



EMERGING AI & ML-BASED TECHNOLOGIES & APPLICATIONS IN SUPPLY CHAIN MANAGEMENT (SCM): FUTURE PROSPECTS

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Abstract:

AI & ML is the buzzword of today's world making their presence in every aspect of life. More prominently in the business world. AI & ML-powered emerging & new technologies have been influencing functional business departments on a large scale, be it financial investments, understanding consumer & employee behavior, and predicting and informing decision-making. Supply chain management one of the critical and complex activities of any firm. SCM has also been a significant area that is quickly adapting to the technological changes powered by AI. The present paper is a viewpoint discussing the major AI-powered technologies that are bringing significant improvement in supply chain efficiency. The paper attempts to discuss those technologies, implications, and prospects.

Introduction:

Supply Chain Management (SCM) is a significant piece of each association, regardless of whether little or enormous. SCM is the effective administration of gracefully fasten exercises to augment client esteem and accomplish a supportable upper hand. SCM likewise manages the development and putting away of materials expected to make an item, just as stock administration and monitoring completed products from where they were made to whom they go to. A decent flexibly chain the executives can improve the proficiency of plants, distribution centers, and vehicles. Income is legitimately expanded because the conveyance of an item is convenient, and customers can buy their products. Unpredictability portrays an arrangement of different parts, interconnected in a non-direct style. Supply chain management nature is along these lines, a framework with an expansive scope of varieties. A regular model would be an all-inclusive working organization with different creation locales, which are all in contact with various circulation communities around the world, providing a vast number of ends focuses.

Three fundamental complexities are Operational intricacy, Sensible intricacy, and Authoritative intricacy. Simulated intelligence furnishes the flexible chain with relevant insight that can be utilized to diminish the working expenses and oversee stock. The logical data encourages them to return to the customers rapidly.

Organizations utilize AI alongside AI to get new bits of knowledge into various zones that incorporate stockroom the board, coordinate, and flexibly chain the board. A portion of the advances utilized in these regions is AI-fueled Visual Inspection to recognize the harm and do necessary revision by taking photographs of the freight by utilizing different cameras and Intelligent Robotic Sorting to sort palletized shipments, bundles and letters. AI can examine the data and utilize the discoveries to upgrade gracefully chain the executives

(SCM). Upgrade the Speed of the Supply Chain. AI can examine timings and handovers as items travel through the flexible chain.

Information can be sourced from numerous territories like the commercial center condition, irregular patterns, advancements, deals, and noteworthy investigation. AI will consolidate this information to foresee interest for explicit merchandise and help deal with the sourcing and assembling of those items. There are many new technologies powered by AI that are making path-breaking developments in SCM. The present paper in the further sections attempts to discuss the most critical such AI & ML powered technologies improving supply chain activities.

Internet of Things (IoT):

IoT is a collection of interconnected devices that are used for sending and exchanging data through networks. IoT can be connected to a system or computer using wifi or data networks. In supply chain management, the use of IoT has a more significant impact. For example, we can track the goods' location by sensors in a company's logistics department. In supply chain management, the products or raw materials shipment can be authenticated using GPS and other technologies [1], [3].

Implementing IoT in the supply chain gives the organization considerable pushback to improve their mode of operations in product production. Generally, by using the IoT devices, we will track the information about the condition of the raw materials and their arrivals to the company. Using the information or data, the production process plans to produce the products that use the raw materials. It gives the state of raw materials and provides the location, arrival time, and weather conditions that may affect it. By using this, the proper planning for the production can be carried out [1].

One can also use data of IoT for locating goods in godowns and warehouses. Defects of the goods during manufacturing can also be identified, enhancing the company's utilization of different departments.

IoT devices are used by farmers to check weather conditions and soil conditions for crop harvesting and send it to processing units [2]. Defects are spot detected by IoT devices like cameras in manufacturing. The safety level of the chemicals in the chemical industry and food retailers identifying the stock levels are some of the various fields where IoT devices are being used that had a more significant impact on the supply chain.

More comfortable supply for the demand of raw materials from suppliers, identification of issues with the supplied goods like delay in time, or loss of goods is made using IoT. Efficient storage, distribution, and location of goods in the warehouse are the most useful functionalities offered by IoT, which can improve the efficient performance in the supply chain of an organization.

Artificial Intelligence:

AI is an area of computer science that uses different computational tools like machine learning, neural networks. It creates human intelligence to perform specific tasks that humans can do. Artificial Intelligence is intelligence displayed by the system based on the actions we can say that intelligence is mostly action-oriented [3].

