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Framework for Evaluating Inventory Health

Opeyemi E. Aro
Washington University in St. Louis

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ABSTRACT
Inventory health is one of the key aspects that most organisations seek to address when it comes to the supply chain since it plays a crucial role in numerous elements such as efficiency and profitability besides the impression the customer gets. In this paper, a detailed analysis of inventory health assessment is proposed, accompanied by the identification of crucial assessment indicators which include turnover rates, inventory accuracy, obsolescence percentage, and demand forecasting. The framework comprehensively links the conventional and advanced theories of inventory management systems with the practical applications, which makes the theory concrete and more suitable for different sizes of enterprises in different fields. By reviewing the current literature and case studies, this paper identifies potential factors needed for proper inventory management in achieving both low cost and high service level goals.

Keywords
Inventory management, supply chain, inventory health, turnover rate, stock accuracy, obsolescence, demand forecasting

I. INTRODUCTION

In the dynamic environment of supply chain management, increasing importance has been given to the effectiveness of inventories, thus; the need for an evaluation framework has emerged. Inventory to a greater extent is a key connector and the problem or solution link between various firms and departments within firms; strategic and tactical management of inventories within supply chains is a unifying factor, as pointed out by Frankel (2006). Inventory control is an essential element of productivity when it comes to managing the flow of goods in business organizations and, in general, the provision of supply chain. A good and efficient way of evaluation of the inventory health will yield better decisions, cut down costs and increased customer satisfaction. However, there is a research gap in this area in the sense that there is no single framework for companies to consider when examining and enhancing the state of inventory. This paper aims to fill that void by outlining a set of feasible strategies to capture standard inventory measures including accuracy levels, stock turn, and the impact of product obsolescence on operational costs.

Inventory management involves identifying, acquiring or producing, storing, and issuing materials and goods in a manner that best meets the organization's needs with regard to inventory and expected customer call-off. As reported by Zietsman & Vooren, 2022, It is crucial to find balance as a retail firm to meet the clients' needs on products while at the same time remaining financially stable. Assessing the health of inventory therefore entails assessment of the physical infrastructure of inventory system, the planning structure of inventory system, information architecture of inventory system as well as the organizational placement of the inventory system.

An important element of inventory health is the capacity to address issues of stock out conditions, the minimisation of the risk of unavailability of stock and the costs involved in managing the stocks (Zietsman & Vooren, 2022). It is, therefore, possible for firms to attain a low-cost strategy for inventory management and this results in business growth especially as observed among the Japanese firms as suggested by Gill et al., (2013).

In contrary to the general importance of inventory management, significant discussion is still uncertain how inventory health can be defined and measured. Other researcher has developed a diagnostic model, which analyzed as follows: process, planning, information, and organization (Vries, 2007). This framework stress on the interdependence of these Dimensions highlighting that the relationship between the Dimensions is very crucial on the Health of the inventory system. For example, a study of the case of inventory management assessment made by Plomp & Batenburg (Vries, 2007) provides that the assessment of inventory management is linked to its elementary process, all-encompassing planning, diverse information, and organizational dimensions.

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II. METHODOLOGY

This study employs a systematic approach to develop a framework for evaluating inventory health. The methodology is based on an extensive review of expert-reviewed articles, industry reports, and case studies from 2019 to 2023, with a focus on inventory management practices across various sectors, including retail, manufacturing, healthcare, and technology. The approach is designed to analyze key metrics that influence inventory health, such as turnover rate, stock accuracy, obsolescence management, and demand forecasting.

III. LITERATURE REVIEW

Inventory management theories including Economic Order Quantity (EOQ), Just-in-Time (JIT), and ABC analysis have been deployed to control stock. As pointed out by Harris (1913), EOQ marks the quantity of inventory order that helps in minimizing the cost both accumulated in holding inventory and in ordering inventory. In the same manner, as with Toyota identified by Ohno (1988), JIT reflects on a continuous effort to minimize the holding of stocks with a view to eliminating waste. However, these theories have a way of supporting inventory optimization in as much as they give little regards to a facility's overall inventory health from turnover, demand forecasts, and obsolescence.

