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Utilizing Internet of Things (IoT) Technology for Supply Chain Optimization in Digital Businesses

Memanfaatkan Teknologi Internet of Things (IoT) untuk Optimasi Supply Chain pada Bisnis Digital

Almasari Aksenta
Politeknik Negeri Samarinda
*a.aksenta@polnes.ac.id

**Corresponding Author*

ABSTRACT
The implementation of the Internet of Things (IoT) in supply chains has become an increasingly important research subject in facing the dynamics of the digital era. In this research, researchers conducted a systematic literature review to investigate the impact, supporting factors, challenges, and implications of implementing IoT to increase supply chain resilience in the digital era. Researchers analyzed various relevant literature studies from international databases such as Scopus, Web of Science, and IEEE Xplore using the Systematic Literature Review method. The research results show that IoT integration at various stages of the supply chain can significantly improve resilience, through increased visibility, operational efficiency, and responsiveness to change. Factors such as senior management commitment, adequate infrastructure and technology, human resource expertise, an organizational culture open to change, and collaboration between departments and business partners have been proven to support IoT implementation. However, challenges such as high implementation costs, data security issues, integration with existing systems, resistance to change, and regulatory uncertainty also need to be overcome. The implications of this research provide practical guidance for businesses and practitioners in implementing IoT to improve supply chain resilience, while highlighting the need to invest in training, collaboration with business partners, and attention to regulatory compliance.
Keywords: Internet of Things, IoT, supply chain, resilience, systematic, literature review, supporting factors, challenges, implications.

ABSTRAK
Implementasi Internet of Things (IoT) dalam rantai pasokan telah menjadi subjek penelitian yang semakin penting dalam menghadapi dinamika era digital. Dalam penelitian ini, peneliti melakukan tinjauan literatur sistematis untuk menyelidiki dampak, faktor pendukung, tantangan, dan implikasi implementasi IoT untuk meningkatkan ketahanan rantai pasokan di era digital. Peneliti menganalisis berbagai studi literatur yang relevan dari basis data internasional seperti Scopus, Web of Science, dan IEEE Xplore menggunakan metode Systematic Literature Review. Hasil penelitian menunjukkan bahwa integrasi IoT di berbagai tahap rantai pasokan dapat signifikan meningkatkan ketahanan, melalui peningkatan visibilitas, efisiensi operasional, dan kemampuan responsif terhadap perubahan. Faktor-faktor seperti komitmen manajemen senior, infrastruktur dan teknologi yang memadai, keahlian sumber daya manusia, budaya organisasi yang terbuka terhadap perubahan, dan kerjasama antar departemen dan mitra bisnis telah terbukti mendukung implementasi IoT. Namun, tantangan seperti biaya implementasi yang tinggi, masalah keamanan data, integrasi dengan sistem yang ada, perlawanan terhadap perubahan, dan ketidakpastian regulasi juga perlu diatasi. Implikasi dari penelitian ini memberikan panduan praktis bagi bisnis dan praktisi dalam mengimplementasikan IoT untuk meningkatkan ketahanan rantai pasokan, sambil menyoroti perlunya berinvestasi dalam pelatihan, kolaborasi dengan mitra bisnis, dan memperhatikan kepatuhan terhadap regulasi.
Kata Kunci: Internet of Things, IoT, rantai pasokan, ketahanan, sistematis, tinjauan literatur, faktor pendukung, tantangan, implikasi.

1. Introduction

The integration of Internet of Things (IoT) technology in supply chain management has transformed the way businesses optimize their operations. By connecting physical and digital systems, IoT enables real-time data generation, analysis, and collaboration, leading to enhanced tracking, monitoring, and communication among supply chain stakeholders (Sharma et al., 2020). Hasan & Habib (2023) emphasize that leveraging IoT in supply chains results in increased visibility, real-time tracking, and seamless connectivity throughout the network. This technology not only optimizes operations but also plays a crucial role in enhancing supply chain sustainability and performance (Radanliev et al., 2020).

IoT adoption rates are increasing, with a specific focus on enhancing supply chain efficiency and performance measurement (Shahzad et al., 2020). Raza et al. (2023) highlight that IoT, along with technologies like blockchain and artificial intelligence, forms the backbone of Industry 4.0, driving digital transformation and intelligent development in supply chain management. These advancements enable businesses to re-engineer processes, enhance traceability, and improve resource efficiency within the supply chain (Iftekhar & Cui, 2021).

