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Supply Chain and Sustainability Research (SCSR) is an independently run non-profit journal dedicated to serve the worldwide scientific community through periodical of high-quality and high-impact scholarly, multi, and inter-disciplinary research that broadly resides in the arenas of supply chain and sustainability research. SCSR is committed to provide a platform that disseminates academic work, findings, and knowledge promptly, openly, and freely to all, and thus promote practical and public conversation and communication. By this, SCSR strives to be one of the important supply chain and sustainability journals in the world.

The Purpose: To support and encourage the writing of academic works. Disseminate academic works of faculty, academics and students both internally and externally as well as being a medium for education, research and dissemination of academic knowledge

The goal is to serve as a hub for scholarly support, knowledge transfer, and dissemination. along with quality research The SCSR strives to publish insightful, innovative, and pertinent research that describes or may have an impact on management and/or innovation within the SCSR framework. Benefits to society, the community, and the country as a whole are frequently published in electronic journals by the SCSR. is diverse and interdisciplinary in character. The magazine accepts essays on all topics related to management as well as those relevant to innovation, regardless of discipline or subject area.

SCSR uses a “double-blind peer review system,” meaning that the authors do not know who the reviewers are, and the reviewers do not know who the authors are. All submitted manuscripts are to be reviewed by three expert reviewers per paper. Reviewers are chosen because of their expertise in the topic area and/or methodology used in the paper. Each article is judged based solely on its contribution, merits, and alignment with the journal’s mission. Should any revision be required, our instructions to authors are designed to move authors towards a successfully published article.

Periodicity: Four a year publication: 1) First Issue: October–December., 2) Second Issue: January – March., 3) Third Issue: April – June., and 4) Four Issue: July – September.

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Greetings from Editor-in-Chief: Supply Chain and Sustainability Review (SCSR)

Jirasek Trimetsoothorn

The application of sustainability issues to supply chain management, logistics, transportation, and various optimization methods has been increasingly popular in recent years. One of the numerous issues that supply chain management encounters on an ongoing basis is operating in a sustainable manner. The goal of the SCSR is to investigate the use of sustainability in supply chain management, operation management, logistics, transportation, healthcare management, and fuzzy sets theory. The first issue of SCSR is to serve this purpose as how sustainable development must go hand in hand with logistics and supply chain management.

We invite academics from a variety of management-related disciplines to submit original, high-quality research papers that primarily address sustainability-management-related challenges and contribute to the SCSR's mission. The articles in the SCSR will emphasize both theoretical and empirical research. Literature reviews, conceptual theory development, qualitative survey research, such as case studies, and quantitative empirical methodologies may all be included in academic papers. SCSR rules must be adhered to by all submitted papers.

In view of current disruptions in global supply chains (e.g., chip crisis), the implications of supply chains for the climate and biodiversity discourse, new supply chain laws to increase social responsibility, and technological innovations (e.g., blockchain), supply chain management has become an imperative for global business.

In this inaugural issue, 6 research papers are presented

(1) Research on the Construction Mode of Talent Supply Chain System in the Logistics Industry of Higher Vocational Colleges.

(2) Impact of the Sino-US Trade War on the Sustainable Development of China's Industrial Supply Chain: An Empirical Study from 2020 to 2022.

(3) Research on Basic Industry and Logistics Supply Chain Systems in India: Challenges, Opportunities and Development Strategies.

(4) Who Supply, Who Use? – How Sustainable Water Supply can be Achieved in Langcang-Mekong River.

The current issue and full text archive of this journal is available on Supply Chain and Sustainability Research at:
https://so08.tci-thaijo.org/index.php/SCSR/index

(5) Moving Towards Sustainable Supply Chains in Cambodia: A Comprehensive Analysis.

(6) Applying Lean and Six Sigma Concept to Reduce Inventory Cost of SME in Thailand After Covid-19 Crisis: A Case Study of Takara Planning Company Limited.

In addition, we would like to inform you about our next issues (Volume 1 No.3,…) in 2023. Recent announcement of the call for papers is accessible on the SCSR website. This issue marks the debut of the SCSR and its birth. It is my pleasure to address you on this occasion. I would like to express a warm welcome to the SCSR readership on behalf of the SCSR Editorial Team. I would like to thank our authors, editors, and anonymous reviewers, who have all voluntarily contributed to the journal's success. Without your participation, this initial issue would not exist.

We look forward to receiving your contributions.

Editorial Team

Editors

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Contents

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SUPPLY CHAIN AND SUSTAINABILITY RESEARCH: SCSR
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Research on the Construction Mode of Talent Supply Chain System in the Logistics Industry of Higher Vocational Colleges

Jian-Cui Ma*

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Abstract

The logistics industry is experiencing a constant increase in demand for talents. However, the existing logistics management curricula in colleges and universities are inadequate in meeting market demands due to the insufficient educational levels and limited learning capacity of students in higher vocational colleges. These students frequently harbor misconceptions about the logistics industry, display a lack of interest in acquiring logistics knowledge, and as a result, possess limited practical skills in the field. To address these problems, this study employs the concept of integrated education to enhance students' interest in learning logistics by improving their professional perception through practice. Additionally, a school-enterprise cooperation model is implemented to improve students' practical skills. The study analyzes the effects of practical teaching on achievement and compares the advantages and disadvantages of independent college logistics training bases versus those built in collaboration with enterprises. A win-win cooperation model is proposed, in which schools and enterprises co-construct training bases led by enterprises and enterprise projects are combined into the teaching process. The teaching model combines theory and practice, enabling students to participate in the construction of enterprise projects. The proposed solutions facilitate the integrated education, co-construction of training sites, and development of the talent supply chain system.

Keywords: Fusion of Education, Co-Construction of Training Sites, Talent Supply Chain System.

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Introduction

At present, the logistics industry is developing rapidly, but the talent supply chain system that adapts to the development of the industry is not perfect. In higher vocational colleges which have logistics majors, the teaching content in the school cannot match the development speed of the industry. Especially in the practical teaching process of enterprises, schools cannot update the training conditions in time according to the development of the industry. Therefore, students cannot perceive the real status of the development of the industry, and the knowledge learned is not adapted to the real development of the industry, which may lead to their lower interest in the learning of logistics knowledge. Therefore, it is particularly important to find an education model suitable for the development of the industry. This paper aims to change students' cognition on logistics and improve their interest in learning by investigating the school-enterprise cooperation mode for talent training strategy under the background of rapid developing logistics industry in China (Zhu, et al, 2011; Li, et al, 2019; Tao, et al., 2021)

This paper presents the findings of a survey conducted in 2021, involving 547 college students who are pursuing a major in logistics management. Table 1 presents the findings on students' comprehension of career selection, professional perception, and job awareness. The data includes statistics on the employment status of logistics management graduates over the past three years, with a sample size of 300 graduates per academic year. The employment statistics are depicted in Table 2 below.

Table 1: Descriptive Analysis of Survey Data on Career Selection, Professional Perception, and Job Awareness

number of investigators	professional choice			professional cognition			Job cognition		
	voluntarily	parental choice	casual	understand	know a little	do not understand	Manager	Express delivery	Transport cargo
546 students	168	262	116	54	436	56	62	398	86
proportion%	30.77	47.99	21.24	9.89	79.85	10.26	11.36	72.89	15.75

Based on the data, the likelihood of logistics management students securing employment within the industry after graduation is relatively low, and this trend of diminishing prospects persists over the years.

Table 2: Statistics of graduates' Employment

	graduatesof the class of 2021		graduatesof the class of 2020		graduatesof the class of 2019	
300 graduates per grade	Number of people	percentage	Number of people	percentage	Number of people	percentage
Employment logistics industry	168	56%	172	57.30%	145	48.30%
Half a year later Employment logistics industry	123	41%	120	40%	130	43.30%
one year later Employment logistics industry			98	32.70%	91	30.30%

According to the data, the probability of logistics management students' employment in this industry after graduation is not high, and they are lost year by year.

A set of three research questions was formulated to explore an appropriate training model.:

1. Exploring the Relationship between Professional Perception and Learning Interest in the Construction of Supply Chain Systems for Logistics Management Professionals.

2. Methods for Implementing Practical Teaching in the Process of School-Enterprise Integrated Education

3. How should enterprise projects be integrated into teaching process?

A logistics professional training base was proposed by analyzing the relationship between schools and enterprises in logistics vocational education. The impact of logistics practice teaching on students, as well as the advantages and disadvantages of two approaches: schools building practice teaching bases alone and jointly building them with enterprises. Additionally, utilizing enterprise projects as teaching resources to develop a teaching model that integrates theory and practice.

Literature review

He (2019) discussed the mode of constructing a training base in his college. This mode features the co-construction of a "school-enterprise" cooperation, where the school and the enterprise sign a cooperation and co-construction base agreement to determine the base construction goals, and to establish an innovative cooperation platform to realize teaching, research, and technological development of the industry, as well as social training service function. He also created five kinds of higher vocational training, including school-enterprise linkage, engineering and learning integration, learning-research interaction, skills competition, and social service. (Jiao, 2018; Li, et al., 2019; Li, et al., 2020)

Liu (2021) proposed an active integration into the regional economic development needs and the formation of alliances with industry brands. To achieve this, Liu suggested the deepening of the education and teaching reform by integrating production and education. Additionally, it is recommended to jointly build and share a win-win virtual training system with domestic and foreign universities and well-known enterprises to integrate educational resources. This would result in talent training that accurately meets the dynamic needs of industrial development, particularly in the logistics specialty and its specialty group in vocational colleges.

Pilz (2009) elucidated the process of transitioning from secondary education to apprenticeship and higher education in Germany. Furthermore, Pilz tentatively identified factors that may explain the motivations of specific school-leavers in this context. According to Gambin and Hogarth (2017), apprenticeship training poses financial risks for enterprises. In her interpretation of the European Common Vocational Training Policy, Cort (2009) noted that vocational training has gradually extended from the policy sphere to encompass general and higher education, as well as the establishment of a European lifelong learning mechanism.

In 1982, the French government introduced the National Vocational Education Plan (NVEP), which allowed regional governments to develop their own programs and curricula, established cooperative education

that links education to the world of work, and created an Assessment and Observation System, as explained by Colardyn and Malglaive (1986). According to Brockmann, Clarke, and Winch (2010), succeeding in the education and training system framework requires considering changes in the labor market, employees' long-term interests, and addressing the problem of employer turnover. Deissinger and Hellwig (2019) investigated the modernization of the German Dual System for apprenticeships, examining the system's development history and the challenges it currently faces.

Hummelsheim and Baur (2014) proposed that in adopting the dual system of primary vocational education and training in Germany as a model, it is necessary to carefully consider its constituent elements rather than simply replicating them. Rauner and Wittig (2010) discussed the theoretical framework of multi-system classification, including dual apprenticeship training, and proposed a method for implementing the framework through data collection and analysis, which can serve as an evaluation tool for expert seminars. Kuhlee. (2015) analyzed political reform initiatives and the changing stakeholder interests and configurations, particularly those of the social partners, and their impact on the functioning and development of the German dual apprenticeship system.

Chen, Cai, and Cui (2017) examined the integration of production and education in higher vocational colleges based on the Belt and Road Initiative. He, Li, and Li (2019) explored and practiced a production-education integration model based on "Industry-Education Integration" development. Gao, Liu, and Hu (2020) conducted research on the integration of production and education in colleges and universities. Lastly, Wu, Chen, and Chen (2020) discussed the application and innovation of production-education integration in higher vocational education. All four studies aimed to investigate and improve the integration of production and education in higher education institutions.

The construction mode of talent training supply chain system based on the integration of industry and education can be graphically shown in Figure 1.

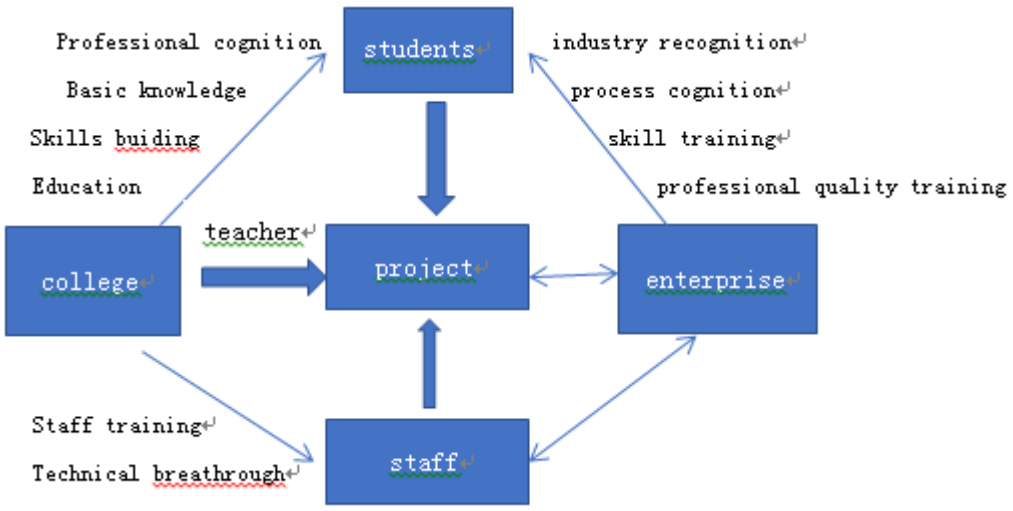

Figure1. The construction mode of talent training supply chain system based on the integration of industry and education

Research Methodology

This paper aims to explore the development of an appropriate logistics personnel training system in response to the rapid growth of the logistics industry. The research methods employed include literature analysis, questionnaire surveys, and discussion. The study draws on a range of sources, including academic literature and investigations of relevant colleges and universities. Practical teaching methods and school-enterprise cooperation modes adopted by vocational colleges were examined to identify best practices.

The present paper is based on the theoretical framework of the integration of production and education. Specifically, the integration of production and education in higher vocational colleges refers to the process of integrating production and teaching, which encompasses three aspects: first, the integration of the educational process and the production process, thereby integrating educational methodologies; second, the integration of educational content and production technical skills, thereby integrating educational content; and third, the integration of educational achievements and technological product research and development, thereby integrating educational outcomes.

Results and discussion

The rapid advancement of e-commerce platforms has accelerated the growth of the logistics industry, leading to an increased need for establishing a talent supply chain system in response. Many students enter vocational colleges without a genuine passion for the subject, merely aiming to secure admission. Consequently, their enthusiasm for studying the profession is not adequately nurtured. Moreover, students have limited exposure to practical experiences before entering college, relying mainly on book knowledge. As a result, their understanding of the logistics industry remains limited, often associating it solely with delivery services. Therefore, it becomes crucial to explore teaching methods that can foster a correct understanding of the dynamic logistics industry and enhance students' engagement and interest in learning. This serves as the focal point for research on training professionals in the logistics field.

(1) The influence of logistics practice teaching on Students

The logistics industry holds the closest connection to our everyday lives. The widespread adoption of e-commerce platforms and online shopping has become a routine for young individuals. As a result, the delivery sector has become familiar to students. In their perception, the logistics industry is often equated with the delivery industry, where employment mainly involves delivering goods and takeaway food. Such limited understanding diminishes their interest in learning, as they perceive delivery jobs as unchallenging and requiring minimal knowledge. Consequently, their motivation to study diminishes. To reframe their perception, it is crucial for students to gain a renewed understanding of logistics enterprises and engage in practical learning experiences that involve more demanding roles. This approach will not only provide them with a genuine comprehension of the logistics industry but also ignite their curiosity and enthusiasm for learning.

(2) Advantages and disadvantages of building professional practice teaching base in colleges.

Based on the needs of professional learning, if colleges and universities can build their own training bases, it will facilitate students' learning and practice and meet the needs of teaching. The establishment of a training base in line with the development of the logistics major can enable students majoring in logistics management to comprehensively learn the skills required by professionals. However, China's logistics industry is currently in a stage of rapid development, and the application of logistics information technology and logistics equipment is constantly being updated. If a training base in line with the development stage of the logistics industry is built on the campus, it is necessary to update and supplement the training equipment and information system in a timely manner, which requires huge investment. and supplements, which require a huge investment. Moreover, repeated investment will also lead to waste of resources. If there is no company involved in the school's training base, students will not have practical project operations to improve their skills, and they will not be able to cultivate students' other abilities other than skills, such as analyzing data, processing data, and adapting to changes in customer needs.

The proportion of each cooperation mode adopted by colleges is shown in figure 2.

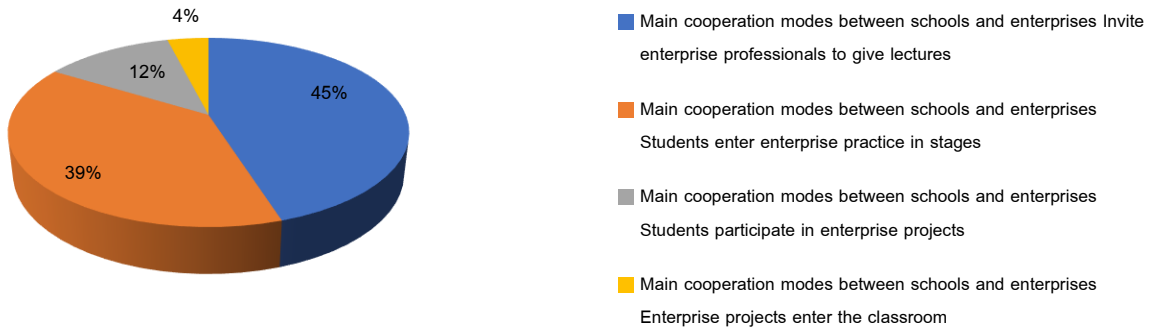

figure 2: The cooperation mode is adopted by colleges

(3) Advantages and disadvantages of enterprises as student practice bases.

Leading enterprises in the logistics industry are in sync with the industry's development stage, showcasing cutting-edge equipment, technology applications, and operational concepts. There are two notable advantages for students engaging in professional learning and internships within such enterprises prior to graduation. Firstly, from the students' perspective, this opportunity allows them to grasp the industry's trajectory, gain a genuine understanding of the logistics sector, and acquire essential professional skills while learning to collaborate effectively within teams. Secondly, from the enterprise's standpoint, students readily embrace the company's corporate culture. Through three years of practical experience within the company, students gradually become familiar with fundamental operational skills and the work environment. As a result, they can seamlessly integrate into the company's team and competently fulfill their job responsibilities upon graduation. Furthermore, the company assumes the responsibility of educating and training students, demonstrating its

commitment to social responsibility. However, this endeavor necessitates companies to allocate resources in terms of time, energy, and cost to provide practice venues for students. Assigning mentors to guide students during their internships is essential, and companies may also face potential challenges arising from students' unfamiliarity with certain work skills.

(4) The method of practical teaching of logistics talents training by school enterprise cooperation.

To cultivate talents, schools and enterprises should collaborate to develop talent training programs that can adapt to the evolving industry. These programs should be flexible enough to adjust the content of knowledge required for training, increasing or decreasing it in accordance with the industry's development.

