**Journal of Information Systems Engineering and Management**
2025, 10(15s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

**Research Article**

# Optimizing Supply Chain Management: A Decision-Making Approach for Performance Enhancement

Carlos Tolentino[1], Eyrán Díaz Gurrola[2], Xochitl Segura Lozano[2], Juan Antonio Granados–Montelongo[3], Juan Antonio Álvarez–Gaona[2], Reimundo Moreno-Cepeda*[2]
[1]*Tecnológico Nacional de México, Mexico*
[2]*Universidad Autónoma de Coahuila, Mexico*
[3]*Universidad Autónoma Agraria Antonio Narro, Mexico*

**ARTICLE INFO**

Received: 07 Dec 2024

Revised: 22 Jan 2025

Accepted: 07 Feb 2025

**ABSTRACT**

**Introduction**: Supply chains have become indispensable elements in the process of conducting modern businesses, continuously adapting to changes in markets and demands from clients. Effective Supply Chain Management (SCM) is essential for achieving success and holding a competitive advantage, with many challenges ahead: encouraging collaboration, new technologies, and best practices.

**Objectives**: This work develops the application of artificial neural networks (ANNs) within SCM based on the Supply Chain Operations Reference (SCOR) model. The SCOR model has been extensively applied because of its great capacity to detect issues within the supply chain; however, it does not indicate the best way to address these issues.

**Methods**: A diagnostic approach based on the SCOR model is proposed in a hybrid manner where ANNs are exploited to provide recommendations regarding the issues detected by the SCOR model. The integration of ANNs allows for data-driven insights to enhance the decision-making process and optimize supply chain operations.

**Results**: The new strategy aims to improve decision-making processes, modernize operations, reduce redundant tasks, and be flexible enough to adapt to future market changes by determining activities that could create greater impact within its supply chain.

**Conclusions**: Furthermore, the proposed methodology should be adaptable to various industries and is expected to optimize the efficiency of SCM, providing a scalable solution to enhance supply chain performance across different business sectors.

**Keywords:** Supply chain management, SCOR model, artificial neural networks, artificial intelligence.

## INTRODUCTION

In today's business world, supply chains are crucial in most operations within an organization, since they contain essential connections among suppliers, producers, and end-users. As global markets grow and competition strengthens, the need for efficient Supply Chain Management (SCM) becomes critical. SCM relies on the integration of logistics for a smooth flow of information, material, and products from origin to destination. With the contemporary business environment being so dynamic and unpredictable, firms have to manage their supply chains (SCs) carefully and accurately, while at the same time being ready to innovate and promptly adapt to any new circumstances that might provide them with a competitive advantage.

One of the biggest challenges in SC management is building collaboration and trust among partners. When it works well, good collaboration can really improve information sharing, help everyone reach their goals, and boost overall performance. But making this happen isn't always easy. Things like different locations, culture, and levels of technology can get in the way. This is when new technologies, where Artificial Intelligence (AI) evidently outstands, can be a game-changer. AI can handle large amounts of data to provide insights to improve decision-making [1], [2].

The Supply Chain Operations Reference (SCOR) framework model, developed by the Association for Supply Chain Management, is nevertheless a useful framework for assessing and improving supply chain activities. SCOR combines business processes, metrics for assessing process performance, best practices, and technology into a coherent and integrated framework [3], [4]

However, the SCOR model has limitations, most notably in that there is no accounts for mathematically rigorous and heuristic methods to come to a reasoned recommendation and dependency on knowledge to assess how to deal with the questions it raises for itself. Classical optimization techniques typically fail to adequately handle questions related to supply chains, mainly because the environments in which organizations operate are always dynamic and changing [5]. Therefore, this paper aims to shift SCOR to a position such that it is more amenable to artificial neural networks (ANN) with some hope for managers for an improvement that can better accommodate regimes of this type of dynamics.

