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DEPARTMENT INDUSTRIAL ENGINEERING

Title of the thesis : balancing product distribution and minimize inventory cost by supply chain techniques (the case of MOHA Soft Drink Company in Mekelle)

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Declaration

We declare that the work, which is being present in this thesis entitled to improve distribution and minimize inventory of product by supply chain techniques in MOHA soft drink company Mekelle is our original work. The work is done under the guidance of INS; leake w/bezgi the project is submitted to ETHIOPIA INSTITUTES OF TECHNOLOGY   MEKELLE (EIT-M) at the Department of Mechanical and Industrial Engineering for the fulfillment of the degree program in Industrial Engineering Department. The thesis work uses all of the data and material required that are collect from the case company and from other necessary information resource in the agents and customers.

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I

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Abstract

Even though MOHA Soft Drink Company is one of the famous and competitive advantages company in Ethiopia. The cost, unbalanced distribution product and waste are specially negatively affect the distribution and Sales department.

This research investigates the effectiveness of supply chain management techniques in inventory level about Economic Order Quantity (EOQ), Just-In-Time (JIT), and Balanced Product Distribution. to improving the product distribution system at MOHA Soft Drink Company in Mekelle, Ethiopia. The study focuses on seven representative agents out of the 80 operating within mekelle city, analyzing current distribution inefficiencies and proposing optimized models. To use the balanced distribution in the seven agents and to minimize the cost.

The index customer's method is balanced the number customer with the number of quantity in the selected agents. The EOQ model is the optimal inventory level was calculated. The major findings of this study reveal that company can save about 624959.4 birr per month from seven agents by minimizing inventory waste. As a result, for the seven agents would able to reduce their overall total cost from 2,367,653.4 to 1,752,693.6 birr that means 26.4 % of the total cost was reduce The findings reveal substantial cost savings, reduced waste, and improved product flow using these techniques.

Table content

FIGURE

Table

LIST OF ABBREVIATIONS

EOQ: Economic order quantity

TC: Total cost

JIT: Just in time

D: Demand

Q: Quantity

SCM: Supply chain management

IC: Index customer

OC: Ordering cost

HC: Holding cost]

GPS: global position system

ROR: Reorder point

FMCG: fast-moving consumer goods

WIP: work in process

Chapter one

Introduction

1, 1 Back ground of the company

 MOHA soft drinks industry is a private company which owned by Mohamed Hussein Al Amoudi. It was established on 2005E.C with capital of 108,654,000 birr. And through gradual process February 15, 2007 was graduated and starts its regular process with the efficiency of filler machine 36,000 bottles per hour. MOHA soft drinks industry produces five flavors of soft drinks these are (7 up, Miranda orange, Miranda apple, Miranda tonic, Pepsi). The company is now one of the leading producers of carbonated soft drinks in Ethiopia. The machines are come from different abroad countries and planted by union engineering company designers and technical. There is one line that is glasses bottle line, it produces about 36,000 per hour and the annual turnover of the company. Mekelle MOHA soft drink industry distributes its products for local customers mainly to the whole Tigray region and southern parts of Amhara in addition same party of afar region.

The company has developed an extensive distribution network across Ethiopia. It relies on both direct delivery and indirect distribution through wholesalers and retailers. The literature suggests that while the company has managed to penetrate most urban markets, it faces significant logistical and infrastructural challenges in rural areas due to road conditions and transport availability. Research by Tadesse (2018) and Gebremedhin (2020) highlights inefficiencies in fleet management, route planning, and warehouse operations that impact timely delivery and cost-effectiveness.

Figure 1 MOHA soft drink company mekelle plant overview

1, 2 Background of the Study

In today's competitive global market, the efficiency of product distribution has become a key determinant of organizational success. The supply chain is the backbone of modern commerce, encompassing the entire flow of goods, services, and information from raw material suppliers to end consumers. Supply Chain Management (SCM) is the strategic coordination of business functions—procurement, production, transportation, and distribution—with the goal of improving long-term performance and creating customer value. As markets become more dynamic and consumer expectations grow, improve supply chain processes, especially product distribution, is critical for organizational competitiveness and sustainability.

Product distribution—the final yet vital phase of the supply chain—involves the movement of finished goods from manufacturing facilities to distributer or retailers. This function plays a key role in ensuring product availability, minimizing lead times, and reducing operational costs. According to a Gartner survey (2022), over 60% of supply chain leaders ranked distribution efficiency as one of their top five priorities for improving customer satisfaction and profitability. To address the complexities of distribution, companies increasingly rely on supply chain optimization techniques such as Economic Order Quantity (EOQ) and Just-In-Time (JIT).

Balanced transportation focuses on designing cost-effective and timely distribution routes that optimize the allocation of goods across different destinations. It ensures that supply meets demand at the right place and time while minimizing transportation costs and to solved the scarcity of the products to meet the retailer. Economic Order Quantity (EOQ) helps organizations determine the most efficient order quantity by minimizing the combined cost of ordering and holding inventory. This model is widely used in sectors like retail and manufacturing, where stock outs and overstocking can be costly.

Just-In-Time (JIT) inventory systems aim to reduce inventory holding costs by receiving goods only as they are needed in the production process or to meet immediate customer demand.

These methods, when integrated effectively within a supply chain framework, can significantly enhance product distribution by reducing delays, minimizing costs, and improving responsiveness to market demands. The optimization of product distribution through supply chain techniques not only strengthens internal operations but also enhances the end-to-end customer experience.

This study aims to investigate the application and integration of supply chain optimization techniques—specifically balance distribution products , EOQ, and JIT—in the context of product distribution. The goal is to identify best practices and develop strategic insights for building more resilient, efficient, and adaptive distribution .

Figure 2 for ready to distributed products for all agents

1.3 Problem Statement

In the competitive manufacturing industry, MOHA Soft Drink Company faces significant inefficiencies in its product distribution. The analysis of seven agents in Mekelle shows ordering costs ranging from 205,943 Birr up to 360800 Birr per month, with uneven distribution of products—some agents receiving up to 2,186 crates more or less than required. The lack of a balanced distribution system leads to overstock, understock, and waste. Furthermore, specific waste categories, such as transportation delays and overproduction, contribute to an estimated 624,959.4 Birr in avoidable monthly costs. These quantifiable inefficiencies highlight the need for strategic intervention using supply chain optimization techniques like EOQ, JIT, and customer-indexed distribution.

1.4 Objective of the study

1.4.1 General objective

The main objective in the research is balancing product distribution and minimize inventory cost by supply chain techniques in the MOHA soft drink company.

1.42 Specific Objectives:

To evaluate the current product distribution process and quantify inefficiencies in inventory, cost, and customer satisfaction.

2. To apply the Index Method to balance product allocation based on customer demand across selected agents.

3. To implement and assess the Economic Order Quantity (EOQ) model to minimize inventory holding and ordering costs.

4. To identify and reduce waste types in the distribution chain using Just-In-Time (JIT) strategies.

5. To compare the performance of the existing system with the proposed supply chain techniques and quantify improvements in cost and efficiency.

1.5 Research Questions

1. What are the current challenges faced by the organization in its product distribution operations?

2. How can to balance the products distribution in all agents.

3. In what ways does EOQ influence inventory performance and order management in the distribution process?

4. How does the implementation of JIT affect inventory turnover and delivery reliability?

1.6 Scope of the Study

This study focuses on the balancing product distribution minimize inventoey cost at MOHA Soft Drinks Industry in Mekelle, with particular emphasis on the application of supply chain management techniques—balanced transportation, Economic Order Quantity (EOQ), and Just-In-Time (JIT). The study is limited to the company's distribution operations within the Mekelle area and its surrounding town. Where significant logistical challenges related to inventory management, delivery scheduling, and transportation cost efficiency have been observed.

The research examines the current distribution structure, identifies inefficiencies, and evaluates how the integration of the supply chain techniques can improve distribution performance.

1.7 Significance study

This study provides practical value to both the academic and business communities. For MOHA Soft Drink Company, it delivers a structured and data-driven road-map to enhance distribution efficiency and reduce supply chain costs. It also demonstrates the real-world application of EOQ, JIT, and balanced distribution techniques in an emerging economy context. For researchers and supply chain professionals, the study offers a replaceable model for analyzing and improving distribution systems in fast-moving consumer goods (FMCG) industries.

1.8 Limitations study

While the study yields useful insights, it is subject to certain limitations in MOHA soft drink Company in Mekelle region.

1. Limited Sample Scope: Only seven out of 80 agents in Mekelle were selected, which may not fully represent all distribution challenges across the entire network.

2. Geographic Focus: The study is specific to Mekelle town and may not reflect the logistics and demand conditions in other town where the company operates.

3. Data Reliability: The analysis is dependent on the accuracy and availability of historical sales and cost data from the selected agents and the company are not pure and specified data is stored per month. We have not apply the EOQ MODEL and all cost sum in per month.

4. Time Constraints: The research was conducted within a limited time-fram, which restricted broader data collection and long-term monitoring of results. Shortage time to analysis the data and other exit exam is influenced .

