

Opinion

ChatGPT in Supply Chains: Initial Evidence of Applications and Potential Research Agenda

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Abstract: *Background:* ChatGPT has been largely discussed since it was launched in November 2022. *Problem statement:* the main approaches of ChatGPT in the recent and scarce literature are more focused on the impacts for general use, applied sciences and educational systems, which evidences a relevant gap for the management field, especially related to the supply chain area. *Objectives:* as a novel and initial contribution, this article aims to provide a viewpoint with the main applications and other issues regarding ChatGPT in supply chains, based on the initial discovered evidence. *Methods:* This viewpoint article is grounded on the few articles available in specialized magazines, blogs and company websites that approach potential applications and other issues of ChatGPT in supply chains, as a systematic literature review was not possible due to the absence of papers approaching the subject in the research databases. *Contributions:* this article contributes to the practitioners involved in supply chain activities who desire to have an initial and structured content related to the impacts and applications of ChatGPT on supply chains. It also seeks to encourage researchers on further research deployments in this field by presenting potential research agenda topics. *Results:* first evidence based on quality results from the analyzed content showed that, although it may take time until this technology evolves to a desirable level of maturity, it may be applied in different areas of supply chain management (e.g., route optimization, predictive maintenance, order shipment, customer and supplier relationships, data analysis, ordering process, automating invoices, reducing waste, workforce training and guidance, amongst others), with a potential generation of significant benefits such as cost reductions and the improvement of supply chain performance.



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1. Introduction

One of the most timely topics of discussion by practitioners and researchers is about ChatGPT. Most of these discussions are pretty much focused on the impacts of this emergent technology on the general use, applied sciences and educational systems, focusing on approaching not only its benefits but also possible weaknesses of this new technology. However, new topics of interests have surged since ChatGPT was launched by OpenAI in November 2022 [1]. With only a few months of existence, this promising technology has been reached by 100 million users in January 2023.

The acronym ChatGPT actually means “Chat Generative Pre-Trained Transformer”. It is a tool based on artificial intelligence and deep learning technologies that can manipulate a large amount of data, be adaptable in the face of different situations and contexts when interacting with humans and which has a purpose of providing accurate responses, explanations and solutions to users on different and broad subjects. According to [2], ChatGPT as an artificial intelligence-based technology will not replace the critical thinking skills of humans involved in supply chain activities. This author emphasizes that, actually, this technology will challenge humans as never before on the ability to ask assertive questions related to supply chain processes.

With the advent of the Supply Chain 4.0 phenomenon, many researchers have claimed the potential impacts of artificial intelligence technologies on supply chains [3–8]. However, there are no research articles specifically covering the impacts of ChatGPT on the supply chain field, as will be demonstrated by this article in Section 2, although some evidence may be currently found in technical and industry articles.

As there are still no publications exploring the theme of supply chains in scientific journals, this motivates the author to bring out this viewpoint article in order to contribute with an initial perspective about the potential applications for practitioners and topics of research to be deployed by researchers interested in the further exploration of this subject. This is relevant because, as can be evidenced by other areas of knowledge, a rapid growth in publications is being observed, demonstrating the importance of understanding the potential impacts that this disruptive technology may generate. Although many challenges and unanswered questions are still in the arena of the ChatGPT discussion, this paper aims to encourage researchers on the deployment of further empirical researches with the purpose to explore different themes of this emergent technology in the supply chain field and discover how this artificial intelligence technology may effectively support the improvement and transformation of supply chain processes.

For this aim, a set of articles covering ChatGPT in supply chains published by experts in industry magazines, specialized blogs and company websites has been collected and studied by applying a content analysis, through which it was possible to identify some applications and other issues involving the use of this technology in supply chains. This allowed the author to establish an initial view regarding the potentialities for applications and research deployments to guide practitioners and researchers on further developments related to the subject.

