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Evaluation of Inventory Management Practice in Food Processing Industries in Lagos: Analytical Hierarchy Process Approach

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Abstract

A survey of food processing industries was conducted to examine different inventory strategies in order to establish the most acceptable inventory practices in Lagos State, Nigeria. The criteria for selection of those inventory techniques are accuracy, cost, stock out, fraud, time, delivery, storage space, product type, features, efficiency, nature of production system, customer satisfaction, trained or qualified staff, the effectiveness of information technology system used, organizational factors, process capability, problem recurrence and characteristics of manufacturing systems. The purpose of the research is to select best inventory management practices in the food processing industry in Lagos State, Nigeria. Structured questionnaires were designed and given to various category of managers in one hundred and fifty (150) food processing industries between the period of October 2020 to December 2020. The Analytical Hierarchy Process (AHP) steps were implemented using Spice Logic Software to compute the criteria weights, criteria priority and the overall priority for inventory alternatives practiced. Based on the highest overall priority, the Analytical Hierarchy Process indicates that the best inventory strategies are Economics Order Quantity (EOQ), Minimum Order Quantity (MOQ), First-in-First Out / Last-in-First Out (FIFO/LIFO), and Safety Stock Inventory, in that order to enhance food processing industry for optimal production or manufacturing, preservation of foods, easy marketing and distribution tasks, increasing food consistency which includes availability of many foods, transportation of perishable foods over long distances, and ensuring the survival of modern supermarkets. The recommended inventory techniques for food processing industries are critical to minimizing inventory costs. As much as this study was designed for Lagos State, similar survey should be carried out for other states, including other industries apart from the food processing industries.

Keywords: Analytical Hierarchy Process, Food Processing Industry, Inventory Techniques, Pair-Wise Comparison, Priority, Satisfactory.

1.0 INTRODUCTION

The number of food processing companies in Nigeria has grown throughout time, as has the variety of products produced. There are 17 industrial food processing sub-sectors in Nigeria, with over 5,000 food processing and production organizations [1]. The conversion of raw materials into food or food into other forms is referred to as food processing. It offers cost-effective food products that are easy to prepare and well welcomed by consumers. The act of preparing food for consumption is known as food processing. Refinement, preservation, and improvement of a product, as well as storage, handling, packaging, and canning, are all aspects of food processing operations. Processing includes receiving and storing raw or partially processed plant, animal, or other food materials, converting raw materials into finished products, and packaging and storing finished goods. The food processing industry, which encompasses industries like fish processing and canning, confectionery, canned fruits and vegetables, dairy products, noodles, bread, and other bakery items, food packing plants, and the sugar industry, is dominated by small and medium enterprises [1–4].

According to Junior [5], the food industry is one of the most challenging for companies to optimize their inventory control. The delicate balancing act of managing such a diverse range of perishable goods while also ensuring that customer service targets are maintained necessitates excellent inventory management. Various large food and beverage companies rely on extremely complex, resource-intensive, and expensive Enterprise Resource Planning (ERP) systems to suit their needs [5]. Inventory (raw materials, semi-finished products, and final products) is vital to the manufacturing industry's sustainability because it accounts for approximately 70% of current resources [6]. The stock of resources used in an organization is referred to

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as inventory. It refers to the physical stock of commodities retained for the easy and efficient operation of an organization's expected matter at the lowest cost of finances delayed reservoirs or supplies. Raw materials, work-in-progress (WIP), and finished goods are the three types of inventory [7–8]. According to Stevenson [9], inventories are an important part of a company because they are not only required for operations but also contribute to customer satisfaction by addressing their needs. Inventory management is used by organizations to arrange, store, and replace inventory in order to maintain a steady supply of goods while reducing cost. In a variety of sectors, it is a discipline tasked with maximizing resource efficiency and achieving total operational efficiency. As experts continue to find perfect solutions across the globe, the totality of inventory management concerns, such as delays, stock-outs, and lost production time, are well recognized [10–11].

Inventory management is a crucial part of the supply chain management (SCM) process, and it involves examining and determining inventory acquisition, inventory level, production, ordering, and holding costs. It is a profit-maximizing system in which a company's profit is maximized by minimizing inventory. Inventory management has also proven to be a difficult task for companies that offer a variety of items, manufacture a sufficient quantity of products, and purchase raw materials. When and how much to order is an important part of inventory management. The corporation wants to meet rising consumer demand while simultaneously attempting to keep inventory costs as low as possible [12]. Using inventory management techniques in a company has many benefits, including ensuring optimal manufacturing, meeting assembly targets, and delivering products on schedule, all of which are tied to operational efficiency [13].

Various techniques have been introduced in the last decade as supply chain management have grown. The most current techniques are material requirements planning (MRP), flexible manufacturing systems (FMS), total quality management (TQM), and Just–in–time (JIT) methods. Inventory management is the main element in supply chain management. It includes a proportion between customer service or product availability, and the cost of inventory [14].

