Smart Inventory Management System with Forecasting Technique Applied to Efficiently Handle Industrial Asset

Article *in* American Journal of Innovation in Science and Engineering · April 2023

DOI: 10.54536/ajise.v2i2.1384

4 authors, including:

Mosaddek Hasan Chowdhury
Notre Dame University Bangladesh
1 PUBLICATION **2** CITATIONS

SEE PROFILE

A. H. M. Saiful Islam
Notre Dame University Bangladesh
16 PUBLICATIONS **113** CITATIONS

SEE PROFILE

AMERICAN JOURNAL OF INNOVATION IN SCIENCE AND ENGINEERING (AJISE)

ISSN: 2158-7205 (ONLINE)

VOLUME 2 ISSUE 2(2023)

PUBLISHED BY
E-PALLI PUBLISHERS, DELAWARE, USA

American Journal of Innovation in Science and Engineering (AJISE)

Volume 2 Issue 2, Year 2023
ISSN: 2158-7205 (Online)
DOI: https://doi.org/10.54536/ajise.v2i2.1384
https://journals.e-palli.com/home/index.php/ajise

A Smart Inventory Management System with Forecasting Technique Applied to Efficiently Handle Industrial Asset

Mosaddek Hasan Chowdhury[1*], Tasfia Ahmed[1], Md. Bayazid Rahman[1], A. H. M. Saiful Islam[1]

Article Information

Received: March 12, 2023
Accepted: April 18, 2023
Published: April 24, 2023

Keywords

Forecasting Approach, Inventory Management System, Operation Management System, Stock Management

ABSTRACT

Managing inventory has become increasingly complex and intriguing in today's business landscape. Companies are striving to optimize their warehousing while balancing various costs. As a result, inventory management is crucial to maintain product quality and meeting customer demands. This paper outlines an effective inventory management system that incorporates demand forecasting to prevent the issues of overstocking or understocking. Furthermore, a performance analysis illustrates how the inventory management system has become essential to the industry sector.

INTRODUCTION

An inventory management system is a type of application that is created to assist businesses in overseeing, regulating, and improving their inventory levels, orders, sales, and deliveries shown in Figure 1. This system is intended to provide businesses with up-to-date information on stock levels, stock movements, and stockouts across different locations, and to help them make informed decisions regarding inventory replenishment, production, and sales strategies. By using an inventory management system, companies can minimize operational costs, prevent stockouts and overstocks, increase customer satisfaction, and boost profits.

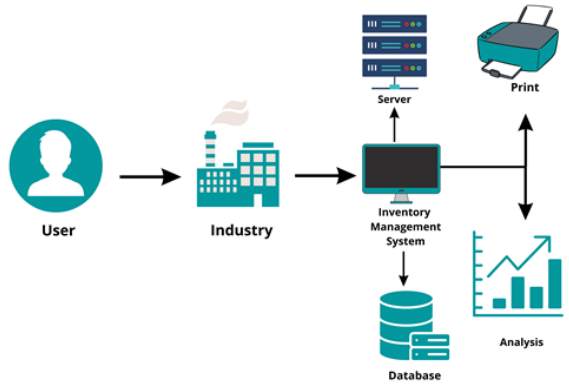

Figure 1: Overview of an inventory management system

Businesses of all sizes and types commonly use inventory management systems, including retail stores, manufacturers, distributors, wholesalers, and e-commerce companies. In summary, any business that wants to improve its inventory management processes and make informed decisions about inventory levels and orders can benefit from using an inventory management system. Using inventory management systems will grant:

1. Better Inventory Control
2. Increased Efficiency
3. Improved Accuracy
4. Better Decision Making

Forecasting can improve the inventory management system by enhancing Decision-Making, improving Production Planning, reducing overstock, preventing stockouts, and optimizing inventory levels.

This paper contributes:

i. Six individual inventory management systems have been created to serve their demands.

ii. Now, these six inventory management systems are accumulated so that one admin can maintain the whole system who has a common ownership interest.

iii. After that, we implemented forecasting techniques to determine upcoming product demands.

iv. Finally, we will evaluate the performance matrix based on our inventory management system software and implemented forecasting techniques.

The format of this paper is structured in the following manner: the initial section presents literature review based on the Inventory management system. Section two delivered materials & methods which described how our inventory management system is developed. Section three discusses a forcasting analysis and results of our inventory management system. Section four describes the conclusion and future scope of this paper.