After presenting the subject contextualization and purpose of this article, it is structured as follows. In Section 2, the current status of ChatGPT research and the gap related to the supply chain field are presented. In the sequence, in Section 3, the subject of ChatGPT in supply chains is presented and discussed based on the content available in specialized magazines, blogs and industry websites. Lastly, in Section 4, the conclusions related to this initial discovered evidence and potential research topics to be further deployed are presented.

2. Current Status of Research on ChatGPT and the Gap for the Supply Chain Area

In a search conducted in March 2023 in the Web of Science database, it was possible to verify that forty (40) articles have been published approaching the ChatGPT subject. These articles are mostly focused on the Education, Educational Research, Multidisciplinary Sciences and Computer Science Artificial Intelligence fields, as can be verified through Figure 1, which shows the areas of Web of Science covered.

By conducting the same search on the Scopus database, ninety-eight (98) more articles were found, which are mostly classified into the medicine, social sciences, computer science and multidisciplinary subjects (Figure 2). Even though this sample of articles is higher than that of the Web of Science database, none of them are related to supply chain, logistics and operations management areas.

It is interesting to note the rapid growth of publications since November 2022 in the two main search databases. These studies are mostly focused on the impacts on science and research conduction, educational systems, medical applications, computers and artificial intelligence and other applied science applications. However, as demonstrated by Figures 1 and 2, these studies do not cover the supply chain and operations management field, which reveals a huge opportunity for research in this area of knowledge. Although many discussions are taking place regarding the potential impacts of ChatGPT in the management field from the practitioners' side, there is an evident gap in terms of published research approaching this matter, especially for the supply chain management area. This evidences an opportunity to explore the theme of logistics and supply chain management as an initial and novel contribution to the field, which is the main purpose of the article herein proposed.

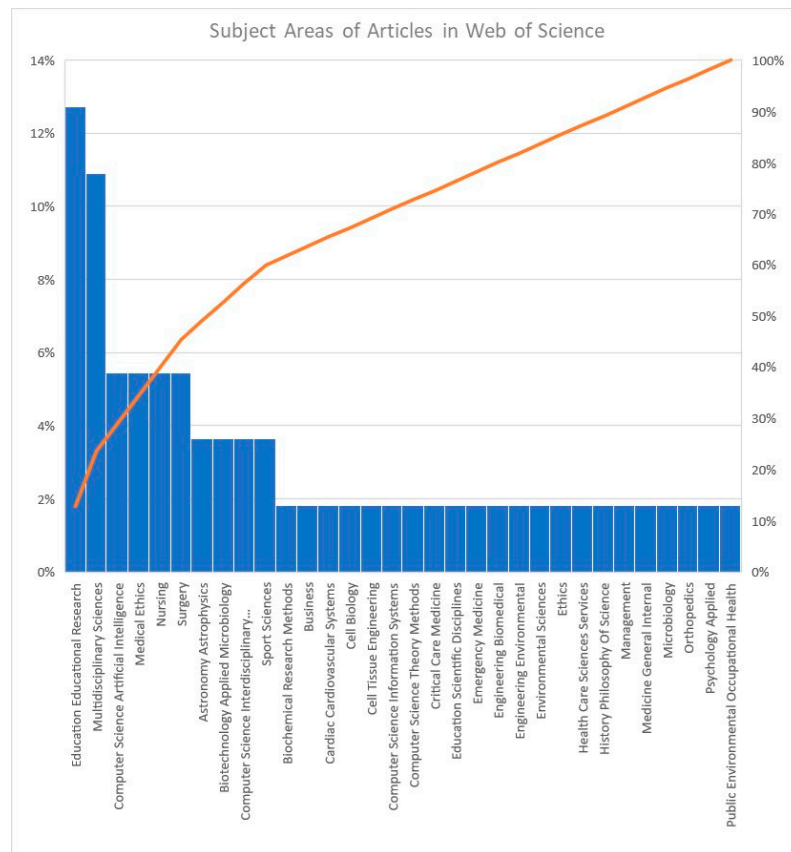


Figure 1. Articles based on subject areas in Web of Science. Source: Data retrieved from the Web of Science database.