Neural networks are already widely used in a variety of industries, from recognizing images and processing language to predicting financial outcomes. They learn from data and refine their performance over time. This capability makes them effective in SCM, where constant adaptation is key. The objective of integrating ANNs with the SCOR model is to create a hybrid method that identifies problems in the supply chain and offers suggestions for improvement [6].

The procedure in this research method embraces a series of sequential steps systematically, starting with diagnostics of the supply chain based on the SCOR model. The diagnostics stage focuses on identifying the existence, operation, and interactions of SCOR model elements in use within the supply chain. Once the SCOR model was reviewed, the data were analyzed and evaluated further by using neural networks to identify patterns in the data and areas of improvement that would have the most influence on the supply chain. Once this phase is completed, the components of the hybrid model recommends improvements to the supply chain area. The improvements are intended to represent the needs and constraints of the supply chain. The role of improvement was to ensure practicality and possibilities of effectively implementing the improvements. This paper applied this methodology in three different industries: metalworking, marble, and food processing. The three industries evaluated different aspects of the supply chain; however, there are many characteristics and challenges to each supply chain that served a useful testing ground for preparing the proposed process. In the case of the metalworking industries, study area components focused on improving the way in which the different processes plan in ways to assure the supply chain delivers its response in a timely manner. In the case marble study, study area components focused on analyzing the delivery separately from the existing delays introduced whilst improving the satisfaction of customers. And finally, for the case of food processing, production process components were examined to improve efficiencies while reducing waste. Results from the three case studies outlined above served as a contrasting value to recognizing the hybrid model is a feasible and valid model for improving each individual supply chain. Contributions of this research will become evidenced in two different aspects. First, it introduces a novel approach to SCM by combining neural networks with the SCOR model, which can be used to overcome the shortcomings of the above-mentioned methods and facilitate a more accurate and flexible solution. Second, it shows through various case studies that such an approach is indeed practical in different industrial contexts.

This paper consists of five sections. The following section, Section 2, reviews the literature in detail to describe the main methodologies and approaches. Further, Section 3, Materials and Methods, describes the proposed hybrid methodology, which explains ANNs' possible integration with the SCOR model for diagnostic and optimization purposes. Steps of the proposed methodology are introduced in Section 4, which will describe the procedural steps applied for the implementation of this hybrid model. The Section 5, results and discussion, describe the application of the methodology in three different industries—metalworking, marble, and food processing—showing the impact on supply chain performance. Finally, Section 6 wraps up the paper by summarizing the results of this work, discussing the implications, and suggesting some avenues that related future research might take in order to complement and extend this approach.

## OBJECTIVES

The supply chain consists of a network organization where there are processes, flows of suppliers, manufacturers, and distributors to retailers in sourcing raw materials and processing them into finished products through successive stages for customer delivery (Ivanov et al., 2010). The processes within the SC are changing in ways that are unprecedented, especially with regards to technological changes due to innovation, such as smart factories and artificial intelligence (Pajares, 2016). There are technologies available that enable real-time integration and collaborative work, reducing time, costs, and errors for each SC process through precise planning and resource optimization (Yépez et al., 2020). The integration of Information and Communication Technologies (ICTs) has led to the creation of Smart Supply Chains (SSC), which must assume key competencies to manage increasingly complex and global supply chains.

The primary objectives of the SC include improving customer service, speeding up product delivery, increasing variety, and reducing costs. Other objectives for an efficient SC include specialization, sensitivity to market variation, constant visibility, integration, supplier empowerment, and sustainability (Vegter et al., 2020). These objectives help measure the performance of SC strategies concerning operational goals. The SC consists of suppliers, manufacturers, transportation providers, distributors, and retailers working together to transform raw materials into finished goods and deliver them to customers (Frohlich & Westbrook, 2001). SC risks can be broadly grouped into two categories: macro and micro risks. The events of natural disasters and geopolitical instability are examples of macro risks, while micro risks include all other disrupting factors, which are internal in nature and relate to demand, manufacturing, supply, and infrastructure [7].

