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Enabling Smart Supply Chain Management with Artificial Intelligence

Thi Hien Nguyen¹, Huu Du Nguyen^{*2}, Kim Duc Tran², Dinh Duy
Kha Nguyen³, and Kim Phuc Tran⁴

¹Laboratoire AGM, UMR CNRS 8088, CY Cergy Paris Université,
95000 Cergy, France

²International Research Institute for Artificial Intelligence and Data
Science, Dong A University, Danang, Vietnam, *Corresponding
author. Email: dunh@donga.edu.vn

³Université de Technologie de Troyes, 10300 Troyes, France

⁴Ecole Nationale Supérieure des Arts et Industries Textiles,
GEMTEX Laboratory, BP 30329 59056 Roubaix Cedex 1, France

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Acronyms

AI	Artificial Intelligence	SCM	Supply Chain Management
IoT	Internet of Things	ERP	Enterprise Resource Planning
CNN	Convolutional Neural Network	RNN	Recurrent Neural Network
RUL	Remaining Useful life	VR	Virtual Reality
DSS	Decision Support System	LSTM	Long-Short Term Memory
CLSC	Closed-Loop Supply Chain	DOE	Design of experiment
BT	Blockchain Technique	BC	Blockchain
ASC	Agriculture supply chain	RF	Random Forest
MAPE	Mean Absolute Percentage Error	MAD	Mean Absolute Deviation

Chapter Summary

It can be said that a well-functioning supply chain management (SCM) is a key to ensuring the success of any business in a competitive global economy. SCM consists of the management of the entire production flow, ranging from supplying raw materials all the way to delivering the final products to the consumer. It aims to minimize the total expenses and maximize the customer value. In recent years Artificial Intelligence (AI) has emerged as a powerful tool that allows SCM to be more effective. The applications of AI techniques have been witnessed in all the components of SCM. This chapter provides a survey on these applications, including the prominent applications of AI algorithms in demand forecasting, logistics, production, and designing a decision support system. We also discuss the use of blockchain for SCM. Finally, in the case study, we present a method for fashion retail sales forecasting using machine learning algorithms.

1 Introduction

Supply Chain Management (SCM) plays a very important role in collaboration among many stakeholders such as producers, suppliers, carriers, distributors, and retailers. The purpose of SCM is to create maximum benefit not as singular realities but also as the result of a sum of interactions between entities sharing common interests. As a consequence, a large number of studies have been devoted to developing effective methods for SCM. In the literature, the number of articles related to the SCM topic has increased dramatically as shown in Figure 1 (extracting from WebofScience). In the period from 2010 to 2020, the number of articles per year has doubled compared to the previous 5 years.

There are different points of view about the definition of SCM. For example, Ellram¹ defined SCM as a network of companies interacting to deliver a product or service to the end customer and involving a set of flows from raw materials to final delivery. Christopher² referred to SCM as "the management of upstream and downstream relationships with suppliers and

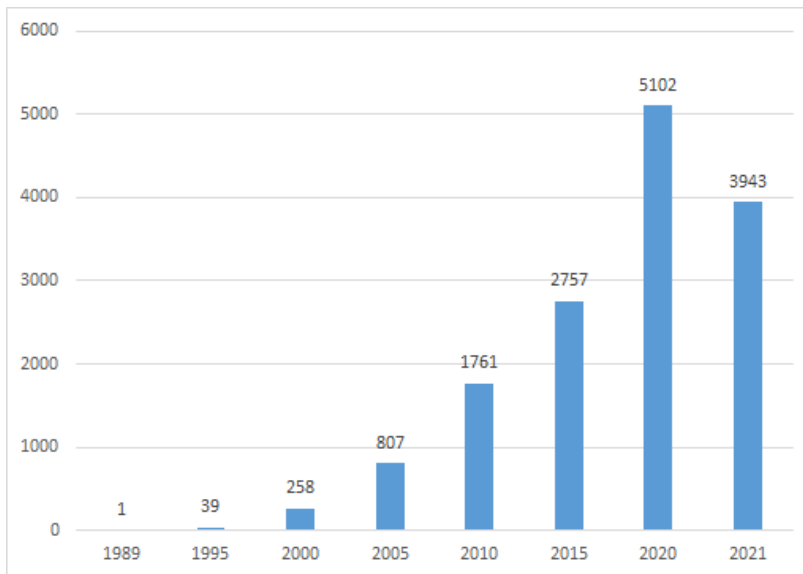


Figure 1: Number of publications on SCM since 1989.