Furthermore, IoT is instrumental in providing solutions for overseeing environmental conditions, product quality, and traceability, ensuring food safety measures and protecting consumer safety within supply chains (Wang et al., 2022). The adoption of IoT in supply chains is considered a disruptive technology that brings about numerous benefits, including improved communication and coordination systems for supply chains (Samaranayake et al., 2022). Additionally, IoT's role in enhancing supply chain risk management is being investigated, highlighting its implications for mitigating risks and enhancing tracking and monitoring capabilities (Birkel & Hartmann, 2020). In conclusion, the integration of IoT in supply chain management is a transformative trend that not only optimizes operations but also enhances sustainability, performance, and risk management within supply chains. By leveraging IoT alongside technologies like blockchain and artificial intelligence, businesses can drive digital transformation, improve efficiency, and ensure seamless connectivity throughout their supply chain networks.

Furthermore, the use of IoT in supply chain management is not without challenges. Security and privacy concerns are paramount, especially as IoT devices collect and exchange sensitive data across the supply chain network (Shahzad et al., 2020). However, advancements in IoT technology have paved the way for secure and effective supply chain systems, addressing issues related to information complexity and availability (Shahzad et al., 2020).

In conclusion, the utilization of IoT technology in supply chain management offers significant opportunities for digital businesses to optimize their operations, improve sustainability, and drive efficiency. By embracing IoT alongside other advanced technologies, businesses can enhance collaboration, transparency, and performance across their supply chain networks.

In a digital era that is complex and full of uncertainty, supply chain resilience is crucial. Disruptions and risks such as natural disasters, demand fluctuations, shipping delays, and cyberattacks increasingly challenge modern supply chains. In this context, Internet of Things (IoT) technology emerges as a potential solution. IoT offers real-time visibility, better decision making, and process optimization, which can improve supply chain resilience.

Modern supply chains face disruptions and risks that can have a fatal impact on business continuity and customer satisfaction. Traditional methods for managing supply chain resilience are often not robust enough to cope with the complexities and dynamics of the digital era. Therefore, the need for innovative solutions to increase supply chain resilience is increasingly pressing.

Although there is research on IoT applications in supply chains, research that specifically focuses on its impact on supply chain resilience in the digital era is limited. There is a lack of deep understanding of how implementing IoT at various stages of the supply chain can

increase resilience to disruption and risk. Therefore, systematic and comprehensive research is needed to fill this research gap.

This research aims to analyze how implementing IoT at various stages of the supply chain can increase resilience to disruption and risk in the digital era. In addition, this research aims to identify factors that support and hinder the implementation of IoT for supply chain resilience and provide theoretical and practical implications for businesses and supply chain practitioners.

This research is unique in combining two rapidly developing fields, namely the Internet of Things (IoT) and supply chain resilience. Using a comprehensive Systematic Literature Review methodology, this research aims to analyze existing literature and identify research gaps. This research also makes a new contribution by presenting a framework for understanding how IoT implementation can improve supply chain resilience in the digital era.

This research is expected to make a significant contribution to knowledge and practice in the field of supply chain and risk management. The findings of this research can help businesses and supply chain practitioners make more informed decisions about implementing IoT to improve supply chain resilience. In addition, this research can also pave the way for further research on IoT applications in improving supply chain efficiency and effectiveness.

2. Research Methods

First, a literature search was carried out through international databases that are known for their credibility, such as Scopus, Web of Science, and IEEE Xplore. To ensure completeness of the search, a number of relevant keywords were selected, including “Internet of Things”, “Supply Chain Resilience”, “Manufacturing”, “Logistics”, “Distribution”, “Retail”, “Digital Business”, and “Systematic Literature Review". The number of articles resulting from the initial search was recorded for further evaluation.

Second, careful inclusion and exclusion criteria were applied to screen for relevant and high-quality articles. Inclusion criteria include articles published in scientific journals that are considered reputable, articles that specifically highlight the implementation of IoT to increase supply chain resilience, as well as articles that present an analysis of the impact of IoT on supply chain resilience both quantitatively and qualitatively. On the other hand, articles that were not directly related to supply chains or IoT, that only reviewed theoretical concepts without practical applications, or that did not provide adequate data analysis or findings, were excluded from this study.

