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AI and ERP Integration for Adaptive Dynamic Costing Based on Consumer Demand Fluctuations in Manufacturing

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ABSTRACT

This research aims to automate product costing based on consumer demand fluctuation using artificial intelligence (AI) integration with the Oracle ERP system. From raw material procurement and factory scheduling to real-time product cost estimates and financial forecasts, AI can simplify and improve many activities as manufacturing processes get more complicated. Automating product costing based on consumer demand allows artificial intelligence to help producers reach higher accuracy, efficiency, and cost optimization, thus enhancing organizations profitability. The paper examines how artificial intelligence changes real-time data analysis, predictive analytics, machine learning, and conventional product costing techniques. Furthermore, the advantages of AI-driven solutions are underlined—cost control, quicker decision-making, enhanced forecasts, and best use of resources. Future developments of artificial intelligence and ERP integration—including autonomous production systems, dynamic pricing models, and improved sustainability practices—predicted to change the manufacturing landscape significantly—are also covered in the paper. Using case studies from top companies such as Siemens, Coca-Cola, and Nestle, the paper illustrates artificial intelligence's practical use and quantifiable advantages in manufacturing. The study concludes that manufacturers who provide a clear road toward operational excellence and long-term profitability depend on the junction of artificial intelligence and ERP.

Keywords: Artificial Intelligence, Machine Learning, ERP Systems, Oracle EBS, Oracle Fusion Cloud, Process Automation, Decision-Making, Dynamic Pricing, Inventory Management, Natural Language Processing, Predictive Analytics, Labor Costing, Manufacturing, and Product Costing.

INTRODUCTION

Artificial Intelligence (AI) and Machine Learning (ML) are changing the industrial sector environment and so altering the possibilities for operational efficiency, data-driven decision-making, and innovation. As manufacturing IT tries to include new technologies into current business processes and operations, it presents special opportunities as well as obstacles. One of the main challenges of this path is combining modern solutions like manufacturing facilities with known ERP systems like Oracle ERP.

In manufacturing, product costing is the computation of all production-related expenses, including raw materials, labor, overhead, and other operational charges. Historically, this procedure has been manual, involving several departments, and it suffers from inefficiencies, delays, and mistakes most of the time. Manufacturers thus struggle to keep margins under control, price goods competitively, and react instantly to changes in the market.

This paper will investigate the effects of artificial intelligence and machine learning in manufacturing, mainly how IT managers could use predictive insights, data connectivity, and system integration to propel operational success. Large datasets in real-time, future trend prediction, resource allocation optimization, and cost-saving potential identification by AI models all help to support one another.

PRODUCT COSTING IN MANUFACTURING- TRADITIONAL METHODS

In manufacturing, traditional product costing sometimes depends on techniques including job order, process, and activity-based costing (ABC), in which case costs are computed using fixed cost structures, past data, and predefined rates. Meanwhile, these approaches can be stationary and might not react to real-time changes in production conditions, such as varying material prices, labor inefficiencies, or manufacturing speed.

CHALLENGES WITH TRADITIONAL COSTING SYSTEMS

Although conventional costing techniques have been used, they find it challenging to meet the needs of contemporary companies and production. Given the limits in accuracy, flexibility, and real-time data, companies find it difficult to properly control expenses and stay competitive in today's fast-paced market. For more dynamic, real-time cost control, many companies are thus looking to more sophisticated approaches, such as Activity-Based Costing (ABC) or combining artificial intelligence and ERP systems.

