

Cloud computing in supply chain management: Exploring the relationship

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ABSTRACT

This research study addresses the advantages and difficulties of Cloud Computing (CC) in Supply Chain Management (SCM). An overview of the current state of SCM and the difficulties businesses in this sector confront is presented at the beginning of the article. It then explores how cloud-based solutions can address these challenges, such as through the use of real-time data analytics, collaborative platforms, and intelligent automation. Additionally, the paper investigates the potential risks and challenges associated with cloud-based SCM, including data security and privacy concerns, vendor lock-in, and the need for robust disaster recovery plans. To provide a comprehensive understanding of the topic, the paper includes a case study that illustrates how a company successfully implemented cloud-based SCM solutions to improve their operations. The paper concludes by highlighting the key takeaways and insights from the research, and by identifying potential future directions for research in this field. Overall, this study delivers insightful information about the function of CC in SCM and offers useful suggestions for companies looking to use this technology to enhance their supply chain operations.

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1. Introduction

The process of organizing the flow of goods and services from suppliers to customers is known as SCM. It entails an intricate web of processes, such as production, transportation, storage, and distribution. Businesses must manage their supply networks effectively if they want to stay competitive in the globalised economy of today, when supply chains might cover numerous continents and nations. SCM is to guarantee that goods and services are supplied to clients on schedule, with the proper quality, and at a reasonable price (Camara et al., 2015). This requires businesses to optimize their supply chain processes and workflows, and to collaborate closely with suppliers, logistics providers, and other stakeholders. Businesses have been able to dramatically improve their SCM practices because to recent technological breakthroughs. Businesses can obtain insight into their supply chain performance and make wise decisions by utilizing data analytics, artificial intelligence, and machine learning algorithms. Additionally, cloud-based solutions are now widely used to provide greater transparency, efficiency, and agility in SCM. However, despite these advancements, SCM remains a complex and challenging field, with numerous risks and uncertainties that businesses must navigate. These include natural disasters, geopolitical risks, cyber security threats, and supply chain disruptions (Sahoo & Goswami, 2024).

So, effective SCM is crucial for businesses to succeed in today's highly competitive and rapidly changing marketplace. By optimizing their supply chain processes and leveraging the latest technologies, businesses can improve their efficiency, reduce costs, and enhance their ability to deliver products and services to customers effectively. A paradigm-shifting technology that

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has changed how people and organizations utilize and interact with digital resources is CC. CC is essentially the distribution of computer services through the internet, including storage, processing power, and software programs (Lin and Lin, 2019). These services are provided by remote servers maintained by third-party providers, rather than on-premises servers maintained by individual businesses or organizations. Scalability and flexibility are two of CC's key benefits. Cloud-based services are a cost-effective option for companies of all sizes since they can be readily scaled up or down dependent on the demands of the customer. The ability to access data and applications from everywhere there is an internet connection thanks to CC also promotes improved productivity and cooperation.

The emergence of new technologies and business models like software-as-a-service (SaaS) and platform-as-a-service (PaaS), which have challenged conventional software delivery patterns, has also been facilitated by the rise of CC. These new models allow businesses to access a wide range of software applications and tools without having to invest in expensive on-premises infrastructure. However, CC is not without its challenges and risks. Data security and privacy concerns remain a top concern for businesses, and there is a need for robust cyber security measures to protect against threats such as data breaches and cyber-attacks (Cao et al., 2017; Sahoo and Goswami, 2024). Additionally, there is a possibility of vendor lock-in, in which companies grow reliant on a single cloud provider and may encounter difficulties if they want to switch providers. The ability to manage digital resources in the cloud has completely changed how companies and people engage with technology. It is flexible, affordable, and scalable. As cloud-based solutions continue to evolve, businesses must remain vigilant in managing the risks and challenges associated with this technology to fully realize its potential.

1.1. The concept of cloud computing in supply chain management

A crucial component of corporate operations is supply chain, which makes sure that goods are delivered to clients quickly and effectively. The use of technology has significantly enhanced SCM, and CC is one of the most important technological developments in recent years. The transmission of computer resources through the internet, such as servers, storage, databases, and software, is referred to as CC (Ageron et al., 2020; Sahoo & Choudhury, 2022). Businesses can operate with unparalleled flexibility, scalability, and agility thanks to the integration of CC and SCM. With cloud-based SCM solutions, companies can collaborate with suppliers, partners, and customers from anywhere in the world, in real-time. Additionally, they have access to insightful analytics that help them streamline their supply chains, cut costs, and boost productivity. In this situation, utilizing CC for SCM has grown into a key component of attaining a competitive edge in the global market. It enables companies to adapt quickly to changing market conditions, innovate faster, and provide better customer service. As such, the adoption of cloud-based SCM solutions is increasingly becoming a priority for companies of all sizes and across industries (Zimmermann et al., 2019). Cloud-based SCM solutions offer several benefits that traditional SCM systems cannot match. For instance, CC gives businesses a more cost-effective way to handle SCM since they only pay for the resources they really use rather than having to invest in pricey hardware and software infrastructure.

Additionally, cloud-based SCM solutions may be readily scaled up or down in response to shifting company requirements, giving businesses the adaptability to meet market expectations. Another significant advantage of cloud-based SCM solutions is the ability to centralize and streamline supply chain operations. With the aid of CC, businesses can save all of their supply chain data in a single, easily accessible location. This centralized approach helps to improve communication, collaboration, and decision-making across the supply chain. Cloud-based SCM solutions also provide companies with greater visibility into their supply chain, enabling them to track shipments, monitor inventory levels, and manage supplier relationships more effectively (Oliveira and Handfield, 2019; Wu et al., 2013). By leveraging data analytics, companies can identify inefficiencies and bottlenecks in their supply chain, enabling them to optimize their operations and reduce costs. For SCM, CC has emerged as a paradigm-shifting technology that offers businesses previously unheard-of levels of scale, flexibility, and agility. As businesses continue to face increasing pressure to reduce costs and improve efficiencies, cloud-based SCM solutions will become an essential tool for success in the competitive global marketplace.

1.2. Empowering sustainability efforts through cloud-based supply chain management

The integration of CC with SCM offers several benefits to businesses, including the following.

- **Improved collaboration:** Cloud-based SCM solutions enable companies to collaborate more effectively with suppliers, partners, and customers, regardless of their location (Jede & Teuteberg, 2015; (Lin & Lin, 2019)). Real-time access to data and analytics facilitates better communication and collaboration across the supply chain, leading to faster decision-making and improved efficiencies.
- **Increased agility and flexibility:** Cloud-based SCM solutions provide companies with the flexibility to scale their operations up or down as per the changing business needs, without incurring any additional costs. This agility enables companies to respond more quickly to market changes and emerging opportunities.
- **Enhanced efficiency:** Cloud-based SCM solutions enable companies to automate their supply chain processes, reducing manual intervention, and improving efficiency (Camara et al., 2015). Automation helps to eliminate errors and reduce lead times, leading to better supply chain performance.

- **Greater visibility:** With real-time access into their supply chain provided by cloud-based SCM solutions, businesses can more efficiently manage supplier relationships, track shipments, and keep an eye on inventory levels. This visibility helps to identify bottlenecks and inefficiencies, enabling companies to optimize their operations and reduce costs.
- **Improved data analytics:** Cloud-based SCM solutions offer advanced data analytics capabilities, providing companies with valuable insights into their supply chain performance (Sahoo & Choudhury, 2022). These insights help to identify trends and patterns, enabling companies to make data-driven decisions and improve their supply chain processes.
- **Lower costs:** Cloud-based SCM solutions can significantly reduce the cost of implementing and maintaining an SCM system. With CC, companies don't need to invest in expensive hardware, software, or IT infrastructure (Hassan et al., 2022; Cao et al., 2017). Instead, customers pay a membership fee only for the resources they really utilize, which is more cost-efficient for small and medium-sized organizations.
- **Better security:** Cloud-based SCM solutions offer better security features compared to traditional SCM systems. Cloud providers have dedicated security teams that work to protect their infrastructure and customer data against cyber threats (Goswami, 2020). Additionally, cloud providers adhere to strict compliance and data privacy regulations, ensuring that customer data is safe and secure.
- **Improved disaster recovery:** Cloud-based SCM solutions offer better disaster recovery capabilities than traditional SCM systems. Cloud providers have built-in disaster recovery and backup processes that ensure that customer data is safe and recoverable in the event of a disaster or outage.
- **Better customer service:** Cloud-based SCM solutions enable companies to provide better customer service by improving the speed and accuracy of delivery. By streamlining the supply chain, companies can improve the accuracy of order fulfillment and delivery times, leading to increased customer satisfaction and loyalty (Sahoo and Goswami, 2024).
- **Competitive advantage:** Companies can gain a competitive edge by using cloud-based SCM systems because they can react to market changes and new opportunities more quickly (Wu et al., 2013). With real-time access to data and analytics, companies can identify trends and patterns in customer demand, enabling them to adapt their supply chain operations to meet customer needs more effectively.