5. External Factors: Market conditions, political stability, and infrastructure challenges in Ethiopia could influence the practical implementation distribution of the product in all places.

 Future research could address these limitations by expanding the sample size, incorporating multiple geographic regions, and conducting longitudinal studies to validate the long-term impact of the techniques.

CHAPTER TWO

Literature review

2.1 Introduction supply chain management.

Different authors have defined supply chain management in different ways. For example one author has defined the supply chain management as follows. Supply chain management is a network or chain of facilities and distribution options of products, the transformation of these products into intermediate and finished goods, and the distribution of these finished goods to customers (Luc Wijffels and Philip Woodall,(2016) Supply Chain Management 3rd edition. involves managing the flow of materials from suppliers to customers in order to reduce overall cost and increase responsiveness to customers. Reidand Sanders and As Reid (2011): hand book of global supply chain network. The network of entities that are involved in producing and delivering a finished product to the final customer is known as supply chain. The objective is to have everyone in the chain work together to reduce overall cost and improve quality and service delivery. Supply chain management requires a team approach, with functions such as marketing, purchasing, operations, and engineering all working together. This approach has been shown to result in more satisfied customers, meaning that everyone in the chain profits. The supply chain encompasses all activities associated with the flow and transformation of goods from the raw materials stage to the end user (along with the associated information flow). For Robert and Ernest (1999), Supply Chain Management is the "integration of these activities" through improved supply chain relationships, to achieve a sustainable competitive advantage

The basic objective of supply chain management is to optimize performance of the chain to add as value as possible for the least cost possible (Sahoo and Mishra, Matiwos .2013) SCM 1st edition ''the objective supply chain management is to maximize the overall value generated, minimize the cost, effective and timely distribution of products needed by ultimate customers''. Managerial efforts are directed towards setting the level of the logistics activities so as to make products and services available to customers at the time and place required, and in the condition and form desired, in the most profitable and cost-effective way.

2.1.1 Supply chain

The SC is a sequence of decision making and execution processes (materials, information, and finance flows that aim to meet final customer requirements, which take place without and between different strategies along a continuum from production phases to final consumption.

Supply: is focused on the raw materials supplied to manufacturing, including how? When and, from what location? The power of the suppliers has an impact on the supply chain operational activities and conveniences of the system.

A supply chain is a set of organizations directly linked by one or more of the upstream and downstream flows of products, services, finances, and information from a source to a customer. Chain consists of all stages involved, directly or indirectly, in fulfilling a customer request. The supply chain not only includes the manufacturer and suppliers, but also transporters, warehouses, retailers, and customers themselves.(Chopra, Sunil, and Peter Meindl, 2003). SCM, 1st edition ''strategy, planning and operation''

The main stages typically include:

- ❖ Suppliers who provide raw materials

- ❖ Manufacturers who convert these materials into finished products

- ❖ Warehouses and distribution centers that store and move inventory

- ❖ Retailers who sell products to end customers

A supply chain is a network of facilities and distribution options that performs the functions of procurement of materials, transformation of these materials into intermediate and fi noshed products, and the distribution of these finished products to customers. (Ganeshan and Harrison, 3rd edition (2018) production operation management).

2.1.2 Supply chain techniques

Supply chain techniques refer to the structured methods, tools, and strategies used to manage and optimize the flow of goods, services, information, and finances across the entire supply chain—from raw material sourcing to final delivery to the customer. These techniques are applied to improve efficiency, reduce costs, enhance responsiveness, and increase the overall competitiveness of a supply chain. More explain the techniques such as network design , inventory models, forecasting and distribution of transportation are defined (sunil chopra and peter meindle, 2nd edition 2019)

2.1.2 Factor affect supply chain distribution products MOHA soft drink company

1, Many routes in and around Mekelle suffer from limited road quality and maintenance, affecting delivery reliability and increasing vehicle wear and fuel cost.

2. Lack of advanced demand forecasting tools leads to mismatch between production and market needs, causing stock outs or overproduction.

3. Ethiopia's fluctuating fuel prices and periodic shortages impact distribution costs and schedule predictability.

4.Government transport regulations, regional conflicts, or checkpoint delays can significantly impact product flow.

2.1.3 Benefits of Supply Chain Distribution at MOHA Soft Drinks (Mekelle)

1. Improved Customer Satisfaction

- ➢ Timely and reliable delivery ensures products reach retailers and consumers fresh, increasing customer trust and loyalty.

2. Reduced Operational Costs

- ➢ Optimized transportation routes and inventory levels reduce fuel usage, storage costs, and product waste.

3. Better Inventory Management

- ➢ Techniques like EOQ and JIT help maintain the right stock levels—avoiding overstocking and stock outs..

4. Enhanced Responsiveness to Market Demand

- ➢ A flexible and data-driven distribution system enables quick adjustments to changing market conditions.

2.2 inventory management in Supply chain

2.2.1 Inventory management

Inventory management plays a crucial role in ensuring the efficient and effective operation of supply chains. It involves the planning and control of stock to balance customer service levels with the costs of inventory. In modern global supply chains, managing inventory is a complex task that affects all stages — from raw materials and manufacturing to distribution and retail.(Steven Nahmias and Tava oslen. 7th edition (2015):production and operation analysis).The goal of inventory management in supply chains is to maintain an optimal balance between supply and demand. Excess inventory leads to higher holding costs and potential obsolescence, while too little inventory results in stock outs and lost sales. Effective inventory control requires coordination across the supply chain, visibility into demand patterns, and responsive systems that can adapt to changing conditions.As businesses increasingly operate in dynamic markets with fluctuating consumer preferences and global competition, the importance of responsive and integrated inventory systems has grown. Tools such as Just-in-Time (JIT) systems, and data analysis are commonly used to improve inventory decision-making.

2.2.2 Inventory in supply chain

Inventories serve as a buffer against uncertainties in demand and supply, enabling firms to decouple their operations and maintain service levels. In a supply chain, inventory is not limited to a single organization; rather, it spans multiple stages, including suppliers, manufacturers, distributors, retailers, and customers. Each stage may hold inventory in different forms — raw materials, work-in-process (WIP), finished goods, and spare parts.Managing these inventories efficiently is critical for cost reduction, service improvement, and risk mitigation. Poor inventory practices can lead to bottlenecks, increased lead times, and dissatisfied customers. Conversely, a well-managed inventory system can enhance supply chain agility and responsiveness.

2.2.3 Inventory Problems in Supply Chains

Inventory-related issues in supply chains can significantly affect performance and competitiveness. Some of the most common inventory problems include:

➢ Stock outs and Back-orders: When demand exceeds supply, stock-outs occur, leading to missed sales and dissatisfied customers. Back orders may be used to fulfill orders later, but this can affect service levels and customer loyalty.

➢ Excess Inventory: Holding too much inventory increases carrying costs and risks of obsolescence. This is especially problematic in industries with short product life cycles or high variability in demand.

➢ Inaccurate Demand Forecasting: Poor forecasts can lead to either overstocking or stock-outs. Accurate forecasting is essential for effective inventory planning and relies on reliable data and predictive models.

➢ Lead Time Variability: Uncertainty in the time it takes to replenish inventory from suppliers or manufacturers complicates inventory planning. Variability can result from delays in production, transportation, or customs clearance.

➢ Lack of Coordination: When different stages of the supply chain operate independently, they may make sub-optimal inventory decisions. Coordination and information sharing are key to optimizing inventory across the chain.

➢ Poor Inventory Visibility: Limited insight into inventory levels across the supply chain reduces the ability to make informed decisions. Technologies such as RFID, bar-code scanning, and cloud-based platforms are increasingly used to enhance visibility.

➢ High Holding and Ordering Costs: Balancing the trade-off between ordering in bulk (to reduce ordering costs) and holding inventory (which incurs storage, insurance, and depreciation costs) is a continual challenge.

2.3 Inventory model

Inventory models are mathematical tools used to manage stock levels and ordering strategies in a supply chain or business operation. The goal is to minimize the total cost of inventory, including ordering, holding, and shortage costs, while meeting customer demand effectively.

Model Type Description:

✓ Deterministic Models: Demand is known and constant over time.

✓ Probabilistic Models: Demand and/or lead time are uncertain.

Deterministic models are inventory models where all parameters (demand, lead time, costs) are known with certainty. These models are used when future conditions can be accurately predicted and remain constant over the time.

An inventory system is the set of policies and controls that monitors the level of inventory and determines what levels should be maintained, when stock should be replenished and how large orders ought to Inventory management techniques are essential for optimizing stock levels, reducing costs, and insuring that products are available when needed. Inventory management relates to the tracking and management

of commodities, which includes the monitoring of commodities moved in to and out of stock room location and reconciling of the inventory balances. (Ford W.Hotel angeling 1st edition. Inventory management ''Economic Order Quantity model (EOQ)'').

