

# Machine learning in e-commerce and Supply Chain Management

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**Abstract**—Recently, the rapid development of e-commerce faces various challenges in information maintenance during online transactions and purchases, server error and security threats are an interactive method of payment; inconsistent data dissemination issues and prolonged customer waiting time during online purchase and transaction lead to several concerns based on supply chain management during the delivery of products. Coupled with the recent advances in artificial intelligence systems and machine learning algorithms, we aim to explore how these developments in the field affect the customer's journey, taking into account the aforementioned trends, as well as the personal user data that these may require to provide proper results. Hence, this research develops a deep logistic learning framework (DLLF) to minimize computational time and improve data dissemination accuracy during an online transaction. Also in this research analyzes the shortcomings and challenges of traditional online shopping behavior prediction methods, and proposes an online shopping behavior analysis and prediction system. As will as this research applies machine learning to help managers understand manage the inventory flow. Building on a dynamic framework, we employ an inductive learning algorithm for setting the most appropriate replenishment policy over time by reacting to the environmental changes.

**Keywords**— *Machine Learning (ML) , E-commerce, supply chains, SCM, AI, Algorithms .*

## II.Introduction

Machine Learning (ML) have become an integral part of everyday life, as it's provided solutions in numerous different domains, with outstanding results being reported over the last few years. One of the areas where ML holds a prominent position is the broad field of e-commerce and supply chain. ML can be successfully applied to influence customers in the search of products and brands, in the evaluation of possible alternatives, in their decision-making process and in their overall consumption, by providing an intelligent, adaptable, and informed customer experience at any point of service.

With the rapid development of the Internet, the e-commerce industry has also developed rapidly, and people have increasingly strict requirements for online shopping. E-commerce enterprises have accumulated a large number of data, contains transactions, interaction and observation data, At present, the precision marketing based on big data has brought challenges and new possibilities for the marketing strategy of the enterprise. In practical applications, the purpose of ML is to improves itself by accumulating data, even its performance, especially discovers hidden rules from big data. So far, ML scholars have proposed a large number of algorithms adapted to different disciplines and problems, such as Bias estimation, decision tree, neural network, SVM, k-nearest neighbor algorithm and so on .One of ML algorithm Naive Bayes used in this paper, focuses attention the feature vector formed by association rule mining, further realize the accuracy in clustering of consumer groups, better for online and offline use personalized referral service to provide a reliable guarantee for the realization of precision marketing. Also, AI techniques have received relatively little attention in relation to supply chain research.

Managing risks in supply chains at a local, national, or global scale has increasingly attracted attention from both researchers and practitioners in recent years, owing in part to the worldwide economic uncertainty that began 5 with the 2008 global financial crisis. The field of supply chain risk management (SCRM), which emerged in the early 2000s has now become more than the overlap of directly related areas such as enterprise risk management and supply chain management. Recently, there has been an AI resurgence 25 due to the availability of increased computing power and large amounts of data, as well as the success of approaches within the broad area of machine learning.

In order to provide a general picture of ML in SCM and E-commerce to, this paper will systemically review the research trends by analyzing the publications and will then explore the frequently used ML algorithms in SCM and the SCM activities and the e-commerce often aided by ML algorithms as a reference for future research directions.

This paper is consisted of five sections with the present section as the first.

The second section will give a brief introduction to the background of ML algorithms applications in SCM and E-commerce, the third will introduce the research methodology of this study. The results are shown in the fourth section. The fifth section will present the conclusion that includes major findings, the limitations in this study and the suggestions for further research.

### **III.BACKGROUND**

In last few years, we have learned a lot of “E-commerce” word, What is it ? E-commerce is buying and selling goods via the internet and transferring money and data to complete the transactions. All stores that sell products online can be classified as e-commerce, this could be anything from a small online store on Etsy to big brand sites like Amazon and everything in between. The e-commerce business has grown exponentially over the last few years, increasing from the Covid-19 pandemic when people couldn't go to stores in person . E-commerce businesses typically fall into one of four main groups, depending on their customers. [7]

1.Business to consumer (B2C), In a B2C model, the business sells directly to a consumer. If you (the customer) buy a product from a retailer like Amazon (a business), you're purchasing from a B2C company.