Third, in guiding the process of literature search, article selection, and data analysis, the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) method was used. The PRISMA method is known for providing a transparent and structured framework for documenting each step in the research process. The use of this method aims to ensure that this research is carried out with high rigor and credibility, in accordance with internationally recognized systematic research standards.

3. Results and Discussion

3.1 Impact of IoT Implementation on Supply Chain Resilience at Different Stages

Implementing IoT in different stages of the supply chain can significantly impact supply chain resilience. At the initial stages, IoT can enhance visibility and transparency, allowing for real-time tracking of goods and processes (Affia & Aamer, 2021). This increased visibility can lead to better decision-making and risk management, ultimately improving the overall resilience of the supply chain (Pettit et al., 2019). As the supply chain progresses, IoT can facilitate data-driven insights that enable proactive risk mitigation strategies, enhancing supply chain sustainability and performance (Zhu & Wu, 2022).

Furthermore, IoT implementation can support supply chain diversification and digital transformation efforts, which are crucial for building resilience, especially in the face of

disruptions like the COVID-19 pandemic (Yin & Ran, 2022). By leveraging IoT technologies, supply chains can become more agile and responsive to changing conditions, thereby improving their ability to withstand and recover from unexpected events (Fang & Ge, 2023). Additionally, integrating IoT with green supplier practices can further enhance supply chain resilience, particularly in terms of environmental sustainability (Ji et al., 2020).

Moreover, IoT can play a vital role in supply chain integration, fostering agility and robustness, which are key components of supply chain resilience (Zhuo et al., 2020). By enabling seamless communication and coordination among supply chain partners, IoT can enhance the overall resilience of the supply chain network (Jiang et al., 2023). As supply chains evolve, IoT can also contribute to the development of Industry 4.0 technologies like SMED 4.0, which aim to improve sustainability and efficiency through predictive strategies (Khakpour, 2024).

In conclusion, the strategic implementation of IoT across different stages of the supply chain can have a transformative impact on supply chain resilience. By leveraging IoT technologies to enhance visibility, data analytics, sustainability, and integration, supply chains can become more agile, responsive, and robust in the face of disruptions, ultimately improving their overall performance and sustainability.

The integration of the Internet of Things (IoT) in supply chains has significantly enhanced supply chain resilience by providing real-time visibility, accurate monitoring, and rapid response capabilities (Singh et al., 2020). IoT technology enables companies to increase operational efficiency, reduce lead time, and enhance delivery reliability by automatically detecting issues like leaks or damages in shipped goods for immediate corrective actions (Singh et al., 2020). Moreover, IoT facilitates predictive analysis using sensor-generated data to identify potential risks and disruptions, enabling proactive planning and effective risk management (Monsreal & Benitez, 2022).

Furthermore, IoT supports inventory optimization by monitoring inventory in real-time and identifying changing demand patterns, thereby reducing the risk of stock shortages or overstocks (Ma, 2023). Cost reduction is another significant benefit of IoT implementation in supply chains, as it helps in reducing operational costs through process efficiencies, waste reduction, and optimized resource utilization (Ma, 2023).

Empirical evidence from literature studies confirms that IoT adoption is a key factor in enhancing supply chain resilience in the digital era, offering benefits beyond operational efficiency, such as increased visibility, inventory optimization, and cost reduction (Bonab et al., 2023). By leveraging IoT technology, companies can innovate, improve sustainability performance, and enhance their capabilities in supply chain management (Bonab et al., 2023).

In conclusion, the positive impact of IoT implementation on supply chain resilience is multifaceted, encompassing operational efficiency improvements, increased visibility, inventory optimization, cost reduction, and sustainability enhancements. The integration of IoT in supply chains not only enhances operational processes but also enables companies to proactively manage risks, optimize resources, and improve overall supply chain performance.

3.2 Factors that Support and Inhibit IoT Implementation for Supply Chain Resilience

Implementing the Internet of Things (IoT) in supply chain management to enhance resilience involves a multifaceted approach that considers various factors. Factors that contribute to successful IoT implementation include strong senior management commitment to digital transformation, the presence of adequate infrastructure and technology, skilled human resources capable of managing IoT technologies, an organizational culture that fosters innovation and change, and effective collaboration between internal departments and external partners within the supply chain (Yadav et al., 2023). These elements are crucial for leveraging IoT to improve supply chain visibility, efficiency, and reliability.