THE ROLE OF AI IN AUTOMATING PRODUCT COSTING

In manufacturing settings, artificial intelligence (AI) changes the handling of product costs. While artificial intelligence can automate, improve, and maximize the whole costing process, traditional costing techniques are sometimes laborious, complicated, and prone to mistakes. The following closely examines how artificial intelligence is helping to automate product costing:

- Machine learning (ML) is one of the fundamental artificial intelligence technologies pushing automation in Oracle ERP systems. Demand forecasts, inventory levels, and sales patterns are just a few future trends that ERP systems enable ML algorithms to predict from past data. Using past production data, ML models may forecast future labor costs and material consumption for forthcoming orders. These realizations allow companies to maximize supply chain management and allocate resources most effectively.
- Another artificial intelligence tool being applied in Oracle ERP systems to improve automation is natural language processing (NLP). By automatically reading and classifying financial data, AI-powered solutions provide real-time tracking of overhead expenses, labor hours, and material costs. NLP also guarantees that cost computations remain correct by helping to find differences between stated pricing and actual costs.
- Robotic process automation (RPA) is another key technology enabling artificial intelligence-powered automation inside Oracle ERP systems. Software bots used by RPA automatically conduct repetitive tasks, including data entry, updating cost data. RPA connected with ERP systems increases operational efficiency and reduces human error potential.

DATA INPUTS IN MANUFACTURING FOR AI

To produce accurate and perceptive cost forecasts, artificial intelligence needs access to several data sources.

- Among the many sources of information gathered were market statistics, consumer opinions, operational data, and outside variables like knowledge of local events, weather, holidays, and economic conditions. This data gave the whole picture of elements controlling demand and inventory levels.
- Changing the cost of materials can significantly influence product costing. Artificial intelligence-tracking of raw material real-time market pricing enables dynamic cost computation change. Artificial intelligence systems can also predict pricing patterns using supply chain data and market analysis, therefore directing manufacturers in their purchase decisions.
- Still another important factor in product costs is labor cost. To precisely project labor costs, artificial intelligence can examine worker performance, labor rates, shift patterns, and productivity. AI can guarantee that labor cost estimates are constantly updated and represent actual performance by connecting with payroll systems and time-tracking systems.
- By examining data from many departments and activities, artificial intelligence can help more precisely distribute overhead expenses. This guarantees that overheads are distributed commensurate to every manufacturing run or product line. By means of resource allocation and identification of cost-cutting prospects, artificial intelligence can also help lower unwarranted overhead.
- Integrating with supplier systems allows artificial intelligence to forecast cost changes depending on pricing policies, vendor relationships, and delivery plans. Depending on cost effectiveness, delivery schedules, and material quality, artificial intelligence can potentially maximize supplier choice.
- Multiple "what-if" simulations done by artificial intelligence (e.g., labor rates, raw material prices, production volumes) help to forecast how changes in important variables—e.g., labor rates, raw material prices, production volumes—would effect product costs. These revelations help manufacturers evaluate the financial effects of various approaches, such switching suppliers or raising manufacturing efficiency.
- AI can enable dynamic, real-time costing models that are far more flexible than traditional methods.

AI INTEGRATION WITH ERP SYSTEMS

Artificial intelligence combined with ERP (Enterprise Resource Planning) systems represents a radical road towards process automation, higher efficiency, and assured exact decision-making in manufacturing. ERP systems help manage these duties themselves, while artificial intelligence improves significant corporate operations, including inventory, procurement, manufacturing, and finance, by means of predictive analytics, automation, and optimization

powers. This thoroughly investigates how artificial intelligence could be included in ERP systems for product costing automation.

Based on real-time production data, artificial intelligence may automatically allocate indirect expenses—that is, overhead—to products. This facilitates a more exact product price free from human involvement. AI systems, for instance, can assign overhead costs depending on machine use data and distribute labor costs according to time sheets and productivity data.

Artificial intelligence (AI) can suggest the most reasonably priced suppliers depending on historical data and demand fluctuation by looking at prior performance, delivery timeframes, and pricing patterns, thereby optimizing procurement decisions. Including artificial intelligence in the procurement module of the ERP system can help producers ensure appropriate levels of inventory and cut material costs.

Real-time costing made possible by artificial intelligence is achieved by constant updating of cost data depending on manufacturing progress, material consumption, worker hours, and overhead. This allows businesses to respond fast to changes in cost structures or manufacturing delays.