Supply chain risk management primarily concentrates on applying quantitative risk analysis and decision-support tools to gain a clearer understanding of system interactions and ultimately boost overall performance [8]. In SCM, the goal is to integrate different subsystems and agents to ensure that goods are produced and delivered at the right time, in the right location, and in the correct quantities. Therefore, effective SCM strategies make a company more capable of meeting demand, reducing the overall costs of logistics, and raising productivity and profitability. According to [9], ICT plays an important role in connecting information flows and enhancing operational efficiency.

To make the process of SCM more effective, several diagnostic models and methods are proposed such as Global Supply Chain Forum, Hierarchical Based Measurement System, Dimension Based Measurement System, Function Based Measurement System, Supply Chain Balanced Scorecard. Other mainstream processes that were followed by most industries are Efficiency-based Measurement Systems, Perspective based Measurement System, and Supply Chain Operations Reference Model. Amongst these, the SCOR model is very popular as it allows for a structured approach to manage supply chain processes along with assessing the performance metrics.

Technological changes have changed the way organisations are working and coordinating with suppliers and customers for extending visibility to improve the decision-making processes. It is through the integration of ICTs in organisations that gave way to SSCs that require new models for handling their complexity. Hybrid models integrate different methods to offer more realistic approaches for a particular problem. For instance, the integration of the SCOR model with other methods such as Analytic Hierarchy Process (AHP) and Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) can facilitate the appraisal performance of SC and development strategy concerning the SC in [10]. ANN models have also been induced into SC diagnosis models, given their capability in solving complex classification problems with their role in pattern recognition. ANNs deal with noisy and incomplete data, which make them appropriate for time series prediction and the solution of intricate problems in SCM. Capable of learning from datasets to make a prediction, ANN has grown to be one of the strong methodological tools in solving complex problems across different industries. The ANNs are inspired by the neural structure of the human brain and hence have an inherent capability to learn complicated nonlinear relationships between input and output data. Improvement in computing capability, together with an increase in the availability of larger datasets, has facilitated the growth of artificial neural networks. In an ANN, there are multiple layers of a set of interconnected nodes or neurons, each with an associated weight. These weights are adjusted based on the error in the actual and predicted output, commonly using a backpropagation algorithm. ANN has been identified as a promise for predicting risks and mitigating them in supply chain risk management. Supply chains consist of complex networks of interdependencies with sources or causes that disrupt, delay, and expose quality, thereby making them vulnerable. ANNs therefore identify and mitigate these risks through the analysis of historical data and prediction of future outcomes. It is reliable in demand forecasting, which is vital for the best inventory management to prevent the risk of stockout or overstocking. Research has documented that ANNs tend to be superior in terms of precision compared to traditional statistical methods in demand forecasting [11].Another critical application is the assessment of supplier risk. Suppliers are one of the key players in the supply chain, and their performances have a great impact on the overall performance of the SC. ANN models can grade suppliers in respect to delivery time, product quality, and financial status. Based on such analysis, ANNs can forecast future risks related to suppliers and support organizations in making preparations for the mitigation of such risks in advance [11].

Besides demand forecasting and supplier risk assessment, ANN can be implemented for the optimization of supply chains with regard to inventory level optimization, route optimizations, or production scheduling [12]. Despite the advantages offered by ANNs, several challenges have remained concerning the application of ANN to the management of SC risks. First, it is about the difficulty with regard to the SC itself: supply chains are dynamic and continuously changing; it is difficult to construct an accurate model [12]. This requires regular updating and retraining of the ANN to reflect the current status of the supply chain. The updating will no doubt involve a tremendous amount of computational resources besides expertise in machine learning and SCM.

The main challenges that come with the application of ANNs involve their interpretability. ANNs have remained a mystery to many, hence the term "black boxes" since their inner details are not covered. Besides that, a number of techniques are also being developed by researchers that enhance the interpretability of ANN: make its processes more transparent and understandable [13]. Recent research has enhanced the capabilities of ANN by embedding them with other advanced technologies. Neurosymbolic machine learning techniques use neural networks along with symbolic reasoning for uncovering the hidden risks in supply chains. This approach leverages the strengths of graph neural networks and knowledge graphs for the inference of various types of latent relationship risks, representing one of the biggest advances in automated supply chain monitoring in some time. GNNs can process such relationships in a supply chain created between company and product entities further enriched with certification information, hence offering complex querying beyond basic supplier-buyer relationships.

