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| Research Article

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Integration of Just-In-Time Production (JIT) and Resource Consumption Accounting (RCA) Technologies with AI: Optimizing Resource Allocation and Reducing Costs

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Abstract: This study aims to analyze the impact of the integration of resource consumption accounting (RCA) and production on time (JIT) technologies with artificial intelligence in improving operational performance and reducing costs in restaurant chains. The theoretical aspect dealt with the most important concepts related to these modern technologies, while the practical aspect relied on quantitative data of five branches of a restaurant chain.

The results showed a decrease in the percentage of food waste from (14.6%) to (6%), an improvement in labor utilization from (70%) to (85%), an increase in the accuracy of demand forecasting from (62%) to (90%), as well as a reduction in the average monthly operating costs by (17%).

The study concludes that the integration of RCA, JIT, and AI represents an effective framework for optimizing resource utilization, reducing waste, and increasing operational efficiency, thereby enhancing the competitiveness of organizations.

Key words: Resource Consumption Accounting, On-Time Production, Artificial Intelligence, Cost Management, Restaurants.

First: Introduction

The increasing challenges in the contemporary business environment, particularly the intense competition and high resource costs, have led to widespread criticism of traditional approaches to cost accounting. This has necessitated the development of modern technologies that keep pace

with market demands and contribute to improving operational efficiency. The most prominent of these techniques is Resource Consumption Accounting (RCA), which provides accurate information about resource consumption and helps in the employment of idle energy, as well as the Just in Time (JIT) technology With the rapid development of technology, AI has become a supporting tool capable of increasing the accuracy of demand forecasting and improving resource allocation decisions. The integration of these three technologies opens up broad prospects for achieving economic units' goals of reducing costs and improving performance.

Second: The Research Problem

The main question of the study is this:

Does the integration of resource consumption accounting (RCA) and on-time production (JIT) technologies with artificial intelligence contribute to improving the resource allocation of economic units and reducing operational costs?

Third: The Importance of Research

The importance of this study is that it addresses the latest costing and management technologies in an integrated manner, by integrating RCA and JIT with artificial intelligence. This integration contributes to addressing the shortcomings of traditional methods, and allows organizations – especially restaurant chains – to improve resource allocation, reduce food waste, enhance demand forecasting accuracy, and reduce operational costs, ultimately improving competitiveness and increasing profitability.

Fourth: Research Objectives

This research aims to:

1. Demonstrate the concepts and techniques of accounting for both resource consumption and on-time production, highlighting their differences compared to traditional methods.
2. Explain the role of AI in supporting cost management systems, improving demand forecasting, and supply chain management.
3. Analyze the impact of the integration between RCA , JIT, and AI in increasing the efficiency of resource allocation and reducing waste and costs.
4. Testing the impact of this integration on the performance of a restaurant chain as an application model.

Fifth: Research Hypotheses

The study is based on the following hypotheses:

1. There is a positive impact of the integration of RCA and AI-powered JIT in reducing food waste.
2. This integration contributes to improved labor allocation and productive time.
3. AI enhances the accuracy of demand forecasting, supporting the application of JIT in restaurants.
4. Triple integration reduces operational costs and improves profitability.

Theoretical Aspect

First: The Emergence of Resource Consumption Accounting (RCA) Technology

After World War II, economic units faced challenges, most notably a lack of resources. This led to the development of accounting systems to support decision-making and correct cost allocation under traditional systems.

The flexible standard cost system **emerged** as an evolution of the German GPK system, which focuses on resources rather than activities (Okutmus, 2015). In the 1980s, **activity-based cost (ABC)** emerged to link indirect costs first to activities and then to products (Al-Samani, 2016).Despite the advantages of ABC, it has faced criticism for ignoring untapped energy and high application costs (Tse & Gong, 2009). TDABC and RCA techniques were subsequently developed to address these issues, while recognizing untapped resources and improving cost allocation (Al-Kasab, 2019).

Second: The Concept of Resource Consumption Accounting (RCA)

RCA was developed in 2000 as a comprehensive and dynamic cost management technology, combining the advantages of GPK and ABC.