For theoretical knowledge, a detailed and specific assessment process and assessment mode need to be formulated considering the job skills requirements of the enterprise. For practical teaching, the same assessment system and standards as the enterprise are formulated. In the teaching process, enterprise technicians and college teachers work together to form a dual-tutorial teaching model. In order to reflect the concept of school-enterprise cooperation and a win-win situation between schools and enterprises, schools and enterprises can jointly build training bases. However, due to the particularity of the logistics industry, constructing a base on campus may cause adverse effects, because logistics requires circulation equipment, which may cause potential safety hazards to students. Therefore, the base is mainly an enterprise planning base, and the school participates in the joint construction. The links of base planning, process reorganization, process improvement, and equipment upgrade are all jointly participated by schools and enterprises, so that teachers can keep abreast of the development trend of the industry at any time, so that teaching content can be updated in time. In the process of base construction and planning, there are convenient channels for field trips, to meet the needs of learning from on-site visits without affecting the operation of the enterprise; at the same time, there are designated school teachers and enterprise mentors providing joint guidance for the students. The training base jointly built by the school and the enterprise is also a base for college teachers to conduct practical learning and scientific research. The co-construction base is not only a practical teaching base for students, but also a working base for enterprises, which can improve the utilization rate and ensure that students' practical activities are in line with the development of the industry.

Integration of enterprise projects into the teaching process

In the construction of the talent training supply chain system, the real projects of the enterprise should be integrated into the students' learning. Students enrolled in higher vocational colleges demonstrate subpar study habits and a lack of enthusiasm for learning, with little to no interest in the study of theoretical knowledge by participating in some simple projects of the enterprise, students can be gradually guided to enter the professional study, or completed some simple projects led by double mentor. For example, in the process of learning the theoretical knowledge of warehousing, we need to guide students to investigate the warehousing situation of enterprises, and formulate warehousing plans or improvement plans for warehousing management. During the process of acquiring theoretical knowledge in distribution, involving students in the development of distribution plans when enterprises encounter diverse business scenarios. Integrating real projects into the teaching process can cultivate students' professional skills while developing their professional ethics and

professionalism. By relocating the classroom to the enterprise practice base, students can actively participate as members of project execution teams. This approach allows for the integration of theoretical teachings with practical experiences during project execution practice activities.

With the development of the industry, the update of business processes and plans can be entered into the classroom in the form of projects. This can not only stimulate students' interest in learning, but also enhance their sense of identity within the logistics industry. Glover & Bilginsoy (2005) proposed that alternative forms of training sponsorship have substantially different effects on enrolment and graduation. Identification of the practices that improve enrolment and retention, and their widespread adoption would enhance the effectiveness of training programs.

Figure 3 illustrates the substantial significance of enterprise project practice teaching for 900 students, as revealed through a survey conducted over the past three years.

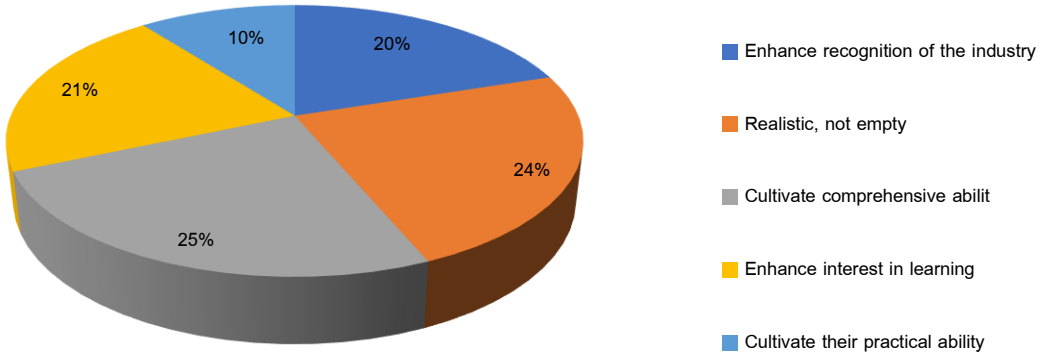

Figure 3: How students think the significance of enterprise project teaching for them

Conclusion

Based on the analysis, the main conclusions of this article can be summarized as follows:

To establish an optimal supply chain system for meeting logistics talent demand, it is essential to initiate a comprehensive integration of production and education through collaboration between educational institutions and enterprises. This involves establishing training bases centered in enterprises. Considering the alignment between industry development trends and vocational education standards, vocational education should receive support. Integrating corporate projects into the classroom and immersing students in real-world projects will enhance their learning experience. As the logistics industry progresses, it becomes imperative to introduce the theoretical training of industry employees and address technical challenges within the curriculum. This approach transforms educational institutions into channels for industry innovation, facilitating enterprise development in tandem.

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Impact of the Sino-US Trade War on the Sustainable Development of China's Industrial Supply Chain: An Empirical Study from 2020 to 2022

Fander Fei*

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Abstract

The US-China trade war has had a significant impact on China's industrial supply chain, which has become increasingly evident over time. This study is an empirical investigation based on data from 2020 to 2022 to seek to explore the effects of the trade war on the sustainable development of China's industrial supply chain. The findings of this study suggest that the impact of the Sino-US trade war on China's industrial supply chain can be observed from three aspects. Since the trade war, China's GDP growth has dropped from 14% to 4%. The value of exports dropped sharply. First, the trade war has dealt a severe blow to Chinese export enterprises, subsequently affecting the production and operation of enterprises in the middle and downstream of the supply chain. Second, the trade war has created difficulties in investment and capital flows of Chinese industrial enterprises, consequently impacting the production and operation of enterprises in the middle and upstream of the supply chain. Finally, the trade war has impeded the technological innovation and product upgrading in Chinese industrial enterprises, ultimately affecting the competitiveness of various enterprises in the supply chain.

The outcomes of this study highlight the negative impact of the US-China trade war on the sustainable development of China's industrial supply chain. To maintain the sustainable development of China's industrial supply chain, the government must strengthen policy guidance, promote the transformation and upgrading of Chinese enterprises, encourage technological innovation and product upgrading, and enhance financial support and risk control for industrial enterprises to increase the anti-risk capability of China's industrial supply chain.

Keywords: US-China trade war, supply chain, sustainability, import and export analysis, regional economy.

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Introduction

Research background and objectives

Since 2018, the US-China trade war has had a significant impact on China's economy and the global economic landscape (Steinbock, 2018) (Fajgelbaum & Khandelwal, 2022); (Steinbock, 2018). The impact of the Sino-US trade war on China's industrial supply chain has become increasingly apparent, posing challenges to the sustainable development of China's industrial supply chain (Steinbock, 2018) (Fajgelbaum & Khandelwal, 2022) (Steinbock, 2018)

The study aims to conduct an empirical investigation using data from 2020 to 2022 to examine the impact of the US- China trade war on the sustainable development of China's industrial supply chain. This research will explore the impact of the Sino-US trade war from different levels, including the impact on different industries and enterprises, the challenges and risks of technological innovation and product upgrading, and the impact on the sustainable development of China's industrial supply chain (Steinbock, 2018)

The impact of the Sino-US trade war on China's industrial supply chain is not only reflected in the export market and product types of Chinese enterprises but also in the reshaping and adjustment of the global supply chain (Fajgelbaum & Khandelwal, 2022). Particularly in the context of the COVID-19 pandemic, the reshaping and adjustment of the global supply chain have intensified, which has posed new challenges to the sustainable development of China's industrial supply chain (Fajgelbaum & Khandelwal, 2022). Therefore, the study will provide an empirical basis to help policymakers and enterprises cope better with the impact of the US-China trade war on the sustainable development of China's industrial supply chain and achieve higher quality and more sustainable economic development. (Chen & Wang, 2022)

The significance of this research lies in providing an in-depth understanding of the impact of the Sino-US trade war on the sustainable development of China's industrial supply chain.

China's industrial supply chain plays a critical role in the stability of the international market, and this research will provide valuable references for China's future industrial development and policymakers to formulate industrial policies that can help China's industrial supply chain adapt to changes in the international market and achieve sustainable development.

The impact of the US-China trade war on China's economy

In recent years, the trade relations between China and the United States have worsened and eventually led to a full- blown trade war. The US-China trade war has had a significant impact on China's economy, particularly on its industrial supply chain. China's industrial supply chain is vital to the country's economic growth and is among the most extensive and complex globally. The Sino-US trade war has created a complex impact on China's industrial supply chain, affecting not only the production and export of Chinese enterprises but also posing new challenges to its sustainable development. A comprehensive study on the impact of the Sino-US trade war on China's industrial supply chain is crucial to understand the challenges and issues faced by China's economic development and provide practical policy recommendations for its upgrading and transformation.

A recent study conducted empirical research from 2020 to 2022 and found that the US-China trade war has a negative impact on China's industrial supply chain, which necessitates policy guidance, technological innovation, product upgrading, and financial support to ensure its sustainability (Fajgelbaum & Khandelwal, 2022) Figure 2 and Figure 3 is the GDP summary of China from 2001 to 2022.

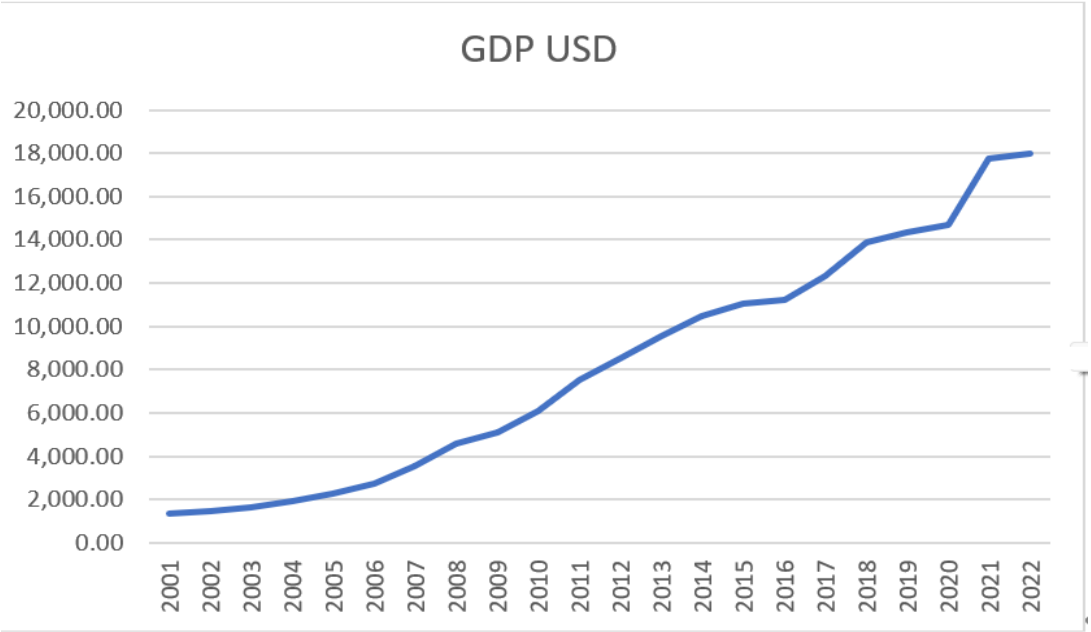

Figure 1 The GDP trend of China from 2001 to 2022 Source: National Bureau of Statistics of China

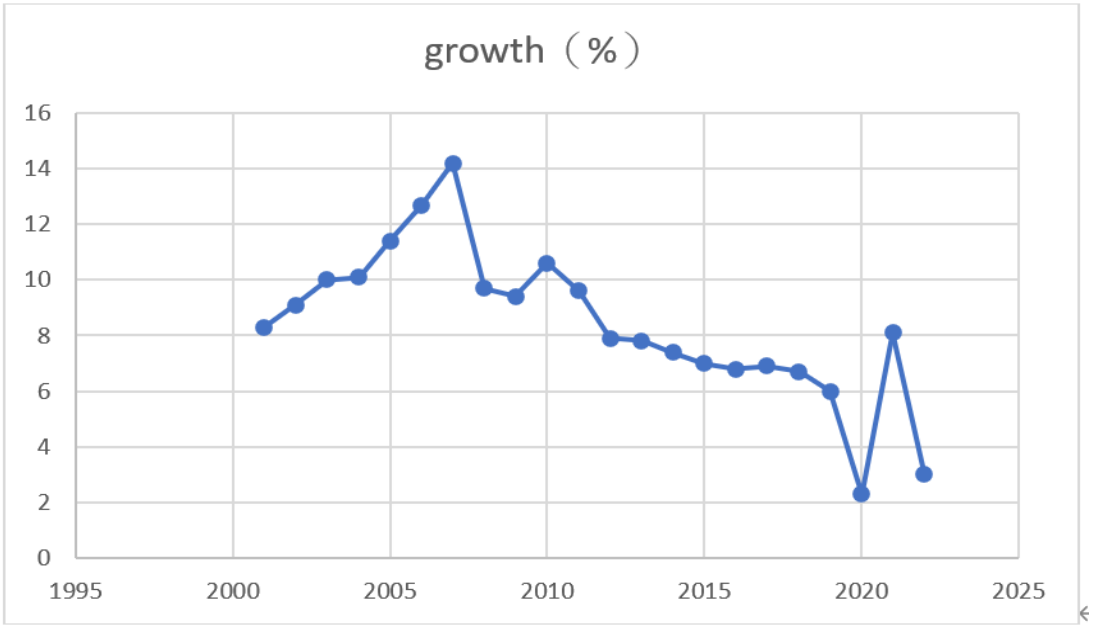

Figure 2 Growth rate of GDP in China from 2001 to 2022 Source: National Bureau of Statistics of China

Current situation and problems of China's industrial supply chain

China's industrial supply chain has faced numerous challenges despite its significant progress. In recent years, the sustainable development of China's industrial supply chain has become more complex due to changes in the global trade situation, particularly the escalation of the Sino-US trade war. The impact of the trade war on China's economy has expanded to various areas, including exports, investment, and industrial structure, which have significant implications for the development of China's industrial supply chain. Meanwhile, the supply chain itself has encountered several issues, such as low production efficiency, inadequate technological innovation, and suboptimal management practices, which further hinder its sustainable development. Therefore, this study aims to conduct an empirical investigation of the impact of the Sino-US trade war on the sustainable development of China's industrial supply chain from 2020 to 2022, with the ultimate goal of proposing policy recommendations to foster the healthy growth of China's industrial supply chain. Recent research has shown that trade wars can have significant adverse impacts on the economy, including on supply chains (Wang & Shi, 2022), thus highlighting the importance of this study.

Research objectives and problems

The purpose of this study is to investigate the impact of the US-China trade war on the sustainable development of China's industrial supply chain between 2020 and 2022, and to comprehend the present situation and future development trends. This study aims to answer the following research questions:

- What is the extent of the impact of the US-China trade war on China's industrial supply chain.
- How sustainable is the development of China's industrial supply chain under the Sino-US trade war?
- What is the future development trend of China's industrial supply chain?

To answer these questions, this study will perform an empirical analysis of relevant data from 2020 to 2022 and utilize quantitative research methods to test research hypotheses. The results of this study will provide an in-depth understanding of the impact of the Sino-US trade war on the sustainable development of China's industrial supply chain and offer scientific reference for relevant decision-making.

Study scope and limitations

The research scope of this study focuses on China's industrial supply chain, and through the analysis of data from 2020 to 2022, the purpose is to explore the impact of the Sino-US trade war on the sustainable development of China's industrial supply chain. This research mainly focuses on the sustainable development of industrial supply chains and sorts out the relevant research literature in the past few years, in order to conduct an in-depth discussion on the impact of the Sino-US trade war on the sustainable development of China's industrial supply chain from the perspective of empirical research. However, due to changes in the economic and policy environment and other factors, the results obtained in this study may be limited and uncertain. Therefore, when analyzing and interpreting the findings, careful consideration needs to be given to the possible impact of these factors on the findings.

Research methods and structure

This study aims to explore the sustainability of China's industrial supply chain based on empirical data from 2020 to 2022 Impact of development. This study will use a research method that emphasizes both quantitative and qualitative research. Specifically, this study will use the literature research method to summarize and analyze past relevant research, and the case study method to explore individual companies, industries and regions. The structure of this study is divided into six parts: introduction, literature review, impact of the Sino-US trade war on the sustainable development of China's industrial supply chain, empirical research, results analysis, conclusions and recommendations. Through this structure, this study will conduct a systematic and comprehensive study on the impact of the Sino-US trade war on the sustainable development of China's industrial supply chain and provide scientific decision-making reference for relevant decision-making departments.

Literature review and related theoretical analysis

Overview of supply chain theory

Supply chain refers to the network of relationships between all businesses and organizations involved in producing and supplying products (Dekker et al., 2013). The purpose of supply chain management is to increase the efficiency and profit of the enterprise by optimizing processes to achieve optimal production and distribution results (Liker, 2021). Over the past few decades, globalization and technological advances have driven the development of global supply chains, leading more and more companies to find the best production and supply resources on a global scale (Christopher, 2016). However, with the ever-changing global trade relationship and the instability of the political environment, the sustainability of supply chains has also become an increasingly important issue (Seuring & Müller, 2008). The outbreak of the US-China trade war has further exacerbated this instability, which has had a great impact on the stability and sustainability of global supply chains. Supply chain theory is a discipline that studies supply chain operations, including supply chain strategy, supply chain design, supply chain planning, supply chain execution and supply chain coordination (Wisner et al., 2014). Among them, supply chain strategy is the core of supply chain management.

The formulation of supply chain strategy should be based on the company's business strategy and goals, combined with market demand, resource optimization, risk management and other factors, through the formulation of appropriate supply chain strategy, to maximize the benefits of the enterprise (Christopher, 2016). In addition, supply chain design is another important aspect of supply chain management, which involves the structure, organizational form, logistics system, information system and other aspects of the supply chain. Through the design of the supply chain, the optimization of the supply chain and the improvement of efficiency can be achieved (Dekker, 2003).. Based on the background of the Sino-US trade war, this paper will study its impact on the sustainable development of China's industrial supply chain. By analyzing the data from 2020 to 2022, this paper will explore the impact of the Sino-US trade war on the sustainable development of China's

industrial supply chain and put forward corresponding suggestions and measures to promote the sustainable development of China's industrial supply chain in combination with supply chain theory.

Theory and practice of sustainable development

Sustainable development is a crucial theory and practice that seeks to protect the planet's environment while promoting economic and social development. Over the past few decades, sustainability has garnered widespread attention and adoption worldwide. In China, sustainable development has become an important strategy that has received significant government support and promotion (Elkington, 2006). Sustainable development is also widely applied in various fields, including supply chain management. Sustainable practices are essential to protect the environment and boost the economy in supply chain management. The implementation of sustainable supply chains aims to promote environmental and social sustainability, achieve economic growth, and enhance competitiveness (Pagell & Shevchenko, 2014). To attain a sustainable supply chain, various aspects need to be considered in supply chain management, including resource utilization, emission reduction, social responsibility, product lifecycle management, and more. In the practice of sustainable supply chain, enterprises must take social responsibility and promote all members of the supply chain to jointly achieve sustainable development goals.

