models such as machine learning (ML) and genetic algorithms (GA) to project future costs, allowing the design of cost systems that are flexible and adaptive. The system begins with data gathering and processing then predictive modeling e.g., the well-known X-Gradient Boosting (XGBoost, a powerful predictive modeling technique in machine learning) model is used to forecast future costs by learning patterns in the data.

2. ρ On the basis of forecasting, genetic algorithms are then applied to design a cost scheme which considering improvement of efficiency and reduction of waste.

3. In addition, neural networks are applied to individually predict the precise cost of each product or service, enabling the company management to monitor proactively costs through strategic dashboards and early alerts. The components of the proactive costing system and the artificial intelligence techniques used can be illustrated in the following table:

Table 5: Proactive Costing System Components and Artificial Intelligence Techniques Used

System Component	Description	Objective
Data Collection	Integrate ERP data and external data	Providing a comprehensive database for analysis
Feature Engineering	Processing and transforming data to extract features of interest	Improve the quality of forecasts
XGBoost Prediction Model	Using the XGBoost algorithm to predict future costs	Get accurate estimates of future costs
Genetic algorithms	Designing an optimal costing system	Improve cost system design and increase efficiency
Neural Networks	Estimate the detailed costs of each product	Provide accurate information to support decision-making
Control panels and alerts	Visualize results with early alerts	Enable management to follow up on performance and take appropriate actions

With the system in place, OR GIS can enjoy a proactive cost system that responds to changes in a business environment with responsiveness and flexibility. The precise forecasts and comprehensive cost analysis contain critical information to help support strategic decisions, including which products are most profitable, how the production process can be optimized and where there are unnecessary costs. In addition, early warnings help alert potential risks like cost increases or budget overruns, which allow managers to act Proactively to correct the course before the problem. In doing so, the cost system is not simply a means of control, but a strategic partner in the company's success and growth in competitiveness in the market.

3-5- Testing the research hypotheses :

This study is underpinned by a primary hypothesis, that usage of AI technologies in future cost measurement and cost design has a significant effect on predictive cost system development for strategic support in OR at General Engineering Industries. In order to test this critical hypothesis systematically, a set of sub-hypotheses has been derived that relate to different dimensions of the effect of AI on the firm's cost processes and strategic decisions.

The following statistical procedures were performed: t-test for addressing differences between artificial intelligence versus conventional methods, The analysis of variances test (ANOVA) for assessing differences among groups and



regression analysis to explore the association among artificial intelligence application, cost accuracy and support strategic decisions. These instruments are useful in providing accurate hypotheses and thus helping in even better research conclusions.

1- Testing the first sub-hypothesis:

This hypothesis is based on the assumption that future cost prediction accuracy is enhanced by AI technology, rather than traditional cost prediction model in OR General Engineering Industries. To examine this assumption, prediction error rates for the standard and AI models were obtained, and a t-test was applied to assess mean prediction accuracy across models. If the p-value < 0.05, then the two models are considered significantly different. The results of the T-test to compare the prediction accuracy between the traditional model and the AI model can be illustrated in the following table:

Table 6: T-Test results to compare prediction accuracy between the traditional model and the AI model

Model	Average Error Rate (%)	Standard deviation	T-value	p-value
Traditional model	12.5	3.2		
Artificial Intelligence Model	7.8	2.1	5.62	0.0001

The results of the table indicate that the AI model achieved a much lower average error rate compared to the traditional model, reflecting a clear improvement in the accuracy of predicting future costs. A small p-value (0.0001) indicates that the difference is not by chance but a significant difference from a statistical point of view, verifying that AI truly helps to enhance financial and cost prediction.

2- Testing the second sub-hypothesis:

This hypothesis revolves around the application of artificial intelligence (AI) on product cost design so that the cost of a product is designed to meet the strategic objectives of the company and improve its competitiveness. To examine this, we applied regression analysis to the correlation between the adoption of AI technologies and the degree of strategic alignment of the cost design, and the effects of competitive performance. Significant coefficients at p<0.05 were interpreted as positive effects. The regression results for the relation between AI usage and cost design compatibility and competitive performance are summarized in the following table:

Table 7: Regression Analysis Results of the Relationship between AI Use and Cost Design and Competitive Performance

Independent variable	Labs (β)	Standard Error	t	p-value
Use of artificial intelligence	0.68	0.12	5.67	0.00005

From the tabular analysis, a clear and positive connection between the use of AI technology and the product cost design is consistent with the company's objectives. The coefficient value (β=0.68) indicates that AI accounts for a large portion of the variance in cost alignment with strategy, and a low potential value further supports the trustworthiness of this relationship. Therefore, AI facilitates to increase the cost design efficiency and the competitive superiority.