LITERATURE REVIEW

Authors proposed that managing inventory is a complex aspect of supply chain management, requiring companies to balance meeting customer demand and minimizing inventory holding costs. Holding excess inventory can

[1] Department of Computer Science and Engineering, Notre Dame University, Bangladesh
[*] Corresponding author's e-mail: mosaddek.mhc@gmail.com

result in the loss of frozen funds, emphasizing the importance of finding the appropriate inventory quantity to fulfill demand. One solution for an assembling company is to utilize inventory management strategies to reduce stock levels and incorporate an agent system for automating inventory management procedures (Plinere & Borisov, 2015).

With the world's population on the rise, the healthcare industry is becoming increasingly important and expanding rapidly. As a result, the demand for assistive devices and healthcare services is expected to increase. Companies operating in this industry must utilize precise forecasting techniques to improve production output. Authors have identified the weighted moving average method as the most effective forecasting method, as it yields lower mean average percentage errors (MAPE) compared to other methods (Fadillah et al., 2022).

Authors examine how a warehouse management system affects supply chain performance by providing an effective and dependable inventory management solution that requires less resource effort. The research involved a review of the warehouse's supply chain procedures, customizing software to manage necessary transactions, and testing the system's efficiency to improve workflow and ensure timely handling. They also introduced a production station in the warehouse to optimize space utilization and handle the product lifecycle of SIM and prepaid scratch cards. The findings provide practical guidance and industrial examples for researchers to create new systems that can reduce supply chain disruptions (Atieh et al., 2016).

Although warehouses are designed for storage, finding a specific product can be difficult due to the need for a detailed manual search of all available stockrooms. A warehouse inventory management system can effectively solve this issue, as it provides detailed product information and identifies which stockroom the product is located in. Authors have found the use of RFID technology and the architecture of the Internet of Things in the developed system results in a cost-effective and efficient solution for managing warehouse inventory (Tejesh et al., 2018).

Authors stated Inventory Management System software is advantageous for businesses operating hardware stores, as it allows store owners to monitor sales and purchases. Mismanagement of inventory can result in customer dissatisfaction, increased warehousing costs, and reduced sales. The software mitigates these issues by eliminating paperwork, minimizing human errors and delays, and accelerating processes. By tracking sales and inventory, generating reports, and issuing alerts for reordering and purchase quantities, store owners can streamline their operations and improve their bottom line (Khobragade et al., 2018).

Effective supply chain management aims to deliver excellent customer service while keeping costs associated with flow between the chain links to a minimum. One major challenge is the rise in costs that results from excessive inventory levels across the chain, due to supply and demand imbalances in the market. Addressing this issue authors proposed demand forecasting as a solution, which relies on efficient data flow and collaboration among all links within the supply chain (Kot & Katarzyna, 2011).

The objective of the research done by the authors is to analyze the inventory management process and identify any problems that may arise. Efficient inventory control can be achieved by identifying these issues, making this research significant. The study used various research methods such as unstructured interviews, on-site study, and analysis of annual reports to analyze the inventory management practices of Linamar India Pvt. Ltd., given the criticality of proper inventory management in the manufacturing industry where mismanagement could result in company failure; the study aims to suggest improvements to enhance the company's current system, which is already good, including the incorporation of additional inventory management techniques (Mishra & Salunkhe, 2018).

Having effective inventory management is very important for the growth and success of different organizations, as well as for the progress of the communities around them. An Inventory Management System (IMS) has been developed by authors to aid in this process, which allows for the documentation and specification of software-intensive systems. That software can improve workflow and enhance inventory management efficiency. He suggests that a computerized IMS can address problems associated with manual inventory systems, including the possibility of human error and the loss or damage of manual records (Mehta et al., 2016).

MATERIALS AND METHODS

This section is divided into several sections. In this section, we have tried to explain the software system, system architecture, system use case diagram, system analysis, and forecasting approach.