2.3.1 Economic order quantity model

Economic order quantity(EOQ) is the idea quantity of unites a company should purchase to meet demand while minimizing inventory .costs such as holding costs, shortage costs ,and ordering cost. This production scheduling model was developed in 1913 by Ford W. but it has been refined over time. EOQ is a company's optimal order quantity that meets demands while minimizing its total cost related to ordering, receiving and holding inventory.The economic order quantity (EOQ) formula has been used both in engineering and business disciplines. Engineers study on the EOQ formula in engineering economics and industrial engineering courses. Alternatively, business disciplines study the EOQ in both operational and financial courses. In both disciplines, EOQ formulas have practical and specific application in illustrating concepts of cost trade offs; as well as specific significance on inventory.

2.3.2 Optimizing Economic order quantity

In the article, "optimizing economic order quantity" focused on the economic order quantity mentions that today's leading technology; many companies are not taking advantage of inventory models. There are various software packages in aiding companies with inventory control, but if the data inputted are in exact, it may direct to poor result. In order to have the suitable results for any inventory model, acceptable product costs, activity costs, forecasts, history and lead time need to be in a place. As a result of bad data, companies have had experiences with some inventory model, which is the one reason they do not take advantage of the EOQ model.

2.3.3 Holding or carrying costs

Relate to having the items physically in storage. Costs include the cost due to interest, insurance, taxes, depreciation, obsolescence, deterioration, Spoilage, pilferage, breakage, and warehousing costs (heat, light, rent and security). They also include opportunity costs associated with having funds which could be used elsewhere tied up in inventory. Note that it is the variable portion of these costs that impertinent. The significance of the various components of holding cost depends on the type of item involved, although taxes, interest and insurance.

2.3.4 Ordering costs

The ordering cost is the costs of ordering and receiving inventory. They are the costs that vary with the actual placement of an order. These include determining how much is needed, preparing in voices, shipping costs, inspecting goods upon arrival for quality and quantity, and moving the goods to temporary storage. Ordering costs are generally expressed as a fixed dollar amount per order, regardless of order size. When a firm produces its own inventory instead of ordering it from a supplier, the costs of machine.

2.3.5 EOQ inventory formula

Sometimes peoples in the retail business or in the manufacturing industry do not know or do not understand what EOQ stands for and how it is used in this article, "the economic order quantity inventory formula" written by James A (roach, 2005).

EOQ, $Q^* = \sqrt{(2DS/H)}$ was; (EQ: 1)

N=   Q/D .... (EQ: 2)

T=365/N in days = 1/N in years or, T=Q/D .....(EQ: 3)

Were,

Q^*=optimal order quantity.

D=annual demand of product in quantity per unit time.

S=the product ordering cost

H=annual carrying cost per unit

i=carrying cost (interest rate)

T=optimal order interval

N=optimal order interval

2.3.6 Reorder point and safety

stock Reorder point (ROP) means the inventory level at which a new order should be placed to replenish the stock before it runs out. ROP uses to prevent stock outs and ensures continuous availability of products. Safety stock also extra inventory kept hand to guard against uncertainties in demand or supply. Safety stock is benefited acts as buffer against unexpected spikes in demand or delays in supply.

In determining the reorder point, the following three factors are needed.

- ➢ Demand-the quantity of inventory used or sold each day

- ➢ Lead time-time (in days)takes for an order to arrive when an order is placed

- ➢ Safety stock – quantity of inventory kept on hand in case there is a unpredictable event like delay in lead time or un expected demand.

If the demand is constant and the lead-time is known, then the reorder point is written as the following:

Reorder point (ROP) = daily usage*Lead time (in days)... (EQ: 5)Reorder point

Order quantity

Lead time   Time
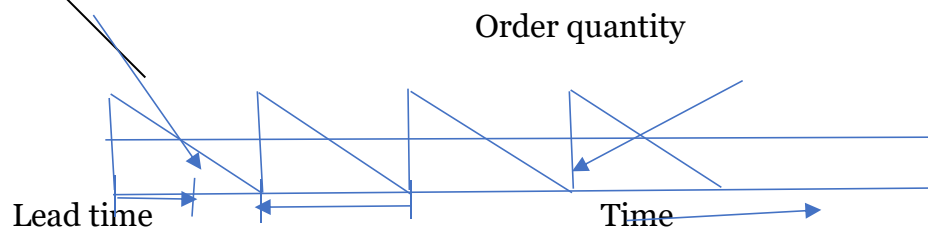
Figure 3 reorder point of EOQ model

2.4. Waste Distribution in Supply Chains

Waste (muda) refers to any activity or resource expenditure that does not add value to the final product or service. Properly identifying and classifying waste is the first step toward eliminating it. Waste is typically distributed across various stages of production, logistics, and business processes. It strives to eliminate sources of manufacturing waste by producing the right part in the right place at the right time. Waste results from any activity that adds cost without adding value, such as moving and storing of an item. It tries to provide the right part at the right place and at the right time.(Paul myerson.1st edition (2012):lean supply chain and logistics)

2 .4.1 just in time distribution techniques

 Just-In-Time (JIT) is a strategic inventory management technique aimed at reducing waste and improving efficiency by receiving goods only as they are needed in the production process. According to Potts (1986), and Banerjee and Kim (1995). ''JIT Manufacturing of change management in the university of lenden'' JIT is a philosophy directed towards the elimination of waste, where waste is anything which adds cost but not value to a product. It is a system driven by final product demand where each item is procured, manufactured, and delivered in the quantities needed JIT to satisfying demand in the next stage of the supply chain system or in the marketplace .

Inventory control by ordering products to arrive just in time as it is needed for sale. (T,C.Edain cheng.1st edition (1996):just in time manufacturing) JIT is a quality-control process aimed at reducing inventory costs. This method can benefit business by reducing average inventory and even improving customer satisfaction when stock outs do not occur. JIT inventory control is generally not sensitive to rapid changes in demand. While today's automated computer systems certainly facilitate a JIT system by maintaining a perpetual inventory, more information is needed to maintain an optimal inventory level and customer satisfaction.JIT is both a philosophy and a set of methods for manufacturing. JIT emphasizes waste reduction, total quality control, and devotion to the customer.

Types of Muda waste

Table 1the seven types of Muda waste

Name of waste	Impact on performance of an organization by eliminating
Transportation	Establish layout to minimize transport and handling
Inventory	Reduce the waste of stocks in all production areas (raw material, WIP, finished goods)
Motion	Study motion for improved economics, productivity and quality
Wait	Synchronize work flow and balance loads through flexible workers and equipment
Over process	Use value analysis production. Processing may be totally or partially unnecessary and capable of being eliminated.
Over production	Reduce setup time, compact layout and improve shop floor visibility
Defects	Build in processes to eliminate defects in the process.

2.5 Transportation distribution products

One of the main characteristics of transportation is the movement of products from production sites to the set destination, taking into account procedures that minimize costs and optimize resources. In this process, it should paid attention and care to reduce damages. In contrast, the operations must be performed in order to meet customer demands, observing the operational capacity of delivery and availability of transportation information. This process should be economically justified, since the movement of goods spent money, time and environmental resources.(Martin christopher.5th edition(2016): logistics and supply chain management) Transportation requires financial re-sources - in the form of internal costs for transportation of goods own rolling stock and external costs for this purpose commercial. Thus, function defines the main transport its goal - delivery of goods to their destination as quickly as possible, cheaper, and with the least damage to the environment. It is also necessary to minimize the loss and damage of goods transported while fulfilling customer requirements for timely delivery and to provide information about the goods in transit.

The transport involves with the movement of goods, routing and use of the operational potential of the vehicles. shows that the transportation system uses a number of methods for handling their raw materials or their final products, perceived as the higher cost of the distribution process, generally representing between 30% and 60% of distribution costs. Pipe, ship, rail and road are the modes of transport used in the petroleum products distribution. The method of transportation that is used to transport product is strongly influenced by demand, geographical barriers, the risks associated with different transport modes as well as the relative costs of transportation. In each case, the choice of transportation has its own strengths and weaknesses. Due to an increasingly competitive market, transportation operations are usually considered as one of the major bottlenecks in the oil industry. Thus, petroleum companies are eager to find ways to pursue efficient transportation schedules within their operational planning so as to organize their activities to achieve better competitive advantages. To efficiently manage the available resources is, in other words, to have their products at the right price, in the right quantity, at the right place and at the right time (Waleed K.Abduljabar and Razman M.Tahar,2011.; transportation optimization model '')

Shortage of trucks causes supply disruption. Supply disruption affects the normal flow of goods and materials within a supply chain. This caused firms within the supply chain to operational and financial risks. Transportation costs become critical components because products are distributed in a long distance with various vehicles and transited in many sites with different capabilities. Transportation costs are all the costs involved in the movement or transport of a shipment. Logically these costs have correlation factors such as, physical characteristics of goods delivered, goods delivery quantities, distance and the used transportation mode.

2.5.1 Warehouse

Warehousing can be defined as the process in which three main functions are accomplished: Receiving products from a source, storing products as long as necessary until they are requested (internally or externally) and delivering the products when they are demanded .Warehouses are a crucial part of supply chains, and their main role is to facilitate movement of goods through the supply chain. It is one of the most important levels of the supply chain, although, it is an activity of high Financial cost for companies. Thus, by improving its internal operations, the performance of the company is also improved. A good warehouse management is a prerequisite for achieving a high level of customer service (Ramaa.A,K.N.Subramanaya and T.M.Rangaswamy, 4th edition. 2012.'' Strategic logistics management ''). Another study indicated the process of warehousing involves a series of sequential activities, namely: reception of the goods put away, storage, order picking, sortation, unitizing and shipping.