Inventory management plays a vital role in most organizations, according to Kontus [15]. Inventory management's purpose is to establish rules that ensure the best optimal inventory investment. Inventory management is the process of balancing the costs of managing inventory against the benefits of holding it. Stevenson [9] opined that not only are stocks essential for operations, but they also add to consumer satisfaction by meeting their requests as and when they arise. The food industry is one of the most challenging for companies to grasp when it comes to inventory control. The sheer complexity of keeping such a large number of perishable components in stock while still providing excellent customer service necessitates the usage of sophisticated inventory control software [5]. Processed foods, on the other hand, have a significant risk of rotting if they are not distributed and inventoried properly. A warehouse must store inputs (food) as inventory for food-processing and distribution enterprises to need inputs and process food from many sources; the increasing complexity and enormous amounts of food make such inventory management tough [16]. According to Kinyua [13], inventory management practices refer to the models used to manage an organization's inventory. These models track, evaluate, and report whether inventories are decreasing or increasing by recording, consolidating, tracking, and consolidating data. Just-in-time (JIT), Material Requirement Planning (MRP), Vendor Managed Inventory (VMI), and barcoding are some of the models accessible.

Because of the importance of food processing in terms of preservation, making marketing and distribution tasks easier, increasing food consistency, increasing yearly availability of many foods, transporting perishable foods over long distances, and ensuring the survival of modern supermarkets; in the food processing industry in Lagos State, Nigeria, the best inventory management practices must be chosen. The following section reviews previous studies in the field. Section 3 details the methodology approach, section 4 shows the analysis and results of AHP in selecting the preferred inventory. The discussion is shown in Section 5, and the conclusion is presented in Section 6.

2.0 PREVIOUS STUDIES

The heart of good inventory management is the knowledge of what is in stock and managing it well. When inventory best practices are put in place, businesses can then optimize stock levels not only to boost efficiency but meet ever-changing customer demands. Furthermore, previous studies on inventory management practices will give more insights into the effectiveness of the practices related to food processing industries.

Imeokpari [17] investigated the link between inventory management, control, and performance in Nigerian food and beverage firms. This study emphasized the relative importance of the organization's inventory management decisions, as well as the consequences of such decisions on consumers. Customer satisfaction, on-time delivery, and order fulfillment are three major attributes that a third-party logistics provider considers when making inventory management decisions at a manufacturing company, according to the study. Olowolaju [18] studied the valid cause for SMEs in the food, textiles, wood, and metal products industries in South-Western Nigeria's inability to implement scientific inventory management systems. Due to a lack of skilled persons and inadequate data to develop inventory models, as well as a low degree of Information Communication Technology (ICT) in SMEs. The study found a significant gap between theory and practice of utilizing models in making inventory decisions in SMEs. In SMEs, the usage of inventory models, ratios, valuation, and processing in reaching acceptable conclusion was found to be very low, with the majority of decisions being made on the basis of rule of thumb and experience.

Some of the challenges to successful inventory management and control in Flour Mills Company were mentioned by Takim [19]. Manufacturing firms in Nigeria face challenges such as determining when to order and how much to order, as well as delivery times or delays in product or material supply, production interruptions, and stock outs of goods or materials during production. The average Flour Mills Company employee, according to the findings, lacked a theoretical and practical understanding of inventory management theories. Uyimadu and Anyibuofu [20] studied inventory management practices in manufacturing firms and used EOQ models to identify the order quantity (Q) that decreases total annual relevant inventory costs.

In the study of John et al. [21] the impact of inventory management methods on operational efficiency in five flour milling companies in Lagos, Nigeria were carried out. Some medium-sized flour milling companies in the study used a variety of inventory management methods, including the EOQ, EPQ, and ABC inventory model. The development of inventory management systems and policies was driven by changes in customer demand, industry practices, forecast predictions and assumptions, and manufacturing facility production capacity. Mean, Standard Deviation, Regression, and Correlation analysis were applied to investigate and evaluate the inventory management practices used. The ABC inventory model, continuous replenishment, EOQ, and EBQ were revealed to be the most common inventory management practices among flour milling companies, while VMI, JIT, Demand Forecast approach, and computerized inventory management were found to be the least common. In addition, the study reveals a link between inventory management processes and organizational performance in flour milling manufacturing firms.

Kanguru [22] studied the efficacy of inventory management techniques used by small, medium, and micro enterprises (SMMEs) in the Cape Metropole of South Africa. In this study, SMMEs were requested to fill out a structured questionnaire survey to determine the most popular inventory management practices, such as EOQ, JIT, ABC Analysis, and Rule of Thumb. According to the study, Rule of Thumb is the most common inventory-management method utilized by SMMEs. As a result, the study will assist SMME decision-makers such as business owners, warehousing facility owners, and supply-chain managers in improving inventory budgets, bulk buying, ordering techniques, stocktaking, inventory forecasting, warehousing facility use, barcoding, and inventory-related challenges, which they can then implement and maintain for improved profitability.