2. Business to business (B2B), The B2B model involves selling products or services from one business to another.

3.Consumer to business (C2B),The C2B model includes individuals who sell their products or services to a business through an online format. Social media influencers and bloggers can fall under this category if they receive money from businesses to promote the brand.

4.Consumer to consumer (C2C),C2C e-commerce models typically involve online sites that allow people to sell goods and services directly to others.

A successful eCommerce company needs to have a good supplier to stay organized, competitive, and keep growing. What is supply Chain? Why its related to e-Commerce? Supply chain focuses on all activities that occur outside of the business and it's involved: Sourcing and processing of raw materials and Organization and storage of goods, Balancing supply and demand ,Tracking inventory, Managing orders, Handling distribution and delivery .[14]

Supply chain management is important because it optimizes cost-effectiveness, boosts customer satisfaction, and helps your company stay competitive.

Machine learning is a branch of artificial intelligence (AI) and computer science which focuses on the use of data and

algorithms to imitate the way that humans learn, gradually improving its accuracy. Now let's think of How to use Machine Learning in eCommerce? [15]

#### **1.Product Feed Recommender Engine**

Have you ever thought about why Amazon can guess which products may interest you? It is simple. Amazon has a recommender engine that analyses user search results and proposes relevant recommendations, Recommender engines work on user data, the Holy Grail of all sorts of consumer insights in big data eCommerce. Throughout the numerous sessions of different users, the algorithm gathers the information and clusters patterns. It creates a cohesive picture of what kind of content and products a particular customer segment likes and prefers. This information is then clustered and classified by machine learning algorithms into a foundation for further recommendations. For example, if the user is looking for calligraphy kits, his query is matched with the similar from the relevant target audience segment.

#### **2.Dynamic Price adjustment - Predictive Analytics**

Price adjustment is the field where you can feel the scope of the benefits of machine learning. eCommerce is one of those industries where competition is beyond fierce, especially when it comes to niche consumer segments such as beauty products or hardware. Because of that, it is crucial to get as many advantages as possible to attract and retain customers. One of the most effective ways of doing that is by offering more competitive prices for the products of interest. This option is made possible by significant big data eCommerce machine learning price monitoring and adjustment. According to the BigCommerce study, price is one of the major drivers for 47% of the customers in eCommerce. So it makes sense to tweak in the right way.

3.Fraud is one of the eCommerce's biggest banes. Just last year the eCommerce industry had lost more than billions on various fraud schemes. It is one of the problems that never really goes away - you can find a way to eliminate present threats, and later it will adapt and come back with the new bag of tricks. Hopefully, with an adoption of AI in eCommerce and implementation of specialized Machine Learning algorithms - predictive analytics are capable of detecting suspicious activity and preventing it from causing damage.

### **IV.REALTED WORK**

In the past decade, ownership and usage of mobile devices has grown in a rapid manner, with users putting trust into these devices for online purchases. Corporations are reporting

a higher number of interactions through mobile devices than on desktops, making these an important medium for online advertising and recommendations used by e-commerce applications.

Artificial Intelligence (AI) and Machine Learning (ML) have become an integral part of everyday life, as they provide solutions in numerous different domains. One of the areas where AI holds a prominent position is the broad field of e-commerce and online retailing. AI can be successfully applied to influence customers in the search of products and brands, in the evaluation of possible alternatives, in their decision making process and in their overall consumption, by providing an intelligent, adaptable and informed customer experience at any point of service.