Warehouse management should focus on ways to improve the efficiency of processes, both internal and external supply chain and continuous monitoring and evaluation of the results. It is necessary to allocate warehouse resources efficiently and effectively to enhance the productivity and reduce the operation costs of the warehouse. Warehouse costs are all the costs to management costs of the facility, material handling costs, labor costs, storage costs and maintenance cost.Warehouses help mitigate supply and demand mismatches by acting as buffers. They also support economies of scale by allowing bulk purchasing and production, which can then be redistributed in smaller quantities. Furthermore, strategically located warehouses reduce transportation costs and delivery lead times by positioning products closer to customers.

2.5.2 Distribution product

Distribution refers to the steps taken to move and store a product from the supplier stage to a customer stage in the supply chain. Distribution is the marketing function that ensures that goods and services are made available at the points of need, for the consumers. Concerned with making goods and services available in the right quantities and locations, when and where on demanded by customers.Which is focused, on ensuring that the products reach the end users on through an organized network of distributors, warehouse, and retailers? And also, according to (C. A. Da Silva and H. M. de Souza Filho, 2007. ;production distribution techniques '') include the producers of the products and its suppliers but also, can be depending on the logistics flows, transporters, warehouses in the phase of the production system, retailers and consumer themselves.

2.5.2.1 Balanced distribution products with customers

Defining a balanced distribution of product quantities and customers involves ensuring that products are distributed efficiently and equitably among all customers based on demand, location, and supply capacity. It's about avoiding situations where some customers are consistently over-supplied while others are under-supplied, or where the distribution doesn't align with strategic goals. (Philip, Kotler.7th edition. 1996; Principles of Marketing Management and Customer Segmentation in North western university).

A. Balanced Product Distribution

This refers to allocating product quantities in a way that Meets customer demand with Each customer receives the required quantity based on their historical or forecasted demand.

- ✓ Minimizes waste and shortages: Avoids overstocking or under-delivering.

- ✓ Optimizes transportation: Reduces fuel, time, and cost by planning optimal delivery routes.

- ✓ Ensures fairness: No customer is unfairly favored or underserved.

B. Customer Definition in Distribution

In the context of distribution and supply chain management, a customer refers to any entity that receives products from a supplier, manufacturer, or distributor. Defining customers correctly is essential to ensure efficient product flow and service delivery.

C. Balanced distribution the products with customers

The Step Index Method is a way to distribute products (or resources) fairly and efficiently among customers (or destinations) based on demand, availability, or priority.

There are some steps of about balanced distribution

1. To add all number of agents customers in the organization .

2. To add all quantity produced in the company

3. Index customer = for one customers agent /all customer agent of the company

4. The balanced quantity = the index customer * the total quantity produced in the company

5. to compare actual and balanced quantity.

6. Finally relocated the products in to customer

2.5.2.2 Relationship between Distribution and Demand

The relationship between product distribution and demand is interdependent and dynamic. Several factors define this relationship:

a) Demand Drives Distribution Decisions: High demand in a region leads companies to locate distribution centers nearby to reduce delivery time and cost.

b) Distribution Impacts Demand Fulfillment: A fast and reliable distribution network increases customer satisfaction and loyalty.

c) Inventory Positioning Based on Demand Forecast:Centralized vs. decentralized warehousing depends on the predictability and location of demand.

CHAPTER THREE

Methodology

3.1 INTRODUCTION

Research methodology is the steps to follow for studying or investigation symmetrically solve the research problem using various research methods. This is the research process which incorporates formulating the research topic, critically reviewing the literature, understanding the philosophy and approach, collecting data through primary data and secondary data collection methods, analyzing data using quantitative or qualitative tools, and presenting the findings. Accordingly, this part presenting the procedures that used in carrying out the research design, population and sampling techniques, and data collection methods and method of data analysis.

3.2 Research design

In this study, both quantitative and qualitative improve product distribution by supply chain method was utilized to identify the problems of inventory , distribution , waste and other factors that could influenced the effectiveness of supply chain techniques . As quantitative method is one of the descriptive survey design, which involve collecting data in order to answer the questions raised in the research. Moreover, quantitative methods use conceptual ideas from distribution techniques to reduce inventory, time, transportation and waste. It is expected to arrive at a deep understanding of how problem of distribution is done, and what factors influence efficiency and effectiveness of supply chain to reduce cost and time. More i balanced distribution product and customer techniques in the MOHA Company around Mekelle city.

3.3 Sampling techniques and sample size

Sampling is a key component of any investigation and involves serial considerations. The aim of most investigations is to obtain about total demand (D). IN MOHA soft drink company has around 80 agents or distributor. We selected seven agents in Mekelle town and to obtain the demand months.   To know the cost, time and waste difference the existing system and the proposed method, sample size of demand of the agent is different. Based on the given data to working by average per months of the demand.

3.4 Data collection methodology

 To conduct this study the analytical descriptive approach was followed, which is suitable to describe the study in depth. The study is performed in MOHA soft drink company   distribution and costing   department . It considering improve products distribution problem   that necessary data are collected by primary and secondary data.

3.4.1 Primary data Sources

3.4.1.1 Direct observation

Direct observation under taken about the all work product distribution in the sells and vehicle department. We have to see all product distribution in all agents. Based on the observation to selected seven agents in mekelle city. To observe data about waste, time, cost inventory and transportation problem to   the place agent in mekelle city are list below.

Figure 4Transportation distribution products in seven agent in mekelle city

1, kedamay weyane   4, Qihea   7, Ayder

2, Lachi   5, Hawelti

3, Adihaki   6, Hadinet

3.4.1.2 Interview

➢ To interview the sellers and vehicle ,finance and production managers'

➢ The driver of truck,FSR and ISUZI

➢ To interview the demand like super market, café, hotel and other public and private Sector in mekelle city.

➢ To interview the seven agents and employment of company as well as warehousing.

3.4.1.3 Questionnaires

Questionnaires were distributed to agents and company employees to collect structured data on inventory costs, distribution satisfaction levels, types of waste encountered , and customer service performance.

3.4.2 Secondary data

The case of company previous record and documents on the distribution data, cost inventory, transportation and other related data's. We tried to collect several written materials, detail recording, browsing related literature, articles and websites of different organization in order to understand, assess, analyze and examine the current status in the MOHA Soft drink company. Additionally, academic literature, journal articles, and books were reviewed to support the theoretical framework and methodology, focusing on supply chain techniques such as EOQ, JIT, and balanced distribution.

3.5 Method of data collection

Both qualitative and quantitative data analysis techniques were used in the study for the understanding and find out of the challenges faced and benefits obtained through implementation of improve products distribution . For quantitative analysis by excel, google sheet and also for qualitative analysis descriptive statistics.

CHAPTER FOR

RESULT AND DISCUTION

As it is stated before, the main objective of this study is to analysis and minimization of inventory waste to improve distribution and minimize the cost of the company.to achieve this objective: the data gathered from the company through questionnaires and company document to solve by different inventory management technique.

4.1 Interview, Questionnaire result and analysis

4.1.1 Data measurement

In order to be able to select the appropriate method of analysis, the level of measurement must be understood. For each type of measurement, there is an appropriate method that can be applied and no other. In this study ordinal scale can be used. Ordinal scale is a ranking or rating the data that normally uses integers in ascending to descending order. The number is used for high, medium and low.

4.1.2 Interview and Questionnaire analysis

Product distribution   was one of identified waste ,cost and un balancing products in the case MOHA soft drink company .so to understand and known more about supply chain of products in the company . , we randomly distributed questionnaire and interview of inventory related cost, balanced product for agents ,customers satisfaction ,about waste distribution of products , about warehousing cost   , driven trucks and FSR transportation and other related topics to the top management , managers of sells, finance and production , agents, customer in mekelle city of the MOHA soft drink company to know whether the inventory , product and waste is balanced or not. And the respondents were as the following table and bar chart.