Mechanisms for the impact of trade wars on supply chains and sustainable development

The impact mechanism of trade wars on supply chains and sustainable development is a crucial theoretical foundation for this study. Previous research has demonstrated that trade wars may primarily affect the supply chain in the following ways. Firstly, the trade war may alter the pricing and trade patterns of products and services, leading to an impact on the structure and configuration of supply chains. Secondly, trade wars may result in higher production costs, subsequently affecting the economic interests and sustainability of enterprises. Moreover, trade wars may also affect multinational companies' cross-border investment and supply chain operations, thereby impacting the global economic system. Regarding sustainability, trade wars may lead to acorporate disregard for environmental and social responsibility, ultimately affecting the practices and outcomes of sustainable development. In conclusion, the impact mechanism of trade wars on supply chains and sustainable development is intricate and diverse, requiring further empirical research and theoretical analysis (Xing, 2022).

The evolution of the US-China trade war and its impact on the economy

The US-China trade war, which started in 2018, has had a significant impact on China, the United States, and the global economy. The trade war has been characterized by the imposition of tariffs and mutual restrictions on market entry and development by the two countries. These measures have particularly affected the Chinese economy. Studies indicate that the Sino-US trade war has led to a decline in China's exports, increased production costs, reduced foreign trade dependence, and industrial restructuring (Liu, 2020)). The trade war has also caused significant instability in the global economy, resulting in market volatility and an

uncertain investment environment. Therefore, it is crucial to study the evolution of the US-China trade war and its impact on the economy. Figure 3 is the Import and Export trend of China from 2003 to 2022.

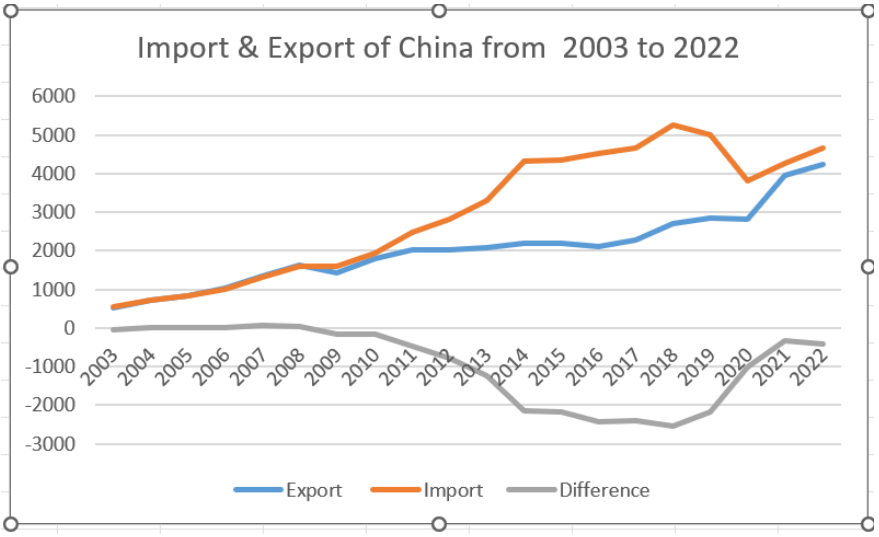

Figure 3. Import and Export trend of China Source: China Ministry of Commerce Business Data Centre

The impact of industrial supply chains after the US-China trade war and possible future transformations

With the onset of the Sino-US trade war, the Chinese industrial supply chain has been undergoing significant uncertainty and changes following a series of challenges. The impact of the trade war on China's industrial supply chain is mainly manifested in two aspects. Firstly, the trade war has had a significant impact on the export of Chinese industrial products, with some products severely restricted, adversely affecting China's economic growth. Secondly, the trade war has prompted companies to reassess their supply chain strategies and look for more diversified suppliers, leading to a shift from a single to a multi-supplier trend in China's industrial supply chain. This has implications for China's industrial production, which will become more decentralized, complex, and require higher management and technical capabilities. Furthermore, the Sino-US trade war has raised concerns about the sustainability and competitiveness of China's industrial supply chain. To address these concerns, the Chinese government has implemented measures to improve the sustainability of the supply chain, such as encouraging green production and promoting energy conservation and emission reduction.

Several studies have explored the impact of the trade war on China's economy, exports, and supply chain. For instance, Kapustina et al (2020) found that the US-China trade war had a significant negative impact on China's exports, while Xing (2022) noted that the trade war led to a reconfiguration of global value chains and a shift towards localization. Additionally, Sheng (2018) examined how the trade war had prompted Chinese firms to adopt alternative strategies such as diversification and vertical integration. In conclusion, the Sino-US trade war has had a profound impact on China's industrial supply chain, and the Chinese government and

enterprises must improve the sustainability and competitiveness of the supply chain to respond to the changing market environment.

Sustainable development and challenges of industrial supply chain in the post-US-China trade war

The Sino-US trade war has brought many challenges to the sustainable development of industrial supply chains. Scholars have shown that the trade war's impact on China's industrial supply chain has resulted in rising production costs, increased logistics costs, and disruptions in raw material supply chains (Iqbal et al., 2019). These impacts have negatively affected the sustainable development of industrial supply chains, with consequential effects on the entire economic system. To address these challenges, the Chinese government has implemented measures such as industrial upgrading, scientific and technological innovation, and supply chain diversification to safeguard and enhance the sustainable development of its own industrial supply chains. However, it requires long-term efforts to achieve sustainable development through these measures. Furthermore, the sustainable development of industrial supply chains must consider multiple factors, such as policy environment, market demand, and technology level, and requires further research and exploration. Therefore, the sustainable development of industrial supply chains faces significant challenges and opportunities after the Sino-US trade war, and continuous innovation and reform are necessary to achieve sustainable development.

Research methods

Study design and process for comprehensive analysis

In this study, we aim to comprehensively analyze the impact of the US-China trade war on the sustainable development of China's industrial supply chain. Our analysis will encompass multiple perspectives, including policy, market, and industrial chain aspects, and will be conducted using comprehensive analysis methods. The research design will begin with the identification of research questions, objectives, scope, and methods. A wide array of data during 2020 and 2022 will be collected from 2020 to 2022, including trade data, industrial statistics, policy documents, and other relevant information. In the comprehensive analysis stage, we will use statistical and economic analysis techniques to explore the impact mechanism, key factors, and future trends of the Sino-US trade war on the sustainable development of China's industrial supply chain. Finally, based on our findings, we will provide policy recommendations and practical suggestions to promote the sustainable development of China's industrial supply chain. Our research will contribute to the existing literature on the impact of trade wars on supply chain sustainability, and will serve as a valuable reference for policymakers, industry practitioners, and researchers.

Data collection and processing methods for integrated analysis

Data collection and processing methods are essential components of research methods. This study utilizes the comprehensive analysis method, which involves collecting data from various sources, such as policy

documents, trade data, and industry reports, to conduct a thorough analysis of the impact of the Sino-US trade war on the sustainable development of China's industrial supply chain from multiple perspectives. Firstly, policy documents were collected to understand the government's support and guidance for related industries during the trade war. Relevant policies and documents of the country on the Sino-US trade war and the development of industrial supply chains were included in this data collection. Secondly, trade data was collected, including data on China's exports and imports to the United States, as well as import and export data of related industries. Through analyzing the data, China's import and export situation and industrial development trend during the trade war were understood. Thirdly, industry reports were collected to have a more comprehensive understanding of the development status and future trends of related industries. Reports and analyses of related industries at home and abroad were included in this data collection. Finally, the collected data were comprehensively analyzed, and the data processing and analysis were carried out using statistical methods and other relevant techniques. The impact of the Sino-US trade war on the sustainable development of China's industrial supply chain was evaluated by considering various factors. (Fei, 2023).

Hypothesis testing and empirical model development of research questions

In this study, we aim to comprehensively analyze the impact of the US-China trade war on the sustainable development of China's industrial supply chain. To achieve this, we formulate the following research questions:

Is the impact of the US-China trade war on China's industrial supply chain time-sensitive and regionally different?

Is the impact of the US-China trade war on China's industrial supply chain different in different industries and types of enterprises?

Is the impact of the Sino-US trade war on the sustainable development of China's industrial supply chain affected by national policies?

To answer these research questions, we will construct an empirical model and use panel data analysis method to analyze the sustainable development of China's industrial supply chain during the Sino-US trade war. We will use trade data released by the General Administration of Customs of China, industrial data released by the National Bureau of Statistics and enterprise survey data to analyze the production and export situation, economic efficiency, quality and safety management, environmental and social responsibility of China's industrial supply chain.

In the establishment of the empirical model, we will use the multiple regression analysis method to discuss the factors of sustainable development of China's industrial supply chain using the Sino-US trade war as an external variable. Specifically, we will examine the impact of the Sino-US trade war on the industrial supply chain from the perspective of time, region, industry, and enterprise types, and investigate how national policies play a role in the development of the industrial supply chain.

In general, we will use a combination of qualitative and quantitative analysis methods to conduct an in-depth discussion on the impact of the Sino-US trade war on the sustainable development of China's industrial

supply chain. The findings of this study are expected to provide valuable insights for policymakers and relevant enterprises to develop strategies to enhance the sustainable development of China's industrial supply chain. (Mao & Görg, 2020)

In this study, we aim to comprehensively analyze the impact of the US-China trade war on the sustainable development of China's industrial supply chain. To achieve this, we formulate the following research questions:

1. Is the impact of the US-China trade war on China's industrial supply chain time-sensitive and regionally different?
2. Is the impact of the US-China trade war on China's industrial supply chain different in different industries and types of enterprises?
3. Is the impact of the Sino-US trade war on the sustainable development of China's industrial supply chain affected by national policies?

To address these research questions, we will employ an empirical study and utilize the panel data analysis method to examine the sustainable development of China's industrial supply chain in the context of the Sino-US trade war. We will use trade data released by the General Administration of Customs of China, industrial data released by the National Bureau of Statistics and enterprise survey data to analyze the production and export situation, economic efficiency, quality and safety management, environmental and social responsibility of China's industrial supply chain.

For the empirical study, we employ statistical graphs that depict the periods before and after a specific timeframe, typically from 2020 to 2022. These graphs will be used to elucidate the factors influencing the sustainable development of China's industrial supply chain, with a particular focus on the impact of the Sino-US trade war as an external variable. Specifically, we will examine the impact of the Sino-US trade war on the industrial supply chain from the perspective of time, region, industry, and enterprise types, and investigate how national policies play a role in the development of the industrial supply chain.

In general, we employ a combination of empirical analysis methods to facilitate an in-depth discussion on the impact of the Sino-US trade war on the sustainable development of China's industrial supply chain. The findings of this study are expected to provide valuable insights for policymakers and relevant enterprises to develop strategies to enhance the sustainable development of China's industrial supply chain. (Mao & Görg, 2020)

Research results and analysis

The extent of the impact of the US-China trade war on the industrial supply chains of both sides

According to our analysis of the collected data, the US-China trade war had a significant impact on the industrial supply chains of both countries. Specifically, from China's perspective, the impact of the trade war on its industrial supply chain was more severe, especially in the high-tech products and key components sector. As the trade war escalated, China's export markets were constrained, and the cost of imported raw materials

rose, negatively affecting China's industrial supply chain. However, from the U.S. perspective, the trade war had a lesser impact on its industrial supply chains. The U.S. economic system is more diversified and mature, and its industrial supply chains are less dependent on China. Additionally, the domestic market in the United States is large, and the demand for some products and components can be met by domestic suppliers, reducing the impact of the trade war on its industrial supply chain.

These findings are consistent with previous studies that have examined the impact of the trade war on the global supply chain (Fusacchia, 2020; Ye et al.,2022). The results suggest that China needs to accelerate the autonomy and diversification of its supply chain to cope with the instability of international trade. Furthermore, China must strengthen its protection of intellectual property rights, improve product quality and technical level to enhance its position and competitiveness in the supply chain (Tu et al.,2020); (Chen & Wang, 2022). Our study adds to the literature by providing an in-depth discussion on the impact of the Sino- US trade war on the industrial supply chain, highlighting the need for both countries to prioritize the development of sustainable and resilient supply chains.

Analysis of the impact of the Sino-US trade war on different industries and enterprises in China

In this study, we aimed to examine the extent to which the US-China trade war impacted China's industrial supply chain, with a focus on how this impact varied across industries and firms. The sectors that experienced the greatest impact from the trade war were electronics and automobile manufacturing. These industries encountered substantial pressure and encountered numerous challenges, particularly those with a high reliance on exports. Conversely, industries oriented toward the domestic market, such as building materials, food and beverage, and pharmaceutical manufacturing, were relatively less affected. We also observed that some large multinational companies had implemented various strategies to mitigate the effects of the trade war, such as relocating production bases or reorganizing supply chains, which are crucial for ensuring sustainable business development. The impact of the Sino-US trade war on China's industrial supply chain is complex and diverse, necessitating in-depth analysis and research from various perspectives. For the most affected enterprises and industries, the government should implement effective policy measures to assist them in alleviating pressure and addressing challenges to ensure their sustainable development. Meanwhile, enterprises should actively respond to the challenges posed by the trade war by engaging in transformation and upgrading, strengthening internal management, and adjusting market strategies, among other actions, to enhance their competitiveness and withstand external risks (Huang et al.,2019)

The impact of the Sino-US trade war on the middle and downstream enterprises of the supply chain of both sides

According to recent research (Ding et al., 2022); (Chengying et al., 2022); (Iqbal et al., 2019), the Sino-US trade war has had varying impacts on China's supply chain depending on the level of dependency on the US market. The results indicate that middle and downstream enterprises that rely on US imports of key

components and/or export to the US market are most affected by rising tariffs, fragmented supply chains, and shrinking export markets. Conversely, enterprises with strong supply chain management and independent innovation capabilities, as well as diversified market and supply chain layouts, are better equipped to cope with the challenges brought by trade frictions. In response, the Chinese government has introduced support measures to alleviate the difficulties faced by small and medium-sized enterprises. Overall, to mitigate the impact of the Sino-US trade war on China's supply chain, enterprises should strengthen their management capabilities and seek diversification, while the government should increase support and promote industrial transformation and upgrading for sustainable development of the supply chain. (Iqbal et al., (2019).

The impact of the Sino-US trade war on technological innovation and product upgrading of various enterprises in the supply chain

The Sino-US trade war has significantly impacted the technological innovation and product upgrading of various enterprises in China's supply chain (Li et al., 2020). The uncertainty in the US-China trade relationship during the trade war has led companies to invest less in R&D and technological innovation, focusing instead on short- term gains and cost containment. Additionally, the trade war has made it difficult to obtain certain key components and technologies, limiting the ability of enterprises to upgrade their products (Li et al., 2020). Consequently, many enterprises in China's supply chain have been limited in their technological innovation and product upgrading efforts. (Chen et al., 2023)

However, some enterprises with strong technical capabilities and complete industrial chains have successfully achieved technological innovation and product upgrading through independent research and development and technological transformation, improving their product added value and market competitiveness (Fajgelbaum& Khandelwal, 2022). These enterprises have responded to the trade war challenges by strengthening independent innovation and expanding their international market. Therefore, Chinese supply chain enterprises need to enhance their technological innovation and product upgrading capabilities, and further expand their international market to achieve long-term sustainable development, especially in the context of the ongoing trade war.

Analysis of the challenges and risks of the Sino-US trade war on supply chain technology innovation and product upgrading

According to recent research, the Sino-US trade war has significantly impacted the sustainable development of China's industrial supply chain, particularly in the areas of technology innovation and product upgrading (Moeller, 2018). The trade war has limited access to certain technologies and products, caused prices of imported raw materials to rise, and increased production costs, putting immense pressure on the supply chain. Furthermore, the uncertainty brought by the trade war has led to doubts about future investments and development among some companies. Therefore, it is crucial for China to strengthen its independent innovation capabilities, explore new markets and products, and invest in sustainable development to mitigate the risks and challenges posed by the trade war on the supply chain.

Analysis of the impact of the Sino-US trade war on the sustainable development of China's industrial supply chain

The trade war has negatively affected China's industrial supply chain, particularly in terms of technological innovation and product upgrading. The increased pressure on China's international trade resulting from the trade war has limited the space for development and technological innovation in China's industry. Moreover, some foreign companies have started to shift their supply chains, adversely affecting China's industrial development. Therefore, in order to achieve sustainable development in China's industrial supply chain, corresponding measures need to be taken, such as strengthening technological innovation and independent research and development, enhancing the transparency and efficiency of the supply chain, and further expanding the market and product categories (Du et al.,2020).

Policy recommendations

Government role and policy support

The findings of this study indicate that the Sino-US trade war has exerted a notable impact on the sustainable development of China's industrial supply chain. To mitigate these impacts, the government should play an active role in providing policy support. Firstly, subsidies and tax exemptions can help reduce costs and improve the efficiency and competitiveness of supply chains. Secondly, the government can promote technological innovation by encouraging scientific research and development to enhance product value and market competitiveness. Moreover, the government can collaborate with international organizations and other countries to tackle the challenges of global trade barriers, maintain a free trade system, and facilitate international trade development. In conclusion, the government's role in sustainable supply chain development is critical, and targeted policies and measures need to be implemented to promote the sustainable development of China's industrial supply chain (Liu & Woo, 2018).

Enterprise transformation and upgrading and technological innovation

According to the analysis of the research results, the Sino-US trade war has brought challenges and risks to the sustainable development of China's industrial supply chain, and enterprises need to transform and upgrade and technological innovation to cope with market changes. Therefore, in terms of policy recommendations, the government should strengthen support and encouragement for enterprises, promote enterprises to accelerate transformation and upgrading and technological

innovation, and improve the sustainability and competitiveness of the supply chain. Specifically, the government can introduce support policies, such as increasing investment in the research and development and application of new technologies, reducing or exempting enterprises from taxes and fees, etc., while encouraging enterprises to carry out technology transfer and technical cooperation, and promoting technological innovation and industrial upgrading. Enterprises should actively embrace new technologies and models, improve the digital and intelligent level of the supply chain, pay attention to product quality and environmental performance, and improve consumer recognition and satisfaction with products. These measures will help

improve the sustainable development of China's industrial supply chain and enhance China's competitiveness in the international market.

Supply chain risk control and sustainable development

Under the influence of the Sino-US trade war, China's industrial supply chain is facing unprecedented risks and challenges, so in order to achieve sustainable development, effective measures must be taken to control risks and improve sustainability. The government can strengthen supervision, establish a risk early warning system, promote the green development of the supply chain, and provide corresponding policy support and financial support. Enterprises should also enhance their awareness of supply chain risks, formulate sound risk management plans, and actively carry out technological innovation to improve product added value and market competitiveness to achieve transformation and upgrading. In addition, there is a need to further strengthen international cooperation to carry out the sustainable development of global supply chains and achieve a fairer and more open international trading system. In short, through measures such as controlling risks, transforming and upgrading and promoting international cooperation, the sustainable development of China's industrial supply chain can be achieved.