- RCA focuses on resources as the primary cause of cost.
- Provides accurate information to support planning, manage idle energy, optimize resource allocation, and enhance the competitiveness of the economic unit (AL-Rawi & Al-Hafiz, 2018).

Third: Structure of RCA Technology

1. **Cost Pools:** These include resources and activities involved in production, while keeping idle energy within resource pools without loading it onto products (Al-Rubaie, 2016) (Al-Hussein, 2016) (Al-Qasab, 2019)
2. **Cost Drivers:** Each complex has a cost charge for activities or products, such as direct working hours or machine operation.
3. **Reciprocal Relations:** RCA illustrates the overlap between different resources to support optimal cost distribution (Karim, 2023).
4. **Cost Objects:** Include products, processes, customers, or services, without being charged with idle energy costs.

Fourth: Steps to apply RCA

1. Identify the different resource pools according to the principle of homogeneity and reciprocal relations.
2. Determine the direct and indirect costs of each compound.
3. Determine the cost guidelines for each complex.
4. Distribution of resource costs to productive departments on the basis of theoretical capacity.
5. Distribution of costs based on actual capacity.
6. Calculate idle energy costs and keep them in resource pools without loading them onto products.

Fifth: On-time Production (JIT) Technology

The JIT philosophy emerged with Ford in 1923, and was developed by Taichi Ono within the Toyota Production System (TPS) to achieve a competitive advantage (Abdullah & Aziz, 2022; AIDT, 2006).

- It aims to produce the required quantities in a timely manner, while minimizing inventory, improving product quality and reducing costs and waste (Khourshed & Youssef, 2025).

A. JIT Application Requirements

- ✓ Senior management support.

- ✓ Identify the underlying production problems.
- ✓ Employee participation in decision-making.
- ✓ Production synchronized with the inventory system.

B. JIT Adoption Features

1. Improve product quality through effective collaboration with suppliers.
2. Enhance all operations in the company, including design, marketing and distribution.
3. Motivate workers to innovate and reduce waste.
4. Improve financial, regulatory and operational performance.
5. Reduce inventory levels to or near zero.
6. Reduce emergency maintenance costs.
7. Enhance competitiveness and achieve customer satisfaction.
8. Improved return on investment and profits.

Sixth: Artificial Intelligence in Operations Management

AI is used to improve demand forecasting, inventory management, and operational data analysis, enhancing resource allocation efficiency and reducing operational costs (Choi, Wallace, & Wang, 2018).

Seventh: Integration between JIT, RCA and Artificial Intelligence

The integration between JIT , RCA, and AI provides an advanced framework for improving operational and financial performance, by:

- ✓ Reduce Inventory and Waste (JIT).
- ✓ Improve cost tracking and accurate resource allocation (RCA).
- ✓ Enhance demand forecasting and decision-making (AI).

This integration leads to intelligent resource management, reduced operational costs, and a sustainable competitive advantage.

The practical aspect of the study

1- Study Model

A chain of 5 branches **was selected in terms of** sales volume and location.

The analysis is based on **a performance comparison before the implementation of the integration** between **RCA and JIT** and the use of **artificial intelligence**, and after implementation, using monthly data for each branch over **the course of 6 months before and after implementation**.

2- Main variables of the study

1. **Food Waste (%) of Raw Materials:** Measures the loss of raw materials.
2. **Labor Utilization Ratio (%):** Measures how efficiently the actual working hours are used compared to the available time.
3. **Demand forecasting accuracy (%):** Measures the extent to which the actual demand matches previous estimates.
4. **Average operating costs ($1,000 per month):** Includes labor, raw materials, energy, and maintenance costs.

3- Quantitative data of the restaurant chain (before and after application)

Table (1) shows the costs before and after the application.