The integration of AI and ML techniques can be useful in all of the three stages of the customer journey (pre-transaction, transaction, and post-transaction). The selection and use of the most prominent technology solutions depends on the purpose of these applications. The analysis of the possible paths for finding the most prolific ones, the identification of issues that occur during the customer's experience, as well as the redesign and the automated transform of the customer journey belong to the primary commercial objectives and goals of almost every online retail system. Furthermore, the measurement, analysis and further optimization of the customer journey contribute to the provision of a prominent and impactful experience.

There are numerous of AI and ML technologies, regarding the customer journey optimization, that a company could include on its operational and marketing plan. The main categories that these technologies fall into, holding the majority of the provided solutions, are recommendation systems (RS), virtual reality systems (VR) and augmented reality systems (AR).

**1.Recommendation systems** are essential tools that have been used in abundance by companies that provide online retail and streaming services. Two popular examples are the platforms provided by Amazon and Netflix, both of which are known for the personalized experience they offer to their customers. The methods deployed include the collection and the analysis of demographic data from their customers, and the combination of this data with information from previous purchases ,it is possible to predict how customers will evaluate related products, or how likely they are to purchase a new product.

**2.Knowledge Based** is A system of this type generates recommendations to users according to explicit information related to their preferences and needs about the item

assortment. However, the processes of acquiring the desired knowledge can time-consuming and tedious.

**3.Current augmented reality (AR) and virtual reality (VR)** technologies can have a thorough impact on a variety of customer journey, by enabling or enhancing consumer tasks and experiences.

Mobile AR advertisement enables the interactive exploration of products and it's used to reduce friction and costs associated with returns in online retailing, by making it possible to try out products at home on avatars or on a visual representation of the customer.

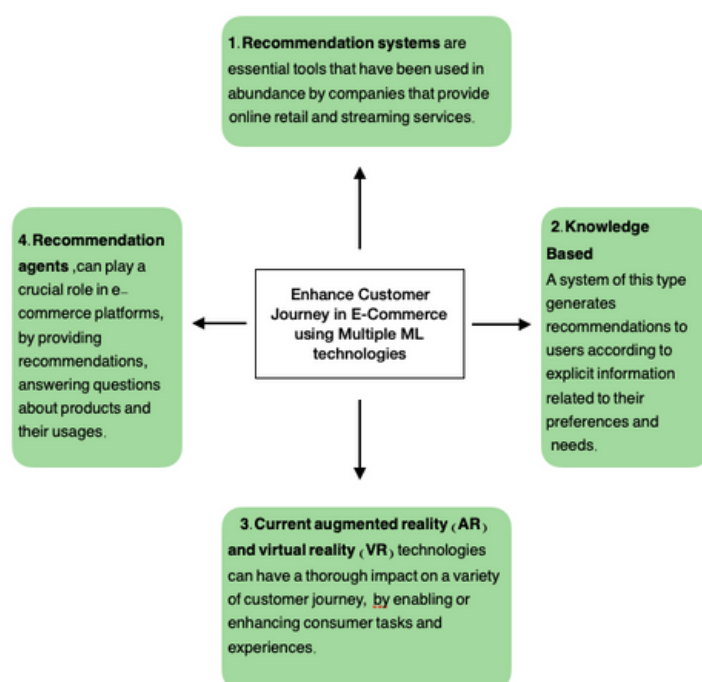
AR applications allow customers to customize products to their specific needs , such as IKEA Place app, which uses AI to offer users accurate and personalized home furnishing advice

**4.Recommendation agents** ,can play a crucial role in e-commerce platforms. They can strongly affect the transaction and post-transaction stages, by providing recommendations, answering questions about products and their usages, and providing meaningful advices to customers in order to reduce uncertainty ,chatbots can provide feedback and facilitate additional consumption.

So we can conclude that Corporations and companies across different business domains and markets, of varying size and revenue, are using AI and ML technologies to improve their customer experience.