However, alongside the benefits, there are challenges that need to be addressed for

successful IoT implementation. High implementation and maintenance costs pose a significant barrier, particularly for organizations with limited budgets. Data security and privacy concerns are paramount due to the sensitive nature of data exchanged in IoT systems, making them vulnerable to cyber threats. Integration issues with existing systems and processes can impede IoT adoption, leading to difficulties in incorporating new technologies into established environments. Resistance to change from employees and uncertainties surrounding regulations and laws also present hurdles in IoT implementation for enhancing supply chain resilience (Al-Ayed & Al-Tit, 2023).

Understanding both the facilitating factors and obstacles to IoT implementation allows companies to develop more effective strategies for integrating this technology into their supply chains. While challenges are inevitable, overcoming these barriers presents opportunities to enhance supply chain efficiency, visibility, and reliability in the digital age. By addressing cost concerns, ensuring data security, promoting integration with existing systems, managing change resistance, and navigating regulatory uncertainties, organizations can harness the full potential of IoT to bolster their supply chain resilience.

3.3 Theoretical and Practical Implications

The Internet of Things (IoT) is a pivotal technology in enhancing supply chain resilience in the digital era. Research has shown that the implementation of IoT in supply chains can enhance visibility, responsiveness, and reliability (Ahmed et al., 2021). By utilizing IoT technology, businesses can effectively monitor products, activities, and processes within their supply chain networks, leading to increased operational efficiency and cost reduction (Rejeb et al., 2019). Moreover, IoT adoption in supply chain management enables real-time tracking and monitoring, fostering seamless connectivity among stakeholders (Hasan & Habib, 2023).

To ensure successful IoT implementation, companies should invest in employee training, collaborate with partners to address data integration and security issues, and stay informed about regulatory compliance (Ahmed et al., 2021). Overcoming challenges in IoT implementation can result in enhanced strategies, operational efficiency, and supply chain performance (Rejeb et al., 2019). Additionally, integrating IoT and blockchain technologies can improve traceability and transparency in supply chains, benefiting stakeholders and consumers (Singh et al., 2020).

The amalgamation of IoT and blockchain technologies presents a promising solution for real-time product tracking, ensuring authenticity, and enhancing supply chain visibility (Hasan et al., 2023). Through the use of IoT-based data-driven frameworks, businesses can improve performance measurement and sustainability in their supply chains (Yadav et al., 2020). Furthermore, IoT technologies can significantly enhance supply chain management across various sectors, including warehousing and food industry logistics (Muhamed et al., 2022; Maulana et al., 2021).

In conclusion, the strategic integration of IoT in supply chains can lead to substantial enhancements in resilience, efficiency, and transparency. By addressing challenges, investing in training, and leveraging IoT and blockchain technologies, businesses can optimize their supply chain operations and drive future research and development in this domain.

4. Conclusion

The integration of IoT technology in various stages of the supply chain shows a significant positive impact on supply chain resilience. The real-time visibility, data-driven insights, and proactive risk mitigation strategies enabled by IoT contribute to increasing supply chain flexibility, responsiveness, and resilience. Empirical evidence shows that IoT adoption results in increased operational efficiency, increased visibility, inventory optimization, reduced costs, and improved sustainability.

From a theoretical perspective, this study contributes to a deeper understanding of the

role of IoT in supply chain resilience, providing empirical support for its transformational potential. Practically, these findings offer valuable insights for businesses and practitioners in effectively implementing IoT to improve supply chain resilience. Investments in employee training, collaboration with partners, and regulatory compliance are critical to successful IoT adoption. Additionally, the integration of IoT with blockchain technology offers promising opportunities to improve tracking, transparency and performance measurement in supply chains.

It is important to acknowledge the limitations of this study. First, the scope of the study is limited to the existing literature, which may not cover all recent developments and emerging trends in IoT implementation. Second, the generalizability of findings may be influenced by variations in industry context, organizational structure, and technological capabilities.

Future research directions may include longitudinal studies to track the long-term impact of IoT implementation on supply chain resilience, comparative analysis across industries and geographic regions, and investigations of emerging technologies that complement IoT in supply chain management. Additionally, exploring the intersection of IoT with other technologies such as artificial intelligence and edge computing can provide further insights into improving supply chain resilience.