Respondent's frequency sex

Table 2 gender of respondent persons

gender	Number of responding	Percent %
Male	45	74
Female	16	26
Total	61	100%

Respondents of interview and questionnaire

Table 3 respondent for interview and questionnaire in and outside of company

Questioned	High	Medium	Low	Number of respondents
Balanced distribution products in mekelle city	4	5	2	11
Inventory cost	3	2	0	5
Customer satisfaction	8	10	5	23
drivers of truck and FSR about distribution of transportation	2	3	1	6
Agent warehouse cost	3	4	1	8
Waste products distribution in the company and outside of company	4	3	1	8
Total	24	27	10	61
Percent %	39.3 %	42.2 %	16.5%	
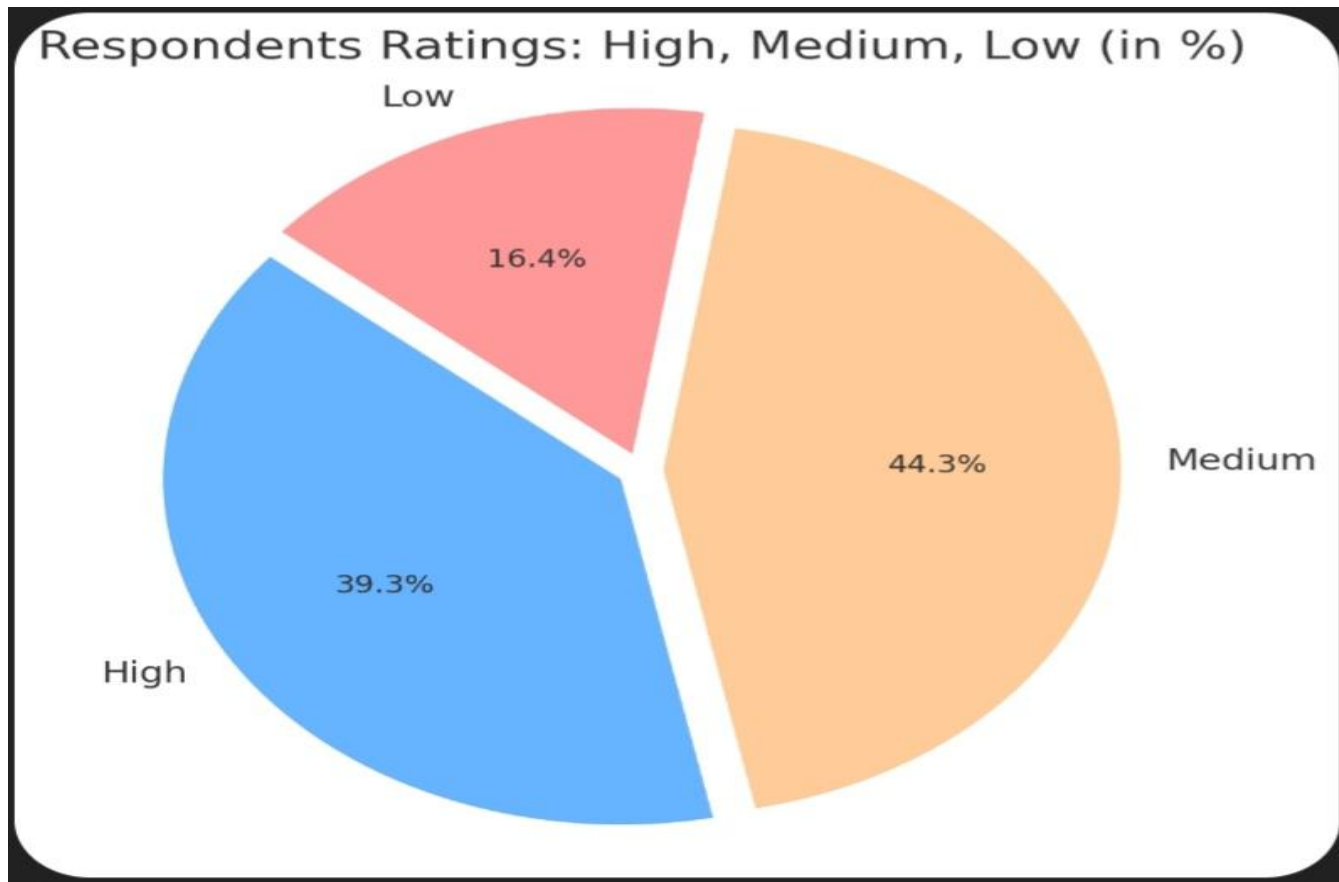
Figure 5 pie chart of respondent persons

4.2 Analysis Existing data

4.2.1 Analysis of existing inventory by EOQ model

Economic order quantity (EOQ) is a very important and necessary concept in determining the optimum order for quantities needed. In this analysis, the following values were considered as per of data obtained. The cost involved in inventory model are established from the company's

Operational information and data as follows;

❖ Constant demand(D) for each agents

❖ Carrying cost per month is 100000 birr for one agents = for one crates per month = total carrying cost/total number of crates.

Ordering cost per order is for one crates is 41 birr . Ordering cost per order = cost one crates * total order crates per months.

❖ Number of order one per months.

Seven Agents were selected out of 80 agents that we have got from company manual data. The selected seven agents are analyzed to know the cost difference between existing system and the proposed method. The selection of seven agent out of 80 is selected in mekelle city. Which may consume a lot of time, energy and resources to analysis, their costs? To overcome the problem the following agents are selected from the population of 80 agents for cost analysis.

Table 4 historical data the seven agent about cost

Name of agent's	unit of the quantity	Number of customers per month	On average monthly demand of quantity	Holding cost per monthly in birr	Ordering cost per order in birr	Total cost in birr
Kedamay weyane	Crates	7200	8800	11.36	360800	410784
Ayder	-	7150	8700	11.49	356700	406681.5
Adi haki	-	6023	7642	13.085	313322	363319.785
Hawelti	-	7078	6928	14.43	284048	334033.52
Hadinet	-	5700	6400	15.625	262400	312400
Qihea	-	6500	5720	17.48	234520	284512.8
Semen (lachi)	-	6800	5023	19.9	205943	255921.85
Total		46451	49213			2367653.455

4.2.2 Analysis unbalanced distribution

The distribution of products in MOHA soft drink company is distributed the products in all place of Tigray and some part of Afare as well as Amhara. The products are move by different type cars like truck, FSR, isuzi and other. The company is distributed products in to 80 agents .we have selected seven agents in Mekelle city placed . In Mekelle town is not equally distribution in the seven agents. Some agent is more products is stored in the warehouse and the other is scarcity of products. So based unbalance products the customers are unsatisfactory and other customers are over satisfaction .the number of customers per months are not to balance with demand quantity per months .The seven agents are distributed below the table .

Table 5 historical data distribution products in seven agents

Name agents	On average number of customers per monthly	On average quantity per monthly In crates
KEDAMAY WEYANE	7200	8800
AYDER	7150	8700
ADI HAKI	6023	7642
HAWELTI	7078	6928
HADINET	5700	6400
QIHEA	6500	5720
SEMEN(LACHI)	6800	5023
TOTALE	46451	49213

Figure 6: histogram of unbalanced distribution products

4.2.3 Analysis waste of distribution

In the MOHA soft drink company is different types waste is formed in the distribution sector. In general the waste are minimize by different techniques .from the product is produced in to customers delivered to formed waste. The different types of waste are classified in to seven or Muda techniques are used.

For all 80 types of agent we have selected seven agents in Mekelle town. To study about all waste in the agents and the department of selling of the company,

Table 6 historical data waste distribution inside the company and the agent

Types of Muda(waste)	Defined the impact on distribution products
Transportation	Excessive movement of products between the warehousing and agents leads to increased fuel consumption and time wastage
Inventory	Same are Overstocking agents or in the warehousing ties up capital and raises storage costs
Motion	Unnecessary movement of employment and equipment during or unloading products slows down distribution
Waiting	Lack of transport availability and agents side unloading reduce overall delivery efficiency
Over processing	Re-checking documents and unnecessary handling steps during distribution adds no value
Over production	Producing or dispatching more than the agents can sell result in unsold products spoilage and returns
Defects	Damage of bottles or cases during transit leads to customer complaints, financial losses and need for rework

4.3 Proposed method by supply chain techniques

4.3.1 Balanced distribution by index method

To apply the Index Method for balancing the distribution of the product among the seven agents of MOHA Soft Drink Company in Mekelle, we follow these some steps.

Step 1: Tabulate the Data

Table 7 The seven agents are number of customers and quantity per month

Name agents	On average number of customers per monthly	On average quantity per monthly In crates
KEDAMAY WEYANE	7200	8800
AYDER	7150	8700
ADI HAKI	6023	7642
HAWELTI	7078	6928
HADINET	5700	6400
QIHEA	6500	5720
SEMEN(LACHI)	6800	5023
TOTALE	46451	49213

Step 2: Calculate Index and balanced quantity for Each Agent

The Index Method uses:

Index for customers(IC) = (average customers per month /total customers per month) *100%

Balanced quantity (BQ) = index customers *total average quantity per month

Then adjust the target allocation based on average customers. Let's compute the distribution index (%) and expected balanced allocation:

- Total customers per month =46451

- Total quantity per month =49213 crates

Example for One Agent (KEDAMAY WEYANE):

Customers: 7200

Index customers = 7200 / 46451 = 0.155

Balanced Crates = 0.155 × 49213 = 7625.18

The others agents worked the same steps

Table 8 customer index and balanced quantity in crates

Name agents	On average number of customers per monthly	Customers index	Balanced quantity in crates=index *49213
KEDAMAY WEYANE	7200	7200/46451=0.155	0.155*49213=7625
AYDER	7150	7150/46451=0.154	0.154*49213=7581
ADI HAKI	6023	6023/46451=0.1296	0.1296*49213=6390
HAWELTI	7078	0.1524	7502
HADINET	5700	0.1227	6037
QIHEA	6500	0.1399	6889
SEMEN(LACHI)	6800	0.1464	7209
TOTALE	46451		49213

Step 3: Compare Actual Crates with Balanced Crates

Now subtract the actual quantity (given in your table) from the balanced quantity (we just calculated).