BENEFITS OF AI IN PRODUCT PRICE AUTOMATION

AI in Product Price Automation is changing how companies handle operational efficiency and revenue maximization. Using data and machine learning, businesses can hone pricing policies to fit consumer preferences, market trends, and driving variables. Higher profitability, better customer involvement, and more scalabilities are just a few of the results this technology enables companies to achieve that conventional pricing strategies find difficult.

1. **Adjustment to market changes:** Through pattern analysis throughout time, artificial intelligence forecasts and adapts to market changes. These predictive powers help companies maintain profitability and efficiency under different circumstances.
2. **Cost Reduction** AI-enhanced ERP systems help organizations reduce costs in several key areas by improving resource utilization using insights from customer purchasing trends and optimizing operational processes. AI-driven predictive analytics can also lead to cost savings by helping organizations avoid overstocking or understocking inventory, which can result in wasted resources or lost sales. AI can also spot operational inefficiencies inside a company, enabling focused cost-cutting initiatives.
3. **Immediate product pricing modifications:** Constant market activity combined with inventory levels monitored by artificial intelligence enable rapid pricing changes. This strategy optimizes margins in important times.
4. **Improved Profit Margins:** By use of artificial intelligence optimizing product costs, firms may more precisely estimate margins and guarantee optimal pricing of items to maximize profitability. Higher profit margins result from AI also helping to find places where cost cutting is feasible without sacrificing product quality.
5. **Enhanced Decision-Making:** AI-enhanced ERP solutions can estimate sales, let decision-makers act early, and enable swift changes to labor expenses or product price by means of real-time insights, predictive analytics, and data-driven recommendations. This greater visibility helps IT managers in a fast-changing environment make more accurate and timely decisions, therefore supporting organizational performance.
6. **Personalized Pricing:** Customized pricing tactics made possible by machine learning algorithms maximize income by means of customer groups, hence optimizing customer satisfaction and loyalty.

CHALLENGES AND LIMITATIONS OF AI AND ML IN ERP SYSTEMS

While the benefits of AI-powered automation in Oracle ERP systems are significant, organizations must also address several challenges and considerations during implementation. These include data quality issues, integration with legacy systems, and third-party applications.

CASE STUDIES: AI AND ML INTEGRATION WITH ERP IN PRODUCT COSTING/MANUFACTURING

Many different industries have successfully included artificial intelligence into their product costing, producing considerable increases in productivity, cost management, and profitability as well as other areas. These case studies and useful graphics explain how results might be affected by artificial intelligence-driven automated product costing in manufacturing.

SIEMENS: TRANSFORMING MANUFACTURING & SUPPLY CHAIN

Within its ERP system, Siemens used artificial intelligence algorithms to forecast equipment breakdowns and plan preventative maintenance. The program produced a 10–15% increase in equipment dependability, a 15–25% decrease in unscheduled downtime, and a 20–30% drop in maintenance expenses [11].