Section	Food Waste Before %	Waste after %	Labor Exploitation Before %	Exploitation after %	Prediction accuracy by %	Accuracy after %	Operating costs before ($1000)	Costs after (thousand $)
1	15	6	70	85	60	90	120	100
2	14	5	68	83	62	88	115	96
3	13	6	72	86	65	91	118	98
4	16	7	69	84	61	89	122	102
5	15	6	71	87	63	92	119	97

Prepared by the researchers based on data

4. Statistical Analysis

A. Food Waste :

- ✓ Average before application: **14.6%**
- ✓ Average after application: **6%**
- ✓ Improvement: **58.9%**
- ✓ The highest reduction was observed in section 2 at **9%,** reflecting the effectiveness of RCA in identifying sources of waste.

B. Exploitation of Labor :

- ✓ Average before application: **70%**
- ✓ Average after application: **85%**
- ✓ Improvement : 15%
- ✓ The biggest improvement was in Branch 3 at **14%,** showing the impact of AI in improving task allocation.

C. Accuracy of Demand Forecasting:

- ✓ Average before application: **62%**
- ✓ Average after application: **90%**
- ✓ Improvement: **28 %**

The largest improvement in Branch 1 at **28% reflects the** efficiency of the intelligent system in estimating demand and reducing the gap between supply and demand.

d. Operating Costs

- ✓ Average before application: **$118.8K**
- ✓ Average after application: **$98.6K**
- ✓ Improvement: **17% decrease**
- ✓ The largest savings in Branch 1 at **17%,** or $**16.7 thousand per month**, resulted from reducing waste and optimizing resource utilization.

5- Analysis Tables:

A. Compare performance before and after integration.

Table (2) shows the comparison of performance before and after the integration

Variable	Average before	Average after	Absolute Difference	Percentage of improvement %
Food waste	14.6	6	8.6	58.9
Exploitation of labor	70	85	15	21.4
Demand forecasting accuracy	62	90	28	45.2
Operating Costs ($1000)	118.8	98.6	20.2	17.0

Prepared by the researchers based on data

B. Distribution of performance for each branch

Table (3) Distribution of performance for each branch

Section	Improvement in food waste %	Improvement in employment utilization %	Improvement in forecast accuracy %	Improvement in operating costs ($1000)
1	9	15	30	20
2	9	15	26	19
3	7	14	26	20
4	9	15	28	20
5	9	16	29	22

Prepared by the researchers based on data

6- Analyze the results

The results of the quantitative study on the restaurant chain under study showed the following:

1. **Food Waste: The**

percentage of food waste decreased significantly from an average of (14.6%) before the implementation of the integration, to (6%) after application, representing an improvement of approximately (59%). This reflects the direct impact of the application of RCA andJIT technologies in reducing raw material losses and enhancing the efficiency of production processes.

2. **Labor Exploitation: The**

rate of labor utilization increased from an average of (70%) before the implementation to (85%) afterwards, indicating an improvement in operational efficiency in manpower management and reducing idle times, as a result of the support of artificial intelligence in work scheduling and task distribution.

3. **Demand Forecasting Accuracy: The**

accuracy of demand forecasting has seen a significant improvement from an average of (62%) to (90%) after implementation, which proves the role of artificial intelligence in improving demand management and reducing the gap between supply and demand, thus supporting the JIT strategy .

4. **Operating costs: The**

average monthly operating costs decreased from ($118.8 thousand) to (98.6 thousand), a decrease of approximately (17%), which confirms the positive financial impact of the implementation of this integration.

Conclusions and recommendations

First: Conclusions

1. The integration between **RCA , JIT, and AI** reduces waste and increases resource efficiency.
2. Improved labor utilization reflects the effectiveness of AI in workforce management.
3. High demand forecasting accuracy supports JIT's success in producing the required quantity in a timely manner.
4. Financial savings boost restaurant competitiveness.
5. The use of accurate quantitative analysis proves the importance of actual data in supporting operational and financial decisions.

Second: Recommendations

1. Adopt **AI systems** for demand analysis and resource allocation.
2. Apply **RCA** to accurately identify cost sources and detect idle energy.
3. Enhance the application **of JIT** to reduce inventory and waste and improve production flow.
4. Train employees to use modern technologies to maximize utilization.
5. Encouraging applied studies on actual data to verify results on the ground.
6. Expanding the study to include more branches or different chains to ensure that the results are generalized.
7. Use graphical analysis and dashboards to track performance continuously.

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