customers in order to deliver superior customer value at less cost to the supply chain as a whole”. Bechtel and Jayaram³ counted more than 50 definitions of the SCM and classified them into five categories. Regardless of differences in the way to express the definition of SCM, there is a common among all these definitions about the increasing importance of SCM for any organizations or businesses in competing in the global market and networked economy (Cooper et al.⁴).

Due to the growth of Internet businesses and mobile computing, there is a profound change in the way of shopping of customers and the operating of businesses. By allowing customers to contact product distributors directly and encouraging cooperation, these new advances shorten the supply chain. Internet businesses like Amazon have improved their service quality in terms of on-time delivery and convenience. Normalizing features like next-day delivery can increase order fulfillment, but also make it difficult for other parts of the chain. Because orders can be made and received faster, they need to be delivered at a faster rate. As a consequence, several disadvantages can be encountered in the supply chain: it leads to waste when businesses order too many raw materials or it does not supply enough products according to the order in the opposite case. This is only one among many challenges a business can meet in its operation and this can only be overcome by developing an efficient SCM method. The application of advanced technologies like the Internet of Things (IoT) and Artificial Intelligence (AI) for SCM is then encouraged.

AI refers to a set of computer algorithms that allows machines to perform complex tasks "as a human" by perceiving the working environment and taking actions to maximize the possibility of success. Shortly, it is regarded as intelligence demonstrated by machines. Recent times witnessed the sharp development and the wide applications of AI in many areas of real life, and SCM is not an exception. Dash et al.⁵ highlighted the recent trends and applications of AI in the retail and manufacturing industry. Oh⁶ introduced an SCM solution connecting many components such as suppliers, manufacturers, customers, and other companies to enable efficient inventory management and timely product supply, based on AI and IoT technologies. A systematic review that aims to identify the contributions of AI in SCM has been conducted in Toorajipour et al.⁷. The authors classified the applications of AI in SCM into four main fields, including marketing, logistics, production, and supply chain. Another review on the implementation of machine learning (ML) techniques within SCM in Younis et al.⁸ concluded that the ML applications are still at the infant stage and their opportunity for elevating SCM performance is very promising. In this chapter, we provide a survey on the applications and perspectives of AI that enable effective SCM approaches. We focus on the benefits of AI algorithms in the important fields in SCM like demand forecasting, logistics, production, and decision support systems. We also discuss the use of blockchain techniques for SCM. In addition, we suggest a novel method for forecasting retail sales in the fashion industry based on a random forest algorithm.

The chapter is structured as follows: In Section 2, we discuss the applications of AI algorithms for demand forecasting in SCM. The benefits of AI for logistics are presented in Section 3. Section 4 and Section 5 are for the covering of AI technique in the production process and in designing a decision support system, respectively. A case study has been conducted in Section 7 where we present a method for forecasting fashion retail sales using several ML algorithms. Finally, some concluding remarks are given in Section 8.

2 AI for Demand Forecasting

Forecasting refers to the prediction of what is going to happen in the future by analyzing what happened in the past and what is going on currently. Demand forecasting is an essential strategy for improving customer service levels and reducing costs related to supply-demand mismatches. For businesses, is very important to keep the balance between supply and demand. Any oversupply or shortage of goods to meet customer needs leads to negative effects on the businesses, both in terms of economy and operations or even the competitiveness with others. However, the customer demand is an unpredictable quantity and this number can only be estimated us-

ing the predictive methods. An accurate forecast of customer demand is able to result in the right decision or an effective policy in managing the supply chain. It facilitates principal business activities such as budgeting, financial planning, sales, marketing planning, material planning, production planning, risk assessment, formulating mitigation plans, and promotional campaigns.