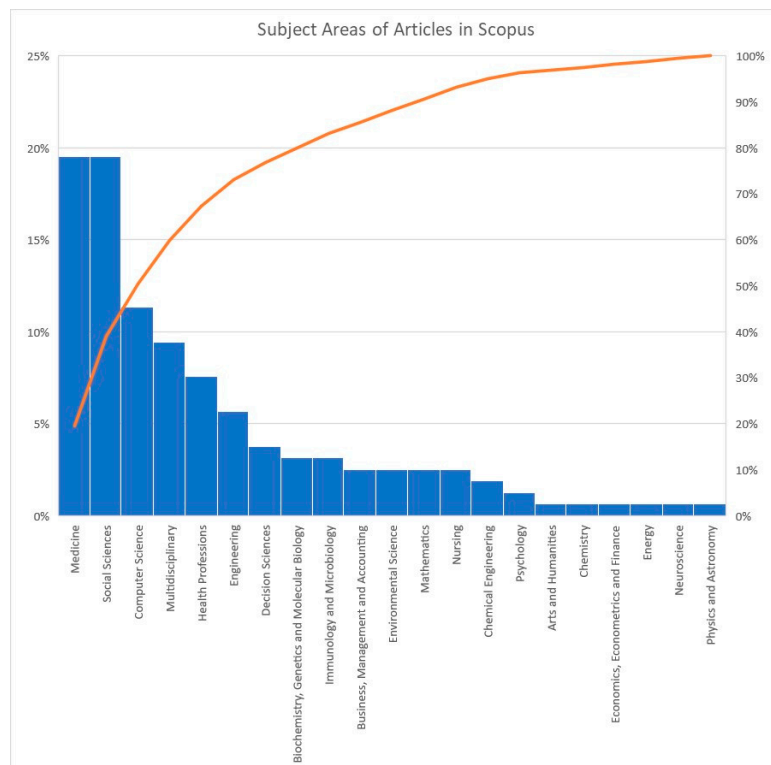


Figure 2. Articles based on subject areas in Scopus. Source: Data retrieved from the Scopus database.

3. ChatGPT in Supply Chains

As already mentioned, some discussions regarding ChatGPT in supply chains are taking place from the practitioners' side, even though this is still in an incipient stage. These approaches can be found through some publications in technical and industry magazines, specialized blogs and company websites. With the aim of finding evidence of these approaches, some publications were selected in a search conducted into the Google search platform. This method was chosen as it would not otherwise be possible to conduct a systematic literature review due to the absence of publications in the field, as already demonstrated in Section 2 of this manuscript. Therefore, the criteria for search into the Google platform were the following words "ChatGPT in Supply Chains" and "ChatGPT in Logistics". Only articles discussing ChatGPT in these specific subjects were selected. Another criterion used for selecting the articles was the reliability of the identified sources. Verified criteria such as time of existence, company's webpage and blog's relevance, as well as authors' expertise were used. After this screening process, as an outcome, a sample of only ten (10) articles approaching ChatGPT in supply chains were found. They were published in 2023 (January to March). Table 1 summarizes these articles by providing their purpose and presenting the main findings and applications as discussed by each one.

Table 1. Summary of articles' content found in specialized magazines, blogs and company websites.