A turnover rate is a key health rate of inventory that states the number of times an inventory turns over in a given period. This assesses the rate at which stock is restocked over a given timeframe: it gives the channel inventory demand (Cachon & Terwiesch, 2009). While stock accuracy guarantees that the stock taken on record corresponds to actual stock on the ground, it prevents issues of mismatches that can cause stockouts or overstocking to occur (Chopra & Meindl, 2016). Stock discrepancies are so common in most businesses that they can be attributed to theft, or damages that occur without any record being made. Another factor that has a bearing to the state of inventory is obsolescence, which is most appropriate for perishable goods or industries with technology products that have short useful lives (Fisher et al., 1994). Reduced obsolescence is achieved by having demand forecasts that predict the quantities to be ordered to ensure that the stocked amounts match future demand (Mentzer & Moon, 2004). Technological innovation and sophisticated statistical modeling in combination with machine learning have enhanced the absolute accuracy of demand forecasting, and thereby, of inventory management (Choi et al., 2018).

IV. PROPOSED FRAMEWORK FOR EVALUATING INVENTORY HEALTH

A well-structured framework for evaluating inventory health enables organizations to maintain optimal stock levels, reduce waste, and align inventory management with broader business goals. Here's a detailed, step-by-step guide to building an effective inventory health evaluation system, enriched with actionable insights and a robust understanding of relevant metrics.

1. **Determine what a good inventory health feels like:**

The first step in evaluating inventory health is defining what it means for your specific business. A one-size-fits-all approach does not work, as different industries and companies have unique inventory needs. For instance, an e-commerce company might prioritize quick turnover rates, tight alignment with demand forecasting, and minimal stockouts, while a manufacturing business might prioritize keeping strategic reserves of raw materials to buffer against supplier disruptions.

A business should start by envisioning what "healthy" inventory means within the context of its objectives, customer demands, and operating conditions. Hopp and Spearman (2000) defined inventory health in the manufacturing context with the parameters being waste minimization, the efficiency of the production line and managing supply chain fluctuations. On the other hand, e-commerce may particular emphasize on the avoidance of delivery times as well as correct range (Silver et al., p 98).

1. Identify Metrics to evaluate inventory management

For purposes of inventory management evaluation, it is always crucial for organizations to select and critically define key performance indicators relevant to their business agenda. The most familiar ones include Inventory Turnover, which shows how many times inventory stock is sold and reordered in given timeframe, and Vendor Lead Time, amount of time suppliers take to deliver goods which is effective in increasing stock availability and subsequent sales. Stock Management, especially through the evaluation of demand forecasting accuracy with the help of Mean Absolute Percentage Error (MAPE), is one of the critical business factors that helps to match stock to demand. Furthermore, Overstock and Understock are used to specifically assess the company's appropriateness of stock holding because excess or less inventory results to financial loss. Currently, there are more than 200 inventory metrics,

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including operational and financial ones, thus, the proper set must be chosen by business to prevent excessive amounts of information (Johnson & Davis, 2018). It is vital then to determine the correct set of these measures in order to manage the inventory and achieve the optimum stock and customer's demand**.**

2. **Deploy levers to evaluate priority metrics:**

From a financial perspective, a priority inventory metric should be positively correlated and directly causal to bad or good financial decisions. Determining the most relevant metrics requires the use of analytical tools and techniques. Regression analysis, for instance, can help organizations understand which inventory metrics are most closely linked to financial performance. For example, analyzing the relationship between vendor lead time and understock rates can reveal how much lead time impacts revenue.

By leveraging historical data on vendor performance, sales, and inventory levels, organizations can identify key performance drivers. Research by Olhager and Persson (2006) emphasizes that lead time uncertainty often increases the risk of stockouts, negatively impacting customer satisfaction and revenue.

However, correlation does not always imply causation. To establish deeper insights, businesses must also analyze decision-making inputs, such as procurement efficiency, the quality of demand forecasts, and the flexibility of their supply chains. A Multi-Decision Criteria Model approach can rank and prioritize metrics based on relevance to strategic goals (Kumar & Kumar, 2018).