Software System

There are six individual inventory management systems in this accumulated inventory management system. Each of them has its own sub-admin panel's authority over all of the Operation Management System (OMS); controlling its accesses and permissions while creating its users and tracking their work here. The OMS can handle inventory, components, groups, stockroom, overseeing products, overseeing product sales, tracking paid and unpaid bills, offering discounts, calculating VAT and service charges, generating invoices, and viewing overall sales., and search records including setup company details here. To manage anything from the OMS; the user is required to have permissions given by the admin and only then they can add, edit, delete, and search the information's for the industry maintaining a clean record for its industry. It has also features like bills that have been paid or are unpaid, discounted services, value-added tax (VAT), and the inclusion of service charges, and a special feature for all

these items, products, categories, orders, attributes, sales, members, and warehouses to be seen in the dashboard for sub-admin to check and keeping track of them in an easily understandable manner with dynamic view UI(User Interface) for OMS. Lastly, all six individual inventory management systems are centrally connected to a dashboard that can be accessed by the main admin as shown in Figure 2.

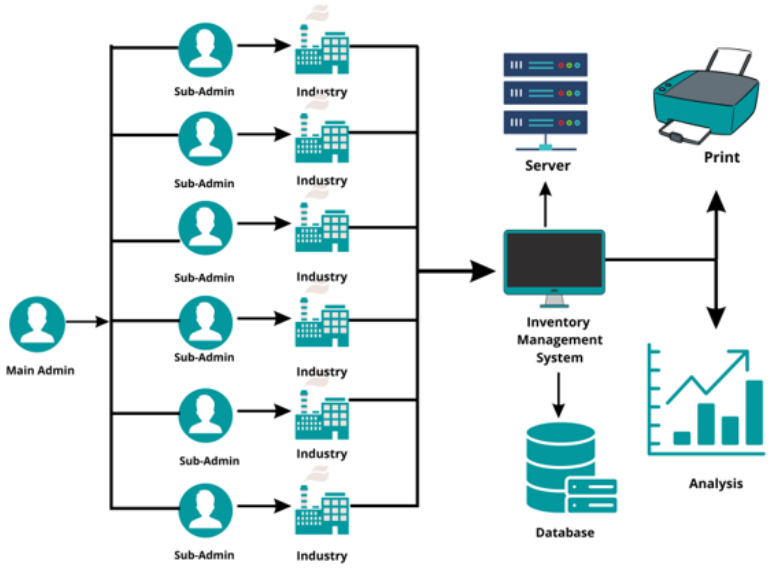

Figure 2: An illustration of software system

System Architecture

Here, in software system the main admin user has all the power and keys for all to supervising all other sub admin user and sub admin have the power to supervise only their industry as shown in Figure 3. The relation is between admins and inventory where seller is the primary actor and inventory is secondary actor or more like reactionary, it gives response on the basis of request or action given to it. First of all, databases saved on the server are maintained and managed by database servers, which also give authorized users access to the data. The data is kept on this kind of server in a centralized location where frequent backups can be made. Finally, it enables us to print or analyze the data as necessary. It also permits users and apps to access the data centrally across the network. Now sub-administrators can create user, update user, view user, delete user with user table and fix permissions for employees dividing their work and role and main administrator can check or supervised if needed.

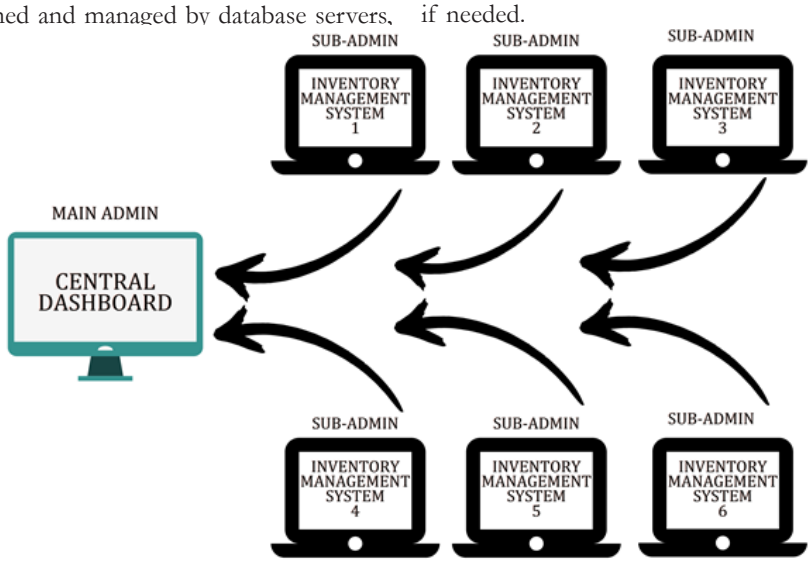

Figure 3: System architecture of accumulated inventory management system

System Use Case Diagram

In software system inventory software is represented by the rectangular box around it anything situated in the rectangle is happening in the software and outside it is not happening in the software. The sub-admin user is a primary actor while inventory is a secondary actor more like reactionary on the request of the primary actor the sub-admin user. In Figure 4 the oval shape represents

the action that accomplishes logging in, managing the dashboard, managing categories, managing items, managing warehouses, managing elements, managing orders, managing members, managing permission, and managing profiles on the request of the admin user.