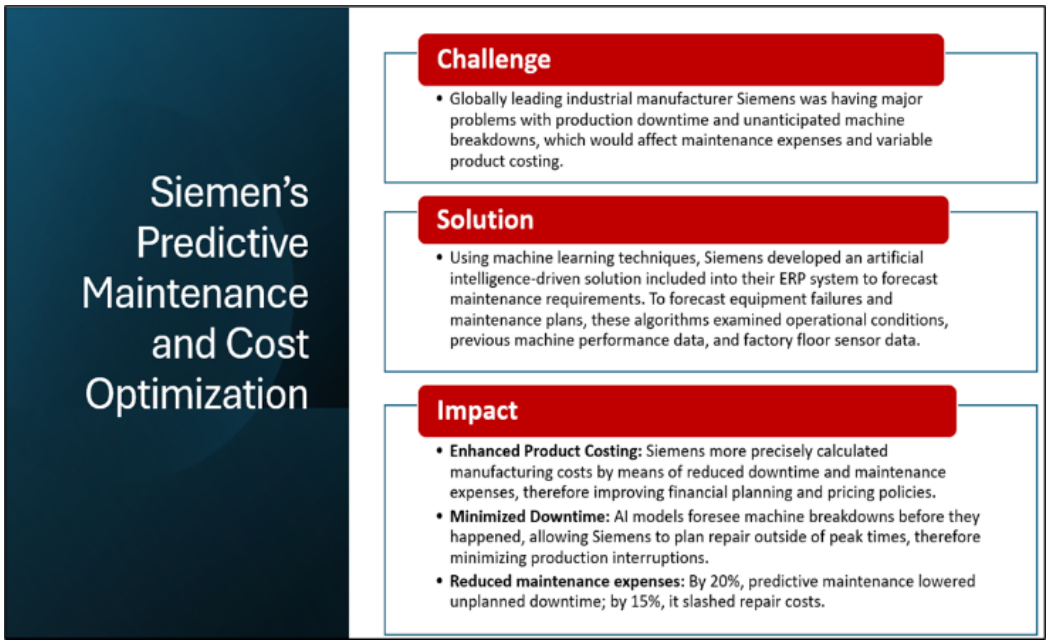

Figure 1: Siemens Predictive Maint. & Cost Optimization.
Source: Authors' own processing.

COCA-COLA - AI FOR SUPPLY CHAIN AND COST OPTIMIZATION

Using artificial intelligence tools inside its ERP system, Coca-Cola optimized manufacturing scheduling and more precisely projected demand. Coca-Cola thus reduced stockouts by 12%, excess inventory by 20%, and production efficiency by 15%, so saving significant costs and improving supply chain agility [11].

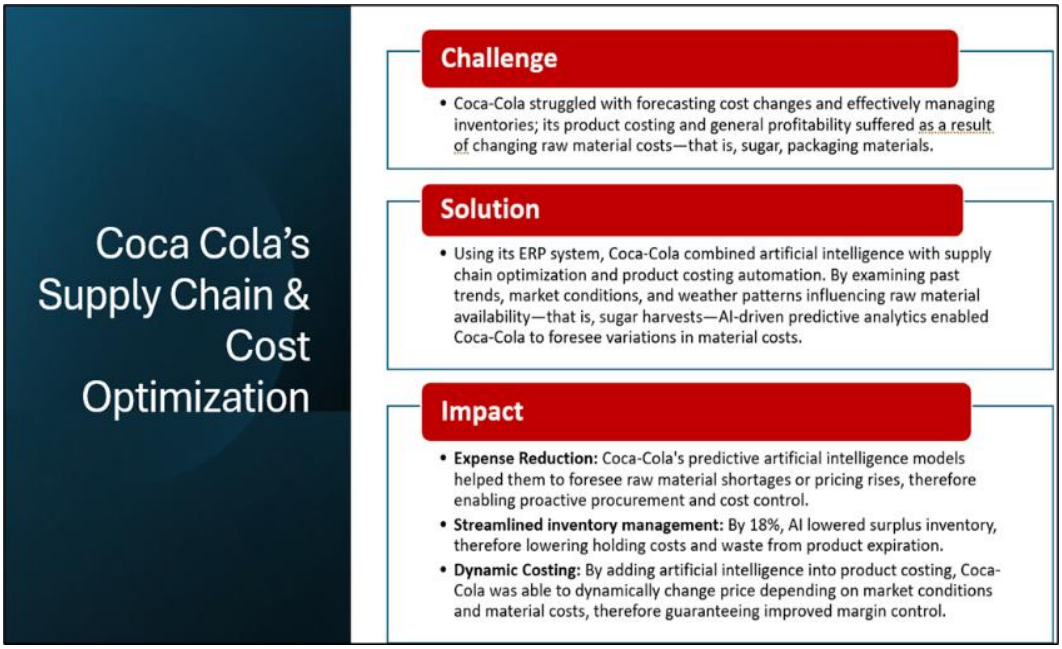

Figure 2: Coca-Cola's Supply Chain & Cost Optimization.
Source: Authors' own processing.