In the literature, a variety of forecasting techniques has been introduced to best suit the specific business environment such as long-term forecasting, short-term forecasting, etc. In general, the core idea in forecasting is that the future needs should follow the past demand patterns, and the forecast is based on the accuracy and validity of historical data no matter the utilized methods. Among many methods applied for demand forecasting, AI algorithms have become increasingly powerful and popular. Yu et al.⁹ proposed a dynamic pattern matching process within an agent-based system framework that combines human expertise and data mining techniques to predict new product demand. Jeong et al.¹⁰ improved the accuracy of the prediction without relying much on historical data by introducing a genetic algorithm-based causal forecasting technique that outperformed traditional regression analysis. These studies are both useful for products that have not yet been introduced to the market because no historical data are required. Snyder and Shen¹¹ presented an overview for the demand forecasting approaches. The authors also made a comparison between the performance of the ML methods and the classical methods for predicting demand, leading to a conclusion that the ML algorithms significantly increase the prediction accuracy. Amirkolaii et al.¹² suggested an AI-based method for the prediction of irregular demands in business aircraft spare parts supply chains. A decomposed deep learning (AL) approach for tourism demand forecasting has been introduced in Zhang et al.¹³. Recent studies about the benefits of an accurate prediction for customer's demand and the AI solutions for the problem can be seen in Carbonneau et al.¹⁴; Raza and Khosravi¹⁵; Bousqaoui¹⁶; Boone et al.¹⁷; Zhu et al.¹⁸; Nguyen et al.¹⁹; Shao et al.²⁰; Kamble et al.²¹, and Nikolopoulos et al.²².

3 AI for Logistics

An important objective in SCM is to make sure smooth and efficient operations at the production side of the chain. Once the scale of the production processes increases, several problems in logistics could be faced such as overstocking, stock-out, and delivery delays. Moreover, the logistics operations should be upgraded due to the increasing complexity and variety of customer orders. The inefficient and inaccurate order picking process may lead to negative effects on order fulfillment. That is to say, it is necessary to have good logistics management and AI algorithms are a powerful tool to per-

form this task: they can lead to a revolution in transportation operations (Wang²³). The assessment of supply chain logistic performance using AI and simulation-based Techniques was presented in Bruzzone and Orsoni²⁴.

In logistics management, warehousing refers to a storage repository that allows the goods and the cargo to be stored properly. The major operation of the warehouse involves the storage and the protection of goods, risk-bearing, grading/branding, and transportations. A number of the necessity for warehousing was mentioned in Pandian²⁵. The authors also proposed a method for automated warehouse logistics in which the sensor networks were utilized to gather the information about the number of the items entering and leaving the warehouse and the AI algorithms was applied to handle these data to perform automatically the tasks in the storehouse such as placing the items in the proper rack, picking back the items from the rack as per the order placed. Lee et al.²⁶ provided an Internet of things (IoT)-based warehouse management system with an advanced data analytical approach using AI techniques to enable smart logistics that improves the warehouse productivity, picking accuracy, efficiency, and robustness to order variability. Mahroof²⁷ discussed many perspectives for the AI adoption in a warehouse along with reviewing a number of studies on warehousing and technology in the literature. Recently, Zhang et al.²⁸ conducted a study to see successful applications of AI in businesses considering an in-depth case study of Alibaba's smart warehouse, a leading e-commerce fulfillment center in China.