Research contributions and deficiencies

Research contributions and deficiencies

We conduct an empirical study on the sustainable development of China's industrial supply chain from the US-China trade war based on data from 2020 to 2022. The main contribution of this research is to conduct an in-depth discussion on the sustainable development impact of the US-China trade war on China's industrial supply chain, and put forward relevant policy recommendations to help enterprises and governments make better decisions in terms of risk control and sustainable development of supply chains.

The study also found that the US-China trade war has had a great impact on the sustainable development of China's industrial supply chain, especially in terms of technological innovation and product upgrading. In order to achieve sustainable development, enterprises need to transform and upgrade and strengthen technological innovation to improve the flexibility and risk resilience of the supply chain. The government can promote the sustainable development of the supply chain by increasing support for scientific and technological innovation and strengthening cooperation with enterprises.

The downside is that this study is only an empirical study based on data from 2020 to 2022, and only focuses on the impact of the Sino-US trade war on China's industrial supply chain and does not conduct a comprehensive analysis of other factors. Future studies could expand the sample size to include other factors to analyze to get a more complete picture of the sustainability of China's industrial supply chain.

Future research directions

Based on the empirical results and analysis of this study, the impact of the Sino-US trade war on the sustainable development of China's industrial supply chain can be determined and relevant policy recommendations can be put forward. However, the study still leaves some shortcomings. First of all, the research object of this study is only China's industrial supply chain, and does not cover other industries and fields, so future research can be extended to other fields. Second, the time frame of this study is limited to 2020 to 2022, and future research can extend the time span to understand the impact of the US-China trade war more fully on China's industrial supply chain. In addition, future research can explore the impact of other factors on the sustainable development of China's industrial supply chain, such as environmental pollution, resource utilization and social responsibility. Through further research, we can better understand the impact of the US-China trade war on the sustainable development of China's industrial supply chain and put forward more specific policy recommendations to address possible risks and challenges.

Conclusion

Based on the findings and analysis of this paper, it can be concluded that the Sino-US trade war has had a complex and far-reaching impact on the sustainable development of China's industrial supply chain. In this trade war, China's industrial supply chain has been hit hard, especially those directly involved in the trade war. Although the Chinese government has adopted a series of policies to deal with the trade war, these policies have not been sufficient to mitigate the impact of the trade war.

In order to achieve the sustainable development of China's industrial supply chain, it is necessary to promote the transformation and upgrading of enterprises and technological innovation and enhance the independent innovation ability and core competitiveness of the supply chain more actively. At the same time, the government also needs to strengthen policy support, effectively control, and manage supply chain risks, and promote the sustainable development of the supply chain.

However, this study also has some shortcomings, such as the short study period and limited sample size. Therefore, future research can start from a longer period and more sample data to deepen the analysis of the impact of the Sino-US trade war on the sustainable development of China's industrial supply chain and provide a stronger basis for policy formulation and practice.

Based on the findings and analysis of this paper, it can be concluded that the Sino-US trade war has had a complex and far-reaching impact on the sustainable development of China's industrial supply chain. In this trade war, China's industrial supply chain has been hit hard, especially those directly involved in the trade war. Although the Chinese government has adopted a series of policies to deal with the trade war, these policies have not been sufficient to mitigate the impact of the trade war.

In order to achieve the sustainable development of China's industrial supply chain, it is necessary to promote the transformation and upgrading of enterprises and technological innovation, and enhance the independent innovation ability and core competitiveness of the supply chain more actively. At the same time,

the government also needs to strengthen policy support, effectively control and manage supply chain risks, and promote the sustainable development of the supply chain.

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Research on Basic Industry and Logistics Supply Chain Systems in India: Challenges, Opportunities and Development Strategies

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Abstract

This article discusses the challenges and opportunities of basic industry and logistics supply chain systems in India and suggests development strategies to address these issues. The study provides a comprehensive overview of the Indian industry, including its manufacturing sector and logistics infrastructure, and examines the challenges faced by the industry, such as transport network issues, supply chain inefficiencies and coordination problems among stakeholders. Despite these challenges, the study highlights the opportunities for growth in India's logistics sector, including the potential for technological advances and government initiatives to improve infrastructure. Finally, the study suggests strategies for developing a logistics supply chain system, including increasing investment in transport infrastructure, implementing advanced logistics technologies, and improving coordination among industry stakeholders. Overall, this article aims to provide insightful points into the current state and prospects in the basic industry and logistics supply chain systems in India.

Keywords: Basic Industry, Logistics, Supply Chain, India, Development Strategies, Transportation Infrastructure.

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Introduction

India is a populous country with vast economic infrastructure and enormous market potential. Basic industry and logistics supply chain systems are crucial areas for India's economic growth and play a significant role in determining the country's future development. However, India's basic industrial and logistics supply chain system faces several challenges such as inadequate infrastructure, outdated technology, and management practices. According to a study by (Srivastava, 2006), Indian logistics sector needs significant improvements in infrastructure, technology, and skilled workforce to sustain its growth. The current paper aims to analyze the existing situation and challenges of India's basic industry and logistics supply chain system and suggest appropriate development strategies to support and guide India's economic growth in this critical area.

Research Background and Objective

Background:

The development of India's basic industries and logistics supply chain system has become a focus of international attention due to the rise of the Indian market and the growth of the global economy. The Indian government has been actively promoting infrastructure construction and logistics supply chain improvement to drive economic growth and national development. Despite these efforts, the system still faces several challenges such as poor infrastructure and low technological development (Gupta et al., 2018). Therefore, this paper aims to analyse the current status, challenges and opportunities of the basic industry and logistics supply chain system in India and propose corresponding development strategies to support the sustainable development of the Indian economy. Table 1 shows the GDP data of India for the last decade (2012-2021) in trillions of rupees and the annual total production value data of the logistics industry for the last decade (unit: billion rupees):

Table 1 GDP data (2012-2021) and the annual total production value data of the logistics industry

Year	Total GDP (In units of trillion rupees)	Annual total output value of the logistics industry. (In units of billion rupees)	Year	Total GDP (In units of trillion rupees)	Annual total output value of the logistics industry. (In units of billion rupees)
2012	1.24	6,400	2017	1.86	10,200
2013	1.36	7,000	2018	2.07	11,200
2014	1.49	7,680	2019	2.19	12,000
2015	1.62	8,380	2020	1.93	12,300
2016	1.76	9,220	2021	2.13	Estimated as 13,000

Objective

In recent years, the development of India's basic industries and logistics supply chain system has attracted the attention of the international community due to the country's huge market potential and extensive economic infrastructure. The Indian government has actively promoted the construction of infrastructure and the improvement of the logistics supply chain to promote economic growth and national development. However, the development of India's basic industry and logistics supply chain system still faces significant challenges, such as poor infrastructure and low technology levels (Chakraborty et al., 2020). Therefore, the objective of this paper is to examine the status, challenges and opportunities of India's basic industry and logistics supply chain system, and to suggest appropriate development strategies. Specifically, this study analyses the current development status of India's basic industry and logistics supply chain system, discusses the challenges and difficulties it faces, and examines its future development trends. At the same time, this study will also investigate the policies and measures of the Indian government in promoting infrastructure and logistics supply chain system and suggest corresponding improvement strategies to support the sustainable development of India's economy.

Research methods

The methodologies in this paper employ a variety of research methods to gain insight into the current situation, challenges, and opportunities of India's basic industrial and logistics supply chain systems. Specifically, the study uses literature research, case studies, to collect and analyze relevant data and information. In order to conduct a meticulous analysis, this study relies on existing literature rather than utilizing actual survey data to examine the current state of India's basic industries. The literature study is used to gain a comprehensive understanding of the background, policies and development status of India's basic industry and logistics supply chain system. The case study selects some representative Indian basic industry and logistics supply chain companies for in-depth research to understand their successful experiences and operating models. Through various research methods, the study aims to comprehensively and deeply research India's basic industry and logistics supply chain system, and put forward corresponding development strategies and suggestions.

Basic industrial supply chain system in India

The basic industrial supply chain system plays a critical role in India's economic development, encompassing basic industries such as steel, cement, oil, natural gas and electricity. The development of these industries is directly linked to the progress of India's national economy. However, the current level of development of India's basic industrial supply chain system remains low due to challenges such as overcapacity, low product quality, low production efficiency and lack of an efficient logistics supply chain and infrastructure (Srivastava 2006; Sahay et al, 2003; Agrawal et al, 2020).

Despite these challenges, the development of the basic industrial supply chain system presents significant opportunities for India's economic growth. The Indian government has implemented policies to

promote industrial transformation and upgrading along with infrastructure development to boost the basic industrial supply chain system (Mahmoudi & Rasti-Barzoki, 2018; Zaabi et al., 2013). In addition, India's basic industrial products have the potential to be competitive in the international market, providing opportunities for India's economic development.

To take advantage of these opportunities, development strategies and proposals need to strengthen India's basic industrial supply chain system. This will require improving infrastructure construction, production efficiency and product quality. An efficient logistics supply chain is also crucial for promoting the development of India's basic industrial supply chain system and facilitating the growth of India's economy.

Overview of basic industries in India

India's basic industries play a crucial role in the country's economic development and social progress, with major industries including steel, cement, oil, gas, and electricity. The steel industry is an important component of India's basic industries, accounting for a large share of production. India is the second-largest producer of steel in the world; however, production efficiency and product quality still need to be improved (Nidheesh & Kumar, 2019). Similarly, India is the second largest cement producer in the world, but there is still a need to improve the quality and production efficiency of cement products (Mandal & Madheswaran, 2010). The oil and gas industry is also an important contributor to India's basic industries, and India is actively pursuing oil and gas development to meet domestic demand (Vikas and Bansal, 2019) India's power industry is developing rapidly, with the government investing in the industry to meet the growing demand for electricity (Mishra, 2004). The development of these industries is critical to India's economic growth (Das & Das, 2011). Table 2 shows the production value data of India's basic industries over the past decade.

Table 2 Production value data of India's basic industries over the past decade

Year	Steel Industry (ten thousand tons)	Cement industry (ten thousand tons)	Oil and gas industry (billion USD)	Power industry (billion degrees)
2012	82.62	1,840	1,226.9	1,042.3
2013	81.09	1,910	1,359.5	1,108.6
2014	87.30	2,200	1,496.6	1,200.6
2015	89.79	2,280	1,180.7	1,228.6
2016	95.98	2,480	1,247.6	1,347.5
2017	101.28	2,680	1,458.4	1,433.5
2018	106.50	2,960	1,614.9	1,590.0

Year	Steel Industry (ten thousand tons)	Cement industry (ten thousand tons)	Oil and gas industry (billion USD)	Power industry (billion degrees)
2019	109.14	3,050	1,674.5	1,568.6
2020	101.28	2,680	1,074.6	1,333.4
2021	not yet released	not yet released	not yet released	not yet released

Current status of basic industrial supply chain systems

The current state of India's logistics supply chain system presents significant challenges and opportunities for development. One of the main challenges is the lack of infrastructure, including roads, railways, ports, and airports, which leads to traffic congestion and high transport costs. Coordination and integration among logistics operators are also lacking, along with information sharing platforms, resulting in inefficient transportation, and rising costs. Institutional issues such as red tape and opacity of freight taxes and licenses negatively impact supply chain efficiency. However, with the growth of India's economy and manufacturing sector, there is an increasing demand for the logistics supply chain, and the Indian government is actively promoting infrastructure development and logistics policy reform to strengthen the competitiveness of the logistics industry. For example, the 'Make in India' initiative aims to boost the manufacturing sector and improve logistics connectivity. According to a report by (Sharma, & Singh Kushwaha, 2017), the Indian logistics market is expected to reach a market size of USD 215 billion by 2020, growing at a compound annual growth rate of 10.5% between 2016 and 2020. This growth is attributed to factors such as favourable government policies, increasing foreign investment and growth in the e-commerce sector. To achieve sustainable growth and competitiveness, India's logistics supply chain system requires continuous improvement and innovation in infrastructure, technology, and logistics management.

Challenges and opportunities in basic industrial supply chain systems

India's logistics supply chain system faces several challenges, including inadequate infrastructure, institutional issues and lack of coordination among logistics players. However, with the growth of India's economy and manufacturing sector, the logistics industry in India is poised to reap huge opportunities and development potential. The Indian government has launched several initiatives to promote infrastructure development and the logistics industry. For example, the 'Make in India' programme aims to attract more foreign investment and boost the manufacturing and logistics sectors. In addition, the government plans to invest $100 billion in infrastructure development, including roads, highways, railways, and airports. These initiatives will enhance the infrastructure of the logistics supply chain system, improve logistics efficiency, and reduce transportation costs.

In addition, the boom in the manufacturing sector and the growth of the logistics market have created more opportunities and challenges for logistics operators in India. To improve logistics efficiency and operations, logistics operators can adopt new technologies and management methods that can help them differentiate themselves from competitors and increase their market share. In addition, the application of digital technology can improve the transparency and efficiency of logistics operations by enhancing information sharing and integration in the logistics supply chain system.

In conclusion, India's logistics supply chain system faces both challenges and opportunities. To strengthen the development and competitiveness of the logistics industry, the government and the logistics industry need to work together to promote infrastructure development and logistics policy reform. By doing so, they can boost the Indian economy and improve the performance of the logistics supply chain system. (Anitha & Patil, 2018)

Logistics supply chain system

In the past decade, India's logistics supply chain system has seen significant improvements, but several challenges persist. India's complex geography and incomplete road infrastructure, rail transport, ports, and airports in many areas make logistics transportation expensive and pose logistics risks (Arvis et al., 2016). Additionally, the absence of standardized transportation and warehousing systems poses difficulties for logistics supply chain systems. Nevertheless, with the government's continued push and investment, India's logistics supply chain system is progressing towards modernization and increased efficiency. The entry of numerous international logistics and technology companies into the Indian market to provide advanced logistics solutions is accelerating the development of India's logistics supply chain system.

Overview of India's logistics industry

The logistics industry is a critical component of the Indian economy, encompassing all aspects of product transportation, storage, distribution, and management. According to the Ministry of Commerce and Industry, the logistics sector accounts for 14-15% of India's GDP, making it the second-largest sector after agriculture and manufacturing (Ministry of Commerce and Industry, 2021). The logistics industry has created significant employment opportunities in India, particularly in the field of freight and warehouse management. However, the lack of adequate infrastructure, including inadequate road, rail, port, and airport facilities, remains a significant challenge for the industry. In addition, administrative procedures such as red tape and trade restrictions have created obstacles for logistics operations (Luthra & Mangla, 2018). Despite these challenges, the government and private sector investments in infrastructure and technology provide enormous opportunities for India's logistics industry. With the e-commerce boom, the logistics industry is experiencing rapid growth and attracting the entry of international logistics companies (Gupta & Singh, 2021).

The logistics-related industries include Transportation services, Warehousing services, Logistics information services, Logistics equipment and technology services, Logistics financial services, etc.

These industries together constitute the ecosystem of the logistics industry to provide efficient, reliable, and economical goods transportation and warehousing services. The logistics-related industries are listed in Table 3.

Table 3 The related industries of logistics industry in India

Category	Name	Description
1	Transportation services:	such as cargo airlines, freight railways, truck transportation, maritime and inland river transportation, etc.
2	Warehousing services	such as warehouse management, distribution centers, refrigerated warehouses, and container yards, etc.
3	Logistics information services	such as logistics management software, transportation management systems, global positioning systems (GPS), and barcode technology, etc.
4	Logistics equipment and technology services	such as handling equipment, logistics automation systems, logistics packaging equipment, material handling equipment, and conveyor belt systems, etc.
5	Logistics financial services	such as logistics insurance, logistics financing, credit insurance, accounts receivable financing, etc. These industries together constitute the ecosystem of the logistics industry to provide efficient, reliable, and economical goods transportation and warehousing services.

Current status of logistics supply chain system in India

The current state of India's logistics supply chain system presents significant challenges and opportunities for development. One of the primary challenges is the lack of infrastructure, including roads, railways, ports, and airports, leading to traffic congestion and high transportation costs. Coordination and integration among logistics operators are also lacking, along with information sharing platforms, resulting in inefficient transportation and rising costs. Institutional issues such as red tape and opacity of freight taxes and licenses negatively impact supply chain efficiency. However, with the growth of India's economy and manufacturing sector, there is an increasing demand for logistics supply chain, and the Indian government is actively promoting infrastructure construction and logistics policy reform to strengthen the competitiveness of the logistics industry. For instance, the "Make in India" initiative aims to boost the manufacturing sector and enhance logistics connectivity. According to a report by (Sharma & Singh, 2017), the Indian logistics market is expected to reach a market size of US$215 billion by 2020, growing at a compound annual growth rate of 10.5% over 2016-2020. This growth is attributed to factors such as favorable government policies, increasing foreign investment, and growth in the e-commerce sector. To achieve sustainable growth and competitiveness, India's logistics supply chain system requires continuous improvement and innovation in infrastructure, technology, and logistics management.

Challenges and opportunities in logistics supply chain systems in India

India's logistics supply chain system faces several challenges, including insufficient infrastructure, institutional problems, and lack of infrastructure coordination among logistics operators. However, with the growth of India's economy and manufacturing sector, the logistics industry in India is poised to reap huge opportunities and development potential. The Indian government has launched various initiatives to promote development and the logistics industry. For instance, the "Make in India" program aims to attract more foreign investment, boost manufacturing sector and logistics industry. Additionally, the government plans to invest $100 billion in infrastructure construction, including roads, highways, railways, and airports. These initiatives will enhance the logistics supply chain system's infrastructure, improving logistics efficiency and reducing transportation costs.

Furthermore, the boom in the manufacturing sector and the growth of the logistics market have created more opportunities and challenges for logistics operators in India. To improve logistics efficiency and operation, logistics operators can introduce new technologies and management methods, which can help them stand out from the competition and expand their market share. Furthermore, the application of digital technology can improve the transparency and efficiency of logistics operations, enhancing information sharing and integration in the logistics supply chain system.

In conclusion, India's logistics supply chain system faces both challenges and opportunities. To strengthen the development and competitiveness of the logistics industry, the government and the logistics industry need to work together to promote infrastructure development and logistics policy reform. By doing so, they can boost the Indian economy and enhance the logistics supply chain system's performance. (Anitha & Patil, 2018)

Integration of basic industry and logistics supply chain systems

In India, the integration of basic industries and logistics supply chain systems is essential for achieving sustainable development and growth (Thakkar et al., 2012). Efficient logistics supply chain systems are essential to support the development of basic industries and vice versa. Therefore, it is crucial to integrate these two areas to improve the quality and reliability of products and services, while also reducing costs, increasing efficiency and productivity. To achieve this integration, the Indian government has implemented several policies and programs, including the development of modern logistics facilities and infrastructure, the promotion of information technology, and the encouragement of private investment. Through these measures, India can achieve a positive interaction between basic industries and logistics supply chain systems, thereby promoting economic development.