Overall, the findings from this study underscore the transformative potential of IoT in improving supply chain resilience. By overcoming challenges, leveraging enabling factors, and exploring future research directions, businesses can optimize their supply chain operations and adapt to the dynamic digital landscape.

5. References

Affia, I. and Aamer, A. (2021). An internet of things-based smart warehouse infrastructure: design and application. Journal of Science and Technology Policy Management, 13(1), 90-109. https://doi.org/10.1108/jstpm-08-2020-0117

Ahmed, S., Kalsoom, T., Ramzan, N., Pervez, Z., Azmat, M., Zeb, B., … & Ur-Rehman, M. (2021). Towards supply chain visibility using internet of things: a dyadic analysis review. Sensors, 21(12), 4158. https://doi.org/10.3390/s21124158

Al-Ayed, S. and Al-Tit, A. (2023). The effect of supply chain risk management on supply chain resilience: the intervening part of internet-of-things. Uncertain Supply Chain Management, 11(1), 179-186. https://doi.org/10.5267/j.uscm.2022.10.009

Birkel, H. and Hartmann, E. (2020). Internet of things – the future of managing supply chain risks. Supply Chain Management an International Journal, 25(5), 535-548. https://doi.org/10.1108/scm-09-2019-0356

Bonab, S., Haseli, G., Rajabzadeh, H., Ghoushchi, S., Keshteli, M., & Tomášková, H. (2023). Sustainable resilient supplier selection for iot implementation based on the integrated bwm and trust under spherical fuzzy sets. Decision Making Applications in Management and Engineering, 6(1), 153-185. https://doi.org/10.31181/dmame12012023b

Fang, L. and Ge, H. (2023). Research on the resilience system of the agricultural supply chain under the blockchain. Journal of Innovation and Development, 2(1), 62-65. https://doi.org/10.54097/jid.v2i1.5445

Hasan, I., Habib, M., & Mohamed, Z. (2023). Blockchain database and iot: a technology driven agri-food supply chain. International Supply Chain Technology Journal, 9(3), 40-45. https://doi.org/10.20545/isctj.v09.i03.01

Iftekhar, A. and Cui, X. (2021). Blockchain-based traceability system that ensures food safety measures to protect consumer safety and covid-19 free supply chains. Foods, 10(6), 1289. https://doi.org/10.3390/foods10061289

Jagtap, S. and Rahimifard, S. (2019). Unlocking the potential of the internet of things to improve resource efficiency in food supply chains., 287-301.