Besides the warehouse-related problems, the management of logistics also faces difficulty in transportation. The rapid development of the economy, as well as the expansion of the scale of production, also mean the increasing requirements of the efficiency of the transporting system, i.e. the ability to transport goods from the factories to the warehouses, from the warehouses to the supermarkets or stores without breaks in the travel chain regardless of functional ability. The advanced technologies, including AI, serve to reduce difficulty in traveling and tailor solutions to the accessibility of a transportation system. By combining many algorithms like the Back Propagation neural network, the Earliest Deadline First dynamic scheduling algorithm and the Controller Area Network communication network to build an AI-empowered communication system for intelligent transportation Systems, Lv et al.²⁹ concluded that the application of AI technology can improve significantly the efficiency of vehicle scheduling and the efficiency of the communication system. A large number of studies on the applications of innovative AI algorithms in decision-making, planning, modeling, estimating, and controlling that facilitate the process of transportation planning and operations has been provided in Sohn³⁰. These studies covered many topics in a transportation system like traffic surveillance, vehicle emission reduction, traffic safety, congestion management, traffic speed forecasting, and ride-sharing strategy. A summary of the potential application of AI in

transportation has recently been presented in Vasudevan et al.³¹.

4 AI for production

Thanks to the development of the new advanced technologies in IoT and cloud computing, the use of AI in production is becoming more and more popular. One can mention many applications of AI for production such as detecting abnormality products, planning production, monitoring the production process in real-time, performing predictive maintenance, and optimizing the manufacturing process.

The production scale in modern industrial production is increasingly expanding with large production lines operating continuously. In that process, the problem of detecting defective products plays an important role, both helping to eliminate these defective products to ensure the quality of factory products and, at the same time, allowing to detect the cause of defects in the line. The machine learning algorithms like support vector machine, Extra Tree, or the deep learning methods like Recurrent Neural Network (RNN), and the Conventional Neural Network (CNN) are the effective tools in AI to perform the classification mission. In the literature, many studies have been devoted to this problem. Graß et al.³² discussed an approach for anomaly detection regarding predictive maintenance in an industrial data-intensive environment. Nguyen et al.³³ using a one-class support vector machine algorithm to separate anomalies from multivariate time series data outputted based on the LSTM Autoencoder network. A comprehensive survey on deep learning approaches for anomaly detection was conducted in Chalapathy and Chawla³⁴.

The unqualified products maybe because of the degradation of machines in the production lines after a certain time of working. Bevilacqua and Braglia³⁵ pointed out that maintenance actions involve high costs, ranging from 15% to 70% of total production costs Therefore, it is necessary to have a good strategy for maintenance. Predictive maintenance refers to a well-known approach that allows determining the right time for maintenance activities. It benefits the production process by minimizing unplanned downtimes, reducing system faults, increasing efficiency in the use of resources, and planning maintenance interventions. Based on the data collected from many sensors appended to the machines, AI algorithms can predict, diagnose, and analyze future maintenance needs. In predictive maintenance, a key idea is to estimate the remaining useful life (RUL) - the remaining time before a machine requires a repair or a replacement when it no longer performs well its function. Several machine learning methods like Linear Regression, Bayesian Linear Regression, Poisson Regression, Neural Network Regression, Boosted Decision Tree Regression and Decision Forest Regression have been applied for RUL prediction in Yurek and Birant³⁶. A hybrid

model combining support vector machines for the prediction of the RUL of aircraft engines was presented in Nieto et al.³⁷. The deep learning algorithms like CNN, RNN, and Long-Short Term Memory (LSTM) network for estimating RUL can be seen in many studies like Li et al.³⁸; Savargaonkar et al.³⁹; Savargaonkar and Chehade⁴⁰ and Wu et al.⁴¹.