So, the integration of CC with SCM offers numerous benefits to businesses, including lower costs, better security, improved disaster recovery, better customer service, and a competitive advantage. Companies that take advantage of these advantages can boost supply chain efficiency, cut costs, and gain a major competitive advantage.

1.3. Addressing the gaps in implementing and managing cloud-based supply chain systems

While the combination of CC with SCM has many advantages, there are some difficulties that companies must overcome. One or more of the difficulties are as follows.

- **Security concerns:** Sensitive data, including customer information, supplier contracts, and financial records, is stored by cloud-based SCM solutions. To safeguard sensitive data from online dangers and unauthorized access, organizations must ensure that their cloud provider has strong security mechanisms in place.
- **Integration issues:** Integration of cloud-based SCM solutions with other enterprise applications such as warehouse management systems, logistics management systems, and ERP systems is required. Compatibility problems, disparate data formats, and different data architectures can make integration difficult and lead to delays and mistakes.
- **Dependence on internet connectivity:** To access data and apps, cloud-based SCM systems need a steady and dependable internet connection (Lu et al., 2022). Supply chain activities can be hampered by poor internet access or outages, which can result in delays and lost money.
- **Data ownership and control:** Businesses need to ensure that they retain ownership and control over their supply chain data, even when stored in the cloud. They need to have clear contracts and service level agreements with their cloud provider regarding data ownership, access, and control.
- **Compliance and regulations:** Regulations governing data privacy and security, including the GDPR, CCPA, and HIPAA, must be followed by businesses. They must make sure that their cloud provider complies with these rules and that their data is processed and stored in a way that complies with these specifications (Lin and Lin, 2019; Sahoo and Goswami, 2024).
- **Vendor lock-in:** Businesses must be careful not to become locked into a specific cloud provider or proprietary technology. Vendor lock-in can limit their ability to switch providers, upgrade systems or customize solutions, and can limit their flexibility and competitiveness in the long term.

- **Data migration and backup:** Businesses may encounter challenges in migrating their data to the cloud and ensuring that their data is backed up regularly (Vemula and Zsifkovits, 2016). Data migration can be complex, time-consuming, and error-prone, and backup procedures must be in place to ensure data recovery in the event of a disaster or outage (Sahoo and Choudhury, 2022).
- **Skill gaps:** Businesses may experience labour gaps in terms of CC and SCM systems. They must make sure that their staff members are properly trained and equipped to use and administer cloud-based SCM systems (Lian, 2015; Gammelgaard and Nowicka, 2023).
- **Lack of standardization:** The lack of standardization in cloud-based SCM solutions can pose challenges for businesses. Different providers use different terminologies, data structures, and interfaces, making it difficult to integrate solutions across the supply chain.
- **Change management:** Adopting cloud-based SCM solutions requires significant changes in business processes, organizational structure, and workforce culture. To effectively manage these changes and ensure a seamless transition to cloud-based SCM systems, businesses must make sure they have a solid change management strategy in place.

Addressing these challenges requires careful planning, effective management, and ongoing monitoring and evaluation to ensure that businesses can leverage the full potential of cloud-based SCM solutions (Suherman & Simatupang, 2017).

1.4. Significance of cloud computing in streamlining supply chain operations

The integration of CC concept with SCM is significant for businesses in several ways.

- i. **Improved efficiency:** By automating repetitive procedures, providing real-time tracking of inventory and shipments, and improving warehouse and logistics operations, cloud-based SCM solutions help streamline supply chain operations. Businesses may be able to lower costs, shorten lead times, and improve customer satisfaction with the aid of this increased efficiency (Sahoo & Choudhury, 2022).
- ii. **Increased agility:** Businesses have the flexibility and scalability to react swiftly to shifting market conditions, consumer demands, and supply chain interruptions thanks to cloud-based SCM systems. Businesses may easily add or subtract resources, change how they operate, and adapt to meet shifting demands, giving them a competitive edge in the market.
- iii. **Better collaboration:** Collaboration between various supply chain stakeholders, such as suppliers, customers, and logistics providers, is made possible through cloud-based SCM technologies. Businesses may boost supply chain visibility, improve collaboration, and eliminate errors and delays by exchanging data and information in real-time (Stergiou et al., 2018; Goswami, 2020).
- iv. **Improved risk management:** Cloud-based SCM solutions can help businesses manage supply chain risks by providing real-time tracking of inventory and shipments, enabling early detection of potential disruptions, and facilitating quick responses to mitigate risks. This improved risk management can help businesses avoid disruptions, reduce costs, and maintain customer satisfaction.
- v. **Increased transparency:** Cloud-based SCM solutions can provide greater visibility into supply chain operations by enabling real-time tracking of inventory and shipments. This increased transparency can help businesses identify bottlenecks, optimize their operations, and improve their supply chain performance.
- vi. **Better customer service:** By enabling real-time shipment tracking, offering precise delivery dates, and enhancing customer communication, cloud-based SCM solutions can aid organisations in providing better customer service (Riahi et al., 2021; Sahoo and Goswami, 2024). This can enhance customer satisfaction and loyalty, leading to increased revenue and profitability.
- vii. **Reduced capital expenditures:** Cloud-based SCM solutions can reduce the capital expenditures required for hardware, software, and infrastructure. By outsourcing these functions to a cloud provider, businesses can reduce their upfront investment and pay for these services on a subscription basis, reducing their overall costs.
- viii. **Improved sustainability:** Cloud-based SCM solutions can help businesses improve their sustainability by optimizing their supply chain operations, reducing waste, and minimizing their environmental footprint. This can enhance their brand image and reputation, leading to increased customer loyalty and revenue.
- ix. **Access to innovation:** Cloud-based SCM solutions provide businesses with access to the latest technologies and innovations without requiring them to invest in new hardware or software (Cegielski et al., 2012). Cloud providers can update their solutions regularly, providing businesses with access to new features and capabilities that can enhance their supply chain operations.

Therefore, the integration of CC with SCM is crucial for businesses as it offers them a variety of advantages, such as increased efficiency, increased agility, enhanced collaboration, better data analytics, enhanced risk management, increased transparency, improved customer service, decreased capital expenditures, improved sustainability, and access to innovation (Camara et al., 2015; Sahoo and Choudhury, 2022). These advantages might aid companies in streamlining their supply chain processes and gaining a competitive edge on the market.

1.5. Objectives of cloud computing in relation to supply chain management

Here are the objectives on SCM and CC, presented as follows.

- To define CC and explain its role in SCM.
- To identify the benefits of CC for SCM, such as increased collaboration, scalability, and cost savings.
- To talk about the difficulties adopting CC presents for SCM, such as data security, difficult integration, and vendor lock-in. To analyze case studies and examples of successful cloud-based supply chain systems, including their implementation and management.
- To provide recommendations for selecting the right cloud provider, ensuring data privacy and security, and integrating cloud solutions with existing IT infrastructure.
- To evaluate the impact of CC on supply chain performance metrics, such as inventory levels, delivery times, and customer satisfaction.
- To discuss the implications of CC for supply chain sustainability, including its potential to reduce carbon emissions and improve supply chain transparency.

