

*A Project Report On*

**A STUDY ON ARTIFICIAL INTELLIGENCE BASED**  
**INVENTORY MANAGEMENT SYSTEM**

*Submitted for the partial fulfilment of the requirement for the degree of*

**MASTER OF BUSINESS ADMINISTRATION**  
**(INTERNATIONAL TRANSPORTATION & LOGISTICS MANAGEMENT)**

*By*

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**INDIAN MARITIME UNIVERSITY KOCHI CAMPUS**

SUBMITTED ON APRIL 2023



**INDIAN MARITIME UNIVERSITY**

*(A Central University under Ministry of Ports, Shipping and Waterways)*

**SCHOOL OF MARITIME MANAGEMENT**

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**CERTIFICATE**

This is to certify that the Project titled "A STUDY ON ARTIFICIAL INTELLIGENCE BASED INVENTORY MANAGEMENT SYSTEM" submitted by SANOOP DANIEL register number 2105305029 student of MBA (ITLM) is a bonafide record of his Project report and submitted to the School of Maritime Management, Indian Maritime University, Kochi campus, under the supervision of Dr. Aravind. T.S, Faculty IMU, Kochi campus. It is also certifying that the above work has not previously formed or submitted for the award of any degree, diploma, associateship, fellowship, or other similar titles, and it is an independent work done by the candidate.

Dr. Aravind. T.S  
Project Guide.

A handwritten signature in red ink, appearing to be "Aravind T.S", is written over the printed name and title.

**Dr. Aravind. TS**

(Project Guide)

## SELF DECLARATION

I, **SANOOP DANIEL** (Registration No: 2105305029) student of School of Maritime Management, INDIAN MARITIME UNIVERSITY-COCHIN hereby declares that this project report titled .

**“A STUDY ON ARTIFICIAL INTELLIGENCE BASED INVENTORY MANAGEMENT SYSTEM”** submitted in partial fulfilment of the requirement for the degree of Master of Business Administration in International Transportation & Logistics Management is my original work carried under the guidance of Dr. Aravind TS. I also confirm that the report is only prepared for my academic requirement, not for any other purpose. It might not be used with the interest of the opposite party of the corporation.

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I would like to sincerely thank our guide Dr. Aravind TS for giving necessary advices and guidance throughout the preparation of this project report.

My thanks and appreciation to my Institution in developing the project and people who have willingly helped me out with their abilities.

I perceive as this opportunity as a big milestone in my career development. I will strive to use gained skills and knowledge in the best possible way, and I will continue to work on their improvement, in order to attain desired career objectives. Hope to continue cooperation with all of you in the future.

I also thank my family and friends for the continuous support in completing my project work.

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## **EXECUTIVE SUMMARY**

This project is a compilation of the practical knowledge and critical information I gathered about the topic ‘A Study on Artificial Intelligence based Inventory Management.’ This report focuses on the adaptation of Artificial intelligence and its various scope of views and trends. The main objective of the project is to find the influence of Artificial-intelligence in the logistic sector. Also, to find the changes and challenges that Artificial-intelligence had brought in the inventory management. Given the massive amounts of hype and promise surrounding AI and related technologies like machine learning and deep learning, it has become increasingly difficult to make critical innovation and investment decisions in the space. Taking a technology-first approach (e.g., selecting a vendor simply because they claim to use the latest AI techniques) has led and will lead to many failed companies and projects. The assigned place of study was at inventory management departments under various logistics sectors.

A review of prior studies on the application of AI and inventory management systems in corporate operations serves as the study's introduction. The results imply that conventional inventory management methods might result in wasteful and expensive inventory management procedures. However, AI-based inventory management systems have demonstrated promising outcomes in terms of lowering inventory holding costs, optimising inventory levels, and boosting profitability.

I used this opportunity to study more about the influence of Artificial-intelligence and the changes and challenges that Artificial-intelligence had brought in the inventory management. The project also provides insights into the history behind the AI, its developmental structure, economic interventions, services, activities, and SWOT analysis provided with suggestions to consider those factors that could possibly be the stepping stones for the adaptation of artificial intelligence in the logistics sector to reach the pinnacle.

The study concludes that AI-based inventory management systems have the potential to revolutionize inventory management practices and improve overall business performance. By automating inventory management processes and providing real-time data analytics, AI-based systems can help businesses achieve greater efficiency, reduce costs, and increase profitability. However, the implementation of such systems requires careful planning and investment in technology and human resources to ensure successful implementation and adoption.

## **OBJECTIVES OF THE STUDY**

- ❖ To evaluate the effectiveness of an AI-based inventory management system in optimizing inventory levels and reducing waste.
- ❖ To assess the impact of an AI-based system on overall business performance, including sales, profitability, and customer satisfaction.
- ❖ To examine the implementation process of an AI-based inventory management system, including the challenges and opportunities encountered.
- ❖ To identify the key factors that influence the successful adoption and implementation of AI-based inventory management systems.
- ❖ To provide recommendations for businesses considering implementing AI-based inventory management systems, based on the insights and findings from the case study.
- ❖ To contribute to the existing literature on the use of AI in inventory management systems, and its impact on business operations and performance.

## **RESEARCH METHODOLOGY**

Secondary data will be gathered in order to conduct the study. Data that has previously been gathered and examined by another party for a different goal is referred to as secondary data. Many other sources, including governmental organizations, academic institutions, and commercial businesses, can provide this kind of information.

The following stages might be included in the research process for a study on an AI-based inventory management system:

**Research design:** The study will adopt a case study research design, which involves a detailed examination of a specific organization that has implemented an AI-based inventory management system. The case study will provide an in-depth understanding of the impact of the system on inventory management practices and overall business performance.

**Data collection:** Data will be collected through a combination of primary and secondary sources. Primary data will be collected through interviews with key stakeholders involved in the implementation and management of the AI-based system, such as inventory managers, IT staff, and senior executives. Secondary data will be collected through a review of relevant literature, including academic journals, industry reports, and news articles.

**Data analysis:** The data collected will be analysed using a qualitative approach, which involves identifying themes and patterns within the data. The analysis will focus on identifying the impact of the AI-based system on inventory management practices and overall business performance, as well as the factors that influenced the successful adoption and implementation of the system.