Another important application of AI that makes the manufacturing process smart is virtual reality (VR). VR refers to an artificial environment that provides users with three-dimensional images and some effects so that they can feel like being in a real space. In smart manufacturing, VR technology supports engineers in evaluating the performance of an object via virtual prototypes, which saves a lot of expense compared to building physical prototypes. That is, it can allow the implementation of complex engineering theory from industrial real-life practice in a virtual 3D model. Several applications of VR in industrial manufacturing have been discussed in Hamid et al.⁴², consisting of Design (design and prototyping), Manufacturing Processes (machining, assembly, and inspection), and Operation Management (planning, simulation, and training). Gong et al.⁴³ proposed a point cloud-based virtual factory modeling approach for factory layout planning applied in many industries such as aerospace and truck manufacturing. The benefit of the introduction of Additive Manufacturing and Augmented Reality in aeronautical maintenance has been analyzed in Ceruti et al.⁴⁴. Dobrescu et al.⁴⁵ provided a review of the studies related to virtual manufacturing systems.

All the specific applications discussed above are ultimately for the purpose of optimizing the production process. This is a highly complex task to make the process as good, functional, and effective as possible and it requires the best combination of many controllable parameters. The AI optimization algorithms enable processing data related to products from raw materials, manufacturing, traveling, and storing, to the end of life-cycle and then refining this process which can maximize the yield in a shorter time and at reduced costs. For example, Ardabili et al.⁴⁶ suggested using several machine learning methods for optimizing the production process of methyl and ethyl esters. Oroojlooyjadid et al.⁴⁷ solved inventory optimization problems using a reinforcement learning algorithm. A review of machine learning for the optimization of production processes can be seen in Weichert et al.⁴⁸.

5 AI for Decision Support Systems in SCM

In today's global scale of industrial production, trade, and services, every important decision of managers has a great influence on the benefit and the long-term development of the whole enterprise. The experience-based method is no longer suitable for them to rely on. That is to say, designing an effective Decision Support Systems (DSS) is a must for any business to assist

Table 1: Top 10 domains that have the most publications on topic DSS and SCM

Categories	Record Count	% of 1.967 publications
Operations Research Management Science	581	29.537
Engineering Industrial Management	389	19.776
Engineering Manufacturing	361	18.353
Computer Science Interdisciplinary Applications	310	15.760
Computer Science Artificial Intelligence	255	12.964
Computer Science Information Systems	220	11.185
Environmental Sciences	203	10.320
Green Sustainable Science Technology	165	8.388
Engineering Electrical Electronic	144	7.321
	141	7.168

their managers in making the most informed decisions. In fact, the concept of DSS covers not only SCM but also a wide field of applications. Applications of DSS in conjunction with several areas such as database management systems, operations research, AI, involve different levels of DSS complexities in businesses and industry. Table 1 reports the top ten categories that have the most publications on the topic of DSS extracted from WebOfScience. Another report in the same source about the Times Cited and Publications Overtime is reproduced in Figure 2. Namely, the references about the methods to design a DSS and its applications in the literature are abundant. Tawfik et al.⁴⁹ highlighted the decision-making process, components in a DSS process, and types of DSS in supply chain management. A comprehensive overview of DSS in SCM was made by Teniwut and Hasyim⁵⁰ providing information on the trends, methodologies, and applications on different sectors and platforms used by scientists for building their decision support systems in the supply chain. The author also pointed in some research questions about the most effective models used on DSS in the supply chain, the use of DSS covers various problems in the supply chain, the advantages of DSS, etc. Govindan et al.⁵¹ developed a practical DSS with the demand management in the health-care supply chain to fight the pandemic Coronavirus disease 2019 (COVID-19) by reducing stress in the community, breaking down the COVID-19 propagation chain, and, generally, mitigating the epidemic outbreaks for health-care supply chain disruption.