## METHODS

It is proposed to enable the decision-maker to enhance the economic choices while simultaneously optimizing the performance of the supply chain. The following are steps in the development and implementation of this hybrid approach to provide a robust data-driven solution for managing and improving supply chain processes.

Step 1: Assessment and Diagnosis Using the SCOR Model

It includes the mapping of all the current supply chain processes with the SCOR model. The SCOR model, which has been developed by the supply chain council, provides a structured method for analysis of supply chain operations. The major processes included within the SCOR model are plan, source, make, deliver, and return. Each of these processes is analyzed for inefficiencies, bottlenecks, or areas for improvement.

1. Plan: This would involve the analysis of demand and supply planning processes, including forecasting, inventory management, and resource allocation.
2. Source: Considers sourcing processes for efficiency and effectiveness, including the selection of suppliers, procurement, and inbound logistics.
3. Make: In this stage, the manufacturing process will be put under scrutiny, looking at production scheduling and the quality control measures employed.
4. Deliver: The distribution and logistics processes would aim at focusing on order fulfillment, transportation, and warehousing.
5. Return: This involves analyzing the process in terms of returns management, reverse logistics, and warranty claims.

The diagnostic phase utilizes performance metrics and key performance indicators (KPIs) defined by the SCOR model to benchmark current performance against industry standards and best practices.

Step 2: data collection and preprocessing

The data should be collected from different streams of the supply chain. The historical sales and inventory, supplier performance metrics, production schedules, and various logistics data are just a few of the many examples of data that has to be captured. The extracted data will undergo preprocessing steps to ensure clean and consistent, high-quality data for ANN analysis to take place.

Examples of data pre-processing include:

- Data cleaning (remove missing, duplicate, or irrelevant entries).
- Data normalization (transformation of data towards a uniform scale).
- Data integration (bringing data from various sources into one dataset).

Step 3: Artificial Neural Network design

We use traditional architecture for the ANN, which includes an input layer, three hidden layers, and an output layer, each containing hundreds of neurons:

1. Input layer: this layer receives the pre-processed data following the specifications of the SCOR model.
2. Hidden layers: perform complex computations and identify key features within the data.
3. Output layer: indicates which activities from the SCOR model should be prioritized by the company.

We will use historical data to help the ANN learn the patterns and relationships within supply chain processes. In training, the network changes weights between neurons by a method called backpropagation, which is loosely speaking an advanced form of the Widrow-Hoff learning rule [14]. This helps the ANN minimize the difference between its predictions and the actual result.

Step 4: model training and validation

The pre-processed data are used for training the model. In simple words, the training of the system contains feeding the data in ANN and modifying the weights by iteratively learning. This is done till desired accuracy is provided by the model.

1. Training phase: The data are divided into a training set to develop the model and a validation set to determine the model performance.
2. Validation phase: the model's performance is measured against the validation set to ensure it generalizes well to new data that the model has not seen. The metrics we will use are mean squared error (MSE, root mean squared error-RMSE, accuracy amongst others.

Step 5: implementation and integration

The ANN, having been trained and validated, is now incorporated into the supply chain management system of the company.

Step 6: monitoring and continuous improvement

The last step is continuous performance monitoring of the ANN as well as the overall supply chain processes.

1. Performance monitoring: This involves routine tracking of the performance metrics of the model and comparing them against the actual performance to determine divergences.

2. Model retraining: The periodic retraining of the ANN with new data ensures its adaptability in the supply chain environment, ensuring continuous validity and accuracy of its predictions and recommendations.

3. Feedback loop: create a feedback loop where supply chain managers offer input about the performance of the model and suggest areas for improvement. It helps in fine-tuning and creating an effective model.