**Ethical considerations:** The study will adhere to ethical guidelines and obtain informed consent from all participants. Confidentiality and anonymity will be maintained to protect the privacy of the participants.

**Limitations:** The study's limitations may include the sample size, which is limited to a single case study. Additionally, the study's findings may not be generalizable to other organizations or industries, as the effectiveness of an AI-based inventory management system may vary depending on the specific context and business environment.

**Conclusion:** The study will provide insights into the effectiveness of AI-based inventory management systems and offer recommendations for businesses considering implementing such systems.

**CHAPTER: 1**  
**INTRODUCTION**

## **INTRODUCTION OF STUDY**

Inventory management helps companies identify which and how much stock to order at what time. It tracks inventory from purchase to the sale of goods. The practice identifies and responds to trends to ensure there's always enough stock to fulfil customer orders and proper warning of a shortage. Once sold, inventory becomes revenue. Before it sells, inventory (although reported as an asset on the balance sheet) ties up cash. Therefore, too much stock costs money and reduces cash flow. One measurement of good inventory management is inventory turnover. An accounting measurement, inventory turnover reflects how often stock is sold in a period. A business does not want more stock than sales. Poor inventory turnover can lead to deadstock, or unsold stock. Inventory management is vital to a company's health because it helps make sure there is rarely too much or too little stock on hand, limiting the risk of stockouts and inaccurate records. Organizations from small to large businesses can make use of inventory management to track their flow of goods. There are numerous inventory management techniques, and using the right one can led to providing the correct goods at the correct amount, place, and time. Inventory control is a separate area of inventory management that is concerned with minimizing the total cost of inventory, while maximizing the ability to provide customers with products in a timely manner. In some countries, the two terms are used synonymously.

Effective inventory management enables businesses to balance the amount of inventory they have coming in and going out. The better a business controls its inventory, the more money it can save in business operations. A business that has too much stock has overstock. Overstocked businesses have money tied up in inventory, limiting cash flow and potentially creating a budget deficit. This overstocked inventory, which is also called dead stock, will often sit in storage, unable to be sold, and eat into a business's profit margin. But if a business does not have enough inventory, it can negatively affect customer service. Lack of inventory means that a business may lose sales. Telling customers, they do not have something, and continually backordering items, can cause customers to take their business elsewhere.

AI is poised to take inventory management to a new level through faster, smarter, and more efficient inventory management systems. AI can enable businesses to

track multiple orders simultaneously and identify any inventory issues and delays in production and shipping times. AI-based inventory forecasting is also expected to gain widespread popularity across the retail industry as businesses seek to gain a competitive advantage. By pulling historical sales data and matching it to consumer trends, AI-based forecasting will enable businesses to identify trends beforehand and increase stock accordingly. AI will also change how businesses perform inventory checks through automated surveillance systems. This will allow businesses to limit reliance on human labour and utilize their assets and resources in other areas of business. AI-based robots are also expected to gain widespread usage across major warehouses due to the level of convenience and cost-effectiveness they provide. In fact, major retailers have already started using these robots, and soon, we are likely to see them being employed in other areas, such as delivery.

**CHAPTER: 2**  
**LITERATURE REVIEW**

### **Algorithmic approaches to inventory management optimization.**

Perez HD et al (2021)

Processes 9(1):102

An inventory management problem is addressed for a make-to-order supply chain that has inventory holding and/or manufacturing locations at each node. The lead times between nodes and production capacity limits are heterogeneous across the network. This study focuses on a single product, a multi-period centralized system in which a retailer is subject to an uncertain stationary consumer demand at each time period. Two sales scenarios are considered for any unfulfilled demand: backlogging or lost sales. The daily inventory replenishment requests from immediate suppliers throughout the network are modelled and optimized using three different approaches: (1) deterministic linear programming, (2) multi-stage stochastic linear programming, and (3) reinforcement learning. The performance of the three methods is compared in terms of profit (reward), service level, and inventory profiles throughout the supply chain. The proposed optimization strategies are tested in a stochastic simulation environment that was built upon the open-source OR-Gym Python package. The results indicate that, of the three approaches, stochastic modelling yields the largest increase in profit, whereas reinforcement learning creates more balanced inventory policies that would potentially respond well to network disruptions.

### **Inventory management in supply chain.**

Singh D, Verma A (2018)

Mater Today 5(2):3867–3872

The Purpose of this paper is to overview the Inventory management in supply chain and their current Inventory related issue in a present-day business and present a conceptual methodology for related issue. The methodology based on the inventory, which are inputs for the methodology and benefits which are output of methodology. A literature review is conducted on management or control of inventory and issues related to inventory in industry, and its various parameters. A conceptual methodology for inventory issues in present business.

### **Implementation of a demand planning system using advance order information.**

Haberleitner H, Meyr H, Taudes A (2010)

Int J Prod Econ 128(2):518–526

In times of demand shocks, when quantitative forecasting based on historical time series becomes obsolete, the only information about future demand is “advance demand information,” i.e., interpreting early customer bookings as an indicator of not yet known demand. This paper deals with a forecasting method which selects the optimal forecasting model type and the level of integration of advance demand information, depending on the patterns of the particular time series. This constitutes the applicability of the procedure within an industrial application where many time series is automatically forecasted in a flexible and data-driven way. The architecture of such a planning system is explained and using real-world data from a make-to-order industry it is shown that the system is flexible enough to cover different demand patterns and is well-suited to forecast demand shocks.

### **An optimized model using LSTM network for demand forecasting.**

Abbasimehr H, Shabani M, Yousefi M (2020)

Comput Ind Eng 143:106435

In a business environment with strict competition among firms, accurate demand forecasting is not straightforward. In this paper, a forecasting method is proposed, which has a strong capability of predicting highly fluctuating demand data. Therefore, in this paper we propose a demand forecasting method based on multi-layer LSTM networks. The proposed method automatically selects the best forecasting model by considering different combinations of LSTM hyperparameters for a given time series using the grid search method. It has the ability to capture nonlinear patterns in time series data, while considering the inherent characteristics of non-stationary time series data. The proposed method is compared with some well-known time series forecasting techniques from both statistical and computational intelligence methods using demand data of a furniture company. These methods include autoregressive integrated moving average (ARIMA), exponential smoothing (ETS), artificial neural network (ANN), K-nearest neighbours (KNN), recurrent neural network (RNN), support vector machines (SVM) and single layer LSTM. The experimental results indicate that the proposed method is superior among the tested methods in terms of performance measures.

