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Can Artificial Intelligence Help Improve Supply Chains' Sustainability?

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About the author:

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Keywords:

Electronic commerce, Artificial intelligence, Supply chains, Optimization, Supply chain management, Sustainability

SDGs:

9, 11, 12

Highlights:

- *Supply chains (SCs) are vital for the flow of goods across the globe.*

- *Roughly 75% of greenhouse gas emissions in many industries are associated with their SCs (Saberi, 2018).*

- *Optimizing SCs will lead to significant reductions in pollution and resources usage, thus contributing to more sustainable operations.*

- *Artificial intelligence techniques can improve the analysis and use of Big Data collected at all facets of the SCs to generate more accurate forecasts needed to optimize their management.*

- *Policy implications: It is crucial for governments around the globe to update the legal framework to facilitate digital data collection at various stages of SCs, provide support for key SC players to determine and implement optimal SC management alternatives, and adopt an integrated approach to addressing sustainability issues in SCs.*

Can Artificial Intelligence Help Improve Supply Chains' Sustainability?

Supply chains are essential for modern business operations. They ensure the smooth and proper flow of products, services, funds, and information from suppliers to customers across the globe. Nonetheless, SC activities such as storage and transportation use significant amounts of non-renewable resources and emit large volumes of polluting gases (Huang, et al., 2009). For instance, the global shipping industry alone uses almost 45% of the total energy consumption (Change, 2015). The consequences for the environment are alarming. The air quality in 75.1% of the Chinese cities, for example, surpassed the safe levels and severe haze engulfed 25 of the 34 provinces (Peng, et al., 2018). This poses a serious dilemma for policy makers and environmental agencies in terms of identifying adequate policy changes that would not negatively impact businesses growth and profitability.

SC activities are predominantly non-value adding; therefore, optimizing SCs would lead to a reduction of waste which in turn leads to more sustainable operations and a cleaner environment. The efficient use of resources and the optimized shipping schedules ensure the sustainability of operations and resources for future generations, in addition to protecting the natural environment and its delicate mix of habitats and ecosystems. However, the quality of the optimization will depend on the accuracy of the forecasts used. In addition to being time consuming, traditional forecasting methods often fail to capture all the intricacies of the real-life situation and render the forecasts even less accurate and usable.

The technological developments witnessed over the last two decades presented significant opportunities for SC management. In particular, large amounts of real-time data are collected digitally at every corner of the SC. Traditional methods are not designed for big data manipulation and analysis. Consequently, artificial intelligence (AI) applications have been devised to improve the performance of forecasting methods in this new, and highly dynamic, environment. Companies in industries as diverse as the automotive, electronics, health care and textile, used AI to manage SC operations (Cannas, et al., 2024). Machine learning (ML), for instance, can render the predictive model simpler by managing the variables during the training without the need for explicit encoding or transformation. Consequently, it makes prediction models more accessible and efficient for mining multiple datasets with different types of variables. Accurate forecasts are vital for optimizing production plans and distribution timelines, which in turn minimizes waste, backorders, and overproduction. Furthermore, Predictive modelling impacts several aspects of supply chain operations and generates information that is crucial for improving decision-making and establishing more effective strategic plans. Such scientifically based and informed management decisions will reduce waste and losses incurred, leading to improved profitability and sustainability.

E-commerce added another layer of complexity to SCs since it enabled an unprecedented reach to global customers. With geographical barriers eliminated, SCs are faced with an explosive growth in orders, and thus further straining the various SC systems such as inventory management, order fulfilment, and delivery logistics. AI-driven forecasting and solution techniques hold significant potential to streamline supply chains and enhance the effectiveness and efficiency of E-commerce operations. There is growing evidence that AI-driven methods have contributed to increasing accuracy, speed and efficiency and enhancing

capacity planning, productivity, quality, and cost-effectiveness (Sayyad, et al., 2024). The proposed approach achieved accuracy rates of 91% and 93% in predicting potential customers and delivery time, respectively. In addition to the operations-related improvements such as commodity quality, distribution accuracy, and timeliness, customers' satisfaction improved. However, a sizeable proportion of customers are expecting further improvements including private data protection, delay insurance, and real-time updates. Integrating state of the art optimization techniques with cutting-edge predictive models will improve the optimization of SC operations resulting in more efficient resources allocation and distribution

Harnessing the power of AI to tackle lingering SCs problems and improve their sustainability is a very recent and promising venue. By considering a holistic approach, policy makers will have to update the legal and regulatory framework to propel the advancements in this field to new heights. Issues related to jurisdiction and privacy protection must be addressed. Protection of privacy data is necessary to facilitate data collection and sharing among various SC members. Additionally, jurisdiction must be clarified to settle the potential disputes that may arise at any transaction between the different, and geographically dispersed, players. The benefits of such a paradigm will not only foster economic growth, but it will do so while ensuring a sustainable environment for future generations.

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