Article	Purpose	Main Findings and Applications
[9]	This article presents pros and cons of ChatGPT	Based on the article, the tool works well for questions regarding supply chain issues; however, it is unable to provide operational breakthroughs in the operations. Additionally, even it is able to give accurate answers, it does not replace the ability of practitioners once they are those who have the enough knowledge to ask logical questions and to properly use the tool.
[10]	This article approaches the main applications that can add value to supply chain management	The ChatGPT is a powerful tool that might be able to support different activities involved in supply chains such as data analysis, chatbot interface with supply chain stakeholders, predictive maintenance on equipment, inventory management and route optimization. It can also support other aspects of the supply chain such as providing sustainability reports, assisting in the evaluation of suppliers and helping to map supply chain sources with less risk.
[11]	This article discusses the power of ChatGPT as a potential game changer in supply chains	For this author, unlike for general use, ChatGPT is not going to have an initial impact on the supply chain in order to revolutionize supply chain processes. This is because supply chains are too complex, and each one has specificities that will require time to obtain the maximum performance of this tool on supply chain applications. Therefore, ChatGPT is not an immediate game changer, but it is a useful available tool that can be improved in time.
[12]	This article aims to present the main benefits of ChatGPT	The author emphasizes that ChatGPT is able to help supply chains enhance customer satisfaction, process efficiency and cost reduction. This is because ChatGPT is able to streamline communication with costumers (e.g., receiving immediate and accurate information about order status), suppliers (e.g., solving supply issues through more effective communication) and other stakeholders involved in supply chains. It may also automate routine tasks such as tracking and monitoring shipments and ordering process. Lastly, ChatGPT is a powerful tool to improve data analysis to support all supply chain processes.

Table 1. Cont.

Article	Purpose	Main Findings and Applications
[13]	This article presents the main benefits of ChatGPT for the logistics industry	The author points out that ChatGPT can support enhancing customer service through effective chatbots, route optimization by analyzing orders and shipping data and making suggestions for cost reduction and better delivery performance, automating activities such as invoicing, improve communication between partners, which reduces risk of miscommunication and errors and makes order processing more efficient. In summary, ChatGPT is able to simplify the complex processes involved in logistics by reducing waste and inefficiencies such as wait times. This article also presents some challenges regarding ChatGPT, which are to ensure the accuracy and up to date data that ChatGPT will use to work and specialized technical support, which involves skilled IT personnel to operate artificial intelligence technology.
[14]	This article approaches how ChatGPT can transform retail	For this author, ChatGPT will significantly improve customer service by handling much higher-level customer service requests, differently from what can be executed nowadays with traditional chatbot mechanisms. Additionally, ChatGPT can support promotional activities of marketing and workforce management by acting as an effective training and guidance tool.
[15]	This article explores how ChatGPT might help supply chains	According to this article, ChatGPT can be a useful tool in the supply chain. It can help with automating processes, providing insights to supply chain managements and supporting communication across the supply chain. The author claims attention for the legal and ethical issues that must be observed regarding ChatGPT in supply chains.
[16]	In this article, the top 3 benefits of ChatGPT in the supply chain industry are listed	Based on this article, there are three main top benefits of ChatGPT for supply chains: increased visibility, streamlined communication and optimized operations. According to the author of this article, ChatGPT can potentially be integrated with IoT (Internet of Things), gather data and generate KPIs, for example. In terms of communication, this tool can significantly enhance communication between supply chain members (e.g., customers, logistics providers, distribution centers, manufacturers) and increase efficiency and productivity. Operations optimization can be achieved, too, with ChatGPT supporting processes such as routing planning and processes' decision-making.
[17]	This article discusses how ChatGPT can optimize supply chain operations	For this author, ChatGPT can support supply chains in terms of demand forecasting, inventory management and supplier relationships. Additionally, ChatGPT has the potential to significantly increase supply chain visibility and transparency in the supply chains, especially when integrated with technologies such as IoT.
[18]	This article aims to present the role of ChatGPT in logistics and supply chains	According to this author, ChatGPT can aid in route optimization by evaluating shipping data and providing recommendations to speed up deliveries. Additionally, this technology can automate some activities, such as invoicing. ChatGPT is able to enhance communication between supply chain members, reducing the risk of errors and misunderstandings regarding supply chain and logistics processes. Additionally, other application opportunities such as warehouse management (e.g., visibility of real-time inventory and optimization of storage space), support with customs clearance (visibility of customs regulations) and customer service applications (e.g., intelligent and customized responses to customer queries).