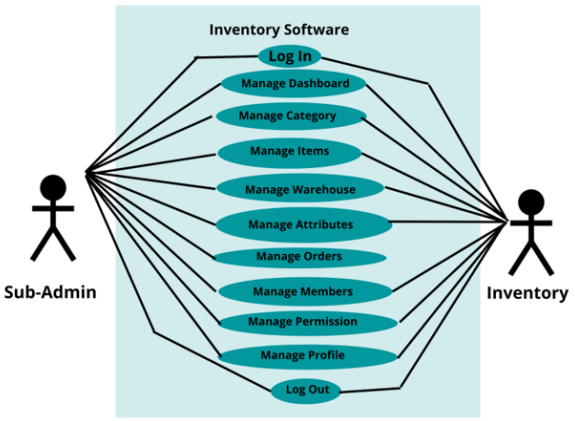

Figure 4: Use Case Diagram of individual inventory management system

Now the individual inventory management systems controlled by the sub-admins are supervised by the main admin of the organization as shown in Figure 5.

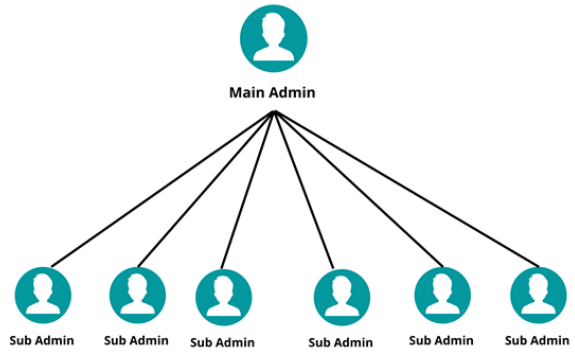

Figure 5: Central Admin Control Diagram

System Analysis

System analysis is stating the features of the software. There are many key features which can be maintained by their respective sub admin as well as main admin of the Inventory Management System (IMS).

1. Manage user (create, update, view, delete)
2. Manage dashboard
3. Manage stock(category, items, attributes, warehouses)
4. Manage orders(sales management, bill management, service discounts, vat calculation, service charge inclusion)
5. Manage privileges
6. Manage profile

Forecasting Approach

Different types of forecasting approaches have been applied to determine the upcoming demands to reduce overstock and understock. The forecasting techniques that have been applied:

i. Moving average

A moving average is a statistical calculation used to analyze time series data by smoothing out fluctuations in the data and highlighting trends over a specific time period.

The formula we have used to calculate this average value is

Moving Average = (Sum of n periods' prices) /n

ii. Weighted moving average

The weighted moving average gives more weight to recent data points than to older ones. The formula we have used to calculate this weighted moving average is

Weighted Moving Average = Sum of (wn * pn)/ Sum of wn

iii. Exponential Moving Average

An exponential moving average assigns more importance to recent data while still considering older data. The formula we have used to calculate this exponential moving average is

Exponential Moving Average = (Close - EMA_prev) x (2 / (n + 1)) + EMA_prev

iv. Single Exponential Smoothing (α=0.3 & α=0.4)

Single Exponential Smoothing only considers the most recent values and assigns greater weight to the most recent value and gradually decreases the weight of older values. The formula we have used to calculate this exponential moving average is

Updated forecast = (Smoothing constant*observed value of series) + (1- Smoothing constant) * old forecast

RESULT AND DISCUSSION

To evaluate, we have collected sales data for a product of an industrial organization that is using our proposed inventory management system. The sales data represents 10 months of product demand. The product demand represents how many pieces of product are sold during this 10 month time period showed in Table 1.