2. Literature Review

For managing supply chains, CC has emerged as a popular and quickly expanding tool. One of the fastest-growing categories of the cloud services market, SCM is predicted to reach \$214.3 billion in revenue by 2019. There are many advantages of CC for SCM, such as improved communication, scalability, and cost reduction. Furthermore, cloud-based systems can offer immediate access to data, facilitating better judgement and quicker response times (Vemula & Zsifkovits, 2016). Nevertheless, there are drawbacks to SCM's usage of CC. One of the primary concerns is data security, as cloud-based systems rely on third-party providers to store and manage sensitive information (Lian, 2015). Integration complexity is another challenge, as cloud-based systems must be integrated with existing IT infrastructure, which can be time-consuming and expensive. Vendor lock-in is also a concern, as companies may become dependent on a single cloud provider, limiting their ability to switch to another provider if necessary. Despite these challenges, many companies have successfully implemented cloud-based supply chain systems. For example, Amazon Web Services (AWS) offers a variety of cloud-based services that can be used to manage supply chain operations, including storage, database management, and data analytics (Amazon Web Services). Coca-Cola has also deployed a cloud-based supply chain system using SAP's cloud platform, which has resulted in better supply chain visibility and efficiency (Suherman & Simatupang, 2017).

There are a number of best practices that have been found in the literature that can be used to guarantee the effective implementation and management of cloud-based supply chain systems. These include selecting the correct cloud provider, guaranteeing data privacy and security, and integrating cloud solutions with existing IT infrastructure (Stergiou et al., 2018; Vemula & Zsifkovits, 2016). Companies can also assess how CC affects supply chain performance indicators including inventory levels, delivery times, and customer happiness. The acceptance and implementation of cloud-based supply chain systems are anticipated to be impacted in the future by a number of upcoming trends and technology. These include the Internet of Things (IoT), block chain, and artificial intelligence. Block chain may be used to deliver safe and transparent supply chain transactions, while artificial intelligence can be used to analyze supply chain data and spot patterns and trends (Riahi et al., 2021). The IoT can be used to provide real-time data on supply chain operations, enabling faster and more efficient decision-making. SCM may take advantage of the enhanced cooperation, scalability, and cost savings that CC provides. The use of cloud-based solutions is not without its difficulties, though, such as data security, difficult integration, and vendor lock-in. Companies can successfully install and maintain cloud-based supply chain solutions, enhancing the performance of their whole supply chain, by adhering to best practices and staying current with new trends and technology (Sahoo & Goswami, 2024).

2.1. Security concern on supply chain and cloud computing

In order to increase productivity and save costs, Cegielski et al., (2012) study examines how CC technology might be used in SCM. The authors examine the advantages of CC, including improved accessibility and flexibility, and present a case study of a cloud-based SCM system put in place in a manufacturing firm. The potential of CC in SCM, particularly in the areas of inventory management, order fulfillment, and logistics, is examined by Cao et al., (2017). They talk about the advantages of cloud-based systems, such as real-time data sharing and collaboration, and they give a case study of a cloud-based SCM system that was put in place in a Chinese logistics firm. Gammelgaard and Nowicka (2023) investigation on the effects of CC on SCM focuses on the areas of innovation, efficiency, and agility. The authors give a case study of a cloud-based SCM

system that was installed in a Dutch logistics company in addition to discussing the possible advantages of cloud-based systems, such as quicker reaction times and improved data analysis. These studies show the growing interest in CC and its potential advantages for SCM. Businesses can increase the efficiency of their supply chains and gain a market edge by utilizing cloud-based technology. To guarantee successful installation and administration, it is crucial to thoroughly analyze the potential difficulties and best practices related to cloud adoption.

2.2. Improved disaster recovery on supply chain and cloud computing

There are studies that discuss the potential for improved disaster recovery in SCM through the use of CC. Schniederjans et al., (2016) explore the potential for CC to improve disaster recovery in SCM. The authors analyze the benefits of cloud-based systems for disaster recovery, such as increased flexibility and scalability, and provide recommendations for implementing cloud-based disaster recovery solutions. Herrera and Janczewski (2016) examine the potential for CC to improve disaster recovery in SCM, specifically in the areas of data backup and recovery. They discuss the benefits of cloud-based systems for disaster recovery, such as faster recovery times and reduced downtime, and provide recommendations for implementing cloud-based disaster recovery solutions. Wu et al. (2013) focus on the areas of data backup and recovery as they study the potential of CC to improve SCM disaster recovery. The authors describe the benefits of cloud-based disaster recovery systems, such as enhanced accessibility and dependability, and provide advice for implementing them. These studies demonstrate how CC might improve SCM disaster recovery overall. By employing cloud-based technology, businesses can strengthen their ability to recover from disasters and reduce the effects of supply chain disruptions. It is essential to carefully examine the potential challenges and best practices linked to cloud adoption for disaster recovery in order to ensure successful implementation and administration.

2.3. Better customer service on supply chain and cloud computing

There are studies that discuss the potential for better customer service in SCM through the use of CC. Bruque et al., (2015) explores the potential for CC to improve customer service in SCM. The authors analyze the benefits of cloud-based systems for customer service, such as increased agility and responsiveness, and provide recommendations for implementing cloud-based solutions to improve customer service. The potential for a cloud-based SCM system to enhance customer service is examined by Giannakis et al., (2019). They go over the advantages of installing a cloud-based SCM system for customer service, including enhanced visibility and real-time tracking, and offer tips for doing so. Wu et al., (2013) explores the potential for CC to improve customer service in SCM, focusing on the areas of inventory management and order fulfillment. The authors discuss the benefits of cloud-based systems for customer service, such as improved accuracy and efficiency, and provide recommendations for implementing cloud-based solutions to enhance customer service. Overall, these studies demonstrate the potential for CC to improve customer service in SCM. By leveraging cloud-based systems, companies can improve their ability to provide timely and accurate information to customers, track orders in real-time, and respond quickly to changing customer needs. To guarantee successful deployment and administration, it is crucial to thoroughly analyze the potential difficulties and best practices related to cloud adoption for customer service.

2.4. Dependence on internet connectivity on supply chain and cloud computing

The following studies examine how SCM using CC is dependent on internet connectivity. The potential of CC to enhance SCM is discussed by Mital et al., (2015), but they also draw attention to the necessity of internet access for cloud-based solutions. The authors point out that sluggish or interrupted data transfer due to inadequate internet access can have an effect on how effective cloud-based SCM systems are overall. Masdari et al., (2016) examine the possible effects of CC on security and operational aspects of SCM. They point out that dependable internet access is necessary for cloud-based systems to function effectively and advise putting redundancy measures in place to guard against potential outages in internet connectivity. In their analysis of a case study of the use of CC in SCM, Mukherjee et al., (2022) point out that dependable internet access was essential to the implementation's success. To maintain business continuity, the authors advise assessing the potential effects of internet connectivity outages and putting backup plans in place. These studies emphasize how crucial dependable internet access is to SCM solutions that are cloud-based. SCM could benefit from CC, but system performance may suffer if internet connectivity is interrupted. To achieve successful deployment and administration, businesses should carefully analyze the potential difficulties and best practices related to internet access for cloud-based SCM.

2.5. Reduced capital expenditures on supply chain and cloud computing

According to several researches, the adoption of CC could result in lower SCM capital expenses. Moga (2017) emphasizes how the use of cloud-based SCM systems has the potential to result in lower capital expenditures. The authors point out that utilizing CC can free up funds for other investments, such as pricey gear and software, which can save businesses a lot of money. A survey of the literature on the effects of CC on SCM is done by Radke and Tseng (2015). They point out that cloud-based systems can free up businesses from having to invest heavily in IT infrastructure and software, which can save them a lot of money. The ability of CC to increase SCM agility is examined by Liu et al., (2018). The authors point out those using cloud-based systems can free up money by removing the need for businesses to purchase pricey IT infrastructure. These

studies show how CC has the potential to lower SCM capital expenses. Utilizing cloud-based solutions allows businesses to forego the purchase of pricey IT hardware and software, which can save them a lot of money. To make sure it is a cost-effective solution for the company's unique needs, it is crucial to thoroughly weigh the potential costs and benefits of adopting the cloud.

2.6. Novelty of present work

There are possible areas of novelty in the intersection of SCM and CC.