Implementation of AI in the supply chain predicts a better future for the business. Machine Learning plays a significant role in predicting a company's future business by analyzing the various data generated in a company's day-to-day activities. For example, when we take an example of e-commerce applications where large amounts of data are generated, AI technologies and tools are implemented in the supply chain, which analyses the data and enhances the company's supply chain management for better business [3].

Generally, the machine learning of AI uses observations or data, trains a data model, and analyses the outcome with different patterns to predict the business [10]. AI software can think, learn, and reason like humans and process large volumes of structured or unstructured data and provide the summaries and analysis of that data instantly. In supply chain management AI is used for data analysis, cost reduction, planning, forecasting, etc [4]. AI optimizes the supply chain's speed by delivering the products in time by scheduling it from the available data. Customer demands are also forecasted by collecting data from different areas like sales, market place, promotions, and seasonal trends, etc [7].

The supply chain's efficiency mainly focuses on the movement of goods or products to retailers or suppliers. The movement can be efficiently handled by analyzing the data available in the company. Managing suppliers is one of the critical tasks for the company; therefore, the different contracts, agreements, quality, and price quotations between various suppliers, which are located globally, are efficiently handled, and AI takes appropriate decisions. Chat bots are used for procurement; voice-based systems are adopted to provide the best experience to customers regarding the features, order booking, and shipment of products. Therefore, the organization's vision is much supported by AI concerning the supply chain by adopting the latest tools and techniques.

Advanced Analytics:

Analytics are generally used for decision making from the data collected from different sources; sometimes, the data may be in the form of graphs, charts. In the supply chain, all these data are analyzed, and finally, better data-driven decisions are made to enhance the organization's future.

The following are different analytics of the supply chain.

Descriptive analytics: In the supply chain, the descriptive analytics are mostly used with the data pertaining to business and provide a vision that what is happening currently around the business.

Predictive Analytics: These analytics are generally used in supply chains to understand future scenarios and business implications. Forecasting and statistical models are implemented and provide future recommendations that could happen to the business.

Prescriptive Analytics: The prescriptive analytics in supply chain are used to fix and solve the problems that occurred in business. It reduces time and effort in mitigating disruptions among various business partners.

Cognitive Analytics: It helps an organization answer complex questions in a natural language like how the person or team responds to a question. In the supply chain, cognitive analytics are implemented using AI methods and techniques and try to learn, understand, and reason for questions like humans.

In the supply chain, effective analytics requires the ability to become more customer-centric by responding to them quickly and maintaining accuracy and integrity. Analytics are used to make better decisions in supply chain management by processing large volumes of data and helps an organization to improve in forecasting, planning, sourcing, logistics, identifying the inefficiencies, better response to customers and innovations to drive the business.

Digital Twin:

Digital Twin is a digital representation of real-world objects, processes, systems. The term digital twin starts by converting the physical and manual business process into an automated form [5]. Digital twin represents a physical system in virtual form and provides more significant benefits.

In the supply chain, Digital Twins are made possible by using IoT connected devices like operational sensors, RFID and gadgets, etc. which forms an ecosystem and continuously

relays on the and information and synthesize the data. This synthesized information is used for the operational or supply chain managers to identify the root cause and optimize it [6]. The digital twin always simulates with the physical entity using IoT, Machine learning, AI, and cognitive analytics. Whenever there is a change in the physical system, it is automatically updated in the digital twin; it means all the physical processes, data, assets of an organization are replicated [6].

A supply chain digital is used to understand the supply chain behavior and dynamics, optimization of inventory, logistics scheduling, and forecasting day-to-day operations. It allows the company to shape, sense, and respond to customer demands in real-time.

Cognitive analytics are used in digital twins to identify and predict patterns variability from an actual plan to demand. On the supply side, the twin is used for the decisions related to the booking of materials, including freeing the space or providing the space for extra booked or new materials. On the fulfillment side, twins are used with IoT-enabled devices, operational sensors, PS technology for better fleet management, and timely delivery of products. Orchestration of the physical ecosystem with a digital twin makes the supply chain business processes easier and enhances the performance.

Blockchain:

Blockchain is a distributed database residing on multiple computers at the same time and continuously grows whenever a new block or records are added to it. Each block contains a link to the previous block and time stamp attached to it. Hence, as it forms a chain and everyone in the network gets a complete copy of the database because it is a shared database, everyone can access it by having the keys encrypted for the blocks.

We know the supply chain initiates by starting from the flow of raw materials from suppliers to manufacturers and eventually ends by delivering the final product to consumers or customers. Therefore, it is imperative to maintain the proper interconnectivity of all elements of a supply chain, which is a complex task that can be implemented using the blockchain.