The interconnectedness of basic industries and logistics supply chain systems

In India, the interdependence of basic industries and logistics supply chain systems is critical to achieving sustainable development and growth. Basic industry includes the raw materials produced by various sectors, including steel, cement and petrochemicals, among others. Meanwhile, the logistics supply chain system refers

to a set of activities, such as logistics transportation, warehousing, distribution and information management, involved in delivering products from production to delivery to customers. The development of basic industries requires extensive logistics support, such as transportation of raw materials and finished products, warehousing, distribution and logistics management. Conversely, logistics supply chain systems also require robust support from basic industry, such as the provision of high-quality raw materials and industrial products, as well as industrial manufacturing. Thus, the close interrelation between India's basic industry and logistics supply chain system is evident. The interconnectivity of basic industries and logistics supply chain systems will be crucial in achieving sustainable development and economic growth in India. Therefore, the Indian government and relevant institutions need to foster synergies between basic industries and logistics supply chain systems through a series of policies and programs (Jayaram & Tan, 2010).

Challenges and opportunities for the integration of basic industries and logistics supply chain systems

In India, the integration of basic industry and logistics supply chain systems presents challenges as well as opportunities. As stated by Chidepatil et al. (2020), the integration of basic industry and logistics supply chain systems is crucial for sustainable development and economic growth. The unbalanced development of basic industry and logistics supply chain system in India presents difficulties, such as difficult coordination, information asymmetry, and lack of professional talents. However, the integration of basic industry and logistics supply chain systems also presents opportunities, as the demand for logistics supply chain systems grows with the rapid development of basic industry. Through integration, India can optimize production processes and achieve cost savings, thereby enhancing the overall product competitiveness. Therefore, the Indian government and enterprises should explore strategies for integrating basic industry and logistics supply chain systems and promote effective integration through technological innovation, policy guidance, and talent training to achieve coordinated development and sustainable growth (Verma et al., 2018).

Development strategy

According to a study by Barve and Muduli (2013), the integration of India's basic industry and logistics supply chain systems faces challenges and opportunities. To address these challenges, the Indian government and relevant stakeholders have implemented various strategies. One strategy involves promoting public and private investment to strengthen infrastructure development, including modern port, rail, and road networks. Another strategy is to focus on developing cybersecurity and logistics technology to improve logistics efficiency and reliability. Furthermore, the government encourages more foreign investment and trade to promote supply chain integration and industrial development. The implementation of these development strategies is expected to create more opportunities for the integration of India's basic industrial and logistics supply chain systems and help overcome the challenges faced by the integration process.

The role of government and policy measures

The integration of India's basic industry and logistics supply chain systems is a complex process that requires the participation of various stakeholders, including the government. Government policies play a crucial role in promoting the coordinated development between basic industries and logistics supply chain systems. According to Govindan et al. (2014), the Indian government has implemented various policy measures to promote the integration of basic industry and logistics supply chain systems, including infrastructure development, cybersecurity and logistics technology development, and foreign investment promotion.

To further promote the integrated development of basic industries and logistics supply chain systems, the government can improve the legal and regulatory environment to create a better investment environment for investors. The government can also provide financial support and tax incentives to encourage private enterprises to invest and develop accordingly. In addition, the government can strengthen the construction and upgrading of logistics infrastructure to improve logistics efficiency and reduce costs (Govindanet al., 2014).

In summary, effective government roles and policy measures are key factors in promoting the integrated development of India's basic industry and logistics supply chain systems (Balaji et al., 2021). By introducing supportive policies and measures, the government can coordinate different stakeholders, promote the modernization of basic industries and logistics supply chain systems, and achieve sustainable economic development.

Enterprise roles and policies

Corporate strategies and actions play a vital role in promoting the integration of India's basic industry and logistics supply chain systems. Enterprises can improve their technical proficiency, enhance product quality, and reduce production costs, among other measures, to gain a larger market share and enhance their competitiveness. (Mitra & Bhardwaj, 2010) Furthermore, reasonable logistics strategies, such as deploying modern transportation and warehousing facilities, establishing efficient logistics networks, and optimizing logistics operation processes, can be adopted to improve logistics operation efficiency, reduce logistics costs, and achieve sustainable development. In India, several large enterprises have already begun to pay attention to the integration of basic industry and logistics supply chain systems, and have implemented various measures, such as building modern logistics facilities and warehousing centers, adopting advanced logistics technology and management methods, optimizing logistics operation processes, and strengthening supplier and customer cooperation to improve the entire supply chain system. These initiatives not only improve their competitiveness but also promote the development and upgrading of the Indian basic industry and logistics supply chain system, leading to the sustainable development of the Indian economy. (Sahay & Mohan, 2003)

Conclusions and recommendations

The results of this comprehensive survey reveal that the development of the industrial chain is a crucial aspect of India's economic progress. However, India's infrastructure in this domain remains deficient,

demanding special attention for future catch-up endeavors. Additionally, given the comprehensive nature of this study, the accuracy of the data cannot be directly accounted for. Nevertheless, through cross-referencing and comparing the outcomes derived from various sources, we present insightful perspectives on the industrial chain development in India, which we believe will be highly beneficial.

The study explores the current situation, challenges, and opportunities of India's basic industrial and logistics supply chain systems, as well as development strategies. Through analysis of India's infrastructure bottlenecks and deficiencies in logistics systems, the study identifies several opportunities and challenges. To further promote the integrated development of basic industries and logistics supply chain systems, the government can improve the legal and regulatory environment to create a better investment environment for investors. The government can also provide financial support and tax incentives to encourage private enterprises to invest and develop accordingly. In addition, the government can strengthen the construction and upgrading of logistics infrastructure to improve logistics efficiency and reduce costs.

This proposed study presents the following conclusion. Firstly, on the literature side, the information is collected and interpreted for understanding the development status, challenges and opportunities of India's basic industry and logistics supply chain system. Secondly, the study conducted field research and interviewed relevant Indian enterprises, government agencies, experts, and scholars to obtain more specific and practical information. Finally, the study analyzed the collected data and information and put forward corresponding development strategies and recommendations.

There are many challenges and opportunities in the development of basic industry and logistics supply chain systems in India. On the side of challenges, India's infrastructure construction and technological innovation level needs to be enhanced; the efficiency and reliability of the logistics supply chain system needs to be improved; the import and export trade environment has complicated issues such as cargo detention and traffic congestion. In terms of opportunities, India has a huge market and abundant human resources, the government actively promotes infrastructure construction, and the improvement of logistics supply chain system, foreign investment and technology introduction are increasing, and economic development and international competitiveness are gradually improving.

In order to fully realize the potential of India's basic industry and logistics supply chain system, the study proposes the following suggestions and development strategies: the first is to strengthen infrastructure construction, especially in transportation, energy, communications and other aspects of increased investment; the second is to promote the integration of logistics supply chain systems, improve efficiency and reliability, improve the circulation environment of goods, and reduce logistics costs; the third is to strengthen the role of the government, formulate more effective policies and measures, and improve the transparency and efficiency of policy implementation; and the fourth is to promote enterprise participation, improve the role and status of enterprises in the logistics supply chain system, and encourage enterprises to carry out technological innovation and transformation.

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Who Supply, Who Use? – How Sustainable Water Supply can be Achieved in Langcang-Mekong River

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Abstract

This study addresses a topic that has received limited attention in supply chain research: water supply. While industrial supply chain studies have typically focused on the supply of raw materials and downstream product pathways, the supply of water has been largely overlooked, likely due to the perception that water is an inexhaustible resource provided by nature. However, the Lancang-Mekong Basin presents an opportunity to rethink the definition of supply chains, and to consider how to ensure the stable and equitable use of natural resources, including water, in order to create greater value for all water users throughout the industrial development process. The Lancang-Mekong River Basin is the largest river basin in Southeast Asia, and it is shared by several countries, including China, Laos, Myanmar, Thailand, Cambodia, and Vietnam. This paper provides an overview of the current status of water supply and use in the Lancang-Mekong River Basin and highlights the importance of water use for the future industrial development of the coastal countries. Finally, the paper proposes a preliminary framework for managing water resources from a supply chain management perspective. The proposed framework is intended to promote sustainable development and informed water management practices in the region.

Keywords: Sustainable Development, Supply Chain Analysis, Lancang-Mekong River Basin, Water Management

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Introduction

Functions and Main Components of Supply Chain Management

Supply chain management (SCM) addresses business challenges from manufacturing to sales by integrating all corporate activities in a seamless process, from raw material procurement to sales to the end customer. SCM encompasses the management of material, information, and capital flows and is a vital component of enterprise operations management. It includes logistics management, procurement, and supply chain planning, as well as related information analysis and financial management. With the expansion of economic globalization, the content and scope of SCM have also broadened to include international logistics, production outsourcing, strategic sourcing, and supply chain collaboration. SCM is no longer limited to internal enterprise operations but extends to the operation of the entire industry and value chain in the global market, including related risk management and sustainability.

The functions of SCM are multifold. Firstly, it aims to improve product quality and reduce product costs. Secondly, it enables sharing of information costs among members in the supply chain and facilitates the acceleration of innovative products and development of new products to enhance the competitive advantage of enterprises. Finally, SCM helps to establish a supply chain management system with the help of information technology. Standardization of report information format and efficient order inspection operations can be achieved, unnecessary warehousing operations can be eliminated, and storage space can be utilized more efficiently. SCM also enables supply and delivery operations to respond to customer needs in a timely manner.

The SCM module should include the following items: demand planning (forecasting), order promising (taking into account delivery time and constraints), strategic network optimization (for determining which market, product, and operational services to target), supplier management, inventory management, customer relationship management, production and distribution planning, production scheduling, transportation planning, and transportation execution. In the context of sustainable supply chain management, one crucial aspect that is often overlooked is the management of raw material supply. Failure to control the raw materials can result in a malfunction of the entire supply chain.

Resource sustainability management of utilities and supply chains

However, the sustainable management of supply chains often overlooks the upstream issue of raw material supply. Failure to control raw materials can cause dysfunction in the entire supply chain. A further important issue in raw material management is the acquisition of key components, such as rare earths. Similarly, utilities are often neglected in supply chain management, and companies assume that the government is responsible for their adequate supply. Utilities include electricity, water supply, waste treatment, sewage treatment, gas supply, transportation, and communications. While public utilities are typically operated by government agencies, public enterprises, or government-chartered companies, the problem of effectively managing finite resources such as water is complex, particularly when multiple units or countries are involved.

To address this, the new supply chain thinking must include front-end public resources as an indispensable part of management. For example, Taiwan's Hsinchu Science Park faced dissatisfaction from manufacturers due to an unstable power supply, demonstrating the impact of public services such as water, drainage, and transportation on the stability of the supply chain. Therefore, this article emphasizes the importance of including these basic utilities in sustainable supply chain management.

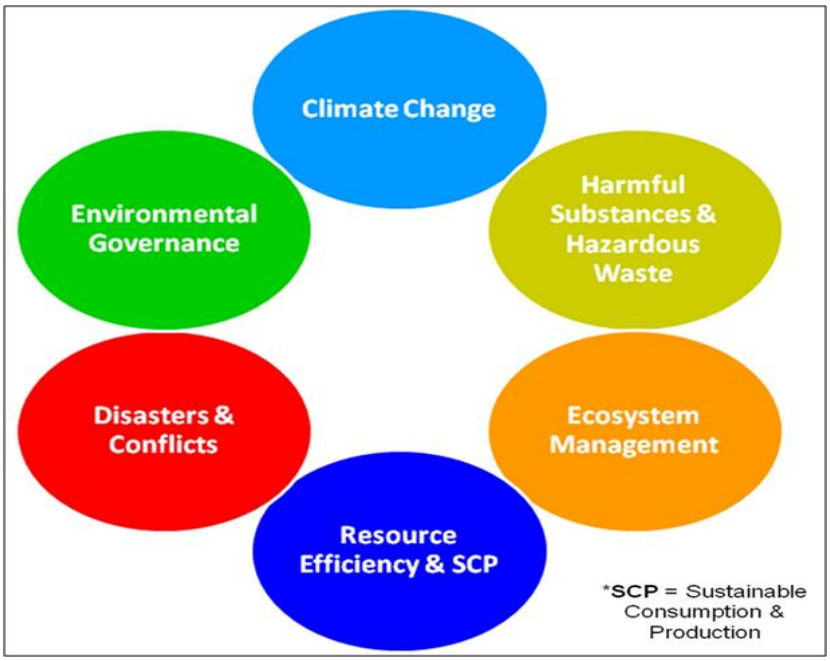

Figure 1 Sustainable supply chain management considering environmental resources

The research question and research object of this thesis are defined

Based on the preceding discussion, this paper aims to examine the sustainable operation and management of the supply chain by exploring the allocation of water rights in the Lancang Mekong River Basin. The Lancang Mekong River Basin, the most significant river basin in the Indochina Peninsula, has the potential to impact the reorganization of the world's supply chain. Therefore, this study will focus on the following three issues regarding the allocation of water resources and its potential consequences:

The significance of water in supply chain management

Potential challenges that may arise in the allocation of water rights in the Lancang-Mekong River Basin (Middleton & Devlaeminck, 2021) One of the key concerns regarding the industrial chains in the Lancang and Mekong basins is the potential impact of water supply issues in the future. This concern arises from the construction of dams in China, which can disrupt the downstream water flow. The downstream regions, encompassing significant agricultural areas and prospective sites for essential industries, are particularly vulnerable. Insufficient water supply in these areas may lead to conflicts over water resources. (Hecht,et AL., 2019)

Literature review

What are the main reasons affecting the sustainable management of the industrial chain?

Traditional supply chain management aims to optimize efficiency and customer satisfaction by coordinating purchasing, production, inventory management, and transportation among all participants in the supply chain. Through assessing and improving supply chain management, many businesses have saved significant time and costs. However, a sustainable supply chain goes beyond this and focuses on measuring and improving the environmental and human impact of products throughout the supply chain, including sourcing raw materials, production, warehousing, delivery, and every transportation step in between. The goal is to minimize environmentally harmful factors such as energy use, water consumption, and waste generation while positively impacting the people involved in the operation and surrounding communities. These additional concerns highlight the need for traditional enterprises to consider supply chain management beyond revenue and profit.

Supply chain management involves both controllable and uncontrollable factors. Managers can control factors such as supply chain operations, branding, investor relations, corporate culture, and regulatory compliance. However, key components, natural resources, and political factors are uncontrollable and are managed through supply chain risk management. Supply chain risk refers to the process of managing the risk of unexpected or changes in the supply chain that affect the system.

Basic industrial facilities and sustainable industrial chain

The provision of basic industrial facilities such as electricity, water, and transportation and telecommunications services are crucial for industrial development. However, in the context of sustainable development, there is a growing need to innovate and adopt circular economy principles in the supply chain. Innovation is key to achieving sustainability, and circular economy and data-driven supply chains are two important paths to achieve this. In this regard, this paper focuses on the sustainable management of electricity, water, and transportation and telecommunications. Electricity is an essential element for the operation of high-tech industries and its stable supply is crucial for industrial development. Similarly, a stable and clean source of water is necessary for smooth plant operation. Therefore, the development of the industry should be premised on the provision of these two basic needs. Additionally, transportation services play a critical role in ensuring that finished products reach their destination on time, which requires careful attention in supply chain management.

Research methods

Investigation on the use of water sources in the Lancang Mekong River Basin

This study aims to investigate the current state of water usage in the Lancang Mekong River Basin and its impact on the industrial chain's future development in this important region. The methodology employed is document analysis, a systematic procedure for reviewing and analyzing documents that involves evaluating a wide range of materials such as books, periodicals, newspapers, diaries, and printed or electronic materials

(Bowen, 2009). The evaluation process involves a systematic review of these documents without the intervention of researchers. This study utilizes literature analysis to assess hydrological evidence, including direct and indirect human impacts on water resources, as well as the impact of international agreements on water resources management.

This article employs a comprehensive analysis approach to explore various texts and examine their implications, culminating in the formulation of research conclusions. To ensure the reliability of these conclusions, a meticulous examination of different arguments is conducted, emphasizing objectivity. Distinct from quantitative analysis methods, this study adopts a comprehensive analysis perspective, allowing for an in-depth analysis of the significant economic and management characteristics of the Lancang-Mekong River Basin. The selection of measurement indicators differs from previous studies, as water resources are chosen as the focal point. Given that water resources serve as a common factor in supply chain management, they are deemed a suitable and credible indicator. Furthermore, evaluating the stability of the supply chain using water resources as a management indicator represents an innovative approach in this study.

Analysis of water rights disputes in the Lancang and Mekong River Basins

For a prolonged period, water resource utilization in the Lancang Mekong River Basin has not posed any issue. However, in recent years, due to the economic growth of coastal regions, the demand for water resources has surged substantially, leading to an imbalance in the distribution of water resources. This phenomenon is a crucial analysis parameter for us to scrutinize the industrial supply chain. (Hung, 2020)

Results and discussion

Overview of the use of water sources in the Lancang Mekong River Basin

The Mekong River, stretching 4,350 kilometers, is one of the longest rivers in the world and the longest in Southeast Asia. Originating from the Qinghai-Tibet Plateau, the river's upper reaches are called the Lancang River, flowing through three provinces of China, namely Qinghai, Tibet, and Yunnan. As it flows down, it passes through Thailand, Laos, Myanmar, Cambodia, and Vietnam before emptying into the South China Sea (Ouyang, 2016)

Figure 2 Location map of the Lancang Mekong River Basin

The Mekong River Basin is one of the most important river systems in Southeast Asia, spanning a total length of 4,350 kilometers and flowing through six countries. The lower basin is home to approximately 60 million people who rely on its abundant water resources for their livelihoods. However, in recent years, the water levels in the lower Mekong have been decreasing, causing significant disruptions to fishing and agricultural activities. According to a study conducted in the United States, above-average humidity was observed at the source of the watershed from May to October 2019, but below-average humidity in the Loyas and Thailand regions, with Thailand experiencing severe drought. Some experts attribute the declining water levels to China's construction of 11 dams in the upper Mekong basin, which could reduce water levels by up to two-thirds in the lower basin. However, the Chinese government has claimed that reduced rainfall is the cause of the drought. The Thai government has criticized the limited data that China has shared with the six countries and has requested more information. In August 2020, the Lancang-Mekong Cooperation (LMC) held a virtual summit to address the issue of the Mekong River's record-low water levels for the second consecutive year. The Mekong River Commission (MRC) has also highlighted the need for China to provide more data. As noted by Ouyang (2016), the capitals of Laos and Cambodia are situated along the Mekong River, and Thailand and Vietnam rely heavily on the river for rice production. Hydropower, which involves the transfer of water from the rainy to the dry season through reservoir storage, has been a significant factor in water management in the region. However, it can lead to droughts, river destruction, ecological changes in water bodies, and dam collapse, as highlighted by Campbell (2009). The Mekong's water resources mainly come from rain and snow-capped mountain meltwater, as noted by Ouyang (2016). Beech (2020) reported that water levels in China

were above average in 2019, but downstream countries suffered from severe drought, with some areas experiencing complete drying up of the riverbed. Dams in China have blocked over 125 meters of water resources, as per one study. (The News Lens. 2020) (Tiezzi, 2020)

Table 1 Basic information of Lancang-Mekong River Basin

No.	Item	Detail
1	Length	4,350 km
2	Discharge	16,000 m^3/s
3	Source	Lasagongma Spring
4	Mouth	Mekong River Delta
5	Countries	Vietnam, Thailand, Laos, Cambodia, China, Myanmar (Burma)
6	Cities	Ho Chi Minh City, Vientiane, Phnom Penh, Nong Khai, Krong Kampong Cham
7	Bridges	Thai–Lao Friendship Bridge No.1, MORE

The role of water in supply chain management

The secure and consistent supply of water is a crucial aspect of supply chain management. However, recent data has left many industry managers uncertain. According to a report by the Stimson Center, a US-based think tank, rainfall during the first six months of 2019 was above average, leading to increased water storage in Chinese dams. Nonetheless, countries in the Lower Basin have faced unprecedented droughts (Eyler & Weatherby, 2020). It has also been suggested that if China's dams did not impede water flow, sections of the Mekong along the Thai-Laos border would have had above-average flows from April 2019 to the present, instead of experiencing severe drought conditions (Eyler & Weatherby, 2020).