- **Scalability:** Organizations may benefit from unparalleled scalability and flexibility from cloud-based SCM systems, which will let them respond swiftly to shifts in demand, supply, and market conditions. This might give businesses a competitive edge in the market and increase the responsiveness and agility of their supply chains.
- **Collaboration:** Supply chain participants, such as suppliers, manufacturers, distributors, and clients, may collaborate and coordinate more effectively thanks to cloud-based SCM solutions. These solutions can help to increase supply chain visibility, efficiency, and performance by offering a common platform for communication, data exchange, and decision-making.
- **Real-time analytics:** In order to help businesses make quicker, more informed decisions, cloud-based SCM systems can offer real-time analytics and insights into supply chain performance. This could increase consumer happiness, lower costs, and improve the effectiveness of the supply chain.
- **Customization:** Cloud-based SCM systems can be customized to meet the specific needs and requirements of different organizations, enabling them to tailor the system to their unique business processes and supply chain operations. This can help to improve supply chain efficiency and performance, and enhance overall organizational effectiveness (Cao et al., 2017; Goswami & Behera, 2021a).
- **Accessibility:** Cloud-based SCM systems can be accessed from anywhere and on any device, enabling users to work remotely and collaborate with colleagues and partners in different locations. This can help to improve supply chain agility, reduce lead times, and enhance overall organizational flexibility.

These fresh areas provide organizations interesting chances to use cloud-based SCM solutions to boost cooperation and communication, improve supply chain performance, and gain a competitive edge in the market.

2.7. Research gap of present work

There are possible research gaps in the intersection of SCM and CC.

- i. **Security and privacy:** One major research gap is the need for more comprehensive and effective security measures to protect the sensitive information and transactions involved in SCM. Cloud-based systems can be particularly vulnerable to cyber-attacks and data breaches, and there is a need for more research on effective security and privacy measures to mitigate these risks.
- ii. **Decision-making and optimization:** There is a research gap in the creation of efficient algorithms and models for analyzing and using this data to enhance supply chain performance and decision-making, despite the fact that cloud-based SCM systems generate enormous amounts of data that can be used for decision-making and optimization.
- iii. **Sustainability:** The potential of cloud-based SCM systems to promote sustainable supply chain practices, such as lowering carbon emissions, cutting waste, and encouraging ethical sourcing, is yet not fully understood. Effective methods for incorporating sustainability issues into cloud-based SCM systems require further study.
- iv. **Vendor lock-in:** Another area for inquiry is the possible dangers and difficulties brought on by vendor lock-in in cloud-based SCM systems. It could be challenging for businesses to transition to a different cloud vendor if they become reliant on one. Effective methods for reducing this risk and preserving vendor independence require further study.

For scholars and practitioners working at the nexus of SCM and CC, these research gaps represent significant challenges and opportunities. By filling in these gaps, cloud-based SCM systems may be made more efficient, secure, and long-lasting instruments for enhancing supply chain performance and decision-making.

3. Challenges Faced by Businesses in Supply Chain Management

The use of CC technology is becoming more and more prevalent in SCM. By giving businesses real-time visibility into supply chain operations, facilitating improved partner collaboration and communication, and increasing supply chain responsiveness and agility, CC enables businesses to improve their supply chain operations. Nevertheless, despite the advantages, firms still confront difficulties when using CC for SCM (Cao et al., 2017).

- i. **Data security:** Data security is a major concern for businesses using CC for SCM. The sensitive information shared between supply chain partners, including customer information, pricing data, and trade secrets, must be protected from unauthorized access, modification, and theft.
- ii. **Integration and interoperability:** Integrating cloud-based SCM systems with other enterprise systems and external partners is still a challenge. There is a need for more research and standardization to ensure that these systems can communicate effectively and efficiently with other systems and partners.
- iii. **Scalability:** As companies grow and expand their supply chains, they require cloud-based SCM systems that can scale to meet the increasing demand. Ensuring the scalability of these systems can be a challenge for businesses (Lin and Lin, 2019).
- iv. **Dependence on internet connectivity:** Cloud-based SCM systems are heavily reliant on internet connectivity, which can be a potential vulnerability in areas with poor connectivity or during network disruptions. Companies must have backup plans in place to mitigate these risks.
- v. **Cost:** Businesses, especially small and medium-sized firms (SMEs), may find it difficult to afford the expense of setting up and maintaining cloud-based SCM systems (Gammelgaard and Nowicka, 2023). Hardware, software, and staff training are all included in this.

While CC presents significant benefits for SCM, it is important for businesses to recognize and address the challenges that come with this technology. By doing so, businesses can maximize the benefits of cloud-based SCM systems while minimizing the risks and challenges.

4. Cloud-Based Solutions Addressing Supply Chain Management

Cloud-based solutions can address SCM by providing real-time visibility into supply chain processes, enabling better collaboration and communication among partners, and improving supply chain responsiveness and agility. Here are some specific ways in which cloud-based solutions can address SCM.

4.1. Real-time visibility

Real-time visibility into supply chain operations can be provided through cloud-based solutions, allowing companies to monitor inventory levels, manufacturing plans, and delivery dates. This real-time visibility can help businesses identify bottlenecks and inefficiencies in the supply chain, allowing for quicker resolution of issues (Schneiderjans et al., 2016; Goswami, 2020). Real-time visibility is crucial for effective SCM. Cloud-based solutions can provide significant improvements in real-time visibility by leveraging data analytics, machine learning, and other advanced technologies. Here are some ways to improve real-time visibility using cloud-based solutions.

- **Centralized data management:** Cloud-based solutions can provide a centralized repository for all supply chain data, making it easier to access and analyze in real-time.
- **Real-time tracking:** Cloud-based solutions can track shipments and inventory in real-time, providing accurate and timely updates on the status of goods in transit (Herrera and Janczewski, 2016).
- **Predictive analytics:** Cloud-based solutions may analyze previous data and forecast future supply chain disruptions using machine learning algorithms, enabling proactive control of prospective problems.
- **Collaborative platform:** Cloud-based solutions can provide a collaborative platform for all stakeholders in the supply chain to share information, coordinate efforts, and resolve issues in real-time (Sahoo and Goswami, 2024).
- **Mobile capabilities:** Supply chain managers may be able to monitor and control their supply chain from any location at any time with the use of cloud-based solutions.
- **Real-time alerts and notifications:** Cloud-based solutions can provide real-time alerts and notifications for critical events such as delays, disruptions, and inventory shortages, enabling proactive management of these issues (Wu et al., 2013).

Cloud-based solutions offer a powerful set of tools to improve real-time visibility in SCM. By leveraging these solutions, businesses can achieve greater efficiency, reduce costs, and improve customer satisfaction.

4.2. Collaboration and communication

Supply chain partners may collaborate and communicate more easily with the use of cloud-based solutions, sharing information and more effectively coordinating their efforts. This can help businesses improve their responsiveness to customer demand and better manage inventory levels. Collaboration and communication are critical to successful SCM, and cloud-

based solutions can play a vital role in improving both. Here are some ways that cloud-based solutions can improve collaboration and communication in SCM.

- **Shared access to data:** Cloud-based solutions remove the need for manual data entry and lower the possibility of errors by enabling supply chain partners to view and share data in real-time.
- **Centralized platform:** Cloud-based solutions provide a centralized platform for all supply chain partners to collaborate, share information, and coordinate efforts.
- **Improved communication:** In order to enable real-time communication amongst supply chain partners, cloud-based solutions include a number of communication capabilities, including as email, chat, and video conferencing (Camara et al., 2015).
- **Task automation:** Cloud-based solutions can automate routine tasks, such as purchase order generation and invoice processing, freeing up supply chain partners to focus on higher-value activities.
- **Transparency:** Cloud-based solutions provide transparency throughout the supply chain, enabling partners to track the status of orders, shipments, and inventory in real-time (Sahoo & Goswami, 2024).
- **Analytics:** Cloud-based solutions can analyze supply chain data to identify inefficiencies and opportunities for improvement, enabling partners to make data-driven decisions.

Cloud-based solutions offer a powerful set of tools to improve collaboration and communication in SCM. By leveraging these solutions, businesses can achieve greater efficiency, reduce costs, and improve customer satisfaction.

4.3. Agility

Businesses may easily react to shifting market conditions and client demand with the help of cloud-based technologies. Businesses may make wise judgements and modify their supply chain strategy by having access to real-time data and analytics. SCM depends heavily on agility, and cloud-based solutions can significantly increase agility. The following are some ways that SCM can become more agile thanks to cloud-based solutions.