### **Safety stock planning under causal demand forecasting.**

Beutel A-L, Minner S (2012)

Mainstream inventory management approaches typically assume a given theoretical demand distribution and estimate the required parameters from historical data. A time series-based framework uses a forecast (and a measure of forecast error) to parameterize the demand model. However, demand might depend on many other factors rather than just time and demand history. Inspired by a retail inventory management application where customer demand, among other factors, highly depends on sales prices, price changes, weather conditions, this paper presents two data-driven frameworks to set safety stock levels when demand depends on several exogenous variables. The first approach uses regression models to forecast demand and illustrates how estimation errors in this framework can be utilized to set required safety stocks. The second approach uses Linear Programming under different objectives and service level constraints to optimize a (linear) target inventory function of the exogenous variables. We illustrate the approaches using a case example and compare two methods with respect to their ability to achieve target service levels and the impact on inventory levels in a numerical study.

### **Simulation of inventory management systems in retail stores: a case study**

Sridhar P, Vishnu C, Sridharan R (2021)

Mater Today 47:5130–5134

Inventory management has become a key factor in today's world of uncertainty, particularly in the retail sector. Accordingly, there is a high requirement of managing and controlling the inventory with appropriate policies to elevate the organization's performance. In fact, a proper system must be implemented for monitoring customer demand. This system will, in turn, assist in maintaining the right level of inventory. In this direction, the present research focuses on a retail store and explores a solution for an inventory-related problem experienced by the firm. A simulation model is developed and run for particular merchandise using Arena simulation software. Rigorous experimentation is conducted with the model by altering the inputs/model characteristics, and a more effective system is proposed. Compared with the existing traditional inventory management system, the proposed system will reduce the inventory level by 40% and lost sales by 87%. Furthermore, the proposed system is optimized using the OptQuest module in Arena simulation software. As a result, the inventory level is further reduced by 73% compared to the existing system. Store managers in various

organizations may utilize the proposed methodology for improving their inventory management system.

### **Inventory management and logistics optimization: a data mining practical approach.**

Granillo-Macías R (2020)

LogForum 16(4):535–547

In the current economic scenarios, characterized by high competitiveness and disruption in supply chains, the latent need to optimize costs and customer service has been promoted, placing inventories as a critical area with high potential to implement improvements in companies. With a practical approach, using a case study in a company in the food sector, this article proposes an inventory classification method with qualitative and quantitative variables, using data mining techniques, categorizing the materials using variables such as picking frequency, consumption rates and qualitative characteristics regarding their handling in the warehouse. The proposed model also integrates the classification of materials with techniques for locating facilities, to support decision-making on inventory management and storage operations. This article uses a method based on the Partitioning Around Medoids algorithm that includes, in an innovative way, the application of a strategy for the location of the optimal picking point based on the cluster classification considering the qualitative and quantitative factors that represent the most significant impact or priority for inventory management in the company. Results: The results obtained with this model, improve the routes of distributed materials based on the identification of their characteristics such as the frequency of collection and handling of materials, allowing to reorganize and increase the storage capacity of the different SKUs, passing from a classification by families to a cluster classification.

### **Performance measurement on inventory management and logistics through various forecasting techniques.**

Nallusamy S (2021)

Int J Perform Eng 17(2):216–228

Currently, inventory and logistics performance play a significant role for the efficiency augmentation and competitiveness of the manufacturing industry. The objective of this research study focuses on inventory management and

measurement of logistics performance metrics of on-time in full and vehicle capacity utilization. The problem of maintaining inventory due to the dynamic fluctuating schedule of the customer results in stock-outs due to fluctuating demand and poor performance of on-time in full. Primarily, annual sales data were collected and classified based on ABC-FSN analysis. Then, the outcome of the analysis was used to classify about 123 parts into three classes such as fast, slow, and non-moving categories. Demand forecasting was carried out using various forecasting techniques, followed by ordering policy by economic order quantity. Reorder point model and safety stock were also analysed. Logistics performance metrics, on-time in full, and vehicle capacity utilization were studied and measured. From the final observed results, it was found that vehicle capacity utilization was poor and all vehicles had an average utilization of 52.61%. Further suggestions were made to demand and adopt the maintaining inventory safety stock and proper packaging of goods to improve the overall performance.

**Design of an inventory management system in an agricultural supply chain considering the deterioration of the product: the case of small citrus producers in a developing country.**

Acosta ICG et al (2018)

J Appl Eng Sci 16(4):523–537

Inventory management along the agrifood supply chain is a subject of great interest due to the constraints related with the perishable condition of product. Significant problems like demand forecasting, inventory management and transportation were evidenced within the supply chain studied. Additionally, the management of perishables and their lifecycle are the most frequently issue in this kind of supply chain. An inventory management policy is defined taking in consideration the optimal quantity for an order and the time for ordering to ward off costs related with understock or overstock. This paper presents a mathematical model for inventory management in agricultural supply chains considering perishability. The supply chain studied involves a retailer, a producer, and a supplier. The advantages of integrating inventory management along the supply chain are discussed and finally some recommendations and research opportunities set forth.

## **Applying actual usage inventory management best practice in a health care supply chain.**

Varghese V et al (2012)

Int J Supply Chain Manage 1(2):1–10

**The demand characteristics and optimal control policies for pharmaceutical items within a multi-echelon provider network are examined within the framework of a case study. This paper lays a foundation for the better understanding of the application and acceptance of more advanced inventory control practices driven by actual usage data within the health care supply chain. Demand forecasting algorithms were applied to forecast demand for inventory control procedures. The costs of inventory control models are compared to the current ordering and inventory control strategies to document potential cost savings using both a single echelon analysis and a multi-echelon analysis. The results indicate that there is great potential for significant cost savings within the provider network. It is likely that if other providers adopt such practices that they will be able to better control material supply costs.**

## **Robust inventory management with multiple supply sources.**

Xie C, Wang L, Yang C (2021)

Eur J Oper Res 295(2):463–474

We study a robust rolling horizon model for a periodically reviewed inventory system with multiple supply sources with general lead times. We restrict the demands in an uncertainty set without knowing the distributions. We prove that under some appropriate conditions, the robust optimal policy for multiple sourcing is a combination of the base-stock policy and a gap-of-base-stock policy with capping effect on supply sources except the fastest source. In particular, the structure of this policy is not a natural extension of the robust optimal policy for the system with two supply sources, for which the recent literature shows that the robust optimal policy is a dual-index, dual-base-stock policy that caps the slow order. We also derive closed-form expressions of the robust optimal policy for the central limit theorem (CLT) uncertainty set. We numerically testify to the effectiveness of the structure of the robust optimal policy for more than two supply sources using both simulation demand and real sales data. The computational results are promising.