Difference =actual quantity -balanced quantity

The seven agent's difference below

For Kedemay weyane the actual quantity 8800 crates and The balanced quantity is 7625 crates.

Difference =8800 - 7625 =1175 crates

The other agent the same steps is calculated

Table 9 balanced distribution and difference the actual and balanced quantity in the seven agents

Name agents	On average quantity per monthly In crates	Balanced distribution crates	Difference the actual and balanced products in crates
KEDAMAY WEYANE	8800	7625	+1175
AYDER	8700	7581	+1119
ADI HAKI	7642	6390	+1252
HAWELTI	6928	7502	-574
HADINET	6400	6037	+363
QIHEA	5720	6889	-1169
SEMEN(LACHI)	5023	7209	-2186
TOTALE	49213	49213	0

Step 4: Reallocate Crates

Take extra crates from agents with positive differences (they have too much). The agents of Kedamay Weyane,Ayder,Adihaki and Hadinet.. are over access is move in to warehouse .Give to agents with negative differences (they have too little) . The agents of Hawelti,Qihea and semen are under supplied or scarcity is formed.
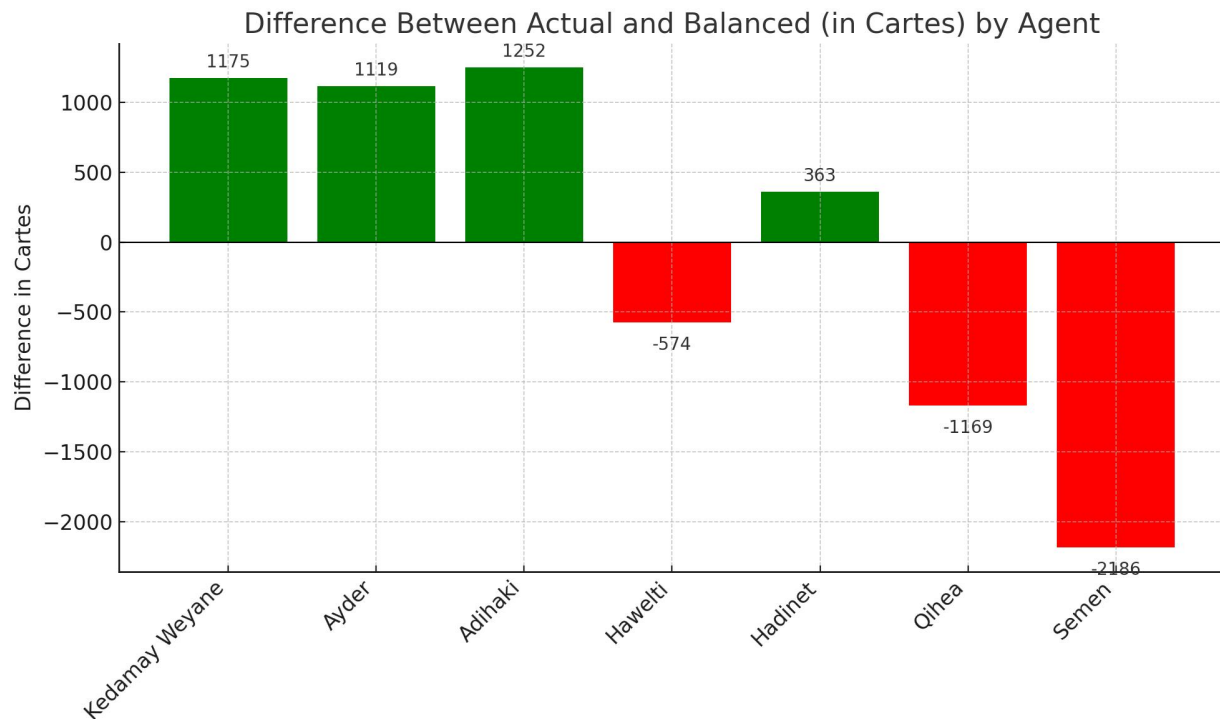
Figure 7 bar chart the difference between agents in crates

4.3.2 Balanced Distribution Using the Index Method

The Index Method was applied to distribute 49,213 crates of soft drinks fairly among the seven agents of MOHA Soft Drink Company in Mekelle, based seven agent's share of the total 46,451 customers.

From the analysis:

- ❖ Some agents like KEDAMAY WEYANE, AYDER, and ADI HAKI received more crates than they should base on their customer share. Others like HAWELTI, QIHEA, and SEMEN (LACHI) received less than their fair share.

- ❖ To correct this, we calculated a balanced (ideal) quantity for each agent using index. Then we identified how many crates should be reallocated (taken from over-supplied agents and given to under-supplied ones).

Final Outcome:

- Each agent ends up with a quantity proportional to their customer base.

- This ensures a fair, efficient, and customer-driven distribution of products.

- The overall supply (49,213 crates) remains the same; only internal adjustments are made.
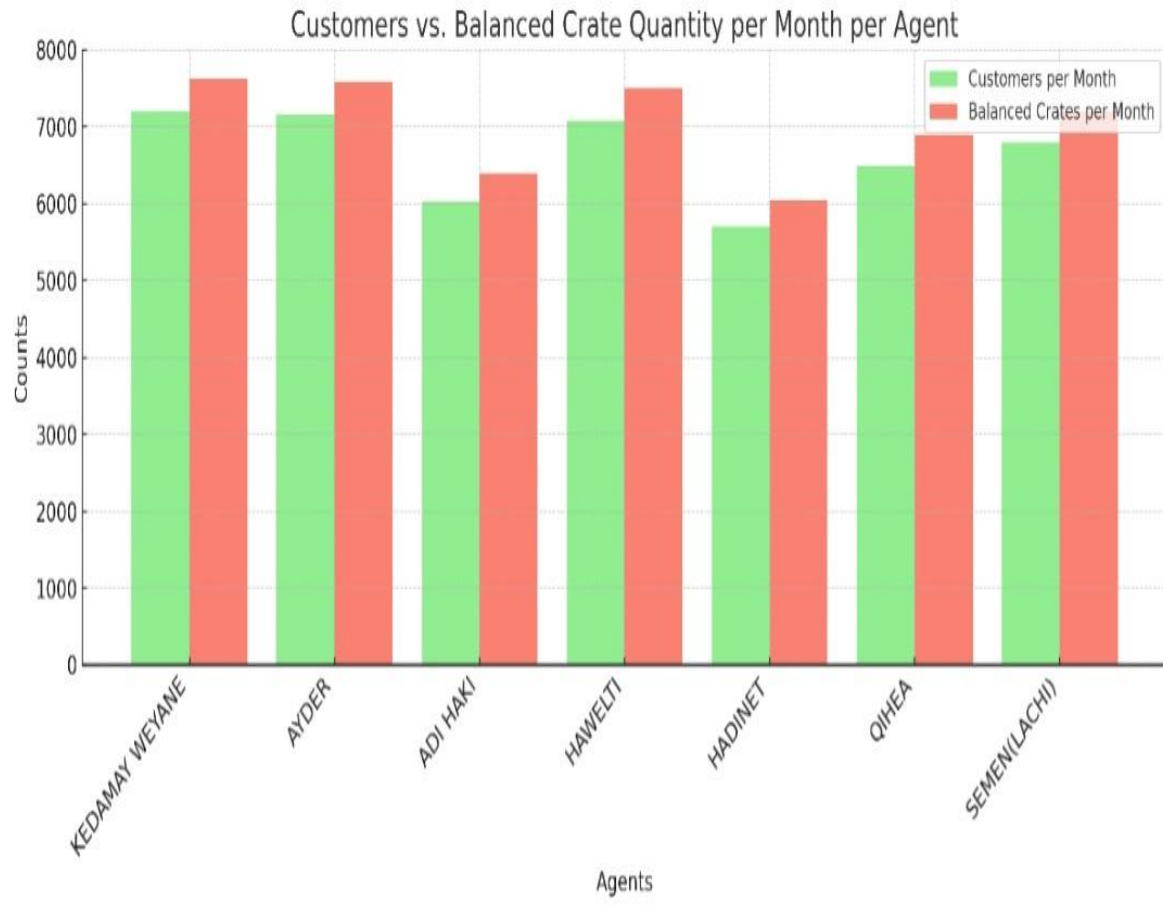
Figure 8Histogram of balanced distribution product in seven agent

4.3.3 Just in time techniques

To address the types of waste (Muda) listed in your above and implement Just-In-Time (JIT) techniques effectively at MOHA Soft Drink Company in Mekelle—particularly for distribution to the seven agents—you can adopt the following targeted solutions:

1. Transportation Waste

Cause: Excessive movement of products leading to fuel and time wastage.

JIT Solution: Optimize delivery routes using route planning software.

Implement direct delivery scheduling based on agent demand (daily or near real-time).

Use centralized dispatching from the main warehouse to prevent back-and-forth movement.

2. Inventory Waste

Cause: Overstocking at agents or warehouse raises holding costs.