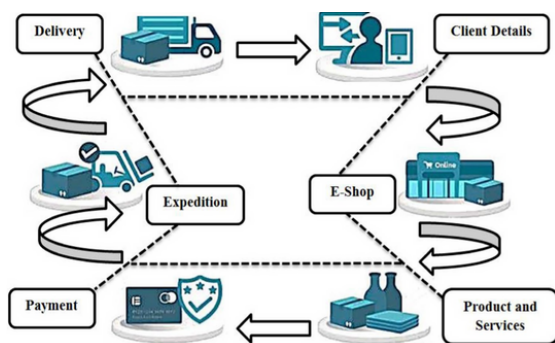
The utilization of these technologies constitutes important opportunities for such companies for increasing their profits and the overall customer satisfaction, but at the same time imposes multiple challenges.

Future research initiatives could expand the capabilities of the existing intelligent applications, or lead to the emergence of new and innovative technologies.



E-commerce growth has been considered a significant area in business organizations and end consumers. E-Commerce refers to the purchasing and sale of items through the use of the internet. The development of e-commerce has changed the customer distributor and created a creative requirement to reshape the entire integrated learning framework that focused on logistics structure and supply chain management. An integrated learning method on supply chain management is widely preferred in the E-commerce business because it achieves solidarity and connectivity across the entire value chain, from purchasing to production planning to logistics. An integrated learning system-based supply chain management is responsible for organizing and providing detailed and reliable solutions to consumers, resource acquisition, monitoring, and inventory management mechanism increase production efficiency. However, a blended learning system based on the supply chain's position becomes evident to facilitate the whole integrated learning system based on supply chain management's sustainable growth through financial and social aspects. This integrated learning system based on a supply chain management system benefits cost savings, enhanced monitoring overproduction, inventory distribution means lower overheads and optimizes efficiency. Though conventional approaches help to optimize the E-commerce system efficiency at the lowest possible expense the required optimization strategy has been taken by either logistics or the integrated learning system based on supply chain management (SCM) may significantly impact the costs associated with the activities of an e-commerce network. With its design and conceptual definition, an appropriate layout is considered the central point for implementing these systems.

Furthermore, machine logistics has been addressed to analyze the movement and storing of products, services, and related data in E-commerce with general architecture, as shown in Fig. 1. Optimization models and algorithms for the design and implementation of dynamic, supply chain-based logistics and integrated learning systems need to be built and tested in computational logistics for effective online transactions.



**Fig.1** An integrated learning system based on supply chain management for E-commerce

E-commerce enables shipping companies to exchange information in databases during the supply chain. E-commerce aids businesses in lowering overall prices, improving data quality, streamlining supply chain services, speeding up business cycles, and improving customer support.

## 2- Deep Logistic Learning Framework (DLLF)

This section, online waiting time and data inconsistency problem during a purchase at the E-commerce platform, has been considered based on the portal's order vector elements. Vector elements describe the total number of orders in the queue as chosen by the customers during purchase. Management of the supply chain relates to integrated learning system plans. First is the functionally integrated learning system of procurement, production, and transport, warehousing operations. It crystallizes proposals for an integrated learning system with business planning supported by logistics specialists, strategists, and businesses. Interest and importance are growing through improved integration of operations between various firms sharing supply chain components.

### 2.1.1 Model of DLLP with Training and Testing Data

E-commerce, known as the e-business or the internet, concerns the acquisition, sale, and conversion of money and data to conduct a specific exchange of products or services using the internet. Cyber threat E-commerce refers to the purchase and sale online. It applies specifically to online business purchases. The danger of e-commerce arises by the internet for deceptive reasons, abuse, and security breaches. This paper, the deep logistic learning framework (DLLF), has targeted reducing device time and increasing data distribution precision during an online transaction. The suggested system DLLF and controlled network improve user behavior and optimally decrease measurement time during online buying—the analysis of user behavior in e-commerce to identifying the threats in user online transactions.