## **Towards a methodology for developing evidence-informed management knowledge by means of systematic review.**

Tranfield D, Denyer D, Smart P (2003)

Br J Manag 14(3):207–222

Undertaking a review of the literature is an important part of any research project. The researcher both maps and assesses the relevant intellectual territory in order to specify a research question which will further develop the knowledge base. However, traditional ‘narrative’ reviews frequently lack thoroughness, and in many cases are not undertaken as genuine pieces of investigatory science. The quality of evidence underpinning decision-making and action has been questioned, for inadequate or incomplete evidence seriously impedes policy formulation and implementation. In exploring ways in which evidence-informed management reviews might be achieved, the authors evaluate the process of systematic review used in the medical sciences. This paper evaluates the extent to which the process of systematic review can be applied to the management field in order to produce a reliable knowledge stock and enhanced practice by developing context-sensitive research. The paper highlights the challenges in developing an appropriate methodology.

## **Knowledge management in environmental sustainability practices of third-party logistics service providers.**

Evangelista P, Durst S (2015)

Vine 45(4):509–529

The purpose of this paper is to provide a structured literature review on knowledge management (KM) and KM strategy in environmental sustainability practices of logistics service providers. The paper highlights the nature and scope of existing research and identifies areas for future research. The study consists of a systematic review of existing research regarding KM in sustainable logistics. In all, 38 refereed research papers formed the basis of analysis. This methodology allows for the minimization of researcher bias and the maximization of reliability and replicability.

## **A new dynamic predictive maintenance framework using deep learning for failure prognostics**

Nguyen KTP, Medjaher K (2019)

Reliab Eng SystSaf 188:251–262

In Prognostic Health and Management (PHM) literature, the predictive maintenance studies can be classified into two groups. The first group focuses on the prognostics step but does not consider the maintenance decisions. The second group addresses the maintenance optimization question based on the assumptions that the prognostics information or the degradation models of the system are already known. However, none of the two groups provides a complete framework (from data-driven prognostics to maintenance decisions) investigating the impact of the imperfect prognostics on maintenance decision. Therefore, this paper aims to fill this gap of literature. It presents a novel dynamic predictive maintenance framework based on sensor measurements. In this framework, the prognostics step, based on the Long Short-Term Memory network, is oriented towards the requirements of operation planners. It provides the probabilities that the system can fail in different time horizons to decide the moment for preparing and performing maintenance activities.

### **Inventory control system design by integrating inventory classification and policy selection.**

Mohammaditabar D, Ghodsypour SH, O'Brien C (2012)

Int J Prod Econ 140(2):655–659

Very large numbers of inventory items complicate the inventory control process. Companies categorize their inventory items into a few groups and take similar inventory control policies for the items in each group to overcome this problem. In this regard many grouping methods have been proposed. Some researchers have studied the appropriate inventory policy for each group. Since both the actions of categorization and policy selection are sub-optimal solutions for the original problem of efficient inventory control policy, this paper proposes an integrated model to categorize the items and find the best policy simultaneously. As it is difficult to find a global solution, simulated annealing is used to find appropriate solutions. The model results are compared with the findings of other methods both for dissimilarity and total inventory values.

**CHAPTER: 3**  
**ARTIFICIAL INTELLIGENCE AND**  
**INVENTORY MANAGEMENT**

### 3.1 INTRODUCTION

The items and supplies a company plan to sell for a profit are referred to as inventory. Therefore, all methods and procedures used in the production, storage, and distribution of items are included in inventory management. Its goal is to guarantee that the appropriate commodities are accessible at the appropriate time and location. It achieves that by tracking all inventory from the manufacturers to the point of sale, allowing you to monitor inventory levels, sales, orders, and deliveries. AI inventory management systems take these processes up a notch by identifying and responding to consumer trends. This ensures that there is always enough stock to meet customer demands.



Any B2B or B2C organisation must have effective inventory management in order to avoid having too little or too much inventory on hand. Additionally, it is important for regulatory compliance with the Securities and Exchange Commission (SEC) standards and the Sarbanes-Oxley (SOX) Act [1], which mandate that all publicly traded corporations must document their inventory management procedures.

In a nutshell, inventory management is the process of controlling inventory in a business. This covers the buying, manufacturing, storing, and consuming of items. Inventory management tracks them from the beginning of their journey to your warehouse and beyond.

This process is regulated by inventory management software, which enables you to keep an eye on and track inventory levels, orders, sales, delivery, and receiving. Purchase orders, bills of materials, and other production-related papers may all be produced using inventory management technologies.

Fortunately, many of these tools are accessible online in 2022, and many of them are cloud-based and available by subscription. The fact that they now include artificial intelligence is superior.

## 3.2 ARTIFICIAL INTELLIGENCE IN INVENTORY MANAGEMENT

Automated inventory management software has vastly improved businesses by creating data-driven manufacturing and distribution centres. AI's capacity to understand real-time inventory control dynamics, which affect inventory stock levels, makes it revolutionary compared to traditional human methods. AI can predict scenarios, recommend solutions, and even perform them for you.

Artificial intelligence inventory management is not here to take over human roles just yet, though, so make sure you have staff to check in on your automated processes and have the final say on stock management decisions.

Artificial intelligence can help optimize business processes at all stages. Implementing AI, for example, in inventory management practices like item-level tagging can increase inventory accuracy to 95%. Here are other ways in which you can use artificial intelligence for inventory management.

- Streamlining the entire inventory management process

Inventory management is not just about keeping track of stored and delivered items. It is also about forecasting, planning, and control. By leveraging AI solutions, a business can minimize the possibility of overstocking and understocking. That is because AI technology can consider location-specific demand, analyse, and correlate demand insights, and detect and respond to consumer demand for a specific product.