JIT Solution: Establish a pull-based system where agents only receive products based on actual sales data. Implement real-time inventory tracking. Reduce batch sizes and deliver more frequently in smaller, demand-based quantities.

3. Motion Waste

Cause: Unnecessary movement of labor or equipment during loading/unloading.

JIT Solution: Standardize loading/unloading procedures. Train staff on ergonomic handling and use of equipment. Pre-packed orders at the warehouse to minimize handling at the delivery point.

4. Waiting Waste

Cause: Delays due to transport or unloading inefficiencies.

JIT Solution: Use a fixed delivery schedule agreed upon with agents. Assign time windows for unloading at each agent's site. Use smaller vehicles to make access easier and quicker if bottlenecks occur.

5. over processing Waste

Cause: Redundant checks and handling that do not add value.

JIT Solution: Digitize documentation and use electronic proof of delivery (EPOD).Conduct quality checks at key control points only. Eliminate manual processes where possible with automatic

6. Overproduction Waste

Cause: Producing or shipping more than agents can sell.

JIT Solution: Use demand forecasting tools based on agent sales trends. Align production with short-term distribution schedules. Involve agents in collaborative planning to adjust orders weekly.

7. Defects Waste

Cause: Product damage and breakage bottles during transport.

JIT Solution: Use protective packaging tailored for soft drink bottles. Train drivers and loaders on safe handling. Monitor and analyze damage reports for continuous improvements.

To Conclusion on JIT Implementation for MOHA Soft Drink Company in Mekelle

Implementing Just-In-Time (JIT) techniques in MOHA Soft Drink Company's distribution process to the seven agents in Mekelle can significantly reduce operational waste and enhance efficiency. By addressing the seven types of Muda—transportation, inventory, motion, waiting, over processing, overproduction, and defects—MOHA can:

- ❖ Improve delivery efficiency through route optimization and scheduled dispatches.

- ❖ Minimize excess inventory and associated costs by aligning production with real-time demand.

- ❖ Streamline handling and reduce delays using standardized, automated processes.

- ❖ Enhance customer satisfaction by reducing defects and ensuring timely, accurate deliveries.

Ultimately, JIT enables MOHA to be more responsive to market demand, reduce unnecessary costs, and build a lean, reliable distribution system that ensures product freshness and customer satisfaction.

4.3.4 Economic order quantity model

The economic order quantity (EOQ) model is a formula used to determine the optimal order quantity that minimizes the total cost of inventory management.

In MOHA company to use minimizes the holding cost and ordering cost in the seven agent in Mekelle town.

The terms EOQ MODEL list below

- ➢ The number of demand is constant

- ➢ Holding cost per month is the sum of tax, rent, insurance, sells persons, break bottles, employment and other works. For the existing some part is minimizes. The rent and sells persons or employment is minimizes. On average the total cost of holding costing per month is 85000 birr. The holding cost per crates = holding cost/total crates in month. So on average holding cost pet crates is 12 birr.

- Ordering cost is the cost of transportation, inspection ,employment , for connection of material, composition of drivers and other costs . Th sum all costs are per order is 70000 birr.

- The number of order is per weak or (4) per month.

- To balance the products distribution for the before data

Table 10 propose of the agents holding and ordering cost by EOQ

Name of agent's	unit of the quantity	Number of customers per month	On average monthly demand of quantity	Per crates Holding costing in birr	Ordering cost per order in birr
Kedamay weyane	Crates	7200	7625	12	70000
Ayder	-	7150	7581	12	70000
Adi haki	-	6023	6390	12	70000
Hawelti	-	7078	7502	12	70000
Hadinet	-	5700	6037	12	70000
Qihea	-	6500	6889	12	70000
Semen (lachi)	-	6800	7209	12	70000
Total		46451	49213		

Based on above table to solved the total cost

1, KEDAMAY WEYANE

 Ordering cost per order=89000 birr

Holding costing per crates = 12 birr

N(ordering number per month) =4

Q= (2SD/H)½

N = D/Q   Q or EOQ = D/N

Q=7625 /4 = 1906 crates

TC= QH/2 + DS/Q

TC = 1906*12/2 +7625*70000/1906

TC = 291472.7 birr

2, AYDER AGENT

D= 7581 crates   N = 4

Q = D/N   =7581/4 = 1895 crates

TC = HQ/2 + DS/Q

TC = 12*1895/2 +7581*70000/1895

TC = 291406.93 birr

So, the other remaining five agent can be solved by using micro soft excel placed in the below table.

Table 11 propose the selected agent of total cost by EOQ

Name of agent's	unit of the quantity	Number of customers per month	On average monthly demand of quantity	Per crates Holding costing in birr	Ordering cost per order in birr	Total cost i birr
Kedamay weyane	Crates	7200	7625	12	70000	291472.7
Ayder	-	7150	7581	12	70000	291406.93
Adi haki	-	6023	6390	12	70000	289669.66
Hawelti	-	7078	7502	12	70000	291324.6
Hadinet	-	5700	6037	12	70000	288920.9
Qihea	-	6500	6889	12	70000	290372.65
Semen (lachi)	-	6800	7209	12	70000	290850.8
Total		46451	49213			1,742,693.6

Therefore, overall cost of the proposed method is the sum of cost of each the seven agent in mekelle town.

The total cost of the existing and the proposed are:

Existing cost = 2367653.4 birr

Proposed cost = 1,742,693.6 birr

The saving cost = existing cost - proposed cost

The saving cost = 2367653.4 - 1742693.6

Saving cost = 624,959.4 birr

The percent of saving is =(saving cost/existing cost)*100%

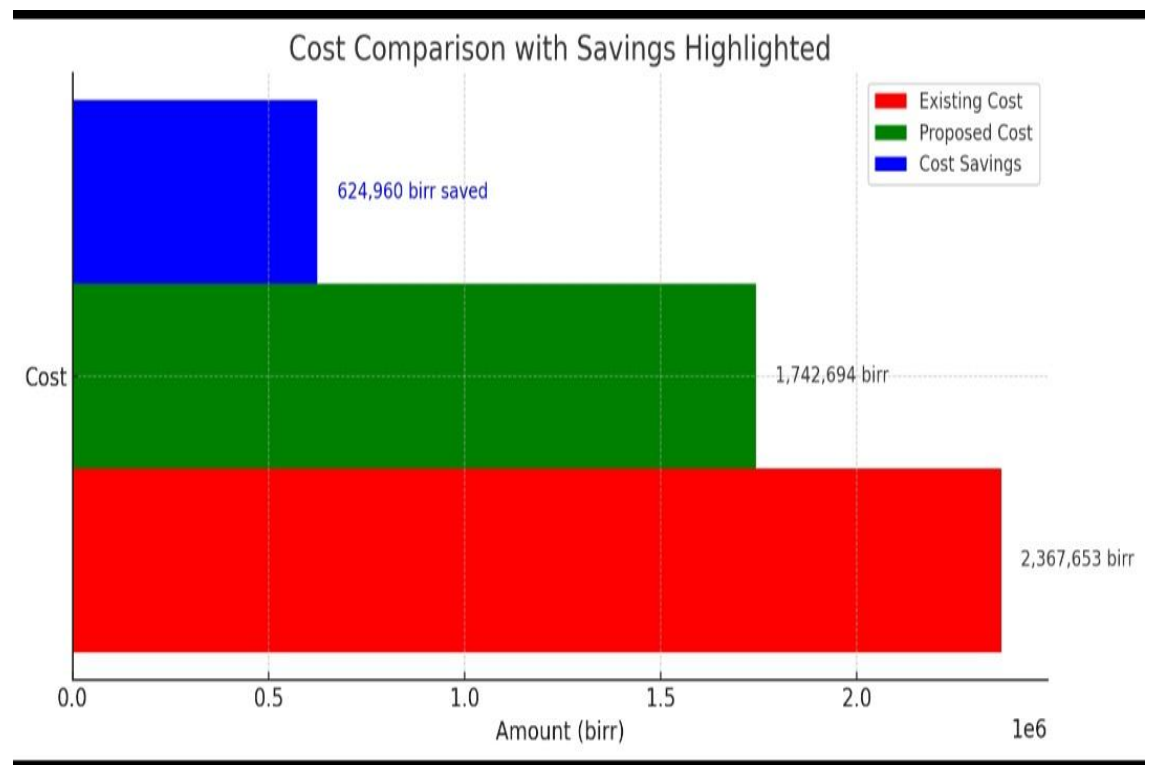Percent % = (624959.4/2367653.4)*100%

Percent % = 26.4%

Figure 9chart of cost comparison with saving,existing and proposed

The adoption of the Economic Order Quantity (EOQ) model for inventory and distribution across the seven agents in Mekelle demonstrates significant operational and financial improvement .Implementing the EOQ model has selected to a substantial reduction in inventory and distribution costs, proving it to be an effective strategy for:

✓ Minimizing holding and ordering costs by optimizing order quantities.

✓ Reducing overstocking and under stocking risks, which improves service levels to agents.

✓ Streamlining distribution frequency, avoiding unnecessary transportation and storage.