As discussed in several studies in SCM, there are five main sectors that affect the capacity of a supply chain, including production, inventory, warehouse, location, transportation, and information. An efficient SCM firstly requires an understanding of each sector. The next step is to extend the evaluation of the results achieved by the various combinations of these sectors. Therefore, a supply chain generates a lot of data, its consequence is that there are many systems with inputs and outputs, which are often too complex to model and optimize analytically. Due to its power in analyzing

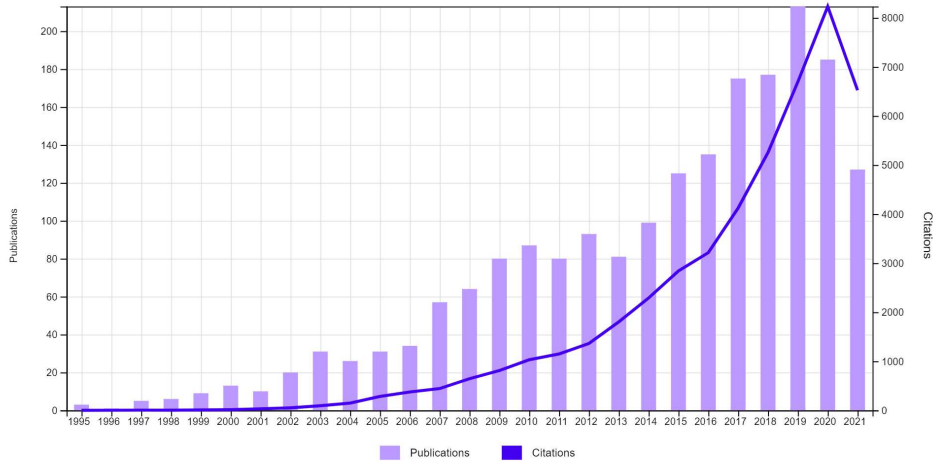


Figure 2: Times Cited and Publications over time

data and the ability to extract important features from data, AI algorithms have been incorporated into the methods to design a DSS in SCM. Chi et al.⁵² proposed a machine learning algorithm as a potential methodology for system modeling and optimization vis-à-vis traditional design of experiment (DOE) methods. The result shows that these algorithms can obviate the need to perform more complex, expensive, and time-consuming DOE, which usually disrupts system operations. The models resulting from the proposed algorithms had strong explanatory and predictive power, comparable to that of DOE. A new methodology was proposed by Rodriguez et al.⁵³ to solve a Closed-Loop Supply Chain (CLSC) management problem through a decision-making system based on fuzzy logic built on machine learning decision support tools, more specifically, decision trees. Very recently, Kamble et al.²¹ developed a predictive decision support system using a Bayesian network analysis featuring the significant factors. It aims to predict an organization’s probability of successful blockchain adoption. Other publications about the application of ML technique on DSS can be found in, for example, Medina-Gonzalez et al.⁵⁴; Ni and Xiao⁵⁵; Alavi et al.⁵⁶.

6 Blockchain technique for SCM

It would be remiss not to mention the contribution of Blockchain to developing effective methods for SCM. Blockchain today is gradually becoming an efficient technology to enhance customer service and enhance company performance. It distributes a database that maintains a continuously growing list of data records that is secure from tampering and modification. So even if the stakeholders are not trusting or unfamiliar, they can share records of data together but still maintain confidentiality. In addition, Blockchain

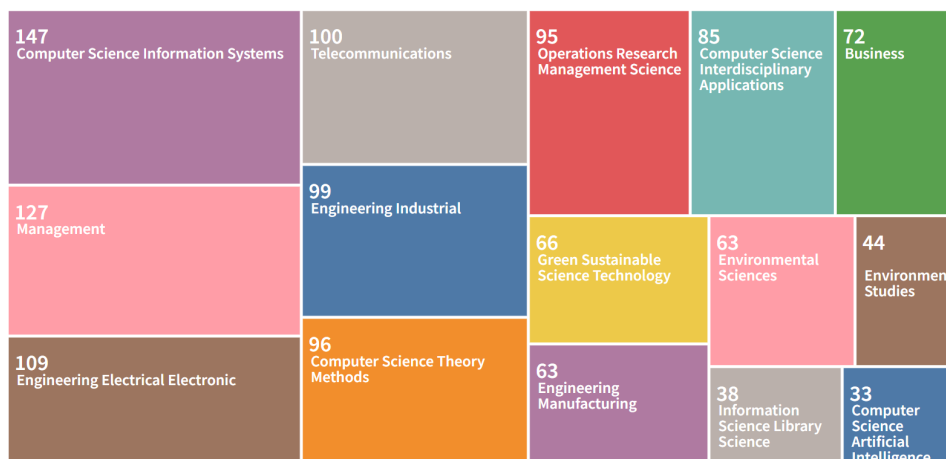


Figure 3: Tree-map chart for number of publications in each the Sciences Categories using Blockchain in SCM