3. Design drill-down mechanism:

Inventory analysis therefore requires the drill-down mechanism with which organizations can structure and analyze data in multiple levels and dimensions with the aim of arriving at accurate insights. These are SKU, color, size, target demographics, performance category, seasonality, age and location as these facets help break down inventory health analysis comprehensively. These dimensions assist in tracking stock turnover, pattern recognition, and also in management decision making. For example, tracking on the SKU level offers specific product positioning while demographic and seasonal data offer the right stock positioning. To perform this level of analysis one has to use more advanced inventory management systems, like ERP tools. When the drill down structure is developed, information can be leveraged into forming strategies on how inventory can be managed to the lowest cost possible meaning the carrying costs. Information regarding turnover rates, inventory stocks, supplier performance, and costs enables one to decide whether to reorder stock, or even decide whether to promote a certain product or simply remove it, bearing in mind that inventory must correspond with demand. Research shows that organizations using such multi-dimensional systems experience better stock rotation and operational efficiency (Smith, 2020; Williams, 2021; Kumar, 2019). Additionally, Modern inventory management relies more on digital platforms like the ERP systems, AI customer demand forecasting, IoT, etc. They further enrich the determination of the health state of inventories by offering updated constants to work with and the ability to make predictive calculations. AI tools can forecast the future inventory requirements by using the past consumption patterns, seasonal trends, and applicable market trends (Chae, 2020) at the same time IoT devices can monitor the condition of inventory at regular intervals and inform stakeholders when the inventory faces potential threats (Bhasin et al., 2022)

4. Form actionable insights:

It is important for an organization to quickly present information based on the current inventory accounts to determine inventory performance and prospects for changing it. This means performing routine assessments of factors like stocks, employee turnover, stock outs and overstock situations. Through these aspects, organizations find bottlenecks—too much inventory consumes capital or frequent stockouts cost sales. In the same way, specific information about a supplier's performance can identify reasons for a delay or an inconsistency in the stock supply, and optimization initiatives can uncover approaches to lower holding and procurement prices. It can be identified that the organisations which have adopted data-driven approaches in managing inventory enhanced the managerial decision process, control operational costs, and make inventory match demand (Smith, 2020; Kumar, 2019). Applying these insights assists in determining which actions will enhance demand forecasting, change the methods of replenishment or determine which products to promote, replenish or 'swap out' in order to support the strategic aims of the organisation.

V. CASE STUDIES

Case Study 1: Amazon - Data-Driven Inventory Health Monitoring

The large selling network coupled with the rapid delivery system employed by Amazon essentially means that inventory health is a critical parameter to continuously monitor and it is

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performed in real time with the help of robust framework involving use of machine learning techniques to evaluate the status of the stock. Through the use of demand forecasting that involves catching the customer buying signals, seasonality, and market trends hence; Amazon is able to predict the market demand so as to adjust its stock in proportion with demand. One tool used here is the inventory turnover rate which assists to recharge fast-moving products while removing the slow movers either by giving them discounts or phasing them out. Also, based on historical consumption data, automatic reordering systems ensure that stock is ordered before the set levels, therefore no stockouts. In consequence, Amazon has significantly decreased stockouts while increasing customer satisfaction, and optimized inventory turnover boosting cash flow and thus, future investments.

Case Study 2: Zara - Fast Fashion Inventory Management Framework

Zara, a fast fashion retailer, uses a low inventory stock approach, reacting to changes in demand patterns to keep replenishment frequencies high and assess inventory health based on a weekly schedule. Leading time is another area the framework seeks to enhance thus allowing for small production cycles that do not take a lot of time to take an idea to the store. By placing small batch orders, Zara ensures that inventory turns over quickly, keeping pace with consumer demand for new trends. Moreover, the system also selects liabilities from the product and deliver the product in the places where they are popular skipping the problem of idle stock. They have reduced the inventory holdings as faster stock turnover has reduced unsold or obsolete stock, and improved their ability to respond to demand, which has enabled Zara to charge higher prices and sell significantly less merchandise at lower prices, thereby increasing its margins of profit.

These case studies have demonstrated different forms of inventory health review process, from the use of data and automation, collaborative supply chain models and lean inventory strategies. Each framework assist the business to achieve a match between inventory management and demand, cut costs, and improve operational effectiveness.

VI. CONCLUSION

This paper puts forward a framework with an understanding of inventory health which involves critical inventory parameters including the turnover rate, stock accuracy, demand forecasting, and management of inventory obsolescence. This framework is industry-independent, and the changes recommended in this article serve as a helpful toolkit for enhancing Inventory Management Systems (IMS}. Further research could be conducted improving the demand forecasting models with real-time data feed and reporting and evaluating effects of new technologies, including block chain and IoT, on inventory health.

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