The impact of inventory management systems on the profitability of medium-scale food enterprises in Lagos, Nigeria, was explored by Oladejo and Ajala [23]. The study found a significant correlation between inventory management methods and profit performance in a sample of medium-scale food companies, implying that an effective inventory management strategy has a major impact on the profitability of the medium-scale food industry.

Kinyua [13] examined Kenyan consumer product producers' inventory management techniques and performance. The EOQ model, Vendor Managed Inventory, and Bar-coding had a greater influence on the operational performance of consumer goods manufacturing firms in Kenya than other inventory management practices investigated, according to the study. It was also discovered that the EOQ, VMI, and Bar-coding are more likely to benefit consumer goods manufacturing companies. Inventory management systems, according to the study, have a considerable impact on the operational performance of Kenyan consumer products manufacturing companies.

In another development, twelve inventory management techniques were listed by Aro-Gordon and Gupte [11], such as (i) setting up and monitoring various stock levels, (ii) creating accurate inventory budgets, (iii) using an automated inventory system, (iv) adhering to proper purchase procedures, (v) using the Inventory Turnover Ratio, and (vi) using the ABC inventory classification technique. (viii) bulk purchasing, (ix) (VMI), and (x) Inventory Control Personnel Outsourcing (xi) Software applications and (xii) Lead-time analysis and tracking system that may handle difficulties that are prevalent in warehouse and store operations across industries, as well as inventory management methods that vary depending on the size of the company, with cost effectiveness and space availability for scrutiny. The study found that by properly implementing current inventory management systems, practitioners may improve corporate service delivery by ensuring a regular supply flow and minimizing carrying costs.

Shen et al. [14] focused on the aspects that affect inventory management systems in a Chinese manufacturing firm, as well as the impact of supplier collaboration on supply chain optimization. Supply contracts, safety stock models, vendor-managed inventory, and postponement were identified as efficient and effective inventory management methods in the study, which provided practical assistance for overseas manufacturers in China.

Apmadu [24] examined the impact of inventory management systems on SMEs in the Cape Coast Metropolis. The study discovered that the most commonly used inventory management practices by SMEs in the Cape Coast Metropolis were information technology (IT), lean inventory systems, and strategic supplier partnerships, and that these practices had a significant impact on SMEs' asset return, return on investment, sales volume, and net profits.

Atnafu and Balda [8]examined the effect of inventory management approaches on the competitiveness and organizational performance of small and medium-sized firms in Ethiopia. EOQ, JIT, VMI, ABC analysis, and Forecasting are among the five primary characteristics of inventory management techniques that they identified using a Structural Equation Modeling (SEM) framework. According to the study, higher levels of inventory management practice will improve competitive advantage and organizational performance.

In a study of agro-allied enterprises in Southwestern Nigeria Olaleye et al. [25], inventory forecasting, investing more in production inventories, perpetual stock taking, centralized storekeeping, and bulk inventory buying practices were examined. For agro-allied businesses, the ABC inventory system, Bin card, EOQ, JIT and MRP were determined to be the most appropriate inventory management techniques. MRP, EOQ, and Bin Card are the most prominent approaches. Demand forecasting, inventory accuracy, inventory loss, lead time, and ordering cost are the key variables of inventory management in agro-allied firms. Low physical assessment of raw materials at the point of delivery, a lack of information from the production planning and inventory control officer, space constraints, environmental factors, and raw material non-availability were also identified as major barriers to implementing effective inventory management practices, according to the study.

According to Sbai et al. [26], multi-echelon inventory management is related with a number of inventory policies. As a result, determining the most appropriate inventory management policies for a distribution system becomes a concern, and an AHP technique is proposed to aid decision makers (DMs) in selecting among multiple viable distribution systems that meet their preferences and needs. According to the study, a combination of a continuous review policy, a decentralized decision system based on installation stock ordering policies, and safety stock allocation to downstream installations will benefit the Moroccan Ministry of Health, with customer service and product availability as key criteria. The proposed framework of AHP technique becomes a simple and effective MCDM for supply chain management domains.

In Ghana's metropolises of Accra, Tema, and Kumasi, Opoku et al. [27] studied the impact of inventory management methods on the operational performance of manufacturing companies. According to this study, manufacturing firms in Ghana implement Strategic Supplier Partnership (SSP) and Activity Based Costing (ABC) practices, which have an impact on material management costs, product quality, production speed, reliability, production cost, and flexibility. The study also discovered that in Ghana, the practice of JIT inventory management is not frequently used and is the least desired among industrial enterprises. According to their research, SSP, Activity Based Costing (ABC), JIT, MRP, VMI, and EOQ are all associated with improving operational performance levels of Ghanaian manufacturing firms.