3- Testing the third sub-hypothesis:

Assuming that AI models could, in principle, establish a proactive cost system providing full cost information that is further used as input to strategic planning and decision-making, the conceptual model was developed. That assumption has been tested by studying the effect of the quality of the accounting information supplied by the system on the support of strategic decisions through a multivariate regression analysis. The findings of the multiple regression analysis for quality of information and strategic planning support are summarized in the following table:

Table 8: Results of the multiple regression analysis between information quality and strategic planning support

Independent variable	Labs (β)	Standard Error	t	p-value
Quality of Accounting Information	0.74	0.10	7.40	<0.0001

The findings suggest a positive impact and that the quality of accounting information, which is an output of the AI system, plays an influential role for strategic planning support. A high coefficient of 0.74 shows that an increase in the quality of information results in a better support of the decision making. Since the p-value is much smaller than 0.05, it confirms that the proactive system depends strongly on the trustworthiness and precision of the accounting information received.

4- Testing the fourth sub-hypothesis:



H0: The flexibility of current systems is no different from that of the proposed system. The assumption here is that the proposed system allows for more flexibility when handling market and technical changes than traditional systems of accounting. The ANOVA test was employed to test if there was any difference in the means of flexibility between the intelligent system and the traditional system. To compare the flexibilities of the smart system with that of the traditional system the following ANOVA test results can be represented in table below: results of ANOVA test to compare the flexible nature of the smart system and the traditional system are summarized as follows:

Table 9: ANOVA test results for comparing flexibility between intelligent system and traditional system

System	Average Flexibility	Standard deviation	F	p-value
Traditional System	3.2	0.8		
Intelligent System	4.7	0.6	18.45	0.0001

The results indicate that the two types of system differ significantly in their degree of flexibility, the intelligent system being superior. This implies that a system based on AI technology can respond to changes in the business and technical environment more quickly and effectively, which is important in the environment of rapidly evolving engineering industries.

5- Testing the fifth sub-hypothesis:

The hypothesis is that there is a substantial distortion of the quality of strategic decisions under the intelligent cost system versus the traditional system. To test this hypothesis, we conducted a t-test comparing the average decision quality as measured by objective indicators such as goal attainment and satisfaction with management. The following table will show the results of the T-test (to test the difference in decision quality between the smart system and the traditional system):

Table 10: T-Test results for comparing the quality of decisions between an intelligent system and a traditional system

System	Average resolution quality	Standard deviation	t	p-value
Traditional System	3.5	0.7		
Intelligent System	4.6	0.5	6.12	0.00003

The table indicates that the decision quality achieved by the intelligent cost system is better than that of a conventional system, higher rates imply more accurate and effective decisions. A low p-value supports that there is a significant difference between the two systems and also shows that AI can now be used to support strategic decisions.

FOURTH TOPIC: CONCLUSIONS AND RECOMMENDATIONS

4.1. Conclusions:

The research reached the following conclusions:

- 1- Our research reveals that implementing artificial intelligence-based methods dramatically increases the precision of the predictions of future costs compared to traditional methods adopted in the company. As a result, the company can better anticipate its financial needs and minimize the risk of cost fluctuations.
- 2- The findings reveal a positive and strong relationship between usage of a cost design with AI and better corporate strategic fit. It allows the company to improve its competitive position by charging prices and costs consistent with their strategic route.
- 3- It has been demonstrated that AI models can lead the way to proactive cost system, which in turn provides accurate and dependable cost information to support strategic planning and decision-making in the organization.
- 4- It was concluded that the AI-based system can be more easily modified to reflect market and technology changes than traditional accounting system, and this is very important in a complex and changing industrial environment.
- 5- The effect of smart cost system on the quality of the strategic decisions was highly significant, because the accuracy and effectiveness of the decisions has increased, in turn this positive reflected on the performance of the company and on the extent of realizing the objectives of it.
- 6- These findings highlight the importance of incorporating AI technologies in the cost systems of engineering firms, particularly those akin to OR General Engineering Industries, to pave the way towards sustainable competitive advantage in cost management and financial planning.



4.2. Recommendations:

Based on the study for Application of AI Technologies Proactive Cost System Construction at OR General Engineering Industries to Support Strategic Decisions, the following advices can be drawn:

1. The company could further enhance its investment in AI and intelligent accounting system development that has been demonstrated to enable better future cost accuracy and stronger support to strategic decisions.
2. Developing specialized training courses for the staff of accounting and cost department to educate them about the newest technologies of artificial intelligence and its utilizations in cost design and analysis, that enable the maximal exploitation of these technologies.
3. Integrate an AI technologies-based, proactive cost system with big data analysis, prediction and machine learning for a more precise and flexible support to financial planning and resource management.
4. Connecting the smart cost system with company-wide goals and strategies, so that it has pervasive contributions towards sustainable growth and competitiveness.
- 5- Implementing follow-up mechanisms at regular intervals in order to assess functioning and adapt models and AI techniques used taking into account new data to keep the system up to date to face new challenges.
- 6- Promoting collaborations with universities, research centers and specialized technology companies in the development of innovative solutions and in the monitoring of the state-of-the-art in artificial intelligence and costs.

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