https://doi.org/10.1007/978-3-030-02312-6_17
Ji, L., Yuan, C., Feng, T., & Wang, C. (2020). Achieving the environmental profits of green supplier integration: the roles of supply chain resilience and knowledge combination. Sustainable Development, 28(4), 978-989. https://doi.org/10.1002/sd.2050
Jiang, R., Liu, C., Liu, X., & Zhang, S. (2023). Supply chain resilience of mineral resources industry in china. Discrete Dynamics in Nature and Society, 2023, 1-10. https://doi.org/10.1155/2023/1338223
Kailaku, S. and Djatna, T. (2022). Traceability and quality monitoring improvement throughout carrot supply chain with the implementation of internet-of-things. Iop Conference Series Earth and Environmental Science, 1024(1), 012079. https://doi.org/10.1088/1755-1315/1024/1/012079
Khakpour, R. (2024). Smed 4.0: a development of single minute exchange of die in the era of industry 4.0 technologies to improve sustainability. Journal of Manufacturing Technology Management, 35(3), 568-589. https://doi.org/10.1108/jmtm-08-2023-0333
Ma, X. (2023). Integrated information management of supply chain in logistics parks based on the iot. Internet Technology Letters, 7(2). https://doi.org/10.1002/itl2.469
Maulana, H., Ginting, S., Aryan, P., Fadillah, M., & Kamal, R. (2021). Utilization of internet of things on food supply chains in food industry. International Journal of Informatics Information System and Computer Engineering (Injiiscom), 2(1), 103-112. https://doi.org/10.34010/injiiscom.v2i1.5457
Monsreal, M. and Benitez, R. (2022). Impact of iot on supply chain performance. Journal of Applied Research and Technology, 20(5), 584-593. https://doi.org/10.22201/icat.24486736e.2022.20.5.1957
Muhamed, A., Sundram, V., Bakar, M., Zainuddin, A., & Mazli, M. (2022). Developing a framework for future warehousing using the internet of things. International Journal of Academic Research in Economics and Management Sciences, 11(1). https://doi.org/10.6007/ijarems/v11-i1/12253
Nozari, H., Szmelter-Jarosz, A., & Ghahremani-Nahr, J. (2022). Analysis of the challenges of artificial intelligence of things (aiot) for the smart supply chain (case study: fmcg industries). Sensors, 22(8), 2931. https://doi.org/10.3390/s22082931
Pettit, T., Croxton, K., & Fiksel, J. (2019). The evolution of resilience in supply chain management: a retrospective on ensuring supply chain resilience. Journal of Business Logistics, 40(1), 56-65. https://doi.org/10.1111/jbl.12202
Radanliev, P., Roure, D., Walton, R., Kleek, M., Montalvo, R., Santos, O., … & Cannady, S. (2020). Covid-19 what have we learned? the rise of social machines and connected devices in pandemic management following the concepts of predictive, preventive and personalized medicine. The Epma Journal, 11(3), 311-332. https://doi.org/10.1007/s13167-020-00218-x
Raza, Z., Haq, I., & Muneeb, M. (2023). Agri-4-all: a framework for blockchain based agricultural food supply chains in the era of fourth industrial revolution. Ieee Access, 11, 29851-29867. https://doi.org/10.1109/access.2023.3259962
Rejeb, A., Keogh, J., & Treiblmaier, H. (2019). Leveraging the internet of things and blockchain technology in supply chain management. Future Internet, 11(7), 161. https://doi.org/10.3390/fi11070161
Samaranayake, P., Laosirihongthong, T., Adebanjo, D., & Boon-itt, S. (2022). Prioritising enabling factors of internet of things (iot) adoption in digital supply chain. International Journal of Productivity and Performance Management, 72(10), 3095-3118. https://doi.org/10.1108/ijppm-12-2021-0698
Shahzad, A., Zhang, K., & Gherbi, A. (2020). Intuitive development to examine collaborative iot supply chain system underlying privacy and security levels and perspective powering through proactive blockchain. Sensors, 20(13), 3760. https://doi.org/10.3390/s20133760
Shahzad, A., Zhang, K., & Gherbi, A. (2020). Intuitive development to examine collaborative iot supply chain system underlying privacy and security levels and perspective powering

through proactive blockchain. Sensors, 20(13), 3760. https://doi.org/10.3390/s20133760

Sharma, M., Joshi, S., Kannan, D., Govindan, K., Singh, R., & Purohit, H. (2020). Internet of things (iot) adoption barriers of smart cities' waste management: an indian context. Journal of Cleaner Production, 270, 122047. https://doi.org/10.1016/j.jclepro.2020.122047

Singh, R., Dwivedi, A., & Srivastava, G. (2020). Internet of things based blockchain for temperature monitoring and counterfeit pharmaceutical prevention. Sensors, 20(14), 3951. https://doi.org/10.3390/s20143951

Wang, S., Fang, Z., & Wu, D. (2022). Internet of things-enabled tourism economic data analysis and supply chain modeling. Technological and Economic Development of Economy, 0(0), 1-18. https://doi.org/10.3846/tede.2022.17120

Yadav, S., Garg, D., & Luthra, S. (2020). Development of iot based data-driven agriculture supply chain performance measurement framework. Journal of Enterprise Information Management, 34(1), 292-327. https://doi.org/10.1108/jeim-11-2019-0369

Yadav, S., Luthra, S., Agrawal, R., & Frederico, G. (2023). Exploring the relationship between digitalization, resilient agri-food supply chain management practices and firm performance. Journal of Enterprise Information Management. https://doi.org/10.1108/jeim-03-2022-0095

Yin, W. and Ran, W. (2022). Supply chain diversification, digital transformation, and supply chain resilience: configuration analysis based on fsqca. Sustainability, 14(13), 7690. https://doi.org/10.3390/su14137690

Zhu, X. and Wu, Y. (2022). How does supply chain resilience affect supply chain performance? the mediating effect of sustainability. Sustainability, 14(21), 14626. https://doi.org/10.3390/su142114626

Zhuo, N., Ji, C., & Yin, N. (2020). Supply chain integration and resilience in china's pig sector: case study evidences from emerging institutional arrangements. Environmental Science and Pollution Research, 28(7), 8310-8322. https://doi.org/10.1007/s11356-020-11130-2