## RESULTS

The next example will refer to the application of ANNs to the SCOR model in process diagnostics and improvement along the supply chain. Results obtained for two enterprises from different sectors are considered: one from the metalworking industry and another from the marble industry. The proposal has represented a chance to systematically find sources of inefficiency in a data-driven way, with actionable recommendations to solve findings in order to optimize overall performance.

### *4.1 Company A: Metalworking industry*

The metalworking company was specialized in machined, fabricated, and laser engravement for industries involving food, mining, and working with metals. The aim of the company was to enhance its plant production planning, which was considered an integral part of the supply chain. The SCOR model pointed out 184 elements that could be put to work, whereas the company used only 161 of them in an active way, while fully running only 116, thus having 45 elements that showed a low implementation or incomplete integration. The major inefficiencies came from issues in the alignment in sub-processes, with weak mechanisms for inventory control and in managing supplier relationships. We used the SCOR model to analyze such conditions of the company assessing historical data such as production schedules, inventory levels, and lead times. Later, the ANN model, capable of highlighting relationships and patterns, showed all inefficient points against areas of improvement.

The estimated initial baseline performance was then 72%. The SCOR model revealed several large-scale inefficiencies within the production planning process: major issues related to the inaccuracies in inventory management regarding demand forecasts and actual inventory levels had led to overstocking and periodic stockouts. The aggregation of demand was not appropriate because demand signals had not been so effectively aggregated across the supply chain. As a result, the resources were not utilized as should have been. Additionally, poor supplier relationship failure to communicate and integrate the activities of outsiders led to delays and quality inconsistencies of material received.

The solution recommended by the ANN included the use of ABC inventory analysis along with demand-driven replenishment strategies to optimize inventory management. This has resulted in an improvement in rate of stock turn by 15%. This also allowed better supplier integration through a set of collaborative forecasting tools. These, in turn, reduced the lead times as much as 10%. Further ways of removing inefficiencies were achieved by designing training programs on demand planning and supplier relationship management, with a view to addressing workforce gaps and giving the desired fillip to overall efficiency. Another recommendation was demand-driven replenishment strategies, which increased the overall turnover rate by 15%. On integrating suppliers, further enhancements were made using the collaborative forecasting tools, reducing the lead times by an additional 10%. On the inefficiencies, it also provided training programs in effectively enhancing demand planning and supplier relationship management skills; hence, workforce gaps were addressed, further improving overall efficiency. This improved the overall effectiveness of the process to 81.3% when recommendations had been realized – about 9.3% improvement.

Advanced technologies, such as predictive analytics, can be used to predict the demand trend with greater precision. In addition to this, the model depicts the opportunities regarding IoT-enabled sensors for undertaking real-time tracking, which is planned by the company for adoption in the next phase of optimization.

*4.2 Company B: Marble industry*

The Marble Company is a family-owned business that started over a decade ago in the manufacture and distribution of marble products such as countertops, flooring pieces, and other decorative pieces. The company would like to revisit the distribution process, which has proved highly inefficient, allowing an alarming amount of product damage besides inaccuracies in the same distribution process. The SCOR model identified 194 applicable elements, of which only 51% were in operation. This indicated a lapse in logistic coordination, human capital capability, and technological integration. The major issues were the insufficient delivery operation accuracy and the missing real-time order tracking system. Data on delivery times, orders, and performance of logistics analyzed through the ANN integrated with the SCOR framework identified places where inefficiency existed. Such findings therefore made practical propositions on the way these functions could be improved. The SCOR model allowed process mapping of the interdependencies in a structured way; thus, the ANN recommendations addressed the most critical areas for improvement.

The process efficiency for distribution at the outset was 58.9%. A few critical issues identified by the ANN were as follows:

- Delivery location errors were frequent.
- There was poor route optimization and lack of maintenance for delivery vehicles, which contributed to delays and increased operational costs.
- There was insufficient training in logistics management and material handling.