- **Scalability:** Cloud-based solutions offer the ability to quickly scale up or down as demand fluctuates, enabling supply chain partners to adjust to changing market conditions.
- **Flexibility:** Cloud-based solutions offer flexibility by providing access to a wide range of software and services, enabling supply chain partners to customize their solutions to meet their specific needs.
- **Real-time data:** Cloud-based solutions offer real-time data, enabling supply chain partners to make informed decisions based on up-to-the-minute information (Schniederjans et al., 2016).
- **Collaborative platform:** Cloud-based solutions provide a collaborative platform for supply chain partners to share information, coordinate efforts, and resolve issues in real-time, improving overall agility.
- **Predictive analytics:** Predictive analytics can be used by cloud-based applications to detect possible supply chain disruptions before they happen, allowing partners to take preventative action to lessen the effects (Sahoo and Goswami, 2024).
- **Mobile capabilities:** Cloud-based solutions provide mobile capabilities, enabling supply chain partners to manage their operations from anywhere, at any time, improving overall agility.

Cloud-based solutions offer a powerful set of tools to improve agility in SCM. By leveraging these solutions, businesses can respond more quickly to changing market conditions, improve their ability to manage supply chain disruptions, and enhance customer satisfaction (Giannakis et al., 2019).

4.4. Scalability

Cloud-based solutions may scale up or down to meet changing business needs, making it easier to manage supply chain operations. Scalability is a crucial aspect of SCM, and cloud-based solutions can considerably improve it. Here are several ways that cloud-based technologies can help SCM become more scalable (Goswami, 2020).

- **Elastic computing resources:** Cloud-based solutions offer elastic computing resources, allowing supply chain partners to quickly scale up or down as demand fluctuates, reducing costs and improving efficiency.
- **Pay-per-use pricing:** Cloud-based solutions offer pay-per-use pricing, enabling supply chain partners to pay only for the resources they use, reducing costs and improving overall scalability.
- **Shared infrastructure:** Cloud-based solutions use shared infrastructure, reducing the need for individual supply chain partners to invest in their own hardware and software, improving overall scalability.

- **Automatic upgrades and maintenance:** Cloud-based solutions offer automatic upgrades and maintenance, ensuring that supply chain partners are always running the latest software and hardware, reducing downtime and improving scalability (Sahoo and Goswami, 2024).
- **Collaborative platform:** Cloud-based solutions provide a collaborative platform for supply chain partners to share information, coordinate efforts, and resolve issues in real-time, improving overall scalability.
- **Analytics:** Cloud-based solutions can analyze supply chain data to identify inefficiencies and opportunities for improvement, enabling partners to make data-driven decisions and improve overall scalability.

Cloud-based solutions offer a powerful set of tools to improve scalability in SCM. By leveraging these solutions, businesses can respond more quickly to changing market conditions, improve their ability to manage supply chain disruptions, and enhance customer satisfaction (Mital et al., 2015).

4.5. Cost-effectiveness

Particularly for small and medium-sized enterprises, cloud-based solutions can be more cost-effective than conventional on-premises solutions. Cloud-based solutions can be more simply managed and maintained and do not require costly hardware and software investments. A key component of SCM is cost-effectiveness, and cloud-based solutions can significantly increase cost-effectiveness. The following are some ways that cloud-based solutions might raise SCM's cost-effectiveness (Masdari et al., 2016).

- **Reduced IT infrastructure costs:** Cloud-based solutions eliminate the need for individual supply chain partners to invest in their own IT infrastructure, reducing hardware and software costs and improving overall cost-effectiveness.
- **Pay-per-use pricing:** Cloud-based solutions offer pay-per-use pricing, enabling supply chain partners to pay only for the resources they use, reducing costs and improving overall cost-effectiveness.
- **Reduced maintenance costs:** Cloud-based solutions offer automatic upgrades and maintenance, reducing the need for individual supply chain partners to maintain their own hardware and software, reducing costs and improving overall cost-effectiveness.
- **Increased efficiency:** Cloud-based solutions enable supply chain partners to share information and coordinate efforts in real-time, improving overall efficiency and reducing costs.
- **Predictive analytics:** Predictive analytics can be used by cloud-based solutions to spot possible supply chain disruptions before they happen, allowing partners to take proactive action to lessen the impact, cut expenses, and boost overall cost effectiveness.
- **Collaborative platform:** Cloud-based solutions provide a collaborative platform for supply chain partners to share information, coordinate efforts, and resolve issues in real-time, improving overall efficiency and reducing costs.

Cloud-based solutions offer a powerful set of tools to improve cost-effectiveness in SCM. By leveraging these solutions, businesses can reduce costs, increase efficiency, and improve customer satisfaction, enhancing their overall competitiveness.

4.6. Enhanced data analytics

Cloud-based solutions can offer improved data analytics capabilities, enabling firms to instantly analyze massive amounts of data from many sources. Businesses can use this to spot trends, streamline supply chain operations, and arrive at better judgments. SCM depends heavily on data analytics, and cloud-based solutions can significantly improve data analytics capabilities. The following are some ways that SCM data analytics can be improved using cloud-based solutions (Mukherjee et al., 2022; Goswami & Behera, 2021b).

- **Real-time data:** Cloud-based solutions offer real-time data, enabling supply chain partners to make informed decisions based on up-to-the-minute information, improving overall data analytics capabilities.
- **Scalability:** Cloud-based solutions offer the ability to quickly scale up or down as demand fluctuates, enabling supply chain partners to analyze large amounts of data, improving overall data analytics capabilities.
- **Advanced analytics:** Cloud-based solutions provide access to advanced analytics tools, enabling supply chain partners to perform complex data analysis, including predictive analytics, and identify opportunities for improvement.
- **Collaborative platform:** Cloud-based solutions provide a collaborative platform for supply chain partners to share information, coordinate efforts, and resolve issues in real-time, improving overall data analytics capabilities (Schneiderjans et al., 2016; Sahoo & Goswami, 2024).

- **Customizable dashboards:** Cloud-based solutions allow supply chain partners to create customizable dashboards that provide a real-time view of key performance indicators, enabling them to make data-driven decisions and improve overall data analytics capabilities.
- **Data integration:** Supply chain partners may now analyse data throughout their entire supply chains thanks to cloud-based solutions, which can connect data from many sources, including ERP systems, warehouse management systems, and transportation management systems.

Cloud-based solutions offer a powerful set of tools to enhance data analytics capabilities in SCM. By leveraging these solutions, businesses can make data-driven decisions, identify opportunities for improvement, and enhance their overall competitiveness.

4.7. Improved forecasting

Cloud-based solutions can improve supply chain forecasting by providing access to real-time data and analytics, enabling businesses to more accurately predict demand and adjust their supply chain strategies accordingly (Moga, 2017). Forecasting is a critical factor in SCM, and cloud-based solutions can play a significant role in improving forecasting capabilities. Here are some ways that cloud-based solutions can improve forecasting in SCM.

- **Real-time data:** Cloud-based solutions offer real-time data, enabling supply chain partners to make informed decisions based on up-to-the-minute information, improving overall forecasting capabilities.
- **Scalability:** Cloud-based solutions offer the ability to quickly scale up or down as demand fluctuates, enabling supply chain partners to analyze large amounts of data and improve forecasting accuracy.
- **Predictive analytics:** Cloud-based solutions provide access to advanced analytics tools, including predictive analytics, enabling supply chain partners to forecast demand, inventory levels, and production needs more accurately (Goswami, 2020).
- **Collaborative platform:** Cloud-based solutions provide a collaborative platform for supply chain partners to share information, coordinate efforts, and resolve issues in real-time, improving overall forecasting capabilities.
- **Machine learning:** Cloud-based solutions can use machine learning to analyze historical data and identify patterns, enabling supply chain partners to make more accurate forecasts.
- **Integration with external data sources:** Cloud-based solutions can integrate data from external sources, including weather forecasts, social media data, and economic indicators, enabling supply chain partners to make more informed forecasts.

Cloud-based solutions offer a powerful set of tools to improve forecasting capabilities in SCM. By leveraging these solutions, businesses can make more accurate forecasts, improve production planning, reduce inventory levels, and enhance their overall competitiveness (Goswami & Behera, 2021a).

4.8. Streamlined procurement

Cloud-based solutions can streamline procurement by enabling businesses to manage purchasing activities more efficiently. By automating procurement processes, businesses can reduce costs and improve supplier performance. Procurement is a critical component of SCM, and cloud-based solutions can play a significant role in streamlining procurement processes. Here are some ways that cloud-based solutions can streamline procurement in SCM.