Other related studies have been carried out in the food manufacturing industries within undeveloped economies by Okopu et al.[6]. Food processing firms in developing economies like Ghana adopt techniques like EOQ, SSP, and Activity Based Costing (ABC). According to this study which used a quantitative approach in the form of descriptive statistics, JIT was indicated as the strategy with the least utilization. They pointed out that these solutions gave food processing companies in Ghana a variety of options for inventory management.

The modeling technique was utilized to examine inventory control in supply chain management (SCM) Gupta et al. [12] In this study, the standard deviation (SD), safety stock (SS), EOQ, Re-Order Point (ROP), and total inventory cost (TIC) are calculated to correlate a link between two corporate models and the EOQ of their preferred model for lowering inventory costs. The proposed EOQ model will aid inventory control in minimizing total holding and reordering costs, as well as determining the appropriate inventory level of the production system, which will be beneficial from both a practical and management perspective.

The available literature revealed that the majority of scholars concentrated on inventory management practices in SMEs such as the food, textiles, wood, and metal products sectors, as well as Agro-Allied and Consumer Goods. With the focus of this study on food processing companies, little or no studies have been reported in literature where large Scale Enterprises were considered to the best of the authors' knowledge. The objective of this study is to consider both Large Scale Industries and Small and Medium Scale Enterprises (SMEs).

3.0 METHODOLOGY

3.1 Analytical Hierarchy Process (AHP)

The analytic hierarchy process is a multi-criteria decision-making model that includes both qualitative and quantitative factors and is based on pair-wise comparison, which results in a recommendation based on expert judgment [28]. It is a technique used to aid in the decision-making of complex situations and is to make parity comparisons to measure the importance of each element (process variables) within hierarchies [29].

According to Taha [30], it is a prominent method for making decisions under uncertainty in which subjective judgment is rationally quantified and then used as a basis for making a decision. It's also designed for situations in which the thoughts, attitudes, and emotions that drive decision-making are quantified in order to offer a numerical scale for ranking options. According to Ernest and Saul [31], it is a method for organizing, measuring, synthesizing, and resolving multi-criteria decision issues. The methodology includes natural pairwise comparisons of objectives and alternatives.

It is one of the most well-known multi-criteria decision making (MCDM) strategies to assist in the complex task of finding the optimal option from a range of available criteria [3]. According to the study of Pérez Verarga [32], decision making in inventory management from multi-criteria techniques has proved to discover the best criteria to classify and control the inventory based on the opinions of the stakeholders participating in the process.

The AHP approach [3–4], [33–35] has the following steps:

Step 1: Make a criteria matrix: Make a hierarchical model or break down the decision into a list of objectives, criteria, and options.

Step 2: Make pairwise comparisons between criteria: To establish their weights, the importance of each criterion is compared pairwise to the desired goal.

Step 3: Determine the criteria's local priority (preferences): Determine the importance of each criterion separately. (i.e., pairwise comparisons of each criterion).

Step 4: Determine Overall Alternatives Priorities: The best option is the one with the highest overall priority.

Step 5: Implement sensitivity analysis.

Step 6: Make a Final Conclusion: Based on the overall priority results and sensitivity analysis, a decision can be reached.

The AHP was implemented on data obtained from food processing industries in Lagos State, Nigeria according to the above enumerated procedures for inventory criteria and techniques, through one hundred and fifty (150) questionnaires from thirty-five (35) junior managers, hundred (100) senior managers and fifteen (15) top managers. Among the respondents are fifty-five (55) from age range of 21-30 years, fifty-seven (57) from age 31-40 years, twenty-five (25) from age 41-50 years and thirteen (13) from age 51 years above, which amounted to ninety-seven (97) males and fifty-three (53) females as depicted in **Table 1** and were solved using Spice Logic Software. As a result, the focus of this study is on using AHP to choose the best available inventory techniques for food processing industries from among EOQ, MOQ, ABC Model, FIFO/LIFO, JIT, Batch Tracking, Safety Stock Inventory, Re-order Point Formular, Cycle Counting, Perpetual Inventory Management, Consignment, and Vendor Management Inventory.

TABLE 1: Background Information

POSITION	TOP MANAGER	MIDDLE MANAGER	JUNIOR MANAGER
	15 (10%)	100 (66.7%)	35 (23.3%)

AGE	21-30	31-40	41-50	51-ABOVE
	55 (36.7%)	57 (38%)	25 (16.7%)	13 (8.6%)

GENDER	MALE	FEMALE
	97 (64.7%)	53 (35.3%)

Source: Authors

4.0 ANALYSIS AND RESULTS

Step 1: Develop the Matrix Criteria

The following Table 2 is the matrix criteria established for this study based on the size of organizations' food processing industries.

Step 2 and 3: Pairwise Comparisons of Criteria and Criteria Priorities

Table 3 shows the pairwise comparisons, scoring weights and relative priority of the criteria used for this study.