AI solutions can also analyse all internal and external factors impacting the successful planning, stocking, and delivery of inventory. This ultimately reduces errors associated with inventory management, thus helping a business save costs and increase customer satisfaction.

- Using AI-based robotics in the warehouse

Large retail companies like Amazon already use AI-based robots in their day-to-day logistical tasks. These machines present numerous benefits over human staff, especially when it comes to increasing productivity in routine operations.

Unlike humans, robots can work tirelessly round the clock moving items around the warehouse. They also come equipped with scanners that enable them to scan inventory for wear before loading it into delivery vans.

Robots are also more efficient from an operational standpoint since they can analyse data and predict demand patterns. They also eliminate the possibility of human error and offer more efficiency in terms of time spent per action.

From a budgetary standpoint, AI-powered robots require less operational costs than human employees. These machines only require a one-time acquisition payment and regular maintenance costs, as opposed to human employees who need monthly salaries and benefits.

- Stocking management and delivery

Warehouses need to run smoothly for optimum business performance. Inventory management issues like planning errors and inadequate stock monitoring can lead to inventory shortages and delivery delays, which could have a negative impact on revenue and customer satisfaction.

Artificial intelligence inventory management systems can analyse customer behaviour patterns and help businesses stock the right inventory, arrange stock, automate inventory fulfilment procedures, and optimize inventory delivery by suggesting the best routes.

Additionally, AI inventory management systems can help optimize factory-to-warehouse and warehouse-to-client transportation, leading to on-time deliveries, which positively impacts customer satisfaction. The systems can also analyse a company's delivery process and suggest ways of improving it.

- Data mining and processing

AI can analyse customer data and transform it into valuable insights that can help a business respond to specific trends. By analysing different aspects, such as trendy goods, sporting events, or any other factors that could drive up demand for a certain product, AI systems can 'advise' a business to overstock or understock specific products, thus driving up sales and minimizing the risk of dead stock.

- Delivering personalized customer experience

Most businesses today have large volumes of customer data. By leveraging AI-based software, businesses can use this data to create personalized customer experiences by tailoring relevant products and services to specific customers. The result is personalized user experiences built around the specific customer's demands.

### **3.3 Benefits of improving inventory management with Artificial Intelligence**

- Effortless demand forecasting

In the past, businesses relied on demand forecasting methods such as exponential smoothing and autoregressive integrated moving averages. But these methods are rapidly becoming antiquated as businesses generate more data, thus necessitating the need for a robust system that can spot demand patterns and use the data to forecast and optimize inventory replenishment plans. That being said, AI uses real-time data to provide instant forecasts on inventory management. This reduces reliance on traditional forecast methods, which are not only time-consuming but are also affected by human error. Additionally, AI-powered demand forecasting can reduce supply chain errors by a big margin, which increases accuracy and reduces monetary losses due to unplanned consumer demand and incorrect stock numbers.

- Automated material procurement

All manufacturing businesses need an elaborate and efficient procurement process. However, the large number of documents and suppliers involved is enough to confuse any human worker, leading to mistakes and inefficiencies.

Artificial intelligence can help automate such processes, right from getting the best quotes to taking the materials through the supply chain. According to a recent McKinsey report, businesses that use AI in their procurement process report a 35% to 65% improvement in inventory and service levels and a 15% reduction in logistics costs.

- Safety stock management

Traditionally, businesses set a static quantity for their inventory levels, which basically meant reserving a bare minimum for walk-in sales that were not factored into other fulfilment channels such as eCommerce.

However, today's ever-changing consumer expectations and omnichannel engagements have made it nearly impossible to conveniently rely on generalized information. In today's market, businesses need to dynamically shift their stock levels to leverage and react to incoming demand.

In order to achieve profitable results across all fulfilment channels, businesses need intelligent solutions that can balance fulfilment costs against service demands to improve customer experience, enhance return on investment, and encourage repeat purchase behaviour.

Using AI in safety stock management can also help avoid inventory issues such as overselling and then over-purchasing inventory, promising customers goods that cannot be delivered, and overstocking on ‘unpopular’ goods.

- Improved productivity through AI algorithms

Artificial intelligence is becoming an integral part of normal day-to-day business operations. AI algorithms can, for example, be used to manage and oversee tasks, thus limiting the need for human workers to undertake mundane, repetitive tasks. The result is improved productivity, efficient utilization of resources, and better monitoring of aspects such as lead times, quantities, and operational inefficiencies.

- Reduced storage and shipping costs

Businesses lose more than \$300 billion in revenue to poor inventory management. However, by leveraging AI capabilities to improve inventory management, they can cut operational costs and improve cash flow by a huge margin.

Artificial intelligence inventory management systems can, for example, help prioritize critical processes to resolve bottlenecks, meet ever-changing customer demands, and mitigate costly risks. The resulting effect is a significant reduction in high rental storage costs, unsatisfied customers due to inventory shortages, and unsold products. AI can also enable you to make additions to your product line-up and inventory with little or no added costs.

- Reduced demand-supply gap

When combined with data analytics, artificial intelligence can accurately predict customer always demands and maintain healthy stock levels. These systems generally work by analysing customer demand for seasonal products for the past few years, then using the data to forecast demands for the upcoming season. Some systems can also pre-order the products, thus streamlining business operations even further.

- Data accessibility support

Lack of visibility is one of the most common data-related inventory challenges that often lead to gaps and inaccuracies in important inventory and sales information. This issue often stems from the use of legacy systems and manual inventory management methods, which are susceptible to human error.

AI inventory management solution enables you to automate the storage, collection, and dissemination of all inventory-related data. These include product tracking, supplier delivery times, product information, and item location within the storage facility.

- Improved employee performance

A well-managed inventory can significantly reduce performance pain points for all employees across all areas of business. Recent surveys reveal that AI can boost employee performance by up to 40%, especially for customer-facing employees, who can make accurate and timely product recommendations based on available data and insights.

AI can also improve the overall performance of a retail business through business education tools such as administration programs that offer trading courses and management information.

### **3.4 AI enhancing inventory management**

AI has the capability of enhancing the inventory management in different ways and those are:

- Effortless Demand Forecasting

Traditional methods of demand forecasting, such as autoregressive integrated moving averages and exponential smoothing, are becoming antiquated because businesses now generate much more data. AI-enhanced inventory management systems can spot demand patterns and use this data for accurate forecasts and optimizing warehouse replenishment plans.