- **Centralized procurement platform:** Cloud-based solutions provide a centralized procurement platform, enabling supply chain partners to manage all procurement activities in one place, reducing the need for multiple systems and improving overall efficiency.
- **Real-time inventory management:** Cloud-based solutions offer real-time inventory management, enabling supply chain partners to track inventory levels and demand in real-time, reducing the risk of stockouts or excess inventory.
- **Automated procurement processes:** Cloud-based solutions can automate procurement processes, including purchase orders, invoices, and approvals, reducing manual errors and improving overall efficiency (Sahoo and Goswami, 2024).
- **Supplier management:** Cloud-based solutions provide tools for managing supplier relationships, including supplier performance metrics and contract management, improving overall procurement efficiency.
- **Electronic document management:** Cloud-based solutions offer electronic document management, enabling supply chain partners to store and share procurement-related documents in a secure, centralized location, reducing the risk of lost or misplaced documents.

- **Analytics and reporting:** Cloud-based solutions offer analytics and reporting capabilities, enabling supply chain partners to track procurement performance and identify areas for improvement.

Cloud-based solutions offer a powerful set of tools to streamline procurement processes in SCM. By leveraging these solutions, businesses can reduce costs, improve efficiency, and enhance their overall competitiveness Radke and Tseng, 2015).

4.9. Better risk management

By delivering real-time data on supplier performance, manufacturing lags, and other possible disruptions, cloud-based solutions can assist businesses in managing supply chain risks more successfully. Due to this, companies may be able to react swiftly to possible supply chain interruptions and lessen their effects. SCM must include risk management, and cloud-based solutions can significantly enhance risk management capabilities. Here are a few ways that cloud-based technologies might enhance SCM risk management (Liu et al., 2018).

- **Real-time visibility:** Cloud-based solutions give supply chain partners real-time visibility into supply chain operations, allowing them to spot potential hazards and address them before they become an issue.
- **Supply chain mapping:** The entire supply chain can be mapped using cloud-based solutions, risks and weaknesses may be found, and contingency plans can be created to reduce those risks.
- **Collaboration platform:** Cloud-based solutions provide a collaborative platform for supply chain partners to share information and coordinate efforts, improving overall risk management capabilities.
- **Data analytics:** Cloud-based solutions provide access to advanced analytics tools, enabling supply chain partners to identify patterns and trends that could indicate potential risks and take proactive steps to mitigate those risks (Goswami and Behera, 2021a).
- **Compliance management:** Cloud-based solutions offer tools for managing compliance with regulations, including environmental, social, and governance (ESG) regulations, reducing the risk of penalties or reputational damage (Sahoo and Goswami, 2024).
- **Disaster recovery:** Cloud-based solutions provide tools for disaster recovery and business continuity planning, ensuring that supply chain operations can continue in the event of a disruption.

Cloud-based solutions offer a powerful set of tools to improve risk management capabilities in SCM. By leveraging these solutions, businesses can identify potential risks, take proactive steps to mitigate those risks, and enhance their overall competitiveness.

4.10. Sustainability

Cloud-based solutions can help businesses improve sustainability in their supply chain by providing data and analytics on the environmental impact of their operations. This can enable businesses to identify opportunities to reduce waste, improve efficiency, and minimize their carbon footprint. Sustainability is becoming an increasingly important consideration in SCM, and cloud-based solutions can play a significant role in improving sustainability practices. Here are some ways that cloud-based solutions can improve sustainability in SCM.

- **Supply chain mapping:** Cloud-based solutions provide tools for mapping the entire supply chain, enabling supply chain partners to identify potential sustainability risks and vulnerabilities.
- **Sustainability reporting:** Cloud-based solutions offer sustainability reporting capabilities, enabling supply chain partners to track and report on sustainability metrics, including carbon emissions, waste reduction, and social responsibility.
- **Collaboration platform:** Cloud-based solutions provide a collaborative platform for supply chain partners to share information and coordinate sustainability efforts, improving overall sustainability practices.
- **Real-time data:** Cloud-based solutions offer real-time data on supply chain operations, enabling supply chain partners to identify potential sustainability issues and take corrective actions before they become a problem (Sahoo and Goswami, 2024).
- **Compliance management:** Cloud-based solutions offer tools for managing compliance with environmental regulations and standards, reducing the risk of penalties or reputational damage.
- **Product lifecycle management:** Cloud-based solutions provide tools for managing the entire product lifecycle, including design, production, distribution, and end-of-life, enabling supply chain partners to reduce waste and improve sustainability practices.

Cloud-based solutions offer a powerful set of tools to improve sustainability practices in SCM. By leveraging these solutions, businesses can reduce their environmental impact, improve social responsibility, and enhance their overall competitiveness (Goswami and Behera, 2021a). Cloud-based solutions offer numerous benefits for SCM, from real-time visibility and enhanced data analytics to improved forecasting and streamlined procurement. By leveraging the capabilities of cloud-based solutions, businesses can improve supply chain efficiency, reduce costs, and increase customer satisfaction.

5. Challenges of Adopting Cloud Computing in Supply Chain Management

SCM can benefit greatly from CC, but there are also a number of issues that must be resolved before CC can be implemented. These are a few of the difficulties.

- i. **Data security:** One of the biggest challenges is data security. SCM involves the exchange of sensitive information between different partners, and storing this information in the cloud can increase the risk of data breaches and cyber-attacks (Goswami & Behera, 2021b).
- ii. **Integration with legacy systems:** Many supply chain partners still use legacy systems that may not be compatible with cloud-based solutions. Integrating these systems with cloud-based solutions can be a challenge and may require significant investment.
- iii. **Connectivity:** CC requires reliable internet connectivity, and supply chain partners in remote areas or with poor connectivity may face challenges in accessing cloud-based solutions.
- iv. **Cost:** While cloud-based solutions can bring cost savings in the long term, there may be significant upfront costs associated with transitioning to the cloud. Additionally, ongoing costs for maintaining and upgrading the cloud-based solutions may be higher than expected (Zimmermann et al., 2019; Giannakis et al., 2019).
- v. **Vendor lock-in:** Moving to the cloud requires working with a cloud provider, and this can result in vendor lock-in. It may be difficult to switch to a different cloud provider if the current provider does not meet the needs of the business.
- vi. **Data ownership:** Supply chain partners may have concerns about data ownership and control when storing data in the cloud. It's important to establish clear guidelines and agreements on data ownership and access to address these concerns.
- vii. **Performance:** Cloud-based solutions require reliable and fast internet connectivity to ensure smooth operations (Sahoo and Goswami, 2024). Slow internet speeds or connectivity disruptions can impact the performance of cloud-based solutions, leading to delays and decreased efficiency.
- viii. **Customization:** Many businesses have unique supply chain processes and requirements that may not be fully addressed by off-the-shelf cloud-based solutions. Customizing cloud-based solutions to meet specific business needs can be challenging and may require additional investment.
- ix. **Regulatory compliance:** SCM involves compliance with a range of regulations, and it's important to ensure that cloud-based solutions meet these regulatory requirements. Failure to comply with regulations can result in significant fines or other penalties.
- x. **Training and adoption:** Adoption of cloud-based solutions requires training and support for supply chain partners to ensure that they are able to effectively use the new systems. Without proper training and support, there may be resistance to adoption or low usage of the new systems.
- xi. **Service level agreements (SLAs):** When working with cloud providers, it's important to establish clear SLAs that define the level of service and support that the provider will offer. Failure to establish clear SLAs can result in misunderstandings and disagreements when issues arise (Schniederjans et al., 2016).

Despite the fact that there are a number of difficulties in implementing CC in SCM, these difficulties can be overcome with proper planning and cooperation between supply chain partners and cloud providers. Businesses can take use of CC's advantages, such as improved supply chain operations and scalability, by addressing these issues.