✓ Enhancing cash flow by tying up less capital in excess inventory.

Overall, the EOQ-based approach contributes to leaner inventory management and more efficient distribution, aligning well with JIT principles and positioning Moha Soft Drink Company for better competitiveness and profitability in Mekelle. Inventory models are fundamental tools in supply chain. Choosing the right model depends on demand variability, lead time, review frequency, and service level requirements. Proper inventory control helps ensure availability, minimize cost, and improve customer satisfaction.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIN

5.1 Conclusion

This study aimed to enhance the efficiency of product distribution at MOHA Soft Drink Company in Mekelle through the application of three key supply chain techniques: Economic Order Quantity (EOQ), Just-In-Time (JIT), and Balanced Distribution. By focusing on seven representative agents out of the 80 operating in Mekelle, the study identified significant inefficiencies in the company's current distribution and inventory management systems.

The implementation of the EOQ model resulted in a substantial reduction in total inventory-related costs, decreasing from 2,367,653.4 Birr to 1,742,693.6 Birr, thereby achieving a cost saving of 26.4%. This demonstrates the model's ability to optimize order quantities and balance ordering with holding costs.

The JIT approach further helped minimize waste across the distribution chain, targeting key areas such as transportation, excess inventory, motion inefficiencies, waiting times, overproduction, over-processing, and defects. As a result, lead times were reduced, operational efficiency was improved, and customer satisfaction was enhanced.

Moreover, the Balanced Distribution technique based on the Index Method ensured equitable allocation of products among agents according to their customer base. This addressed the problem of product overstocking in some locations and shortages in others, leading to more reliable product availability and better service quality.

In summary, the integration of EOQ, JIT, and Balanced Distribution techniques proved effective in creating a leaner, more responsive, and cost-efficient supply chain. These methods, if scaled company-wide, could significantly improve MOHA's overall distribution performance and competitive edge in the market.

5.2 Recommendations

To improve product distribution efficiency, MOHA Soft Drink Company in Mekelle can adopt several strategic supply chain practices. Based on a study of seven representative agents, the following recommendations are proposed:

1. Expand Supply Chain Techniques to All Agents

The successful application of EOQ, JIT, and balanced distribution among seven agents should be scaled across all 80 agents in Mekelle to maximize efficiency , balanced distribution and cost savings.

2. Use Real-Time Inventory Tracking

Implementing digital tools like barcode or GPS systems will enable better inventory visibility and support timely restocking decisions.

3. Train Staff in Modern Distribution Practices

Providing staff with targeted training on route optimization, inventory handling, and lean operations ensures smooth implementation and consistency.

4. Improve Collaboration with Agents

Regular communication and shared forecasting with agents will enhance demand accuracy and reduce overstock or shortages.

5. Continuously Review Distribution Strategy

Establish a system for periodic evaluation of distribution performance to identify areas for improvement and maintain operational agility.

By embracing these practices, MOHA Soft Drink Company can strengthen its distribution network, reduce waste, and enhance service quality across Mekelle.

Reference

1, Luc Wijffels and Philip Woodall, (2016); supply chain management 3th edition.

2, Reidand Sander, 2011 and AS REID (2011); hand book of global supply chain network.

3, Robert and Ernest, (1999) supply chain management the integration of the activity

4, Sahoo and Mishra, 2013 and Matiwos(2013) ; SCM 2nd edition 'the object supply chain management to maximize the overall value generated'.

5, Chopra.Sunin and Pieter neindl.2ndedition(2003);SCM, strategy,planning and opration 2n

6, Ganeshan and Harrison, 3rd edition (2018) ; production operation management,

7, Ford W, Hotel Angeling .1st edition. the production schedule models EOQ.

8, Potts (1986) and Banerjee and kim(1995). JIT Manufacturing of change management in the university of lenden.

9, Rodrigo, D., & Soliani, D. (2010).urban logistics and products distribution.

10, Waleed k,abduljabar and razman M.tahar (2011);transportation optimization of model.

11. Ranaa, A,k,N subramanaua and T.M rangaswany.(2012) strategic logistic management 4th edition, 'a good warehouse management pre request from achieving level customer service'

12. Philip, Kotler, (1996). _Principles of Marketing Management_, 7th edition, North Western University.

13.SCM and PPC TWO module or hand book of Mekelle university .

14.Jay Heize and Chuck Munson, 12th.(2017):Operations Management - Sustainability and Supply Chain Management,

15.Steven Nahmias and Tava oslen. 7th edition (2015):production and operation analysis.

16.Paul myerson.1st edition (2012):lean supply chain and logistics)

17.T.C.Edain cheng.1st edition (1996):just in time manufactring

18.Martin christopher.5th edition(2016): logistics and supply chain management.

19.Research by Tadesse (2018) and Gebremedhin (2020) : highlights inefficiencies in fleet management, distribution products, warehouse and transportation in MOHA company.

5

APPENDIX

APPENDIX A;

Questionnaire 1

Mekelle University

Ethiopia Institute of Technology-Mekelle (EIT-M)

Department of Industrial Engineering

BSc' thesis questionnaire on balancing product distribution and minimize inventory cost by supply chain in MOHA soft drink company in Mekelle plant .

(To agent)

The researchers make a study on " balanced distribution and minimize inventory products " for getting the BSc degree. The researchers imply this questionnaire to get the required data and information for acquiring the importance of wastes in agent unbalanced distribution and customer dissatisfaction to getting solutions to develop and improve these distribution.. The questionnaire consists of one pages directed to agent for the unique scientific purpose.

HINT: about waste which include seven Mudas namely but more focused on inventory, over-products, defect, transportation, delay and waiting. In addition about complain and dissatisfaction of the demand.

1. have you balanced the products in all agents? A. High   B. Medium   C. Low

2. 2.do have satisfied the customers by there are products ?

number	High	Medium	Low
K/weyane			
Ayder			
Adihaki			
Hawelti			
Hadinet			
Qihea			
Semen or lachi			

Questionnaire 2

Mekelle University

Ethiopia Institute of Technology-Mekelle (EIT-M)

Department of Industrial Engineering

BSc' thesis questionnaire on balancing product distribution and minimize inventory cost in MOHA soft drink company in mekelle.

(To distribution and financial managers, Operator and driven of the company)

The researchers make a study on "to balanced distribution and minimize inventory of product" for getting the BSc degree. The researchers imply this questionnaire to get the required data and information about inventory related cost for the waste that was identified in questionnaire one to know whether the ordering cost and carrying cost are balanced, the product are equal distribution in all agent with related number of demand to getting solutions to develop and improve inventory and distribution of products of the MOHA company.

The questionnaire consists of one pages directed to distribution and finance managers for the unique scientific purpose.

1. Do you believe that minimizing of inventory, wastes and balanced distribution can increase balanced distribution and satisfied the customers?

Yes ☐   No ☐

2. If your answer for question no 1 is "YES" to what degree to put the following response ?

List waste	High	Medium	Low
Transportation			
Delay			
Waiting			
Defects			
Over process			

Over production			
Motion			

3. If you have equal distribution products and inventory cost in the seven agents in Mekelle city?

List agent	High	Medium	low
K/weyane			
Ayder			
Adihaki			
Hawelti			
Hadinet			
Qihea			
Semen or lachi			

Interview Guide

Target: Managers, Warehouse Staff, Truck Drivers, Agents

Sample Questions:

1. What are the biggest challenges in the current product distribution system?

2. How do you currently decide the quantity of product allocated to each agent?

3. Are customer complaints common regarding product availability?

4. What methods are used to track inventory and delivery?

Field Observation Checklist

Objective: To assess the distribution, transportation, and inventory handling process.

Observation terms	Observed yes or no
Are trucks arriving/departing on schedule?	
Is loading/unloading done with minimal delay?Are crates well organized in the warehouse?	
Are crates well organized in the warehouse?	
Are product damages visible during handling?	

APPENDIX B;

Historical data the seven agent for the 80 agent of the company.

List	Kedamy weyane	Ayder	Adihaki	Hawelti	Hadinet	Qihea	Semen or lachi
November 2016 EC	9100	8500	7700	6900	6200	5500	4900
Desember 2016 EC	8700	8 800	7600	7000	6500	5900	5100

January -	8600	8500	7650	6800	6300	6020	5200
February -	9200	8900	7700	7100	6500	5700	4968
March -	8700	8700	7600	6900	6400	5600	4900
April -	8800	8800	7650	6649	6200	5900	5100
May -	8600	8600	7700	7000	6500	5800	5000
June -	8900	8800	7422	7100	6400	5600	4900
July -	8700	8700	7650	6950	6300	5700	5100
August -	8800	8600	7700	6800	6600	5500	5000
September 2017 EC	8900	8600	7600	7000	6400	5700	5100
October -	8600	8700	7650	6900	6500	5800	5000
November -	8800	8 800	7700	7050	6300	5600	4900
Desember -	8700	8700	7600	6800	6400	5900	5200
January -	9000	8600	7650	7000	6500	5700	5000
February -	8700	8900	7700	6950	6400	5600	5000
Total customers per month	7200	7150	6023	7078	5700	6500	6800