also promotes transaction activities, improves transparency while reducing unnecessary costs. It is showing huge potential for growth in a secure and efficient future economic and social system. The supply chain shows many positives today, but there are also unavoidable challenges such as Lack of traceability, Limited transparency, Outdated means of data sharing. However, with the application of the Blockchain technique, the supply chain will become more efficient, improving efficiency, increasing transparency, and reducing costs. With two keywords "Supply chain management" and "Blockchain", Web of Science shows us a tree-map chart that describes the areas where scientific publications use blockchain technique (BT) in SCM, (see Fig 3). In the sequel, we discuss the main benefits Blockchain to SCM.

Advanced traceability. Blockchain creates a checkable trace of all items that travel through the network. With the help of IoT technology, it can collect a large amount of data of items in real-time along with timestamps and collection location. Thanks to that, Blockchain has created a complete, accurate, and easy to access inspection trail, from the origin of the product to the customer. Moreover, the data in Blockchain is immutable and always requires an electronic signature to confirm ownership of information, so the technique always provides a reliable history of any product and gives provides faster traceability in the event of a compromise. Advanced traceability helps to solve problems faster, reduces product recall costs, and improves product authenticity and quality. For example, Kamble et al.⁵⁷ found that among the identified enablers, traceability was the most significant reason for blockchain technology implementation in agriculture supply chains (ASC) followed by suitability, immutability, and provenance. Some examples of

traceability are mentioned in the following articles Caro et al.⁵⁸; Hastig and Sodhi⁵⁹; Wamba and Queiroz⁶⁰; J.Sunny et al.⁶¹; T.K.Agrawal et al.⁶².

Improved transparency Thanks to the transparency and completeness of product information, companies will make better forecasts and decisions against the existence of fake goods. Blockchain technology transparency has become a technological answer to address some sustainability problems, it helps us in improving the processes involved in production. For example, Madumidha et al.⁶³ explained how blockchain technology (transparency) helps in the food supply chain management. The work of C.Bai and J.Sarkis⁶⁴ build an appraisal model of blockchain technology supporting supply chain transparency to mitigate sustainability risks and build global supply chain competitiveness. Like in F.Wamba et al.⁶⁵; J.Sunny et al.⁶¹; Kamble et al.⁵⁷, the results confirmed that the power of blockchain to enable more transparency in supply chains is real and verifiable.

Greater security Supply chain security has become a subject of massive interest in both academia and industry. Several recent studies discuss the importance of security in supply chains and the measures required to achieve that, for instance, see Salman et al.⁶⁶; Tukur et al.⁶⁷; W.Viriyasitavat et al.⁶⁸. With the structure of Blockchain (BC), to be able to penetrate a particular loot, all previous blocks in the entire history must be modified. Therefore, hacking to threaten a centralized database in BC is almost impossible. BC technology-powered business and transaction log storage becomes much more secure. With the research in Lemieux⁶⁹, we can understand more about Blockchain technology as a solution to creating and preserving trustworthy digital records, presenting some of the limitations, risks, and opportunities of the approach.