Artificial intelligence inventory management enables enhanced and instant forecasts based on real-time data. This can be collected from internal and external

sources, such as demographics, weather, online feedback and reviews, and social media.

By using external data and machine learning algorithms, businesses utilizing AI in inventory operations should outperform those who rely on human data analysts and manual methods. It has been found that AI-powered demand forecasting can reduce supply chain errors by 30 to 40 percent. This increase in accuracy also leads to a reduction in lost sales due to issues such as incorrect stock numbers and consumer demand.

- **Improved Productivity Through AI Algorithms**

Computer algorithms are becoming a popular method for increasing workplace productivity. In a nutshell, an AI algorithm is an extended subset of machine reinforcement learning that allows a machine to learn to operate on its own. In turn, the AI continues to gain knowledge, thus constantly improving tasks and making them more efficient.

In terms of artificial intelligence inventory management, algorithms can have a plethora of benefits, including constant monitoring of:

- Quantities.
- Cycle times.
- Lead times.
- Temperatures.
- Errors.
- Planning downtime.

By having AI oversee these tasks, resources are freed up, and staff no longer must undertake mundane, repetitive jobs.

- **Better Customer Support Using Chatbots**

The rise of the chatbot is upon us with the chatbot market predicted to reach \$102.29 billion by 2026. Artificial intelligence inventory management is no exception. AI chatbots help you stay updated on your ERP inventory system, keep track of orders, and other updates. For example, you could ask a chatbot for the lowdown regarding a specific order. This makes it easier for staff to carry out their tasks, too.

On top of this, chatbots bring top-level customer service that goes beyond instant messaging. For example, DHL now offers a service where you can ask a smart

device like Amazon's Alexa for instant updates on your parcel's location and estimated delivery time. This type of voice-assisted chatbot is becoming ever more popular. Statista predicts there will be 4.2 billion digital voice assistants being used by 2024.

The level of customer support afforded by AI improves the customer experience by giving instant answers and is likely to increase retention and satisfaction rates. Some other ways chatbots can aid your inventory management include:

- Quickly assisting with delivery requests, processing orders, and issuing billing and receipts.
- Improving customer service by tracking items, solving customer queries, and allowing them to ask further questions.
- Allowing your business to collect feedback from customers and suppliers.

- **Wiser Warehouse Management**

AI inventory management makes warehouse management easier, more efficient, and more focused. Streamlining and optimizing warehouse management processes lessens the chance of human error while freeing up staff to be deployed elsewhere. Some of the ways AI can improve warehouse management include:

- **Better Communication:** Automated AI systems can communicate accurate information quicker than human operatives. Implementing cloud-based devices allows for instant and on-the-go updates.
- **Logistics:** Optimizing logistics tasks such as counting pallets or designating the required equipment for staff can now be done by AI, reducing processing time and human error.
- **Inventory Optimization:** Using AI frees up resources and budgets usually spent on inventory control.
- **Automating Wages and Performance Updates:** Using AI lets you automate wages and schedule performance updates. These could be linked to data to give better insights into employee performance.

All of these warehouse management improvements combine to give you a competitive advantage.

- **Minimized Downtime Through the Help of Predictive Analytics:**

Predictive analytics has become a useful tool for decision-makers, allowing them to make data-driven decisions with greater insights. This cost-effective solution utilizes predictive algorithms to allow you to detect anomalies and failure patterns, learn from them, and predict future failing issues. The result is lower downtime as predicted problems can be prevented before they occur.

For example, your AI might log that it takes six months until components within the conveyor belts need replacing. A decision can then be made to change the components every five months to avoid downtime. Or perhaps you have recently had network issues across your IT infrastructure. Predictive analytics can help you prevent future server downtime.

- **Automated Material Procurement**

Procurement is an essential part of any manufacturing business that needs supplies and equipment. This process often involves managing a large number of documents, suppliers, and more. With many aspects to procurement, it is clear to see how inefficiencies and mistakes can creep in. AI analytics can automate such warehouse processes from the first stage of quoting right through to the supply chain. According to McKinsey, companies that have introduced AI into their business have reported a reduction in logistics costs of 15 percent and an improvement in inventory and service levels of 35 percent and 65 percent, respectively.

Examples of automated procurement include:

- Procurement spend classification.
- Vendor matching.
- Collecting market and supplier data.
- Detecting anomalies.

- **More Lucrative Marketing Strategies**

A considerable benefit of AI-enhanced inventory management is the way it offers better insights that can lead to more lucrative marketing strategies. AI and machine learning can highlight the short-lived demand for products and their market. Not only this, but with smart inventory tools such as machine learning-based anomaly detection, and with AI that can spot sporadic changes in product interest, you can achieve an enriched database of likely prospects. This allows you to tailor marketing strategies and personalize them to your ideal customer. Using AI in this way enables you to keep up with current trends as well as keep tabs on what products and services are losing popularity. With marketing

strategies informed by data science, you can focus on ensuring increased revenue for your efforts.

**CHAPTER- 4**  
**CHALLENGES AND FUTURE**

## **4.1 AI implementation challenges:**

Artificial Intelligence (AI) is changing our lives with each passing day. From writing tools to self-driving cars, we are slowly learning to incorporate the various uses of AI into multiple aspects of our lives. Another field where AI can be used with great success is online learning. However, companies and institutions looking to update their learning systems with Artificial Intelligence might find themselves having to deal with unexpected hurdles. Here we will discuss different AI implementation challenges as well as ways to overcome them.

- Insufficient Or Low-Quality Data

AI systems function by being trained on a set of data relevant to the topic they are tackling. However, companies often struggle to “feed” their AI algorithms with the right quality or volume of data necessary, either because they do not have access to it or because that quantity does not yet exist. This imbalance can lead to discrepant or even discriminatory results when operating your AI system. This issue, otherwise known as the bias problem, can be prevented if you make sure to use representative and high-quality data. In addition, it would be best to start your AI journey with simpler algorithms that you can easily comprehend, control for bias, and modify accordingly.