In a fiercely competitive market where businesses are constantly striving to enhance profit margins, reduce costs, and provide exceptional customer experience, disruptive technologies like Machine Learning (ML) and Artificial Intelligence (AI) offer some excellent opportunities. Comprehending the supply chain interdependencies between processes, decisions, and structures is far from being trivial, which makes decision making a challenging task. The complexity becomes evident in the field of inventory management, one of the cornerstones of the supply chain discipline. The primary purpose of inventory is “to meet demand in support of production or customer service”. So a machine-learning approach to inventory management could help firms manage their supply chains more effectively and reduce their operating costs.

They recommend that the use of model predictive control techniques defines a promising solution strategy for the problem under consideration. Machine learning techniques could be useful for improving the control of inventories in contexts with inventory inaccuracies, i.e. deviations between the actual and the recorded inventory.

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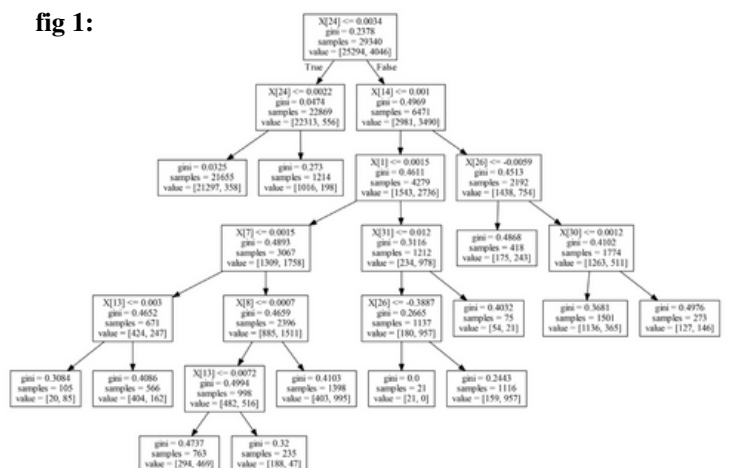
graph TD
    w0[w0] -- "[0,0.748]" --> br1[βr]
    w0 -- "(0.748,0.839]" --> br2[βr]
    w0 -- "(0.839,1]" --> br3[βr]
    br1 -- "[0,0.562]" --> n1["POUT_H  
OUT"]
    br1 -- "[0.562,1]" --> n2["POUT_M  
POUT_H"]
    br2 -- "[0,0.298]" --> n3["POUT_H  
OUT"]
    br2 -- "(0.298,0.318]" --> n4["POUT_M  
POUT_H"]
    br2 -- "(0.318,1]" --> n5["POUT_L  
POUT_M"]
    br3 -- "[0,0.086]" --> n6["OUT"]
    br3 -- "(0.086,1]" --> n7["POUT_L  
POUT_M"]
  
```

Discussing potential improvements, “The purpose of this parameter is to enable the learning model to correctly classify

Classification algorithm	Before feature selection	After feature selection
ANN	0.82	0.86
SVM	0.78	0.79
Decision Tree	0.73	0.75
XGBoost	0.93	0.96

### The trade-off between performance and interpretability

**fig 1:**





in table 2 show that decision trees without restrictions are capable of achieving comparable results with SVM, performing slightly worse with regard to average precision and recall but doing slightly better in the case of balanced metrics, F1 score and MCC ,A classifier whose results can be interpreted achieves 37% lower average precision, 15% lower MCC score, 11% lower F1 score and 5% lower recall. The decision is case-specific and is entirely dependent to the particular set of data, SCRM plan and prediction priorities. On the other hand, the primary goal of the SCRM plan is to understand what factors may contribute more to a delivery being late, some reduction in prediction performance may be deemed acceptable

Classifier	AP	F <sub>1</sub>	Recall	MCC	Acc
SVM	0.851	0.791	0.973	0.775	0.943
DT	0.698	0.821	0.823	0.792	0.950
RDT	0.533	0.704	0.928	0.655	0.916

we proposed a risk prediction framework for SCRM that utilises data-driven AI techniques and relies on the collaboration and interactivity between AI and supply chain experts. The framework emphasises the need for linking choices of metrics and algorithms to SCRM goals which may prioritise interpretability over prediction performance or vice-versa. It also illustrates the difficulties of working with imbalanced datasets, which may feature in SCRM-related scenarios. The applicability of the framework is demonstrated through a real-world case study of a multi-tier aerospace manufacturing supply chain affected by the risk of delayed deliveries. Results of experiments conducted within the case study show that the framework can achieve good performance across a variety of metrics using both black box and interpretable machine learning techniques. Prioritising interpretability over performance requires a compromise that is minor in terms of recall (5% decrease in prediction performance) but much higher in terms of average precision (37% decrease).