If the consistency ratio is not satisfied (CR < 0.1), the judgments should be evaluated until they have an acceptable consistency index value, according to Razente et al. [29]. However, the consistency ratio is satisfactory (as -24.6%, normalized to 0.00 % by the spice logic software) The consistency index is (-0.3957) and Radom Index (RI) is 1.6086 from the matrix value of 17

Step 4: Derive Overall Priorities of the Alternatives
Table 4 is the overall priorities of inventory alternatives through the spice logic software.

Table 2: Establishment of Matrix Criteria

Goal	Select best inventory technique
Criteria	Accuracy
	Cost
	Stock-Out
	Fraud
	Time
	Delivery
	Storage Space
	Product Types & Features
	Efficiency
	Nature of Production System
	Customer Satisfaction
	Trained & Qualified Staff
	Effective of IT system Used
	Organizational Factors
	Process Capability
	Process Recurrence
	Characteristics of Manufacturing System
Alternatives	EOQ
	MOQ
	ABC Model
	JIT
	FIFO/LIFO
	Batch Tracking
	Safety Stock
	Re-Order Point Formular
	Cycle Counting
	Perpetual Inventory Management
	Consignment
	Vendor Managed Inventory

Sources: [7–8, 11, 36–37]

Table 3: The Pairwise Comparison, Criteria Scoring Weight and Relative Priority

Criteria	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	Relative Priority
A	1.00	6.00	0.20	5.00	1.00	0.20	5.00	6.00	6.00	7.00	0.20	1.00	7.00	6.00	6.00	7.00	6.00	**7.68%**
B	0.17	1.00	0.17	0.20	0.20	0.17	0.20	5.00	1.00	6.00	0.17	0.20	6.00	1.00	5.00	7.00	6.00	**5.12%**
C	5.00	6.00	1.00	6.00	5.00	1.00	6.00	6.00	6.00	7.00	0.20	5.00	7.00	6.00	6.00	8.00	7.00	**9.77%**
D	0.20	5.00	0.17	1.00	0.20	0.20	1.00	5.00	5.00	7.00	0.17	0.20	6.00	5.00	6.00	7.00	6.00	**6.54%**

Criteria	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	Relative Priority
E	1.00	5.00	0.20	5.00	1.00	0.20	5.00	6.00	5.00	7.00	0.20	0.20	7.00	5.00	6.00	7.00	6.00	**7.38%**
F	5.00	6.00	1.00	5.00	5.00	1.00	5.00	6.00	6.00	7.00	0.20	5.00	7.00	6.00	6.00	8.00	7.00	**9.77%**
G	0.20	5.00	0.17	1.00	0.20	0.20	1.00	5.00	5.00	7.00	0.17	0.20	6.00	5.00	6.00	7.00	6.00	**6.54%**
H	0.17	0.20	0.17	0.20	0.17	0.17	0.20	1.00	1.00	6.00	0.17	0.17	6.00	1.00	5.00	6.00	5.00	**4.5%**
I	0.17	1.00	0.17	0.20	0.20	0.17	0.20	1.00	1.00	6.00	0.17	0.17	6.00	1.00	5.00	7.00	6.00	**4.91%**
J	0.14	0.17	0.14	0.14	0.14	0.14	0.14	0.17	0.17	1.00	0.14	0.14	0.20	0.17	0.17	5.00	0.20	**2.29%**
K	5.00	6.00	5.00	6.00	5.00	5.00	6.00	6.00	6.00	8.00	1.00	5.00	7.00	6.00	7.00	6.00	7.00	**11.05%**
L	1.00	5.00	0.20	5.00	5.00	0.20	5.00	6.00	6.00	7.00	0.20	1.00	7.00	6.00	6.00	7.00	6.00	**7.99%**
M	0.14	0.17	0.14	0.17	0.14	0.14	0.17	0.17	0.17	5.00	0.14	0.14	1.00	0.17	0.20	6.00	1.00	**2.84%**
N	0.17	1.00	0.17	0.20	0.20	0.17	0.20	1.00	1.00	6.00	0.17	0.17	6.00	1.00	5.00	7.00	6.00	**4.91%**
O	0.17	0.20	0.17	0.17	0.17	0.17	0.17	0.20	0.20	6.00	0.14	0.17	5.00	0.20	1.00	6.00	5.00	**3.78%**
P	0.14	0.14	0.13	0.14	0.14	0.13	0.14	0.17	0.14	0.20	0.17	0.14	0.17	0.14	0.17	1.00	0.17	**1.80%**
Q	0.17	0.17	0.14	0.17	0.17	0.14	0.17	0.20	0.17	5.00	0.143	0.17	1.00	0.17	0.20	6.00	1.00	**3.14%**
SCORING WEIGHT	**11.52**	**7.68**	**14.66**	**9.81**	**11.07**	**14.66**	**9.81**	**6.75**	**7.36**	**3.43**	**16.57**	**11.98**	**4.26**	**7.36**	**5.67**	**2.70**	**4.71**	**CR = -24.6% (0.00%)**