Based on these articles presented in Table 1, it is possible to identify that, although ChatGPT can support and facilitate supply chain activities and processes, especially those related to the interface between supply chain members (e.g., focus company, customers

aquaculture [23]). As showed by these examples, this potential for innovation on different fields' supply chains may be achieved with ChatGPT implementation. However, as argued by [24], it is important to take into consideration the barriers when implementing artificial intelligence technologies such as ChatGPT on supply chains. These are dependency on multi-actor collaboration in supply chains, disparate data sources, the unwillingness of actors to embrace artificial intelligence, change management issues and lack of artificial intelligence governance framework. Additionally, this author points out the importance of the government's intervention to support emergent technology's adoption in supply chains.

4. Conclusions

Although ChatGPT is one of the most emergent promising technologies, many questions still remain regarding its potential application in supply chains in the short term. As identified in the analyzed articles, this technology may take time to achieve a certain stage of maturity and generate significant benefits in the complex processes of supply chain management. However, it is certain that ChatGPT is a technology that is here to stay, and it is rapidly going to start to be incorporated into supply chain activities. Another relevant evidence obtained is that the level of expertise of practitioners involved in supply chain's activities will continue to be required, once ChatGPT can only provide accurate answers if plausible questions are performed. Therefore, the evidence demonstrates that ChatGPT can support, but it cannot replace, the whole ability of supply chain experts in the decision-making process.

As can be noticed in Table 1, initial evidence shows that ChatGPT can benefit supply chains through many applications such as route optimization, predictive maintenance, order shipment, customer and supplier relationships, data analysis, ordering process, automating invoices, reducing waste and workforce training and guidance, amongst others. These applications can potentially generate strategic outcomes in terms of cost reduction and processes' performance. Although this article is limited by the lack of more robust content to be analyzed, especially available in the scientific databases, it accomplishes its purpose, which is to provide initial evidence regarding ChatGPT in supply chains, as an element of guidance and encouragement for practitioners and researchers interested in the development of this subject.

Potential Research Agenda

Concerning the research related to ChatGPT, it was highlighted that there are no approaches covering the subject for the supply chain field, which was the reason that motivated the author to write this viewpoint article. Due to this reason, many questions may be raised regarding this new technological phenomenon. Therefore, as one of the purposes of this manuscript, the following topics attempt to establish an initial research agenda, which is surely not limited to, but aims to contribute as an initial encouragement for researchers interested in deploying research topics related to the subject. Some topics that may be deployed, based on the initial evidence observed in this study are:

- How can ChatGPT positively impact the performance of supply chain processes (e.g., plan, source, make, delivery, return)?;
- What are the main supply chain activities that can benefit from ChatGPT technology?;
- How can ChatGPT be applied to these supply chain activities?;
- How effective can ChatGPT technology be for the supply chain's activities? What are the most relevant ones? What are the limitations and uncertainties of ChatGPT application for supply chain activities?;
- What are the pros and cons of ChatGPT application in supply chains?;
- How can ChatGPT influence the search for more sustainable and resilient supply chains?;
- What are the barriers and critical success factors to be considered in the implementation of ChatGPT in supply chains?;

- How can ChatGPT be integrated with other emergent technologies (e.g., Big Data Analytics, Metaverse, Additive Manufacturing, Blockchain) in order to achieve a higher performance on supply chain processes?;
- What are the different attributes to be taken into account when comparing ChatGPT for general use and its applications on supply chain processes?;
- How can ChatGPT contribute to supporting supply chains during disruptive and unexpected events (e.g., pandemics, war, natural disasters)?;
- What is the role of ChatGPT in the transition from Supply Chain 4.0 to Supply Chain 5.0?;
- What aspects must be considered in terms of the confidentiality, information security and ethical aspects of supply chains when implementing ChatGPT technology?

In order to understand these potential topics, empirical research such as multiple case-studies and surveys are recommended to investigate this phenomenon. Additionally, once satisfactory content regarding ChatGPT in supply chains becomes available in the scientific search databases, a systematic literature review would be more than welcome to show the structural knowledge regarding this disruptive technology in the supply chain area. Action research could be also deployed in the sense to understand implementation issues and barriers during the rollout process of this technology in the supply chain processes of organizations.

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