- Outdated Infrastructure

For Artificial Intelligence systems to give us the expected results, they need to process large amounts of information in fractions of a second. The only way to achieve that is by operating on devices with suitable infrastructure and processing capabilities. However, many businesses are still using outdated equipment that is in no way capable of taking on the challenge of AI implementation. Therefore, it goes without saying that businesses that want to revolutionize their Learning and Development methods with machine learning must be prepared to invest in infrastructure, tools, and applications that are technologically advanced.

- Integration into Existing Systems

Incorporating AI in your training program is much more than downloading a few plugins on your LMS. As we have already discussed, you need to take extra time to consider whether you have the storage, processors, and infrastructure necessary for the system to function properly. At the same time, your employees must be trained to use their new tools, troubleshoot simple problems, and

recognize when the AI algorithm is underperforming. Collaborating with a provider who has the necessary AI experience and expertise can help you overcome all these issues and guarantee the smoothest transition to machine learning possible.

- Lack Of AI Talent

Speaking of expertise, considering how new the concept of AI in learning and education is, it's safe to say that finding people with the necessary knowledge and skills is a considerable challenge. In fact, lack of internal knowledge keeps many businesses from trying their hand at AI. Although searching for a provider who can transition your company to machine learning is a viable solution, forward-thinking companies are concluding that it is more beneficial in the long run to invest in your internal knowledge base. In other words, they suggest training your employees on AI development and implementation, hiring AI talent, and even licensing capabilities from other IT companies so that you can develop your learning prototypes internally.

- Overestimating Your AI System

The technological advancements we have witnessed sometimes lead us to believe that technology can do no wrong. But AI relies on the data it is given, and if that is not correct, neither will the decisions it makes. A great AI implementation challenge is that the process of learning is rather complex, especially when trying to formulate it into a set of data we can import into a system. For this reason, AI explain ability is crucial for a successful transition into machine learning. Breaking down algorithms and training users on the decision-making process of Artificial Intelligence provides transparency and helps prevent faulty operation.

- Cost Requirements

Based on everything we have discussed so far, it is easy to understand that developing, implementing, and integrating Artificial Intelligence into your training strategy will not be cheap. To get it right, you're going to have to collaborate with AI experts that have the necessary knowledge and skills, launch an ongoing AI training program for your employees, and probably update your IT equipment to be able to handle the requirements of your machine learning tools. Although it is impossible to avoid some of these costs, you can minimize them by looking into budget-friendly training programs or free applications. There are various options available that can help you figure

out which AI capabilities your training program would benefit from before spending money on acquiring them.

In addition to the AI implementation challenges, we could also mention the discrepancies in AI availability around the world. Specifically, while some countries are already making leaps in AI technology, others are struggling to conquer much simpler technological advancements. Moreover, there are many legal and ethical concerns surrounding Artificial Intelligence, as the data it needs are sometimes subject to data protection laws. There are already many talks in place to set regulations which will ensure transparency and security.

Despite the number of challenges AI implementation poses for businesses, governments, and institutions, it is essential that they overcome them in order to enjoy its advantages and become part of the future of machine learning. Hopefully, as more research is done on AI, the mystery surrounding it will slowly dissolve.

## **4.2 Inventory management and supply chain challenges**

A computer-based inventory system calculates the optimum levels for each product to help with stock management and achieve the best inventory balance for a business. Artificial Intelligence (AI) has arrived and transformed how we do inventory management. AI is already showing an impact on the way companies manage their inventory.

- An excess size of data

Without computerized data management, any small company would have employees simply collecting and grooming data from its systems. Even if this seems like a trivial problem, it is not the case for giant corporations. Moreover, data management at this scale can require multiple departments working in close coordination to ensure efficiency and accuracy.

There are three main types of inventories: raw materials, work in progress (WIP), and finished goods. Each type of inventory requires database management software and specific processes to track and report the data.

- Inventory tracking issues

The biggest threat to a big business is losing track of inventory, whether it is a single essential item or hundreds of individual items. When inventory tracking becomes difficult, management decisions become slow, and customers lose trust in the company. In addition, if a business does not have sophisticated inventory systems in place, management must look for signs of stock levels getting low or high by manually counting supplies and checking stock receipts.

- Barriers in business planning

Proper planning is the fuel of all business plans. The right is level driven by adequate data analyses that take into account the strategic positioning and future of the business. Different companies in different spheres deal with planning methods; some are suitable for short-term goals, while others define long-term objectives.

- Operations budgets are very high.

Effective management is a key to growth for any business. One of the most critical aspects that need attention is a company’s operational budget. Since the operating budget is tying to inventory growth, it can be a complex task to operate the business. An excess supply leads to an excessive number of stock positions and, thus, a higher operating budget. In modern times of technological development, inventory as a factor in business – from small trading companies to large retail chains – has changed significantly. To keep a steady profit, as a result, operational costs have become an important issue for businesses.

### 4.3 Advantages and disadvantages of AI

<b>Advantages of AI</b>	<b>Disadvantages of AI</b>
Reduction in human error	High costs
Zero risk	No creativity
24/7 Availability	Unemployment
Digital assistance	Make humans Lazy
New inventions	No ethics
Unbiased decisions	Emotionless
Perform repetitive jobs	No improvement
Faster decision making	
Pattern identification	

## **4.4 Future of artificial intelligence inventory management**

AI is poised to take inventory management to a new level through faster, smarter, and more efficient inventory management systems. AI can enable businesses to track multiple orders simultaneously and identify any inventory issues and delays in production and shipping times.

AI-based inventory forecasting is also expected to gain widespread popularity across the retail industry as businesses seek to gain a competitive advantage. By pulling historical sales data and matching it to consumer trends, AI-based forecasting will enable businesses to identify trends beforehand and increase stock accordingly.

AI will also change how businesses perform inventory checks through automated surveillance systems. This will allow businesses to limit reliance on human labour and utilize their assets and resources in other areas of business.

AI-based robots are also expected to gain widespread usage across major warehouses due to the level of convenience and cost-effectiveness they provide. In fact, major retailers have already started using these robots, and in the near future, we are likely to see them being employed in other areas, such as delivery.

Artificial Intelligence (AI) has the potential to revolutionize inventory management by making it more efficient, accurate, and cost-effective. In the future, AI-powered inventory management systems are expected to become more advanced, personalized, and capable of making more intelligent decisions based on real-time data. Here are some potential developments that could shape the future of AI-powered inventory management:

**Predictive Analytics:** AI-powered inventory management systems can analyse data from multiple sources, such as sales data, weather patterns, and supplier performance, to predict future demand for products. This will help businesses optimize inventory levels and reduce the risk of stockouts or overstocking.