Blockchain is prominently used for a cryptocurrency (Bitcoin). The reality that lies in the blockchain is a distributed digital ledger used for contracts, agreements, tracking, payments, and traceability among the different elements of the supply chain. Blockchain uses software known as a smart contract to execute an agreement that functions by taking input from the ledger and trigger the event. Blockchain consistently maintains the refreshed digital ledger, which incorporates data from all the parts of the supply chain.

Traceability improves operational efficiency by mapping and visualizing the supply chain about the consumer demand for the products and price variations of the product. Blockchain offers scalability, and it is a distributed database that can be accessed from multiple locations around the globe by building a transparency feature.

Streamlining of product recalls can be quickly done with less cost by locating manufacturers about the affected products in the supply chain by traceability and transparency of the blockchain. Blockchain compliance will enhance corporate governance by presenting the information in real-time and distributing the proper data to all the company stakeholders in the supply chain. Automated compliance, reporting costs, and the errors associated with manual activities are reduced by implementing blockchain [11].

Blockchains are used by the companies to record the product status at every stage of production. These records are permanent and immutable, which are easily used to trace the product status and provide consensus. There is no dispute in the chain regarding transactions where all the entities on the chain will have the same version of the ledger. By

using Bitcoins transfer of funds is easier and safer to all the elements of the supply chain, which are located globally without using the traditional banking system.

RPA(Robotic Process Automation):

Robotic Process Automation is a technology where anyone can configure computer software or robots to emulate and integrate humans' actions to execute the business process. RPA robots use the user interface to capture data and manipulate the applications as humans can do [8]. Artificial Intelligence and machine learning software are used by RPA to handle high volumes of repeatable tasks such as queries, record maintenance, calculations, and transactions, etc. humans can do that.

In the supply chain, RPA plays a significant role by automating all the operational processes in the business [9]. The bots are intelligent and can perform specific tasks eliminating human errors. In RPA, each task is done by bots (software bots), which can log into the application, enter the data, calculate and complete the tasks. Bots are of three types: probots, knowbots, and chatbots.

- Probots follow repeatable and straightforward steps or rules to process the data.
- Knowbots search the internet to gather and stores the information specific to the users.
- Chatbots are used to respond the customer queries in real-time.

Supply chain RPA automates the end-to-end processes such as supply, procurement, planning, production, sourcing, forecasting, monitoring, warehousing, etc. to lower costs and increase efficiency. Inventory is RPA can efficiently handle a backbone to supply chain, therefore inventory management by notifying the stock levels, new shipment orders, and tracks the warehouse and perform a job like an employee.

Scaling the operations according to the demand in the supply chain is done by stakeholders. The scaling is done since each process is automated and makes the tasks simpler. RPA eliminates human errors in the supply chain, which results in a higher quality of products and streamline the process. Supply chain managers use RPA to research the suppliers and manufacturers based on particular criteria for selecting them and creating, managing, and updating the contracts among the different suppliers.

RPA efficiently handles purchase order management through automated criteria such as pricing, quantity, and price regularity. RPA reduces the need for human intervention where the processing of returns and refunds in high volumes can be done quickly in all the supply chain elements. Invoice management, customer service management, and logistics management are effectively operated in the supply chain by using RPA. The retailers and manufacturers get early shipping notifications to plan and receive the finished products according to the customer needs and demand in the market. Therefore, RPA has emerged as a cost-efficient way for the supply chain to optimize the administrative and operational overheads by lowering the staffing costs.

Conclusion:

With the advent and adaptation of AI & ML-powered technologies, SCM is experiencing significant changes and is to see some more soon. Some of the techniques that will change the Future of SCM are first, plan the movement of goods based on demand, i.e., proficient flexibly chains depend on items being in the ideal spot at the perfect time. AI can survey client necessities and improve the upstream gracefully chain. It coordinates the ideal flexibility of merchandise with commercial center requests. Second, oversee suppliers and documentation, i.e., managing providers is one of the most tested SCM pieces. AI can investigate the sorts of agreements, documentation, and different zones that lead to providers' best results and utilize them as a reason for future understandings and organization. Third, guarantee quality from suppliers, products, and assets. Quality is

essential to acceptable SCM as waste and defective items make pointless revamp and increment costs. AI can screen how quality fluctuates after some time and propose enhancements. The application does not merely apply to materials and items. It can follow different territories, for example, transportation, provider, and outsider quality. Hence, the above-discussed technologies would play a major role in bringing SCM efficiencies to its best in the near future.

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