What problems may arise in the allocation of water rights in the Lancang Mekong River Basin?

The lack of a fair and reliable mechanism for water rights allocation has led to a series of environmental problems that have directly impacted the stability of water supply in the region. Some of the most significant water-related disasters include droughts, floods, and dam collapses. Despite the Third Lancang-Mekong Cooperation Leaders' Meeting held on August 24, 2020 Grünwald, R. (2021). which aimed to reach a consensus among the countries, these disasters continue to cause damage (Basist & Williams, 2020).

Changes in water ecology

Alterations in the water ecology have compelled numerous farmers in Chiang Rai, Thailand to relocate their farms to higher ground to evade artificial flooding. Consequently, the agricultural yield, including sprouts, has been significantly impacted, with a noticeable reduction in the number of bean sprout fields (BBC, 2018). The resultant ecological changes, including the impact on plants, birds, and aquatic animals, are a major cause for concern among biologists. (Godoy, 2019)

Dam collapse

The collapse of Saddle Dam D in Laos in 2018 had significant impacts on the region. On July 23, approximately 500 million cubic meters of water were released, leading to flooding, and causing extensive damage in at least seven villages. (Doquese, 2020; Kailu. 2010) The incident resulted in the loss of over 20 lives, with hundreds more reported missing. Furthermore, approximately 7,000 individuals were forced to evacuate, and 14 bridges were destroyed. The Lao government declared the affected area a National Emergency Disaster Zone (NCDR, 2021)

Table 2 The Collapse of Saddle Dam D in Laos (NCDR 2021) (STIMSON, 2021)

month	date	time	Description
July	22nd	21:00	Engineers found more than 10 cracks in Saddle Dam D, and the Laos authorities notified populations downstream to evacuate. However, heavy rain damaged the road and the repair team cannot fix the cracks.
July	23rd	03:00	Released water from the main dam to lower the water level.
July	23rd	12:00	Dam problems were not controlled, and the Laos government evacuated downstream residents.
July	23rd	20:00	Dam collapsed and flooded villages downstream with about 500 million cubic meters of water.
July	24th	09:30	At least seven villages were flooded, more than 20 people killed, hundreds missing, about 7,000 evacuated, and 14 bridges destroyed.
July	26th		The South Korean government sent rescue team to help.

River Destruction

The Thai government announced in December 2017 that the Chinese government had agreed to stop blasting. However, the blasting had already altered the ecological environment, and the construction of dams had a negative impact on water resources and fishing activities. As a result, it can be observed that the river's ecology has been disrupted, with over 125 meters of water resources blocked. (Grunwald, 2020). (Middleton & Devlaeminck, 2021)

The Change of Lancang-Mekong River Basin

Satellite data has revealed that surface humidity in China's Yunnan province was above average from May to October 2019, while water levels in Thailand and Laos were three meters below average, suggesting that no water was released downstream even during the monsoon season (Reuters, April 2020). Data also showed that while the Tibetan Qingqing Plateau, the source of the Mekong River, did not experience drought, downstream countries such as Cambodia and Thailand faced severe water shortages

What industrial chains may be affected by water supply in the Lancang and Mekong basins?

The ecological changes in the river basin have had a significant impact on the future economic development of the region. In recent years, Thailand, Vietnam, Laos, and other countries have seen a continuous influx of foreign investment, leading to the rapid formation of new industrial clusters. The instability of the water supply due to the aforementioned changes may seriously hinder the future industrial development of the region. To understand the possible impact, this study compiles and analyzes potential new industrial clusters in the Lancang and Mekong basins and predicts their possible impact.

Greater Mekong Subregion Economic Cooperation (GMS).

Source: MRC Strategic Environmental Assessment: ICEM, 2010
*Initially proposed as a 3,300 MW project, 465 MW and 2,600 MW options have also been studied.

Figure 3 Regional map of economic cooperation in the Greater Mekong Subregion

In 1992, the Greater Mekong Subregion Economic Cooperation (GMS) mechanism was launched, including China's Yunnan Province and Guangxi Zhuang Autonomous Region, Cambodia, Laos, Myanmar, Thailand, and Vietnam, with a total area of 2,568,600 square kilometers and a population of approximately 326 million. The region has rich resources, including water, biological, and mineral resources, with tremendous economic potential and development prospects. However, this also means that in future economic development, all countries will have a high demand for water resources. (Grunwald, 2020; Rafaeli & Raban, 2005)

The GMS project covers seven areas of cooperation: transport, energy, telecommunications, environment, tourism, human resources development, and trade and investment. It is expected that there will be a high demand for utilities in the region in the future. Based on the "three vertical and two horizontal" transportation corridors, the GMS Economic Corridor will be built into an economic belt integrating industry, trade, and infrastructure, leading to rapid economic development. The "three verticals" are north-south, and the "two horizontals" are east-west (see Table 2)

The construction of the sub-regional economic corridor will strengthen economic and technological cooperation in the region and gradually improve the overall economic level. However, it also means that the industrial chain will accelerate its formation, leading to greater pressure on water demand.

Table 3 Areas through which the GMS Economic Corridor passes

direction	numbering	route
Longitudinal	Longitudinal 1	Kunming, Yunnan - Dali, Yunnan - Dehong in Yunnan - Mandalay, Myanmar - Yangon, Myanmar
	Longitudinal 2	Kunming, Yunnan - Xishuangbanna, Yunnan - Laos - Bangkok, Thailand
	Longitudinal 3	Kunming, Yunnan - Honghe in Yunnan - Hanoi, Vietnam - Haiphong in Vietnam
across	Horizontal 1	Mawlamyine, Myanmar – Phitsanulok, Thailand – Savannakhet, Laos – Da Nang, Vietnam
	Horizontal 2	Yangon, Myanmar – Bangkok, Thailand – Phnom Penh, Cambodia – Ho Chi Minh City, Vietnam.

Eastern Economic Corridor of Thailand

The Eastern Economic Corridor (EEC) represents the most significant investment plan by the Thai government over the last 30 years. The plan involves setting up economic zones in Chachoeng, Chonburi, and Rayong provinces on the eastern coast, coupled with developing infrastructure and a range of investment preferential policies. The objective is to transform eastern Thailand into a world-class economic, trade, transportation, and logistics center that integrates sea, land, and air transportation systems. The EEC area covers a total land area of 30,000 rai (1 rai = 1,600 square meters) in Chon Buri, Rayong, and Chachoengsao. Four large-scale infrastructure projects are currently underway in the EEC: (1) high-speed rail connecting

Suvarnabhumi, Don Mueang, and U-Tapao airports; (2) U-Tapao Airport Renovation Project; (3) Map Ta Put Industrial Port Phase 3 Expansion; and (4) Laem Chabang Port Phase 3 expansion project. The total investment for these projects is 620 billion baht (about NT$529.3 billion), with an actual investment of 10 billion baht (about NT$8.5 billion) expected this year. The EEC aims to attract investment in 12 S-curve industries, including automotive, smart electronics, medical and health tourism, agriculture and biotechnology, food, industrial robotics, logistics and aviation, biofuels and biochemistry, digital technology, medical services, defense, and education development. However, given the EEC's proximity to the Lancang-Mekong River basin, competition for water and electricity resources may put significant pressure on the distribution of water resources in this region.

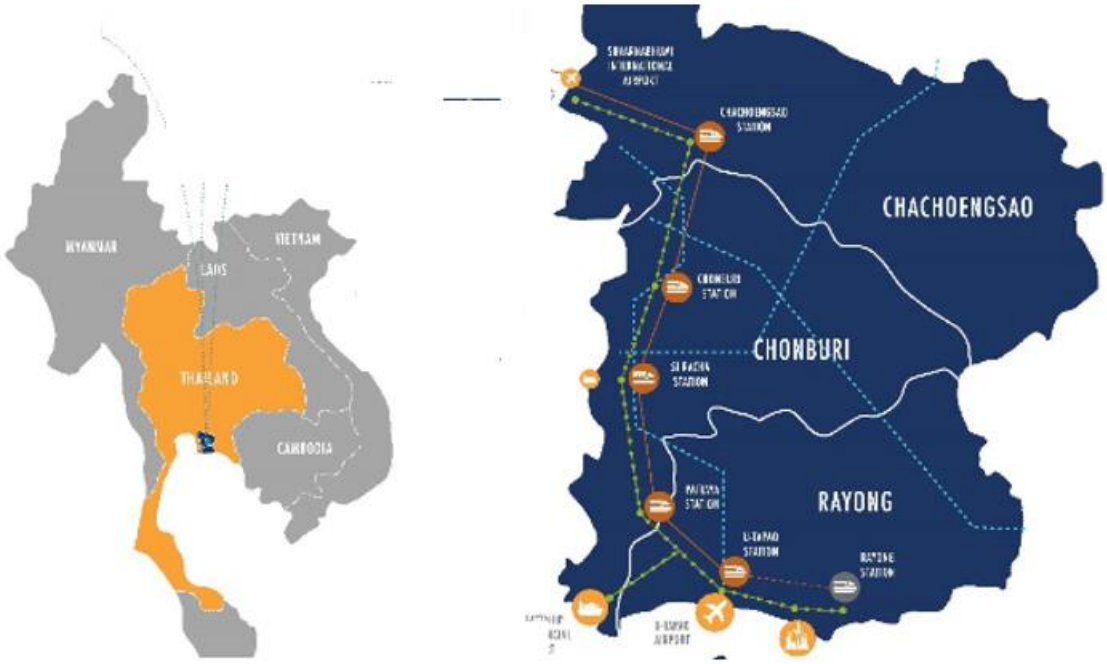

Figure 4 Regional Map of Thailand's Eastern Economic Corridor

Industrial and agricultural areas in southern Vietnam

The lower reaches of the Lancang Mekong River Basin flow into the southern coast of Vietnam, which is the country's most significant agricultural area and the fastest-growing economic region. The Southern Key Special Economic Zone (SKEZ) comprises eight provinces and cities, including Ho Chi Minh City, Binh Duong, Dong Nai, Long An, Ba Ria Vung Tau, Binh Phuc, Xining, and Qian Giang. Due to its proximity to shipping and low transportation costs, the SKEZ focuses primarily on light industry, furniture manufacturing, and other low-value, high-volume products. Ho Chi Minh City is one of the country's economic centers, comparable to Shanghai, China, and has the most developed industries, such as textiles, machinery, sugar refining, and rice milling, accounting for about a quarter of Vietnam's total industrial output value. To promote foreign investment and expedite infrastructure development, the Linh Trung Export Processing Zone and Tan Thuan Export

Processing Zone have been established. Ho Chi Minh City is a crucial transportation hub in the south, and its port network, with the port of Saigon at the center, accounts for 67% of Vietnam's total port throughput. However, Vietnam's competitive advantages, such as low labor and land costs, are diminishing due to the global trend of manufacturing and processing transfers. For instance, the rental price of industrial land in the Giang Dien Industrial Park in Dong Nai province has risen from US$60 to US$70 in 2017/square meter to $90/square meter in early 2019, and in some regions, it has reached $130 per square meter, similar to industrial parks in major Chinese cities. This development underscores the controversy surrounding the region's industries and their water resource competition in the Mekong River Basin.

Table 4 Major industries in industrial zones in southern Viet Nam

No.	category	description
1	Textile and Garment:	The textile and garment industry is one of the largest industries in southern Vietnam, with many industrial zones dedicated to the production of fabrics, clothing, and accessories.
2	Electronics	With the rise of electronic devices, the electronics industry has become an important sector in southern Vietnam. Many industrial zones in the region specialize in the manufacturing of electronic components and devices.
3	Food and Beverage:	The food and beverage industry is another major industry in southern Vietnam, with many industrial zones dedicated to the production of food and drink products such as seafood, rice, coffee, and beer.
4	Plastics:	The plastics industry has experienced significant growth in southern Vietnam, with many industrial zones producing a range of plastic products, including packaging materials, containers, and consumer goods.
5	Chemicals:	The chemical industry in southern Vietnam includes the production of a wide range of chemicals, such as fertilizers, pesticides, and cleaning agents.
6	Mechanical engineering:	The mechanical engineering industry in southern Vietnam includes the production of a range of machinery and equipment, including automobiles, motorcycles, and industrial machinery.
7	Construction materials:	The construction materials industry in southern Vietnam includes the production of a range of building materials, such as cement, bricks, and roofing materials.
8	Leather and Footwear:	The leather and footwear industry is another major industry in southern Vietnam, with many industrial zones specializing in the production of shoes, bags, and other leather goods.

Conclusions and Recommendations

In conclusion, this study sheds light on the critical issue of water supply in the Lancang-Mekong River Basin and its importance for sustainable industrial development in the region. The paper highlights the need to consider water supply as an integral part of supply chain management, and to ensure equitable and stable access to water resources for all users. The proposed framework provides a preliminary guide for water management practices in the region, promoting sustainable development and informed decision-making. As the Lancang-Mekong River Basin continues to face challenges related to population growth, economic development, and climate change, effective water management practices are essential to ensure the long-term availability and sustainability of this critical resource. By adopting a holistic approach that considers water supply as an integral part of the supply chain, we can create greater value for all water users and contribute to a more sustainable future for the region.

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Moving Towards Sustainable Supply Chains in Cambodia: A Comprehensive Analysis

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Abstract

This article presents a study on sustainable supply chain management (SSCM) practices in Cambodia, a developing country. The introduction provides background information on the Cambodian supply chain and highlights the importance of SSCM. The research aims and objectives, as well as the study scope and limitations, are also discussed. The literature review examines the definition and importance of SSCM, challenges and opportunities for SSCM in developing countries, and provides an overview of sustainable supply chain management practices in Cambodia, including successful case studies. The methodology section outlines the study design, data collection and analysis methods, as well as methodological limitations. The results and analysis section presents an overview of current supply chain practices in Cambodia, identifies gaps, and challenges, and analyzes current SSCM practices. Finally, recommendations are provided to improve sustainable supply chain management practices in Cambodia, and the conclusion summarizes the findings of the study.

Keywords: Supply chain, Sustainable management, Cambodia, developing countries, regional economy

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Introduction

Functions and Main Components of Supply Chain Management

Cambodia has emerged as a key manufacturing hub in the Asian region due to its favorable location, abundant natural resources, and skilled workforce. However, in the era of increasing global emphasis on sustainability and supply chain responsibility, Cambodian companies must also focus on sustainable supply chain management to remain competitive. The aim of this study is to conduct a thorough analysis of existing supply chain practices in Cambodia and identify the challenges and opportunities in sustainable supply chain management. The findings of this study will provide practical recommendations and references to Cambodian enterprises and other developing countries on how to improve sustainable supply chain management. The study will contribute to the ongoing discourse on sustainable supply chain management, which is gaining significant attention globally. For instance, recent research by (Reyes-Soriano et al., 2022) highlights the importance of sustainability initiatives in supply chain management for firm competitiveness and long-term sustainability. Table 1 is the recent GDP of Cambodia and other ASEAN countries. (ASEANStatsDataPorta, 2023a)

Table 1. Gross domestic product, at current prices (nominal), in US dollars

Country	Currency	2017	2018	2019	2020	2021
Brunei Darussalam	Dollar (B $)	16.7	18.3	18.4	16.6	18.8
Cambodia	Riel	89,831	99,544	110,014	105,892	110,506
Indonesia	Rupiah (Rp)	13,589,826	14,838,756	15,832,535	15,434,152	16,970,789
Lao PDR	Kip	140,698	152,414	162,657	172,919	184,982
Malaysia	Ringgit (RM)	1,372.3	1,447.8	1,512.7	1,418.0	1,545.4
Myanmar	Kyat	90,451	92,789	105,259	112,770	108,206
Philippines	Peso (PhP)	16,557	18,265	19,518	17,939	19,387
Singapore	Dollar (S $)	473.9	508.5	512.2	476.4	533.4
Thailand	Baht	15,489	16,373	16,892	15,637	16,179
Viet Nam	Dong	5,005,975	5,542,332	6,037,348	6,293,145	8,398,606

Source: ASEAN Secretariat Database, compiled/computed from country data submission, publications and/or websites of ASEAN Member States' National Statistics Offices (NSOs), Central Banks and relevant government agencies, and from the International Monetary Fund World Economic Outlook (IMF WEO) Database Oct 2019 (ASEANStatsDataPorta, 2023a).