Enhanced trust From the research of trusted protocol in Alam⁷⁰, Blockchain proved better security when it always requires relevant electronic signatures to perform transactions on the supply chain. At the same time, Blockchain also records the time, location, and other data in the Supply chain system and synchronizes all of that data in real-time. This is called a reliable identity management mechanism. As a result, the trust of stakeholders in the Supply chain network has been enhanced. Blockchain technology promises overpowering trust issues and allows a trustless, secure, and authenticated system of logistics (see D.Dujak and D.Sajter⁷¹; Oh et al.⁷²; P.Dutta et al.⁷³; Alazab et al.⁷⁴).

Boosted efficiency The main purpose of BC when it comes to the Supply chain is to replace outdated processes today. The data will be aggregated, backed up, and updated for relevant parties. Blockchain helps minimize human error and minimizes the need for third parties because transaction information requires instant commitment and authentication from related parties, and Blockchain synchronize also all of this data automatically with local copies.

7 Case study

In this section, we demonstrate a specific application of a machine learning method in SCM. In particular, we compare the performance of several ML algorithms in forecasting retail sales in the fashion industry.

Fashion has been determined as a factor in the creation of value on a global scale. The business of buying clothes from manufacturers and selling them to customers is known as retail. Retailers make initial purchases for resale three to six months before the customer is able to buy the clothes in-store. For this reason and the "sensitivity" of mode, sales forecasting plays a very important task in fashion retailing. A review of several AI approaches for sales forecasting in the fashion retailing service industry can be seen in Liu et al.⁷⁵. In this study, we apply many ML algorithms, including Random Forest (RF), Support Vector Machine (SVM), Linear Regression (LR), and Elastic Net CV to predict the fashion retail sales based on the data set introduced in a part of Kaggle competition (<https://www.kaggle.com/c/retail-case-study-batch14/data>). This sales data set contains the temporal data like Month, Year, and Product category and Sales, the macroeconomic data like GDP and unemployment rate, the weather data, and the events and holiday data. Based on this information, the goal of applied models is to forecast the retail sales that can help the retailer to plan their budgets or investments in a period (monthly, yearly) among different product categories like "WomenClothing", "MenClothing" and "OtherClothing".

The performance of the proposed methods is evaluated using the measure of Mean Absolute Percentage Error (MAPE)- a measure of prediction accuracy of a forecasting method. Whilst the Mean Absolute Deviation (MAD) calculate the disparity between the predictions and the reality of bookings, the MAPE put a percentage value to that calculation. Namely, it provides the information about how many percentage points a forecasting method are off on average. The formula for MAPE is

$$\text{MAPE} = \frac{1}{n} \sum_{t=1}^n \left| \frac{A_t - F_t}{A_t} \right| \times 100\%$$

where A_t is the actual value and F_t is the forecast value, and n is the number of fitted points. The value of MAPE for each method is displayed in Table 2. As can be seen from this table, the RF method is superior to the rest, corresponding to the smallest value of MAPE, which is 13.7328%. The LR model is not effective for the data set as the corresponding value of MAPE is highest: 37.9%. For ElasticNet CV and SVM approaches, the values of MAPE indicate similar accuracy, both are about 20%. That is to say, among all the applied methods, the RF leads to the best performance.

Table 2: The Value of Mean Absolute Percentage Error (MAPE) for each method

Method	The Value of Mean Absolute Percentage Error
Linear Regression	37.9000
ElasticNet CV	20.0387
Support Vector Machine	20.0481
Random Forest	13.7325

8 Conclusion

In this chapter, we have conducted a survey on the applications of AI algorithms in SCM, aiming to highlight the potential of these advanced techniques to enable a smart SCM. We have focused on several important sectors in SCM, including Demand Forecasting, Logistic, Production, and Decision Support Systems. We have also discussed the benefits of the Blockchain technique for SCM. In addition, a case study where we demonstrated the performance of several ML models to forecast retail sales in the fashion industry has been provided. Since the last two years, the Covid-19 pandemic has disrupted the global supply chains due to months of lock-down. However, this is also a motivation for the need to develop applications of advanced technologies such as IoT and AI as the recovery of the global economy requires a more effective SCM to easily adapt to day-to-day changes in current conditions

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