6. A Case Study

One case study of a company that successfully implemented cloud-based SCM solutions is Flex, a global electronics manufacturing services company. Flex wanted to improve their supply chain visibility and reduce lead times, while also ensuring compliance with regulations and reducing costs. Flex used a cloud-based supply chain platform provided by GT Nexus for its SCM system (Zimmermann et al., 2019; Sahoo & Goswami, 2024). Flex was able to centralize their supply chain data and work in real-time with their suppliers thanks to the solution. By providing visibility into the entire supply chain, Flex was able to identify bottlenecks and inefficiencies and take corrective action quickly. The solution also enabled Flex to improve their forecasting accuracy, reducing lead times and improving their responsiveness to customer demand. By automating processes

and improving collaboration with suppliers, Flex was able to reduce costs and increase efficiency in their supply chain operations.

The international food and beverage firm Nestle, which used a SAP cloud-based SCM solution, is another example study. Nestle was able to identify and reduce risks, as well as optimize their operations, thanks to the real-time visibility the technology gave them into their supply chain. The SAP cloud-based solution enabled Nestle to collaborate more effectively with their suppliers, improving communication and reducing lead times. The solution also provided Nestle with advanced analytics capabilities, allowing them to analyze supply chain data in real-time and makes data-driven decisions. The solution helped Nestle to streamline their supply chain processes, reducing costs and improving efficiency. By optimizing their supply chain operations, Nestle was able to improve customer satisfaction and gain a competitive advantage in the market. The cloud-based SCM solution from SAP helped Nestle to achieve their goals of improving supply chain visibility, reducing lead times, optimizing operations, and reducing costs (Hassan et al., 2022; Goswami and Behera, 2021a). The solution enabled Nestle to enhance their SCM capabilities and improve their overall business performance.

7. Key Takeaways and Insights from Cloud-Based Supply Chain Solutions

These are some key takeaways and insights from cloud-based SCM solutions.

- **Improved supply chain visibility:** Real-time visibility into supply chain operations is made possible by cloud-based SCM tools, allowing organizations to spot inefficiencies and move swiftly to address them. Lead times are shortened and overall supply chain performance is improved.
- **Enhanced collaboration:** Cloud-based SCM solutions enable businesses to collaborate more effectively with their supply chain partners, improving communication and reducing lead times. This leads to greater efficiency and reduces the risk of supply chain disruptions (Lu et al., 2022).
- **Advanced analytics:** Cloud-based SCM solutions provide advanced analytics capabilities, enabling businesses to analyze supply chain data in real-time and make data-driven decisions. This improves forecasting accuracy and enables businesses to respond more quickly to changes in customer demand.
- **Scalability and flexibility:** Cloud-based SCM solutions are highly scalable and flexible, enabling businesses to adapt to changing business needs and growth. This improves agility and enables businesses to stay competitive in a rapidly changing market.
- **Cost-effectiveness:** Because they need less infrastructure and hardware up front than traditional on-premise solutions, cloud-based SCM solutions are often more affordable. This enables companies to cut expenses and boost profits.
- **Challenges:** While there are several benefits to cloud-based SCM solutions, there are also several challenges that need to be addressed, including performance, customization, regulatory compliance, training and adoption, and service level agreements (SLAs) (Giannakis et al., 2019).
- **Improved risk management:** Cloud-based SCM solutions enable businesses to improve their risk management capabilities by identifying potential risks and mitigating them in real-time. This reduces the risk of supply chain disruptions and improves overall supply chain performance.
- **Sustainability:** By lowering waste, enhancing transportation, and enhancing supplier sustainability practices, cloud-based SCM tools can assist firms in becoming more sustainable. This aids companies in achieving their sustainability objectives and lessening their environmental effect (Stergiou et al., 2018).
- **Innovation:** By utilizing cutting-edge technology like artificial intelligence (AI), machine learning (ML), and the Internet of Things (IoT), cloud-based SCM systems help organizations innovate and stay ahead of the competition (Goswami and Behera, 2021b).
- **Increased customer satisfaction:** Cloud-based SCM systems help companies increase customer satisfaction by enhancing supply chain visibility and cutting lead times. This aids companies in retaining clients and gaining an upper hand in the marketplace.

Businesses may take advantage of a number of advantages that come with cloud-based SCM solutions, including increased supply chain efficiency, cost savings, and improved business operations. Businesses will be able to take advantage of evolving technology and boost their competitiveness in the market as long as they continue to employ cloud-based solutions (Riahi et al., 2021; Goswami & Behera, 2021b).

8. Conclusion

Supply chain visibility, collaboration, analytics, scalability, flexibility, cost-effectiveness, risk management, sustainability, innovation, and customer happiness are just a few of the many advantages that cloud-based SCM solutions provide enterprises.

Businesses may optimize their supply chain operations, save costs, increase efficiency, and maintain competitiveness in a market that is changing quickly by utilizing cloud-based technologies. Although implementing cloud-based solutions comes with a number of problems, these difficulties can be overcome with proper planning, training, and cooperation with solution providers. Businesses will be better able to take advantage of developing technology and boost their overall performance as long as they continue to employ cloud-based SCM systems. Cloud-based SCM solutions represent a significant shift in the way businesses manage their supply chain operations. By embracing this shift and adopting cloud-based solutions, businesses can improve their supply chain operations and position themselves for future success.

8.1. Practical and theoretical implications

Businesses aiming to optimize their supply chain operations should consider the practical implications of cloud-based SCM solutions. Consider the following practical implications.

- i. **Improved supply chain visibility:** Real-time visibility into supply chain operations is provided by cloud-based SCM tools, allowing companies to spot inefficiencies and move swiftly to address them. This may result in shorter lead times, better delivery outcomes, and more customer satisfaction.
- ii. **Enhanced collaboration:** Cloud-based SCM solutions enable businesses to collaborate more effectively with their supply chain partners, improving communication and reducing lead times. This can lead to greater efficiency and reduced risk of supply chain disruptions.
- iii. **Advanced analytics:** Cloud-based SCM solutions provide advanced analytics capabilities, enabling businesses to analyze supply chain data in real-time and make data-driven decisions. This can lead to improved forecasting accuracy, optimized inventory levels, and reduced waste.
- iv. **Scalability and flexibility:** Cloud-based SCM solutions are highly scalable and flexible, enabling businesses to adapt to changing business needs and growth. This can lead to improved agility and competitiveness in a rapidly changing market.
- v. **Cost-effectiveness:** Because they need less infrastructure and hardware up front than traditional on-premise solutions, cloud-based SCM solutions are often more affordable. This may result in lower expenses and more profitability.
- vi. **Improved risk management:** Cloud-based SCM solutions enable businesses to improve their risk management capabilities by identifying potential risks and mitigating them in real-time. This can lead to reduced risk of supply chain disruptions and improved overall supply chain performance.
- vii. **Sustainability:** By lowering waste, enhancing transportation, and enhancing supplier sustainability practices, cloud-based SCM tools can assist firms in becoming more sustainable. This can assist companies in achieving their sustainability objectives and minimizing their environmental effect.

Businesses aiming to optimize their supply chain operations, cut expenses, and boost their competitiveness in the market can benefit from cloud-based SCM tools. Businesses may take advantage of new technology and stay one step ahead of the competition in a market that is changing quickly by implementing cloud-based solutions.

8.2. Limitations

While cloud-based SCM solutions offer many benefits, there are also several limitations to consider.

- i. **Security and data privacy:** Data security and privacy are two of the key issues with cloud-based solutions. Businesses run the danger of data breaches and cyber-attacks when they commit their data to third-party services. Make sure the service has effective security procedures in place to safeguard data.
- ii. **Integration with legacy systems:** Many companies continue to rely on antiquated technologies that might not work with cloud-based alternatives. This may lead to integration difficulties, higher costs, and longer implementation times.
- iii. **Dependence on internet connectivity:** Cloud-based solutions require internet connectivity to function properly. Any disruptions in internet connectivity can impact the ability to access data and use the system.
- iv. **Reliance on third-party providers:** As businesses rely on third-party providers for cloud-based solutions, they may experience downtime or disruptions in service if the provider experiences issues.
- v. **Complexity of implementation:** Cloud-based SCM solutions can be complex to implement, requiring significant changes to business processes and operations. This can result in a steep learning curve for users and additional costs associated with training and support.
- vi. **Limited customization:** Cloud-based solutions may have limited customization options, which can restrict businesses' ability to tailor the solution to their specific needs.

- vii. **Regulatory compliance:** Depending on the industry and geography, businesses may be subject to regulatory compliance requirements. It's important to ensure that the cloud-based solution meets these requirements to avoid compliance issues.