The company implemented the following data-driven recommendations of ANN: real-time tracking systems and standardized procedures for handling orders so that the incidences of delivery errors could be reduced by a large degree. Then, sophisticated routing tools and predictive scheduling, based on which vehicle maintenance is scheduled, resulted in higher delivery at lower costs. Thirdly, material handling and customer service and logistics coordination programs have enhanced operational efficiencies for the workforce training on account of overcoming the skill gaps amongst the employees. The company implemented these recommendations over a period of three months gradually and continued tracking key metrics regarding delivery accuracy, operational costs, and customer satisfaction.

Over a three-month period, the company carried out these recommendations, continuously monitoring metrics such as delivery accuracy, operational costs, and customer satisfaction. This resulted in an 18% increase in delivery precision, a 20% reduction in product damages during transit, and a 15% decrease in logistics-related operational costs. The inventory holding cost was further optimized so as to help more towards the overall cost efficiency. After implementation, the overall process efficiency went up to 61.86% with a strategic increase of 5%. Delivery time was reduced by 12%, hence making delivery promises more accurate. There was also a reduction of 22% in customer complaints on issues in delivery; this therefore means that there has been effective improvement in the level of service and customer satisfaction. ANN suggested that omnichannel strategies may be adopted toward further streamlining distribution. Integrated into the e-commerce platform, logistics systems will enable more flexible choices for delivery to customers, hence increasing satisfaction, but also reach more markets. ANN also proposed a batch tracking system using a QR code or barcode that allows better value chain visibility.

## DISCUSSION

The SCOR model is one of the most outstanding management tools to help improve supply chain management by describing, evaluating, and communicating the business processes involved in satisfying customer demand. However, the SCOR model is not able to recommend the most convenient ways to address the issues identified. The integration of Artificial Neural Networks, along with the framework provided by the SCOR model, represents a novel way for companies to both identify and address problems within the supply chain efficiently.

Probably the most outstanding result of this study is increased predictive accuracy of the ANNs. ANNs learn complex nonlinear relationships in historical data and therefore substantially improved demand forecasting accuracy. The immediate consequence of this improvement is a better inventory management, thereby reducing excess stock and stockouts. Accurate demand forecasts from the ANNs allow for a realistic and correct resource allocation and planning process. This is of prime importance for maintaining optimum inventory levels and timely availability of products. Along with the SCOR model, improvements have meant a structured approach toward appraisals and enhancements of supply chain processes with benefits in operational effectiveness and efficiency.

Operational efficiency also gained immensely on account of the use of ANNs. These models worked out optimum production schedules and plans for logistics that resulted in a full improvement in the efficiency of the overall supply chain. These were quantified with reduced lead times and enhanced throughput, thereby showing the ability of ANNs in effectively streamlining supply chain processes. The SCOR model of supply chain operation gave a good framework that helped point out the critical processes and performance metrics, thus allowing focused improvement with a guarantee that all the elements in the supply chain were aligned in trying to achieve operational excellence.

The other main benefit of using ANNs in the managing of a supply chain is cost efficiency. By having accurate forecasts of demand and optimizing operations, both holding and stock-out costs can be brought under check to achieve considerable financial savings on account of these cost efficiencies. These cost efficiencies, besides adding to the bottom line, go a long way in enhancing the competitiveness of the supply chain. Quantification of such improvements is done using the performance metrics provided by the SCOR model and thus presents tangible proof of the money saved through integrating ANNs.

Despite these advantages, challenges are to be found in the implementation of ANNs. The first challenge that presents itself regarding ANNs is that large quantities of good-quality data being a big requirement while training ANNs. That is, the moment the data is limited or poorly presented, the ANN might perform poorly. This calls for investment in robust practices for data collection and preprocessing. Besides, ANNs have high computational training requirements. The full actualization of ANNs requires an organization to invest in relevant hardware and software infrastructures.

Among the critical challenges toward the wide acceptance of ANN models, interpretability stands out. Due to the complex inner structure, usually ANNs are treated as "black boxes" and are not transparent. In many applications where explainability is a key issue, this may be a barrier. Therefore, the development of methods for the interpretation and visualization of ANN results is one of the important steps towards wide acceptance and trust. SCOR can contribute much in this direction since, through the structured framework provided, improvement in optimization processes can be obtained by being more transparent and interpretable.