Table 1: 10 months sell's data of a product

Sell Period(months)	Product's Demand(Pcs)
1	315
2	439
3	401
4	437
5	575
6	407
7	682
8	475
9	581
10	646

Now, we take this data to determine the demand for the stock of the future by using different forecasting techniques. This comparison in Figure 6 shows that the organization can determine the stock much earlier than before. Here we can see the moving average was the closest to real demand. Also this analysis will give

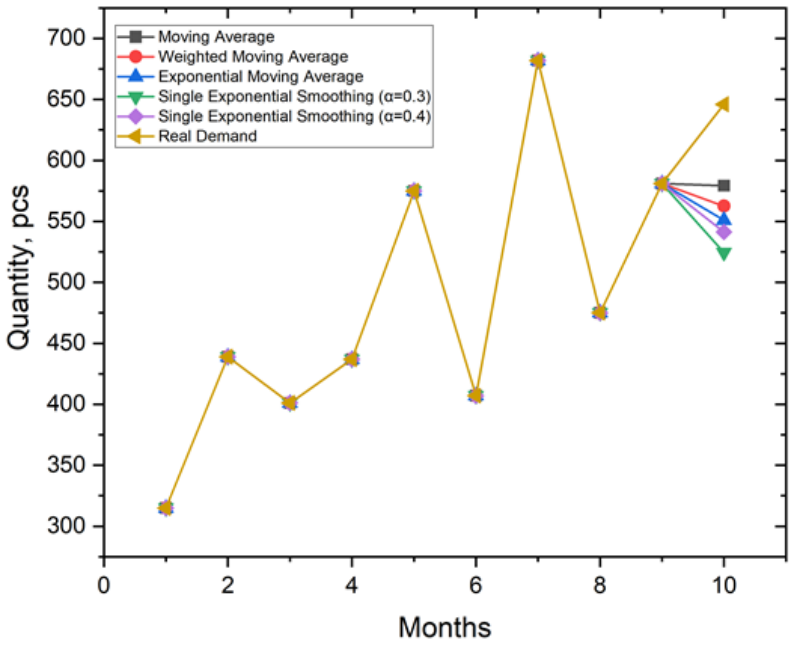

Figure 6: Forecasting future demands

organization an overview of their stock demand. By applying forecasting methods organizations can protect against overstocking and understocking.

CONCLUSION

The proposed inventory Management System is a crucial aspect for any group of industry or Company with multiple branches that handle inventory. While companies must maintain stocks, it is equally important to keep them at optimal levels to prevent instances of both out-of-stock and overstock situations. In this paper, we have seen that the forecasting approach can help the organization manage stocks by forecasting future demands ahead of time. For future work, we will try to enhance the efficiency and accuracy of inventory management systems by integrating emerging technologies such as the Internet of Things, artificial intelligence, and machine learning.

REFERENCE

Plinere, D., & Borisov, A. (2015). Case study on inventory management improvement. *Information Technology and Management Science, 18*(1), 91-96. https://doi.org/10.1515/itms-2015-0014

Fadillah, A. D., Wantuah, A. F., Surya, M. H. B., Azka, M. Z. A., & Nurprawito, D. Improving Inventory Management by Better Forecasting Method for Healthcare Industry Company.

Atieh, A. M., Kaylani, H., Al-Abdallat, Y., Qaderi, A., Ghoul, L., Jaradat, L., & Hdairis, I. (2016). Performance improvement of inventory management system processes by an automated warehouse management system. *Procedia Cirp, 41*, 568-572.

Tejesh, B. S. S., & Neeraja, S. J. A. E. J. (2018). Warehouse inventory management system using IoT and open source framework. *Alexandria engineering journal, 57*(4), 3817-3823. https://doi.org/10.1016/j.aej.2018.02.003

Khobragade, P., Selokar, R., Maraskolhe, R., & Talmale, M. (2018). Research paper on inventory management system. *International Research Journal of Engineering and Technology (IRJET), 5*(4), 252-254.

Kot, S., & Grondys, K. (2011). Theory of inventory management based on demand forecasting. *Polish journal of management studies, 3*(1), 147-155.

Mishra, A., & Salunkhe, H. A. (2018). A Study of Inventory Management System of Linamar India Pvt. Ltd, Pune. *Amity Journal of Operations Management, 3*(1), 35-41.

Mehta, S. S., Puranik, P. S., & Sharma, S. B. (2016). A Review on Inventory Management System for Improving Efficiency of Project Development Cycle. *Journal of Advanced Database Management & Systems, 3*(3).