Background information on Cambodia's supply chain

Cambodia is an important manufacturing hub in Southeast Asia, benefiting from its abundant natural resources and labor force, which have attracted many multinational companies to the region. The country's main exports include textiles, clothing, leather products, and electronics, with textiles and clothing being the most significant export commodity. However, Cambodia's supply chain is predominantly controlled by foreign multinationals, with the participation of local manufacturers, contractors, and retailers. The supply chain faces numerous challenges, including inadequate infrastructure, weak regulations, and suboptimal labor quality, which can negatively affect the productivity and competitiveness of Cambodian enterprises. Therefore, achieving sustainable supply chain management is critical for Cambodian companies and the entire supply chain. This study aims to identify the challenges and opportunities for sustainable supply chain management in Cambodia and provide recommendations for enhancing sustainability in the supply chain. The research will contribute to the ongoing discourse on sustainable supply chain management, which is gaining significant attention globally. For instance, recent research by (Köksal et al., 2017) highlights the importance of sustainable supply chain practices for environmental and social performance in the textile industry. Table 2 is the GDP per capita of ASEAN countries. (ASEAN Stats Data Porta, 2023b)

Table 2 Gross domestic product per capita, at current prices (nominal), in US dollars

Country	2017	2018	2019	2020	2021
Brunei Darussalam	28,806.1	30,642.1	29,403.7	26,462.1	32,383.1
Cambodia	1,415.7	1,539.8	1,685.7	1,588.9	1,603.0
Indonesia	3,880.1	3,937.2	4,200.4	3,919.8	4,348.6
Lao PDR	2,456.6	2,580.3	2,621.4	2,621.8	2,693.3
Malaysia	10,036.2	11,066.5	11,207.9	10,361.6	11,399.7
Myanmar	1,260.0	1,417.1	1,223.8	1,280.1	1,314.4
Philippines	3,134.1	3,261.2	3,512.0	3,323.6	3,552.5
Singapore	61,190.6	66,799.9	66,034.5	60,716.3	72,399.7
Thailand	6,745.5	7,468.7	8,001.8	7,333.0	7,645.3
Viet Nam	2,376.2	2,528.2	2,713.2	2,785.3	3,674.4
ASEAN	**4,370.0**	**4,626.9**	**4,841.5**	**4,536.0**	**5,024.2**
ASEAN 6[1/]	5,246.4	5,544.0	5,815.7	5,382.8	5,871.3
CLMV[2/]	1,940.9	2,091.2	2,149.4	2,198.7	2,703.0

Source ASEAN Macroeconomic Database (compiled/computed from data submission, and/or websites of ASEAN Member States' national statistics offices and relevant government agencies

Notes Data is computed by dividing GDP in US dollar term by the projected midyear population for the respective year.

1/ ASEAN 6 consists of Brunei Darussalam, Indonesia, Malaysia, Philippines, Singapore, and Thailand

2/ CLMV comprises Cambodia, Lao PDR, Myanmar, and Viet Nam (ASEANStatsDataPorta, 2023b).

The importance of sustainable supply chain management

The global emphasis on sustainable development and the increasing demand for supply chain responsibility has made achieving sustainable supply chain management an essential goal for many enterprises. Sustainable supply chain management involves the consideration of environmental, social, and economic factors to achieve long-term sustainability and social and environmental responsibility. If Cambodian companies can achieve sustainable supply chain management, they can meet global demand for sustainable products and services, while also gaining the following important benefits:

Firstly, achieving sustainable supply chain management can improve a company's reputation and brand value. Companies that meet the growing demand for sustainable products and services can attract and retain consumers, thereby increasing market share. Research by (Chen et al., 2018) shows that sustainable supply chain practices have a positive effect on consumer perception and purchase intention.

Secondly, achieving sustainable supply chain management can reduce risks for businesses. In the globalized environment, supply chain risks are increasing, such as natural disasters, political unrest, labor rights, and other issues. Sustainable supply chain management can help companies build more robust and secure supply chains, reducing risk and uncertainty. According to recent research by Meyer et al. (2021), sustainable supply chain practices can mitigate supply chain disruption risks.

Finally, achieving sustainable supply chain management can improve the competitiveness of enterprises. Sustainable supply chain management can not only reduce costs and improve production efficiency, but also enhance the innovation and market development capabilities of enterprises, thereby maintaining a competitive advantage. Research by (Arda et al., 2023) suggests that sustainable supply chain management can improve the operational performance and competitiveness of firms.

In conclusion, achieving sustainable supply chain management is a necessary way for Cambodian enterprises to move towards sustainable development. The benefits of sustainable supply chain management include improving reputation and brand value, reducing supply chain risks, and enhancing competitiveness. These benefits align with the global trend towards sustainable development and supply chain responsibility.

Research aims and objectives

The objective of this study is to explore the feasibility and necessity of sustainable supply chain management through a comprehensive analysis of the current situation and challenges of supply chains in Cambodia. Specifically, this study aims to achieve the following objectives:

First, to understand the current situation and characteristics of Cambodia's supply chain, including the industrial structure of Cambodia's supply chain, the roles and relationships of supply chain participants, and the operating mode of the supply chain. By gaining insight into the current state of supply chains in Cambodia, it is possible to better understand the challenges and opportunities of supply chain management (Dhillon et al., 2023).

Second, to analyze the sustainability challenges and issues facing Cambodia's supply chain, such as environmental, social and economic aspects, as well as labor rights, human rights, corruption and other issues.

Through an in-depth analysis of sustainability challenges and issues in the supply chain, the necessity and urgency of supply chain management can be better understood (Gimenez & Sierra, 2013).

Finally, to explore the feasibility and strategies of Cambodian enterprises to achieve sustainable supply chain management. By considering Cambodia's economic, political, and cultural factors, this study will propose a series of feasible strategies and recommendations to help Cambodian enterprises achieve sustainable supply chain management to achieve long-term sustainable development and social and environmental responsibility. Silva et al., (2022).

By achieving these objectives, this study will contribute to the literature on sustainable supply chain management in developing countries, and provide practical recommendations for Cambodian enterprises to improve their supply chain management practices.

Study scope and limitations

The research scope of this study is Cambodia's supply chain, focusing on Cambodia's industrial structure, the roles and relationships of supply chain players, the operating model of the supply chain, and the challenges and issues of sustainable development in the Cambodian supply chain. The research method is mainly carried out by comprehensive analysis, combined with literature research and field investigation.

However, this study also had its limitations and limitations. First of all, due to time and resource constraints, this study will select some industries in the Cambodian supply chain for research, which may not cover all industries. Secondly, this study may face some difficulties and challenges when conducting field research due to factors such as language and cultural differences. Finally, the conclusions and results obtained in this study are only representative of the situation within the scope of the study and are not necessarily universal and extensive.

Literature Review

Definition and importance of sustainable supply chain management

Sustainable supply chain management has gained significant attention in contemporary business as an effective approach to attain social, environmental, and economic sustainability objectives. It encompasses managing the entire supply chain operations in an environmentally friendly, socially responsible, and economically viable manner to realize sustainable development goals. Sustainable supply chain management offers numerous benefits to companies, such as reducing operating costs, improving market competitiveness, enhancing corporate image, and mitigating environmental pollution and resource waste. Furthermore, it fosters collaboration and communication among supply chain participants to achieve supply chain integration. In the field of sustainable supply chain management, numerous scholars and experts have contributed to valuable theories and practical experiences. For instance, sustainable supply chain management can be analyzed through the lens of supply chain transparency, green procurement, environmental management, social responsibility, supplier evaluation, among others. Thus, examining Cambodia's supply chain situation, its development status, and challenges through the prism of sustainable supply chain management will contribute

to promoting sustainable development goals in Cambodia (Do et al.,2020; Panigrahi et al., 2019; Villena & Gioia, 2020).

Challenges and opportunities for sustainable supply chain management in developing countries

The implementation of sustainable supply chain management in developing countries presents both challenges and opportunities. One of the primary challenges is the lack of advanced technology and resources, which can hinder the implementation of sustainable supply chains Moreover, the importance that governments place on sustainable development varies from country to country, which may result in flawed policy implementation and regulations. However, developing countries also have significant opportunities to promote sustainable development. Due to their smaller environmental and social impact, they can more readily adopt sustainability concepts and practices (Esfahbodi et al., 2016). Additionally, developing countries often possess abundant natural resources and low-cost labor, which provide opportunities for sustainable supply chains. Therefore, it is crucial to conduct in-depth research on the challenges and opportunities for achieving sustainable supply chain management in developing countries to support their sustainable development goals.

An overview of sustainable supply chain management practices in Cambodia

Cambodia, as a developing country, is making efforts to adopt sustainable supply chain management practices. The Cambodian government has introduced policies and measures to promote sustainable supply chain management practices, such as the Cambodian Industrial Development Policy Red Paper and the Cambodia Sustainable Development Policy Red Book (Helldén et al., 2022). In addition, some industries in Cambodia have also begun to adopt sustainable supply chain management practices, such as the textile and footwear industry. In this industry, Cambodian companies are actively implementing sustainable supply chain management principles such as green production, energy conservation, and human rights protection (Homlong & Springler, 2016). These companies are achieving sustainable supply chain management by adopting greener production technologies, improving employee welfare, and protecting labor rights. However, Cambodia still faces challenges and problems in promoting sustainable supply chain management, such as poor policy implementation and lack of advanced technology and talent. Therefore, it is necessary to conduct further research to explore the current situation and challenges of sustainable supply chain management practices in Cambodia and how to promote the development of sustainable supply chain management in Cambodia.

A successful case study of sustainable supply chain management in Cambodia

Cambodia, with abundant natural resources and low labor costs, has attracted numerous foreign enterprises to invest and carry out production activities. However, in the past, Cambodia's supply chain management faced several issues, such as labor, environmental and corporate social responsibility issues. To address these issues, the Cambodian government has started to actively promote sustainable supply chain management, and there have been some successful cases. For instance, H&M, a well-known international

brand, reduced its use of local water resources while improving farmers' livelihoods by implementing a sustainable cotton farming program in Cambodia (Arnold & Toh, 2010). Similarly, Cambodia, a Cambodian footwear manufacturer, has also achieved good results in practicing corporate social responsibility (Gugler & Shi, 2009). These success stories demonstrate the potential and benefits of sustainable supply chain management in Cambodia. By studying these cases, we can gain insights into the factors that lead to successful sustainable supply chain management in Cambodia and provide a reference for future sustainable supply chain management practices (Menon & Ravi, 2021).

Methodology

Study design

In this study, a comprehensive analysis approach will be employed to assess the sustainability of Cambodia's supply chain from economic, social, and environmental perspectives. To begin, a thorough review of Cambodian literature and materials will be conducted to investigate the theory of sustainable supply chain. Subsequently, a survey of the current state of Cambodia's supply chain will be conducted to collect related data and information. Using this information, a comprehensive analysis method will be used to evaluate the sustainability status of Cambodia's supply chain, identify the challenges and opportunities for sustainable supply chain management, and provide corresponding recommendations. This study aims to investigate the feasibility of Cambodia's transition to a sustainable supply chain and to offer practical solutions to promote the development of sustainable supply chains in Cambodia (Turker & Altuntas, 2014).

Data collection methods

To conduct a comprehensive analysis of the sustainability of Cambodia's supply chain, relevant data must be collected and analyzed. Given that Cambodia is a developing country, its supply chain practices and development are still in their early stages. Therefore, data collection will require a combination of sources, including government agencies, international organizations, academic research, and industry reports. Relevant data will be collected from Cambodia's laws, regulations, and policy documents, as well as statistics and reports on related industries, corporate social responsibility reports, and relevant data from websites and databases. During the data collection process, relevant data will be selected and screened based on its reliability, validity, and comparability. Ultimately, the collected data will be analyzed and synthesized to achieve the study's objectives. The accuracy and validity of the study's findings depend on the reliability and validity of the collected data.

According to (Seuring, 2004), data collection is a critical process for conducting a comprehensive analysis of sustainable supply chain management. In their study, the authors collected data from multiple sources, including government reports, corporate social responsibility reports, and industry publications, to analyze the sustainable supply chain practices of a Chinese manufacturer. The authors highlighted the importance of ensuring data quality by selecting and screening relevant data based on its reliability, validity, and comparability.

Data analysis methods

In this study, a comprehensive analysis method will be used for data analysis. Comprehensive analysis is a method that combines quantitative and qualitative research methods, extracts, and analyzes data from multiple studies synthetically, and these data can be compared and statistical. Before conducting a comprehensive analysis, a literature review will be conducted to understand the current state of Cambodia's supply chain and the challenges of sustainable development. An evaluation framework will then be designed to explore the sustainability performance of Cambodia's supply chain and identify success stories and shortcomings. Assessments will be conducted from policy, environmental, social, and economic perspectives, and analyzed using qualitative and quantitative data. Finally, some actionable recommendations will be made to help Cambodia achieve sustainable supply chain management for economic, environmental, and social sustainability (Nachmias, 1999).

Methodological limitations

There are some limitations when conducting the methodological design of this study. First, we may be subject to data collection limitations due to data constraints on sustainable supply chains in Cambodia. This means that we need to rely on open sources of information and existing literature to obtain data. Secondly, this study adopts quantitative analysis methods, only considers the perspective of data analysis, and lacks in-depth qualitative analysis. Therefore, the conclusions of this study should be considered as an overview of sustainable supply chains in Cambodia, not representative of all scenarios, and more research is needed to further validate and support it. In addition, due to time and resource constraints, this study may not be able to conduct a detailed investigation and analysis of all aspects of Cambodia's sustainable supply chain, and further research and in-depth exploration are still needed.

Results and Analysis

An overview of current supply chain practices in Cambodia

Cambodia faces significant challenges in the development of its supply chain, including limited resources, weak infrastructure, and a shortage of skilled workers. The government has implemented various measures to promote supply chain development, including trade liberalization, economic diversification, legal and regulatory reform, and infrastructure improvement. However, there are still significant challenges that remain, including environmental issues, social concerns, and technological immaturity. A comprehensive analysis of Cambodia's supply chain practices reveals that there are limitations in terms of sustainable development. The supply chain is dominated by industries such as textiles, garments, and agriculture, which contribute significantly to the economy but also face environmental and social problems. For instance, there are issues related to water pollution, deforestation, and labor rights. However, some positive steps have been taken by the government and international businesses to promote sustainable supply chain practices, such as

worker training and sustainable agriculture. Cambodia's supply chain has become an essential component of its economic development through exports of textiles, footwear, aquatic products, and agricultural products. However, the COVID-19 pandemic has had a significant impact on the supply chain, exacerbating existing challenges related to infrastructure, government regulation, human resources, and environmental pollution. The Cambodian government and businesses have recognized the importance of sustainable supply chain management and have taken steps to improve infrastructure, employee treatment, and environmental protection. Yet, more investment and support are needed to achieve sustainable development of Cambodia's supply chain.

Identification of gaps and challenges in Cambodia's supply chain

A comprehensive analysis was conducted to identify gaps and challenges between Cambodia's supply chain practices and sustainable supply chain management. The analysis revealed that Cambodia's supply chain faces significant environmental and social problems, such as environmental pollution and labor rights issues, which pose a serious threat to sustainable development. Additionally, there is a lack of sustainable planning and strategies in Cambodia's supply chain, with insufficient attention given to all parties in the supply chain. Furthermore, the weak supply chain management system in Cambodia results in inadequate information exchange and cooperation.

To address these challenges, the Cambodian government and companies in the supply chain need to take measures to promote sustainable supply chain management. The government can develop and implement laws and policies that encourage sustainable practices while raising awareness and accountability among all parties in the supply chain. Moreover, companies can adopt sustainable production methods and management strategies to improve their own sustainability performance and work with other companies to promote sustainable development throughout the supply chain.

Recent studies have emphasized the importance of sustainable supply chain management in developing countries such as Cambodia. For instance, (Hoque et al., 2023), highlighted the need for regulatory frameworks that foster sustainability in Cambodia's garment industry. Similarly, the importance of stakeholder engagement and collaboration can improve the sustainability of supply chains in developing countries. Additionally, Silvestre et al. (2018) Schilling and Seuring (2022) identified the role of technology in promoting sustainable supply chain practices in developing countries.

In conclusion, sustainable supply chain management is critical for the development of Cambodia's supply chain, and addressing the identified gaps and challenges is essential for achieving sustainable development goals. The Cambodian government and companies in the supply chain must work together to promote sustainable practices, with a focus on environmental, social, and economic sustainability, and effective management of the supply chain.

Analysis of current sustainable supply chain management practices in Cambodia

Based on the data collected and analyzed, it can be concluded that Cambodia's current sustainable supply chain management practices have deficiencies that need to be addressed. Firstly, traditional industries, especially the textile and footwear industries, dominate, and the supply chains of these industries have environmental and social issues that cannot be ignored, such as emissions, pollution, labor rights, and so on. These issues affect the sustainability of Cambodia's overall economy and damage the country's business reputation (Majumdar & Sinha, 2018 ; Majumdar et al., 2020; Zeng et al., 2017). Secondly, Cambodia's supply chain still suffers from a lack of sustainable demand and support from intermediaries and buyers. Since most of Cambodia's supply chain is exported to foreign markets, if the demand for sustainability in these markets is not high, then there will be little incentive for the supply chain to change (KeleŞ & Güngör, 2021). Additionally, the Cambodian government's legal framework and implementation of sustainable supply chain management are inadequate, which makes it difficult for companies to be forced to take sustainable supply chain management actions and to obtain support and resources (Anser et al., 2021).

Overall, the deficiencies in sustainable supply chain management practices in Cambodia are mainly focused on industry, market demand, and government legal framework. Therefore, Cambodia needs to strengthen its policy framework, improve infrastructure, and upgrade its technology to further promote sustainable supply chain management practices. This will require businesses and the government to work together to achieve Cambodia's goal of a sustainable economy. The Cambodian government can develop and implement laws and policies to promote sustainable supply chain management while raising awareness and accountability among all parties in the supply chain. In addition, companies in the supply chain can adopt sustainable production methods and management strategies to improve their own sustainability performance, and cooperate and communicate with other companies to promote sustainable development throughout the supply chain.

Recommendations to improve sustainable supply chain management practices in Cambodia

Improving sustainable supply chain management practices in Cambodia is a critical issue as it can promote sustainable economic development while safeguarding local environmental and social interests. Based on the findings and analysis of the study, several recommendations can be made to enhance sustainable supply chain management practices in Cambodia. Firstly, the government needs to strengthen its regulatory and legal frameworks to control environmental and social impacts and encourage companies to adopt more sustainable practices. This can be achieved through providing financial and technical support to businesses, as well as enforcing regulations and policies. Secondly, companies should enhance their supply chain transparency and accountability by communicating with suppliers and consumers, providing product information, and promoting sustainable products. Finally, social organizations and consumers can play a role in supporting and monitoring sustainable supply chain management practices. Social organizations can provide support and

advice to companies, while consumers can promote better environmental and social performance through feedback and purchasing sustainable products.

These recommendations are consistent with previous research on sustainable supply chain management practices. For example, research has shown that regulatory frameworks are essential in promoting sustainable supply chain management practices (Barari et al., 2012), and that transparency and accountability are crucial in building trust among stakeholders (Svensson, 2007). Additionally, research has highlighted the importance of collaboration among various stakeholders in promoting sustainable supply chain management practices (Martins & Pato, 2019).

In conclusion, improving sustainable supply chain management practices in Cambodia requires collaborative efforts among the government, businesses, civil society organizations, and consumers. The proposed recommendations can serve as a guideline for promoting sustainable supply chain management practices in Cambodia, which can contribute to achieving sustainable economic development while protecting environmental and social interests.