## V.CONCLUSION AND DISCUSSTION

It is this work. Four research papers were discussed and summarized, all of which included the topic of machine learning in electronic commerce and the supply chain. It was The first topic searched for Applications of AI and Machine Learning in E-Commerce, and the problem of how to exploit artificial intelligence in supply chain management was solved, and many artificial intelligence techniques were found, namely: 1- Recommendation systems 2- Knowledge-based 2- Augmented reality 4- Recommendation agents The second research is about the Deep Logistic Learning Framework for E-Commerce and Supply Chain Management Platform, which includes an integrated learning system based on the supply chain management system that is useful in saving costs

And increased production in control, inventory distribution means reduced overhead and improved efficiency. And the third paper on Applying machine learning to the dynamic selection of replenishment policies in fast-changing supply chain environments includes a machine learning approach to inventory management that can help companies manage their supply chains more effectively and reduce costs Operation, using model predictive control methods identifies a promising solution strategy for the problem under study. Machine learning techniques can be useful for improving inventory control in contexts with inventory imprecision, i.e. deviations between actual and recorded inventory. A fourth research on supply chain risks using machine learning: The trade-off between performance and interpretability and includes contributing to research exploring the untapped potential of data-based AI technologies within SCRM and we proposed a risk prediction framework for SCRM that uses data-based AI techniques and relies on collaboration and interaction between AI experts and the supply chain. In the case study, the framework can perform well across a variety of metrics using both black box and interpretable machine learning techniques.

# TABLE I. COMPARISON BETWEEN RELATED WORKS

References	Techniques Used	pros	cons
[1]	Prediction purchase using XGBoost algorithm	layer of the XGBoost algorithm consists of a shopping cart decision tree. It treats these decision trees as the basic "units" of operations and combines them for joint decision making to solve the problem of a single decision tree being over-fitting.	Not much, XGBoost has a greater impact in training fusion models.
[1]	C4.5 algorithm based on decision trees	which can process continuous and discrete attribute data, data sets with missing values	The decision trees produced by C4.5 are relatively bigger .
[2]	inductive learning,C4.5	solve new problems by assigning a class to the set of values of the attributes defining them.it can achieve a very good trade-off between error rate and speed of learning	Has limited data types and lacks the facility to label data as not applicable, slower in terms of processing speed
[5]	Collaborative Filtering	filtering methods can yield exceptional results when there is a large record of previous user-item interactions.	significant issue when the requirement is lacking. This is expressed as the “cold start problem”
[5]	Knowledge Based	generates recommendations to users according to explicit information related to their preferences and needs , avoid the cold-start problem.	The processes of acquiring the desired knowledge can time-consuming and tedious.
[5]	Augmented and Virtual Reality	enables the interactive exploration of products, allows consumers to interact with printed and outdoor media by providing a QR code, reduce friction and costs associated with returns in online retailing.	It may issue inaccurate information.
[5]	Recommendation Agents	providing recommendations, answering questions about products and their usages , chatbots can provide feedback.	Required a lot of effort.

[13]	SVM model	performing slightly better with regard to average precision and recal	doing slightly worse in the case of balanced metrics
[13]	decision tree models	doing slightly better in the case of balanced metrics	performing slightly worse with regard to average precision and recall
[12]	DLLF model	minimize computational time and improve data dissemination accuracy during an online transaction.	may significantly impact the costs associated with the activities of an e-commerce network With its design and conceptual definition

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