In summary, integration of ANN into SCOR-supported supply chain management is one of the firm solutions to improve predictive accuracy, operational efficiency, and effectiveness in terms of cost. Given the presence of potential barriers, advantages accruing from ANNs have made them a salient tool for the optimization of a modern supply chain. The above-mentioned research underlines how advanced technologies, such as ANNs, could be introduced on a systematic platform represented by the SCOR model-basically required for efficiency and responsiveness in a fast-evolving global market. Companies that apply ANN integrated with the SCOR model may have a very high possibility of increasing the supply chain performance and managing the competitive advantages much better.

## REFRENCES


[1] M. Pournader, H. Ghaderi, A. Hassanzadegan, and B. Fahimnia, "Artificial intelligence applications in supply chain management," *Int J Prod Econ*, vol. 241, p. 108250, 2021.

[2] N. Silva, L. M. D. F. Ferreira, C. Silva, V. Magalhães, and P. Neto, "Improving supply chain visibility with artificial neural networks," *Procedia Manuf*, vol. 11, pp. 2083–2090, 2017.

[3] N. Sooksaksun, K. Wavnum, J. Thepklang, and S. Seehaworg, "The application of supply chain operations reference (SCOR) model: Herb supply chain in Dong Bang Village, Thailand," *Engineering and Applied Science Research*, vol. 50, no. 3, pp. 244–250, 2023.

[4] S. H. Huan, S. K. Sheoran, and G. Wang, "A review and analysis of supply chain operations reference (SCOR) model," *Supply chain management: An international Journal*, vol. 9, no. 1, pp. 23–29, 2004.

[5] A. G. Akbar, "CHALLENGES AND OPPORTUN\.IT\.IES OF IMPLEMENT\.ING SCOR MODEL \.IN AGR\.ICULTURAL SUPPLY CHA\.IN MANAGEMENT," *Endless light in science*, no. апрель, pp. 583–586, 2023.

[6] M. Mrad and Y. Boujelbène, "Multilayer perception neural networks method-based supply chain performance prediction by a new augmented of SCOR® metrics: SCOR® 4.0," in *2024 IEEE 15th International Colloquium on Logistics and Supply Chain Management (LOGISTIQUA)*, 2024, pp. 1–8.

[7] P. Romano, "Co-ordination and integration mechanisms to manage logistics processes across supply networks," *Journal of purchasing and supply Management*, vol. 9, no. 3, pp. 119–134, 2003.

[8] J. Oh and B. Jeong, "Tactical supply planning in smart manufacturing supply chain," *Robot Comput Integr Manuf*, vol. 55, pp. 217–233, 2019.

[9] A. Boiko, V. Shendryk, and O. Boiko, "Information systems for supply chain management: uncertainties, risks and cyber security," *Procedia Comput Sci*, vol. 149, pp. 65–70, 2019.

[10] G. E. Delipinar and B. Kocaoglu, "Using SCOR model to gain competitive advantage: A Literature review," *Procedia-Social and Behavioral Sciences*, vol. 229, pp. 398–406, 2016.

[11] I. Güven and F. Şimşir, "Demand forecasting with color parameter in retail apparel industry using artificial neural networks (ANN) and support vector machines (SVM) methods," *Comput Ind Eng*, vol. 147, p. 106678, 2020.

[12] M. Soori, B. Arezoo, and R. Dastres, "Artificial neural networks in supply chain management, a review," *Journal of Economy and Technology*, 2023.

[13] C. He, M. Ma, and P. Wang, "Extract interpretability-accuracy balanced rules from artificial neural networks: A review," *Neurocomputing*, vol. 387, pp. 346–358, 2020.

[14] D. E. Rumelhart, G. E. Hinton, and R. J. Williams, "Learning representations by back-propagating errors," *Nature*, vol. 323, no. 6088, pp. 533–536, 1986.