Table 4: OVERALL PRIORITIES OF ALTERNATIVES

Option Name	Priority
EOQ	44.34209
MOQ	44.34209
ABC MODEL	42.52791
JIT	43.48179
FIFO AND LIFO	44.18311
BATCH TRACKING	43.13905
SAFETY STOCK INVENTORY	44.34209
RE-ORDER POINT FORMULAR	42.52791
CYCLE COUNTING	43.32281
PERPETUAL INVENTORY MANAGEMENT	42.84587
CONSIGNMENT	43.16383
VENDOR MANAGED INVENTORY	42.68689

Step 5: Sensitivity Analysis.

The Figures 1, 2, 3, 4, 5, 6 and 7 are the sensitivity analysis performed for the study.

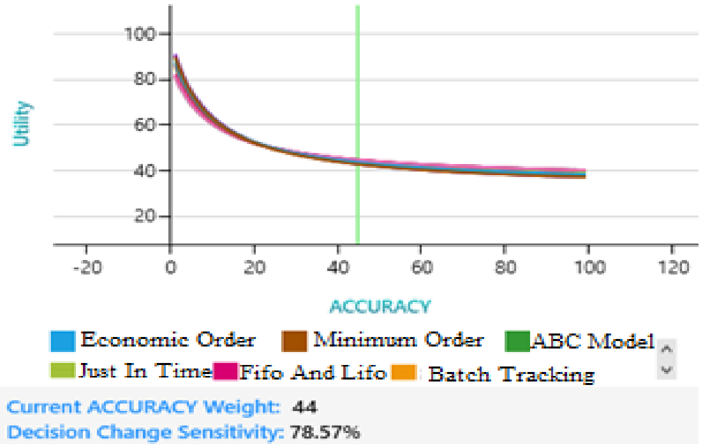

Fig 1: Sensitivity analysis for Accuracy VS Stock Out for all Alternatives