While cloud-based SCM solutions offer many benefits, businesses should also consider these limitations and address them accordingly to ensure a successful implementation.

8.3. Future scope

The future scope for cloud-based SCM solutions is vast and exciting. As technology continues to advance and businesses become more dependent on digital solutions, cloud-based SCM is expected to become more prevalent. Here are some potential future developments in this field.

- i. **Artificial intelligence and machine learning:** As cloud-based solutions gather more data, businesses will have the opportunity to leverage artificial intelligence and machine learning to improve forecasting, demand planning, and overall supply chain optimization.
- ii. **Block chain technology:** Because it may offer a secure, open, and immutable ledger, block chain technology is growing in popularity in SCM. Blockchain technology could be incorporated into cloud-based applications to increase the traceability and transparency of the supply chain.
- iii. **Internet of Things (IoT):** The IoT is expected to play a significant role in SCM by providing real-time data on inventory levels, delivery times, and other critical information. Cloud-based solutions could leverage IoT technology to improve visibility and collaboration across the supply chain.
- iv. **Advanced analytics:** Cloud-based solutions could leverage advanced analytics to provide insights into supply chain performance, allowing businesses to optimize their operations and reduce costs.
- v. **Integration with other systems:** In order to provide a comprehensive perspective of corporate operations and enhance decision-making, cloud-based SCM solutions may interact with other systems, such as ERP and CRM systems.

Cloud-based SCM solutions have a bright future, and companies that adopt them now will enjoy a considerable competitive edge in the coming years.

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Conflict of interest

The author(s) declare that there are no conflicts of interest to disclose.

References

- Ageron, B., Bentahar, O., & Gunasekaran, A. (2020). Digital supply chain: challenges and future directions. In *Supply Chain Forum: An International Journal*, 21(3), 133-138.
- Camara, S. B., Fuentes, J. M., & Marín, J. M. M. (2015). Cloud computing, Web 2.0, and operational performance: The mediating role of supply chain integration. *The International Journal of Logistics Management*, 26(3), 426-458.
- Cao, Q., Schniederjans, D. G., & Schniederjans, M. (2017). Establishing the use of cloud computing in supply chain management. *Operations Management Research*, 10, 47-63.
- Cegielski, C. G., Jones-Farmer, L. A., Wu, Y., & Hazen, B. T. (2012). Adoption of cloud computing technologies in supply chains: An organizational information processing theory approach. *The international journal of logistics Management*, 23(2), 184-211.
- Gammelgaard, B., & Nowicka, K. (2023). Next generation supply chain management: the impact of cloud computing. *Journal of Enterprise Information Management*.
- Giannakis, M., Spanaki, K., & Dubey, R. (2019). A cloud-based supply chain management system: effects on supply chain responsiveness. *Journal of Enterprise Information Management*, 32(4), 585-607.
- Goswami, S. S. (2020). Outranking methods: Promethee i and promethee ii. *Foundations of Management*, 12(1), 93-110.

- Goswami, S. S., & Behera, D. K. (2021a). Solving material handling equipment selection problems in an industry with the help of entropy integrated COPRAS and ARAS MCDM techniques. *Process Integration and Optimization for Sustainability*, 5(4), 947-973.
- Goswami, S. S., & Behera, D. K. (2021b). Evaluation of the best smartphone model in the market by integrating fuzzy-AHP and PROMETHEE decision-making approach. *Decision*, 48, 71-96.
- Goswami, S. S., Mohanty, S. K., & Behera, D. K. (2022). Selection of a green renewable energy source in India with the help of MEREC integrated PIV MCDM tool. *Materials today: proceedings*, 52, 1153-1160.
- Hassan, A., Bhatti, S. H., Shujaat, S., & Hwang, Y. (2022). To adopt or not to adopt? The determinants of cloud computing adoption in information technology sector. *Decision Analytics Journal*, 5, 100138.
- Herrera, A., & Janczewski, L. (2016). Cloud supply chain resilience model: Development and validation. In *2016 49th Hawaii International Conference on System Sciences (HICSS)* (pp. 3938-3947). IEEE.
- Jede, A., & Teuteberg, F. (2015). Integrating cloud computing in supply chain processes: a comprehensive literature review. *Journal of Enterprise Information Management*.
- Lian, J. W. (2015). Critical factors for cloud based e-invoice service adoption in Taiwan: An empirical study. *International Journal of Information Management*, 35(1), 98-109.
- Lin, C., & Lin, M. (2019). The determinants of using cloud supply chain adoption. *Industrial Management & Data Systems*, 119(2), 351-366.
- Liu, S., Chan, F. T., Yang, J., & Niu, B. (2018). Understanding the effect of cloud computing on organizational agility: An empirical examination. *International Journal of Information Management*, 43, 98-111.
- Lu, Q., Chen, J., Song, H., & Zhou, X. (2022). Effects of cloud computing assimilation on supply chain financing risks of SMEs. *Journal of Enterprise Information Management*, 35(6), 1719-1741.
- Masdari, M., ValiKardan, S., Shahi, Z., & Azar, S. I. (2016). Towards workflow scheduling in cloud computing: a comprehensive analysis. *Journal of Network and Computer Applications*, 66, 64-82.
- Mital, M., Pani, A. K., Damodaran, S., & Ramesh, R. (2015). Cloud based management and control system for smart communities: A practical case study. *Computers in Industry*, 74, 162-172.
- Moga, L. M. (2017). Cloud computing based solutions for monitoring the supply chain of fish and fishery products. In *2017 Eighth International Conference on Intelligent Computing and Information Systems (ICICIS)* (pp. 33-38). IEEE.
- Mukherjee, S., Chittipaka, V., Baral, M. M., & Srivastava, S. C. (2022). Integrating the challenges of cloud computing in supply chain management. In *Recent Advances in Industrial Production: Select Proceedings of ICEM 2020* (pp. 355-363). Springer Singapore.
- Oliveira, M. P. V. D., & Handfield, R. (2019). Analytical foundations for development of real-time supply chain capabilities. *International Journal of Production Research*, 57(5), 1571-1589.
- Radke, A. M., & Tseng, M. M. (2015). Design considerations for building distributed supply chain management systems based on cloud computing. *Journal of Manufacturing Science and Engineering*, 137(4).
- Riahi, Y., Saikouk, T., Gunasekaran, A., & Badraoui, I. (2021). Artificial intelligence applications in supply chain: A descriptive bibliometric analysis and future research directions. *Expert Systems with Applications*, 173, 114702.
- Sahoo, S., & Choudhury, B. (2022). Optimal selection of an electric power wheelchair using an integrated COPRAS and EDAS approach based on Entropy weighting technique. *Decision Science Letters*, 11(1), 21-34.
- Sahoo, S. K., & Goswami, S. S. (2024). Theoretical framework for assessing the economic and environmental impact of water pollution: A detailed study on sustainable development of India. *Journal of Future Sustainability*, 4(1), 23-34.
- Schniederjans, D. G., Ozpolat, K., & Chen, Y. (2016). Humanitarian supply chain use of cloud computing. *Supply Chain Management: An International Journal*.
- Stergiou, C., Psannis, K. E., Kim, B. G., & Gupta, B. (2018). Secure integration of IoT and cloud computing. *Future Generation Computer Systems*, 78, 964-975.
- Suherman, A. G., & Simatupang, T. M. (2017). The network business model of cloud computing for end-to-end supply chain visibility. *International Journal of Value Chain Management*, 8(1), 22-39.
- Vemula, R., & Zsifkovits, H. (2016). Cloud computing for supply chain management. *BHM Berg-und Hüttenmännische Monatshefte*, 161, 229-232.
- Wu, Y. U. N., Cegielski, C. G., Hazen, B. T., & Hall, D. J. (2013). Cloud computing in support of supply chain information system infrastructure: understanding when to go to the cloud. *Journal of supply chain management*, 49(3), 25-41.
- Yenugula, M., Sahoo, S. K., & Goswami, S. S. (2024). Cloud computing for sustainable development: An analysis of environmental, economic and social benefits. *Journal of future sustainability*, 4, 45-60.
- Zimmermann, M., Rosca, E., Antons, O., & Bendul, J. C. (2019). Supply chain risks in times of Industry 4.0: Insights from German cases. *IFAC-PapersOnLine*, 52(13), 1755-1760.



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