**Real-Time Monitoring:** Real-time monitoring of inventory levels, stock movements, and customer demand will enable businesses to make informed decisions quickly. AI algorithms can analyse large volumes of data to identify patterns and trends that can inform supply chain management decisions.

**Autonomous Systems:** Autonomous inventory management systems powered by AI can reduce the need for manual intervention, increasing efficiency and

reducing costs. For example, AI-powered robots can be used to manage inventory levels in warehouses, reducing the need for human labour.

**Personalized Experiences:** AI can personalize the inventory management experience for individual customers, making it easier for them to find the products they need. For example, AI algorithms can analyse customer purchase history and preferences to recommend products that they are likely to buy.

**Sustainability:** AI-powered inventory management systems can help businesses reduce waste and improve sustainability. By analysing data on product expiration dates, for example, businesses can reduce the amount of food waste generated by overstocking perishable goods.

Overall, the future of AI-powered inventory management looks promising, with the potential to optimize supply chain management, improve customer experiences, and reduce costs. However, it is important to note that there are also challenges to be addressed, such as data privacy and ethical concerns around the use of AI.

**CHAPTER: 5**  
**FINDINGS AND SUGGESTIONS**

## 5.1 FINDINGS

Information technology has played a vital role in inventory management. This has resulted in increased accuracy and efficiency, as well as reduced costs. By automating inventory management processes, businesses have been able to streamline their operations and improve their bottom line. In supply chain management, artificial intelligence can be used to automate tasks, forecast demand, optimize routes, manage inventory, and even monitor security and compliance. These capabilities are crucial for companies looking to stay ahead of the competition and meet the demands of their customers.

IT inventory management is one of the examples of how inventory management works. It enlists all the technical property of the company such as desktop computers, keyboards, servers, load balancers, routers, firewalls, switches, headphones, and other items that participate in internet connectivity or in carrying out developers' mundane duties. Together with hardware, loads of references about this property require appropriate storage. For instance, the brand of any device, model, or serial number, a configuration of the server, location of the equipment, data about assigned computers, and much more information, which the inventory management process monitors. One more inventory management asset in IT companies is the installed software on each personal computer, which also requires control.

Generally, there are two models of inventory management. These are created to find out the perfect level of inventory that requires maintenance within businesses. These models are:

- Independent inventory demand (perpetual inventory and periodic review)
- Dependent inventory demand (e.g., EOQ – Economic Ordering Quantity, ABC – Activity-Based Costing, and JIT – Just-in-Time).

If independent models depend on a certain non-decisiveness based on the demand levels and time of restocking, dependent models assume that everything is decided according to demand and restocking.

## 5.2 SUGGESTIONS

Though AI is an ideal deposit into inventory management, there is still space for improvement. For example, gradually improving inventory management and AI will help your business thrive and accumulate profits. Therefore, the ways of improvement should consist of:

- focusing on your needs
- engaging with suppliers
- planning the use of AI in inventory management system
- using only present-day data
- going mobile

With the right attitudes and actions, major improvements in inventory management can be achieved using AI, its scenario predicting capabilities, recommendations, and solutions to the problems occurring in the future. Analytics presented by AI and a bit of independent decision-making allow data enrichment, standardization, and consolidation, and, basically, everything that employees are incapable of doing within short periods, without human errors and, most importantly, manually.

Based on the ways of improvement discussed above, there are different ways to optimize your inventory management using Artificial Intelligence.

- Use inventory monitoring and robotic automation to reduce time and costs spent on manual work.
- Use a warehouse management system to enhance warehouse functionality, and optimize it.
- Use supply chain planning techniques to be one step ahead of your competitors.

- Use Risk Management/Network Management to achieve the company's goals and leverage profits.
- Use Predictive Demand/Capacity Planning to fit into the budget and demand.
- Use Intelligent Route Optimization to succeed in the dynamic environment.

**CHAPTER: 6**  
**CONCLUSION**

In conclusion, in many aspects, artificial intelligence has transformed inventory management. AI-based inventory management systems can reliably estimate demand, optimise inventory levels, and save costs while increasing operational efficiency by utilising cutting-edge algorithms and machine learning approaches. By forecasting supplier performance, spotting possible hiccups, and offering real-time visibility into inventory levels, these tools may help improve supply chain management. AI-based inventory management solutions will become more and more crucial for organisations wanting to stay competitive in today's dynamic and fast-paced market as technology continues to advance and become more complex. The complexity and interconnectivity of today's manufacturing and purchasing and supply management (PSM) systems are paving the way for new technological advancements in the manufacturing and purchasing and supply sectors. Recent developments in artificial intelligence (AI) and the extensive amount of generated manufacturing data, known as big data, are allowing the integration of new kind of analytics tools in the supply chain, which are optimizing the way goods are produced. The focus of this paper is the application of such AI systems in the manufacturing and purchasing and supply management processes in factories, leading to concepts like smart factory and smart manufacturing, and the restructuring and digitalization on the production floor, dominated till to now by the human workforce.

This study aimed to study and find out the use of artificial intelligence technology to improve inventory management. As guidance of the writing process, two questions introduced which by answering them directed the thesis to the result: Can Artificial intelligence improve inventory management? How can the organization utilize Artificial intelligence in inventory management activities? The qualitative research method was used, and research information was collected through a literature review from a different researcher. Articles, books, and web pages were used as the source of information to answer those questions by understanding in the broader perspective the concept behind inventory management, the different types of inventories, the purpose of holding inventory, the technique used to manage inventories, costs involved. There were also needed to understand in the big picture the concept behind Artificial intelligence technology, how it is defined, the history, types of AI, where it is possible used. Also, there was a need to analyse which sectors implemented artificial intelligence and how it has improved their daily activities. Finally, after a more comprehensive review of research in inventory management and artificial intelligence and case study, the results show that the application of AI and machine learning can improve the activities related to inventory management. It improves data accuracy, improves productivity, quick decision-making, minimizes costs, and consistently ensures customer satisfaction. As a conclusion

of the research concerning the results found, profit, accuracy, and speed in businesses are possible with artificial intelligence.

# CHAPTER: 7

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