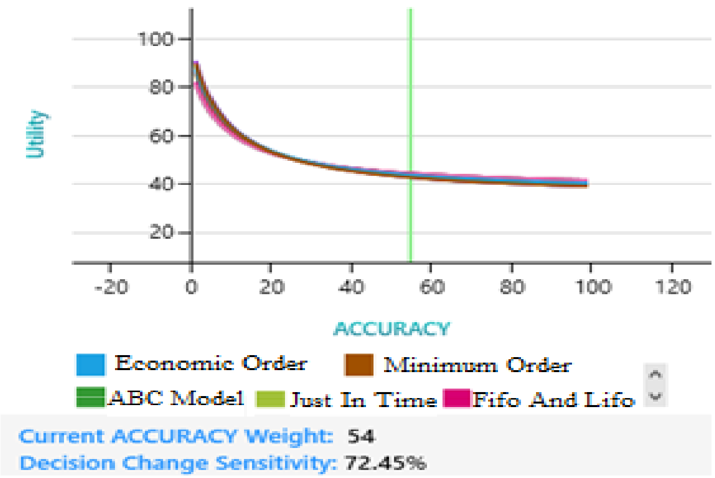

Fig 2: Sensitivity analysis for Accuracy VS Storage Space for all Alternatives

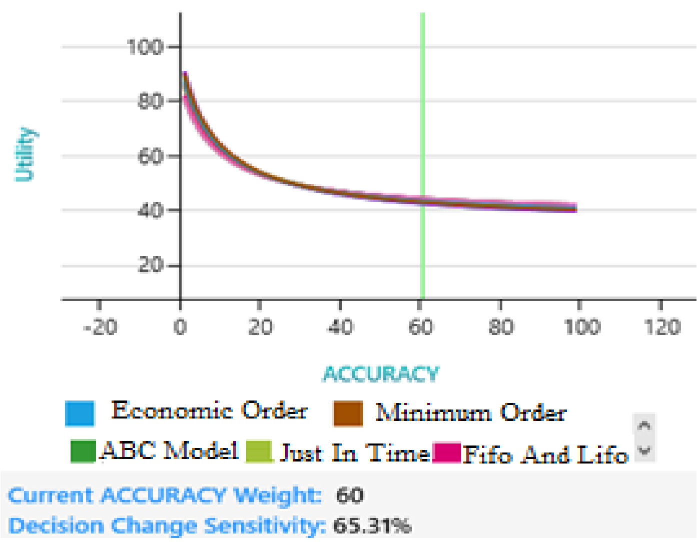

Fig 3: Sensitivity analysis for Accuracy VS Cost for all Alternatives

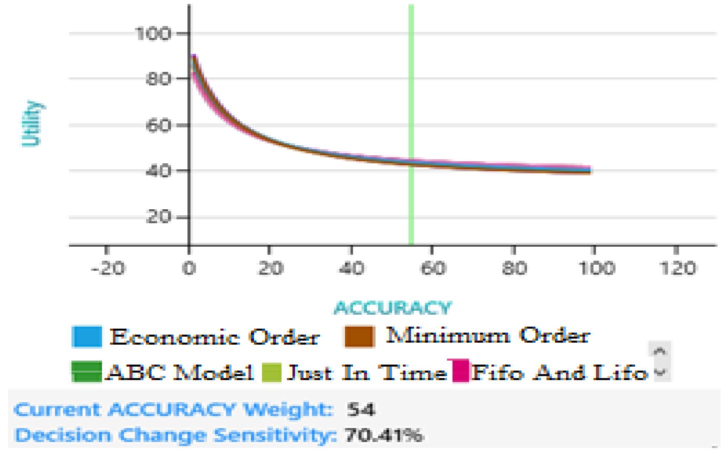

Fig 4: Sensitivity analysis for Accuracy VS Fraud for all Alternatives

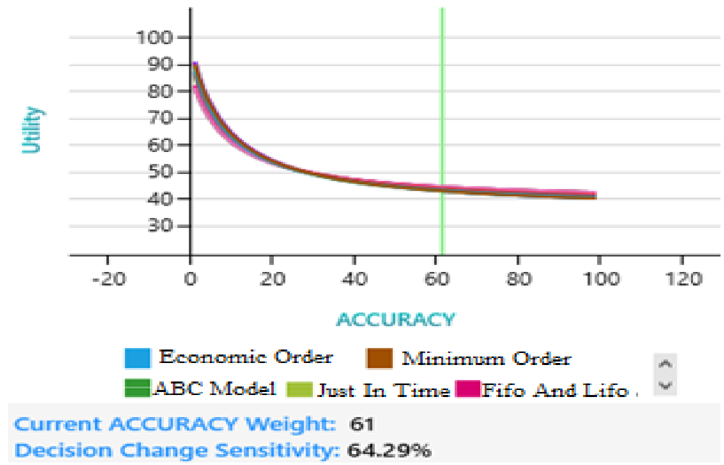

Fig 5: Sensitivity analysis for Accuracy VS Organizational Factor for all Alternatives

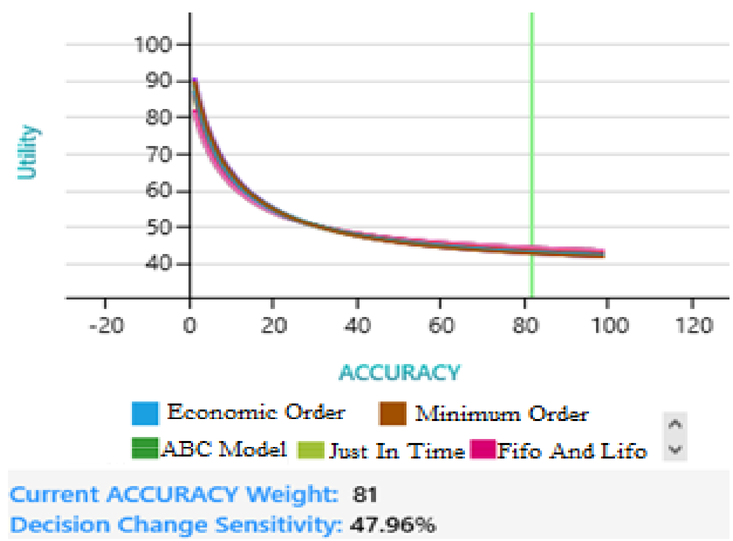

Fig 6: Sensitivity analysis for Accuracy VS Problem Recurrence for all Alternatives