Nestle's - AI for Dynamic Pricing and Cost Optimization

Using predictive analytics and artificial intelligence to drive sophisticated dynamic pricing algorithms, Nestle adjusts prices in real-time depending on demand fluctuations, rival pricing, and other pertinent considerations. Nestle keeps competitive in the online market by constantly adjusting prices to maximize sales volume and income by tracking consumer behavior and state of the market conditions.

Figure 3: Nestle's Dynamic Pricing & Cost Optimization.
Source: Authors' own processing.

RESULTS

The results of the study depend on the recommended strategy for evaluating how integration of artificial intelligence with Oracle ERP manufacturing systems would influence various aspects. The data acquired by way of surveys and interviews are given in this paper. One can better grasp the cost reduction and inventory optimization by looking at them both before and after the incorporation of AI-powered automation.

The performance of the artificial intelligence models was evaluated using a set of criteria comprising Mean Absolute Error (MAE), Mean Squared Error (MSE), Root Mean Squared Error (RMSE), and Mean Absolute Percentage Error (MAPE).

By dynamically changing cost projections depending on real-time data, several machine learning techniques can be used to raise the accuracy of product costing. These are some main strategies:

When costs vary over time owing to market conditions, time series forecasting models such as ARIMA or LSTM can be applied to forecast future material or labor costs depending on historical trends, therefore providing especially helpful information.

Deep neural networks (DNN) or artificial neural networks (ANN) are quite successful in cases when complicated interactions among the several cost drivers cannot be adequately represented with more basic models. Big amounts of ERP data can be analyzed and more precisely product costs can be predicted using these techniques.

More precisely, the random forests model predicted changes in labor and material costs, therefore lowering the 15% difference between projected and actual costs [21].

Time series forecasting models driven by artificial intelligence were coupled with the ERP system of the business to examine past production data and project labor and material expenses. Using historical patterns and outside variables, the model predicted variations in labor hours needed for manufacturing using LSTM networks [23]. By 20%, the AI-powered solution enhanced the accuracy of labor cost projections, which let managers better allocate resources and hence increase profitability [22][13][11].

Random forests, LSTM networks, and time-series forecasting give manufacturers wishing to apply artificial intelligence in product costing strong tools for increasing accuracy and enabling data-driven decisions [23].

CONCLUSION

Driven by automation, improved efficiency, and data-driven decision-making, integrating artificial intelligence (AI) with Enterprise Resource Planning (ERP) systems in manufacturing is transforming the sector. AI enables enterprises to react faster to market changes, lower running costs, and increase profitability by automating difficult tasks such supply chain management, manufacturing optimization, and product costing.

More precise product costing, real-time data analysis, best use of resources, and a more agile production environment are among the main advantages. Manufacturers may forecast trends, identify dangers, and apply prescriptive solutions that reduce waste and inefficiencies using artificial intelligence (AI), so preserving their

freedom to change with the times. Combining artificial intelligence with IoT, edge computing, blockchain, and sustainable practices will also transform manufacturing operations, so increasing their openness, security, and environmental impact.

Future developments in ERP systems will see increasing importance of artificial intelligence. Future trends such autonomous production systems, sophisticated human-machine collaboration, dynamic pricing models, and real-time risk management will keep pushing the envelope of what's feasible, so providing manufacturers with a competitive edge in an ever complicated and fast-paced market.

Integration of artificial intelligence with ERP systems is ultimately a strategic advantage rather than only a technical trend. Companies who use AI-driven automation and optimization will be more suited to innovate, grow, and flourish going forward in manufacturing. Random forests, LSTM networks, and time-series forecasting give firms wishing to use artificial intelligence in product costing strong tools for enhancing accuracy and generating data-driven decisions [23].

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