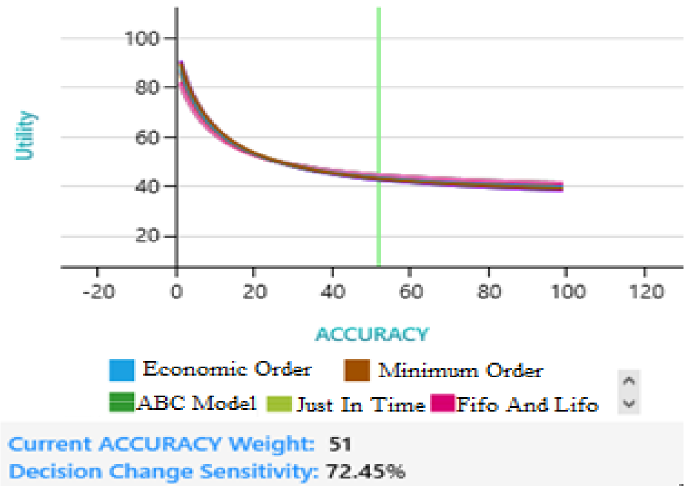

Fig 7: Sensitivity analysis for Accuracy VS Time for all Alternatives

5.0 DISCUSSION

Table 3 shows pairwise comparison of seventeen key criteria with their scoring weights and relative priority based on the AHP steps, with six of the criteria for the food processing industries having a high relative priority of 11.05 % for customer satisfaction, 9.77 % for stock out, 9.77 % for delivery, 7.99 % for trained or qualified staff, 7.68 % for accuracy, and 7.38 % for time. Customer satisfaction, stock out, delivery, trained or qualified labor, accuracy, and time criteria revealed how crucial they are to enhance the prevention of understocking to avoid permanent customer losses, improve order fulfilment, reduce lead times, provide a well-organized warehouse, improve productivity and efficiency, customer loyalty, improve the skills, knowledge and capabilities of staff which will enhancing their overall efficiency, quality performance and reduction of inventory wastes in food processing industries.

Table 4 depicted the overall priorities of inventory alternatives for food processing industries, as well as the relative efficiency/priority of each alternative: 44.34209 for EOQ, 44.3409 for MOQ, 42.52791 for ABC Model, 43.48179 for JIT, 44.18311 for FIFO &LIFO, 43.13905 for Batch Tracking, 44.34209 for Safety Stock Inventory, 42.52791 for Re-order Point Formular, 43.32281 for Cycle Counting, 42.84587 for Perpetual Inventory Management, 43.16383 for Consignment and 42.68689 for Vendor Managed Inventory. EOQ, MOQ, FIFO/LIFO, and Safety Stock Inventory have higher comparative efficiency/priority than other alternatives, and are therefore recommended as the best inventory alternatives for food processing firms in Lagos State, Nigeria. The selected best inventory alternatives will assist the inventory management practitioners to know the optimum purchase quantity that will be enough/adequate to meet the needs and prevent capital hindrance in the inventory, improves cash flow, reduce inventory costs, better profit margins, improve relationships with supplies, tracking current stock levels accurately by taking into account present and future market situations, to correlate the present costs against current return or profit, to minimizes losses generated by obsolete and perishable stock.

5.1 Sensitivity Analysis

There are two scenarios considered for the sensitivity analysis.

5.1.1 Scenario 1: Low Percentage.

There are low percentages of change needed to alter the decision in Figures **1, 2, 3, 4, 5** and **7.** The low percentages of decision changes are 21.43% in Figure **1** for accuracy against stock out, 27.55% in Figure **2** for accuracy against storage space, 34.69% in Figure **3** for accuracy against cost, 29.59% in Figure **4** for accuracy against fraud, 35.71% in Figure **5** for accuracy against organizational factor and 27.55% in Figure **7** for accuracy against time are highly sensitive in inventory management practices for food processing industries because of little or less percentage of change. The percentages of decision changes are determined or derived as thus, 100 – X, "where X means percentage of change required in the current value of the variable to alter the decision" 100 subtracted from decision change sensitivity in Figures **1, 2, 3, 4, 5** and **7** respectively.

5.1.2 Scenario 2: High Percentage.

The decision change for accuracy against problem recurrence in Figure **6** is 52.04%. Because, the percentage of change required to alters the decision is high, the problem recurrence criterion is very less sensitive in inventory management practices for food processing industries.

Therefore, accuracy is an important criterion in selecting the right inventory techniques. The results of the sensitivity showed that the proposed model is robust.

6.0 CONCLUSION

An AHP model was used to identify the optimum inventory management practices in food processing industries in Lagos State, Nigeria, and Spice Logic Software was used to solve the problem. The study shows that EOQ, MOQ, FIFO/LIFO and Safety Stock inventory techniques are the best inventory management practices for food processing industries because they have the highest overall utility or comparative efficiency than other techniques. The customer satisfaction, delivery, stock-out, trained or qualified staff, accuracy and time are identified as the criteria that influenced the inventory management techniques for food processing industries.

Hence, food processing industries in Lagos State will enjoy or derive benefits such as better food safety, improved customer satisfaction, helps compliance with food safety regulations agency, quantity ranges for orders, improve productivity, increase inventory turnover, absorb the variability of customer demand and buffer to protect organizations stock-outs.

It's imperative to note that the output judgment is based on the data source provided, which can be viewed as a blueprint of preference and alternatives based on the degree of relevance acquired for the various criteria while analyzing the comparison judgements. To put it in another way, the AHP technique enables us to identify which alternative is most compatible with the considered criteria and the weight assigned to them.

From the results of this study, the AHP application would be best considered for use in a number of industries and business establishments, with inventory managers and practitioners acquiring proper training. The study was conducted in Lagos State, but a similar survey should be conducted in other states and industries other than food processing. The recommended best inventory techniques for food processing industries are capable of lowering inventory costs and maintaining good inventory management practices due to the increased volume of inventory in an organization's assets.

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