Conclusion

Summary of findings

This study aims to comprehensively analyze the sustainable supply chain management practices and their current status in Cambodia and make recommendations for improvement. In the literature review, we find the definition, importance of sustainable supply chain management, and the challenges and opportunities faced by developing countries in implementing sustainable supply chain management. In methodology, we used questionnaires and expert interviews to collect and analyse data. In the Results & Analysis section, we provide an overview of the current state of Cambodia's supply chain practices, identify gaps and challenges with supply chains in other countries, and analyze existing sustainable supply chain management practices in Cambodia. Finally, we offer recommendations to improve sustainable supply chain management practices in Cambodia, including government-business collaboration, employee skills and awareness, and regulatory and enforcement efforts. The comprehensive analysis shows that Cambodia faces many challenges, but there are also many opportunities to take advantage of, such as strengthening international cooperation and promoting sustainable supply chain certification. Overall, improving sustainable supply chain management practices in Cambodia requires the joint efforts of the government, enterprises, and all sectors of society to further enhance the awareness and action of sustainable development.

Impact of sustainable supply chain management on Cambodia

According to the comprehensive analysis conducted in this study, the impact of sustainable supply chain management on Cambodia is significant. The current supply chain management in Cambodia faces several challenges, including an imperfect management system, low technical level, incomplete environmental protection regulations, and lack of protection of labor rights and interests, which hinder the development and sustainability of Cambodia's supply chain. However, some successful cases of sustainable supply chain

management exist in Cambodia, such as certain international brand companies making positive progress, bringing a positive impact to Cambodian supply chain management (Oka, 2010; Sok & Yu, 2015; Weinberger et al., 2008). Thus, the study proposes that the joint efforts of the government, enterprises, and all parties in society are essential to improve the sustainable supply chain management practices in Cambodia.

To achieve sustainable development, the government must strengthen the formulation and enforcement of environmental protection regulations, protect the rights and interests of workers, and promote the sustainable development of supply chain management. Enterprises should adopt technological and management innovations, enhance communication and coordination with suppliers, improve the transparency and traceability of the supply chain, and promote sustainable supply chain practices. All sectors of society should pay attention to the supply chain management in Cambodia, strengthen the supervision and promotion of enterprises and the government, and promote the realization of sustainable supply chain practices (Ansett, 2007; Durdyev et al., 2018). In summary, sustainable supply chain management in Cambodia requires the participation and efforts of the government, enterprises, and all parties in society to achieve sustainable development.

Impact of sustainable supply chain management on developing countries

With the growth of globalization, developing countries are increasingly transforming their industries to achieve sustainable economic development. Sustainable supply chain management has emerged as an important strategy to achieve this goal, improving supply chain efficiency and reliability, while reducing negative environmental and social impacts (Fang et al., 2022). This paper uses Cambodia as a case study to examine the impact of sustainable supply chain management on developing countries. Results indicate that the implementation of sustainable supply chain management can effectively enhance supply chain transparency, reduce environmental and social risks, and promote sustainable development, thereby improving enterprise competitiveness and brand value. However, the study also identifies challenges faced by Cambodia in adopting sustainable supply chain management, including insufficient training and technical support, inadequate environmental regulations, and limited cooperation among supply chain actors (Jia et al.,2018). Therefore, to achieve sustainable development, governments, enterprises, and all parties in society must work together to address these challenges (Carter & Rogers, 2008) learn from successful experiences, and establish sound systems of environmental laws and regulations.

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Applying Lean and Six Sigma Concept to Reduce Inventory Cost of SME in Thailand After Covid-19 Crisis : A Case Study of Takara Planning Company Limited

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Abstract

During COVID-19 lock down crisis, most of SMEs who are exporter, faced the problem of high inventory holding costs, especially the cost of warehouse space rental that tend to keep increasing, due to a sudden product halted and massive returned products leading to cause disorganised warehouse and improper inventory control. For SMEs, warehouse space has a significant impact on their operational cost. Once the shipment arrives at the warehouse, it becomes the warehouse's responsibility to manage the movements and transfers of the goods. The purpose of this paper is to analyse and improve the warehouse space resulting in reducing of the inventory cost of the company by applying the 5S tool and ECRS principle for Lean, together with applying Six Sigma (DMAIC) technique for problem analysis and improvement. The result showed that applying Lean Six Sigma techniques, as described in this paper, can reduce the warehouse rental cost from 8,140,000 Baht to 5,816,400 Baht by lean warehouse space from 92% to 62% occupancy. After implementing the proposed methodology, the business owner and managers saw an improvement in their warehousing operations in terms of inventory cost saving by 2,323,600 Baht and the potential of the production line expansion after COVID-19 crisis utilising the available space gained. This study illustrates that Lean Six Sigma can be applied as a 'quick-win' solution for the SMEs in Thailand after the COVID-19 Crisis.

Keywords: SMEs, COVID-19 Crisis, Lean Six Sigma, DMAIC, 5S, ECRS, Inventory Cost, Warehouse Management

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Introduction

Rationale and Significance of the Study

For the first time since the Great Depression, both advanced and emerging market economies will be in recession in 2020. The epidemic of COVID-19 is considered as a major global crisis. Aside from its unprecedented scale, the Global Lockdown is playing out in ways that are very different from past crises. The June World Economic Outlook Report 2020 was likely to show negative growth rates even worse than previously estimated by the International Monetary Fund (IMF) reported in the 2020 World Economic Outlook Report 2020, expecting that growth in Emerging and Developing Asia could decline from 5.5% to 1.0% between 2019 and 2020, projecting a sharp 'V-Shaped' recovery up to 8.5% in 2021 (International Monetary Fund, 2020). Small and medium-sized enterprises (SMEs) are significant contributors to economic activity and employment worldwide, and Thailand is no exception. In Thailand, SMEs represent most firms and employ the bulk of the domestic workforce. According to the Office of SMEs Promotion in 2018, approximately 3 million companies were classed as SMEs in the country, comprising 99.8% of all companies. SMEs also accounted for 14 million jobs, or 86% of total employment. Although SMEs contribute as much as 45% (or $215 billion) to Thailand's gross domestic product (GDP), their participation in international trade and global value chains (GVCs) remains limited. In 2018, the export volume of SMEs comprised only 29% (or $76 billion) of total exports and grew only 0.5% from the previous year. In contrast, large domestic firms and multinational enterprises dominate GVCs and therefore benefit greatly from the new opportunities that arise because of their participation. During the coronavirus disease (COVID-19) pandemic, both SMEs and large firms are experiencing disruptions in Global Value Chains (GVCs). However, SMEs are among the most vulnerable as they are relatively more labor-intensive and financially less liquid. SMEs are finding it more difficult than ever to participate in value chains. Moreover, although some SMEs are managing to engage or remain in GVCs, it is unlikely that they are fully benefiting from their participation under the current situation. According to the Office of SMEs Promotion (OSMEP, 2020), approximately 1.33 million SMEs, accounting for 44% of the GDP generated by SMEs, are affected by COVID-19, while 4 million people are at risk of being unemployed. If the situation is prolonged until the end of the year, SMEs are expected to lose more than $110 million in revenue, especially in the services sector. One of the challenges that most of SMEs who are in "made-to-order" business are facing during COVID-19 crisis is the fact that they use the Just-In-Time method of inventory management and the constant communication with their suppliers to ensure they have material inventory ready on-hand for the orders to avoid the delays to the customer. In combination with the non-systematic way of managing the warehouse and inventory system, they end up with over-stock of raw materials and bear the burden of the inventory cost. The more time passes, the more it accumulates and became causing a cash flow problem and other financial issues.

Takara Planning Company Limited is a small SME with 21 employees and executives. Its business is taking orders from overseas customers, mainly from Japan to re-packs various balloons-sets and selling to customers, as per the orders. The company exported a total of more than 400,000 sets per month, which is

worth the sales value of more than USD$1,000,000 per year, since started in December 1999 with a registered capital of 2,000,000 Baht (USD$65,000) until the beginning of 2020, the company faced the problem of a sudden stop of the orders due to the COVID-19 Crisis lock-down. The customers are more rigorous with the quality of the product. They started to emphasis on the product's quality auditing and pointed out that the company's warehouse is under the standard by mean of the warehouse layout and warehouse organizing which could impact the quality of the product and services. The company lacks a systematic warehouse management system. This results in a lack of work efficiency and further impacts on the cost of inventory due to product waste, out of date, including inventory loss, which leads to a high total cost of operation. Therefore, a quick-win solution for Takara Planning Company Ltd. focusing on improving the warehouse operation to reduce inventory cost is indeed needed amid the situation of COVID-19 where everyone is struggling for survival.

Review of Related Studies

In the development of an integrated LSS framework, the focus is on ensuring the simultaneous development of both the Lean and Six Sigma phases with the aim that the company simultaneously tackles the 'waste reduction' element. Myerson (2021) said that Lean Six Sigma is a synergized managerial concept of Lean and Six Sigma. Combining Six Sigma methods and tools with the lean manufacturing philosophy strives to eliminate the waste of physical resources, time, effort, and talent, while assuring quality in production and organizational processes. The Six Sigma methodology used for process improvement is the Define-Measure-Analyse-Improve-Control methodology, also known as DMAIC. Murray, M. (2019) pointed out that the DMAIC problem-solving method can produce significant improvements for an organization that is using the Six Sigma methodology and tools to solve existing issues by eliminating waste and improve efficiency very quickly. For SSME's businesses, the Six Sigma Strategy's DMAIC Problem-Solving Method is the ideal with to create a competitive edge that will help SSME to succeed. The DMAIC problem-solving method of Six Sigma methodology is used to solve existing issues by eliminating waste and improve efficiency very quickly by the following steps: Define: to identify problems of the company. The Fish bone diagram is used at this step to emphasis the cause-and-effect analysis, Measure: to measures and collects data regarding current process performance, Analyse: to identifies the difference between the current and desired process, this comparison shows defects in the current process, Improve: to implements solutions to remove identified defects, Control: to implements the change management procedure to ensure the changes are controlled, so the improvement is at its best (Salah & Rahim, 2019). explained how lean compares to the Six Sigma and outlines the benefits for integrating them, also discussed the existing models that describe how Six Sigma and lean fit together. The conclusion of this research confirms that Six Sigma and lean are related and share common grounds in terms of striving to achieve customer satisfaction and their integration is beneficial. The result of this study is the proposal of a new lean Six Sigma (LSS) approach and provides a detailed description of its phases developed to provide an improved approach for Continuous Improvement (CI). Regarding the use of Lean Six Sigma (LSS) in the SMEs business, Lande et al. (2016) explained in their research paper which was purposely to

identify and list critical success factors (CSFs) of Lean Six Sigma (LSS) framework affecting and influencing quality, operational and financial performance of small and medium enterprises (SMEs). The conclusion of this study was that it is important for researchers to understand the importance of CSFs and focus on vital CSFs in their studies and implementations. The study drastically reduces implementation hassles and simplifies execution for empirical studies. The findings are not restricted to India but are generalizable and can globally utilized in deciding determinants of LSS framework. The DMAIC problem-solving method of Six Sigma methodology is widely used to solve existing issues by eliminating waste and improve efficiency very quickly as presented by Smetkowska and Mrugalska (2018) in their research of how to implement the DMAIC cycle as an element of continuous improvement in practice of using Six Sigma DMAIC to improve the quality of the production process. The conclusion they had was nowadays, Six Sigma is getting more and more popular among organizations from various industries. It focuses mostly on improving production processes what leads to an increase in profitability for the company. Achieving Six Sigma level requires organizations understanding the reasons of processes variability, performing their analysis of cause and effect and the assessment of their costs. The application of DMAIC, which is one of the methods of quality improvement used in Six Sigma concept, can increase effectiveness while adequate reacting for the appearing problems. With the fact that the inventory cost has an important impact on the production cost as it includes both the raw material and the semi-finished parts in the manufacturing process. Applying Lean Six Sigma to control the inventory cost effectively was described by Hong (2017) in his study of “Implementing Lean Six Sigma to achieve inventory control in supply chain management”. This paper reports the inventory control from the perspective of manufacturing process by using statistical techniques including DMAIC, Control Chart, and Statistical Process Control. The demonstration in power meter production shows the inventory is decreased from 25% to 0.4%, which indicates the inventory control can be achieved with Lean Six Sigma philosophy and the inventory cost in production can be saved for future sustainable development in supply chain management.

The 5S Method (Sort, Set in Order, Shine, Standardise, and Sustain).

5S concept was developed in Japan and was identified as one of the techniques that enabled Just in Time manufacturing (Osada, 2017). The 5S method is a Lean strategy that helps accomplish one of the basic objectives of Lean: making problems visible and therefore able to be solved quickly. The 5S method is a Lean strategy that helps accomplish one of the basic objectives of Lean: making problems visible. Having a clean and organized warehouse makes the operation more efficient, excelling at training, communications, habits, and discipline. At the end, it helps saving time and money. A warehouse that has implemented 5S is able to identify or surface issues quickly and address the root causes and solve the problems in the short term to prevent recurrence. Rizkya et al. (2021) described in their research related to implementation of 5S methodology in warehouse that the 5S is a proven concept that able to eliminate waste in one of the Oil Packaging Industries, which has a low spare part area and is not well maintained. The development of the evaluation shows that the 5S application in the warehouse area is more suitable with the actual concept and it is necessary to improve by the 5S implementation principles. As a result, there are problems such as damaged

spare parts, which require special handling in storage, due to crushed by metal materials. Besides that, the warehouse area looks dirty, unorganized, has no clear storage boundary, and items are not stored in the right place. As a result, it isn't easy to find the things you need. The assessment is carried out on the warehouse area based on the 5S criteria, using a questionnaire containing questions to determine the condition of the warehouse department. Moreover, the application of 5S method in the SMEs was proven with the case study in India, research carried out by Dwivedi et al. (2021) for "Application of 5s Methodology in a Small-Scale Enterprise". This study showed that a very known 5s technique (lean manufacturing method) is applied in one of the small industries. After applying this technique, the results and the final effects of this technique were analyzed based on the wastages of materials, time, and other miscellaneous items. Finally, the results are concluded by comparing costs incurred before and after applying this 5s technique.

Waste reduction through ECRS principle

ECRS is one of the motion study techniques used to analyse processes in a production line. ECRS analyses processes and activities using the following core principles: E = Eliminate unnecessary work C = Combine operations R = Rearrange sequence of operations S = Simplify the necessary operations. ECRS is not only used with processes in the production line, but also used to improve warehouse operations to improve efficiency in warehouse operations. Thus, ECRS can be used as an improvement tool in administrative processes given the fact that the main aim of this method is to reduce the non-value adding activities. It enables us to determine the excess or inefficient space and time by using the simple principle of observing to find out which area or task is unproductive because there are some 'waste-of-spaces' used or 'waste-of-time' activities. Step by step according to the general principles of good management to improve work processes with the principles of ECRS, resulting in a more efficient outcome and meeting the real needs, as referred to in the research carried out by Krajungduang et al. (2021).

Objectives of the Study

1. To examine the cause of problems in work process of the warehouse which impact inventory cost of the SMEs in Thailand after COVID-19 Crisis.
2. To determine the 'quick-win' solution to reduce inventory cost of the SMEs in Thailand after COVID-19 Crisis.

Definition of Terms:

1. SMEs in this study refers to the enterprises with value of fixed asset less than THB 200 million or number of employees less than 200 persons for Manufacturing and Services SMEs or enterprises with value of fixed asset less than THB 100 million or number of employees less than 50 persons for Wholesale SMEs.
2. COVID-19 Crisis in this study refers to the impact of COVID-19, the disease caused by SAR-CoV-2, the coronavirus that emerged in December 2019, on the world caused millions of deaths around the world as well as lasting health problems in some who have survived the illness.

3. Lean in this study refers to a process improvement approach that identifies and minimizes wasted time and effort or a way of thinking about creating needed value with fewer resources and less waste.

4. Six sigma in this study refers to a process that makes use of statistics and data analysis to analyze and reduce errors or defects.

5. Inventory cost in this study refers to the costs to a business associated with the warehouse operational cost of Takara Planning Company Limited.

6. Warehouse in this study refers to a place where raw materials and finished goods of Takara Planning Company Limited are stored. It is a planned space for the efficient storage and handling of goods and materials.

7. Warehouse process in this study refers to the six fundamental warehouse processes in warehouse operation comprise receiving, put-away, storage, picking, packing, and shipping.

Research Methodology

The methodologies included both detailed analysis and basic descriptive statistics. The data collected was gathered by means of survey, interview, and observation at the warehouse of Takara Planning Company Limited in 2021, followed by data analysis and determining the solution by applying Lean Six Sigma concept with the 5S method and ECRS principle as the tools for Lean. In this study, a systematic approach of DMAIC technique of the Six Sigma is adopted to improve organisation of the warehouse layout and operations. The findings from data collection process, by means of survey, interview, and observation, showed that the warehouse was disorganised due to a poor designed layout and lack of proper warehouse management such as, there was no tag/sign to indicate where material items/goods stored. There was no boundary between materials in the material warehouse. The raw material (RM) and finished goods (FG) were stored together in the warehouse without separate location. Moreover, there were items not relevant to production were kept mixed-up with FGs and RMs and took up the space of the warehouse non-productively whereas some inventory items found left scattering around the office area without proper process of inventory control. There was no workflow process was not defined properly to handle returned materials back to stock inventory. The physical inventory count was not done regularly. The result of data analysis using DMAIC technique and Fishbone diagram found that the root cause problem was summarised that the warehouse was disorganised and not properly designed layout. It's found that the cost of warehouse space rental is increasing because there was not enough space to store materials/goods, whilst the current warehouse space was disorganised and not properly utilised. The production area was not separated completely from the warehouse/ store area. The warehouse space utilisation (Before improvement) can be presented in the table below.

Table 1 Warehouse space occupancy (Before improvement)

Floor	Total Space (Sq.m.)	Used by*			Total Used (Sq.m.)	% Total Used
		RM**	FG***	Others		
1	300	104	104	52	260	87%
2	300	56	140	84	280	93%
3	300	135	81	54	270	90%
4	300	145	58	87	290	97%
Total	**1,200**	***440***	***383***	***277***	***1,100***	**92%**
		37%	32%	23%		

**The proportion of used space is estimated by a holistic survey.*
*** RM = Raw Material ****FG = Finished Goods*

As shown in table1 above, the total occupancy in the warehouse was 1,100 Sq. m. from 1,200 Sq. m. (92% used-up). The unavailable space of 440 Sq. m. was used to store RMs (37% used-up by raw material). The unavailable space of 383 Sq. m was used to store FGs (32% used-up by finished goods). The unavailable space of 277 Sq. m. was used for other purposes, including for storing other items that were neither RMs nor FGs, including the non-productive items. This is equal to 23% of the total used space.

Lean Six Sigma and DMAIC problem-solving method.

In this study, applying Lean Six Sigma by using the five phases of DMAIC to identify the root cause of inefficient work process in the warehouse, inventory control and cost accounting. This tool is a synergized managerial concept of Lean and Six Sigma used for this research study to eliminate the waste of the inventory cost, especially the holding cost occurred by warehouse utilisation while assuring quality in production and organizational processes. The Fishbone diagram was used as a tool for implementing the first-three steps of Six Sigma (DMAIC), “Define, Measure, Analyse” to define the problem and identify the root causes of the problems in the warehouse that affect the inventory cost of the company were identified as shown in a diagram below.

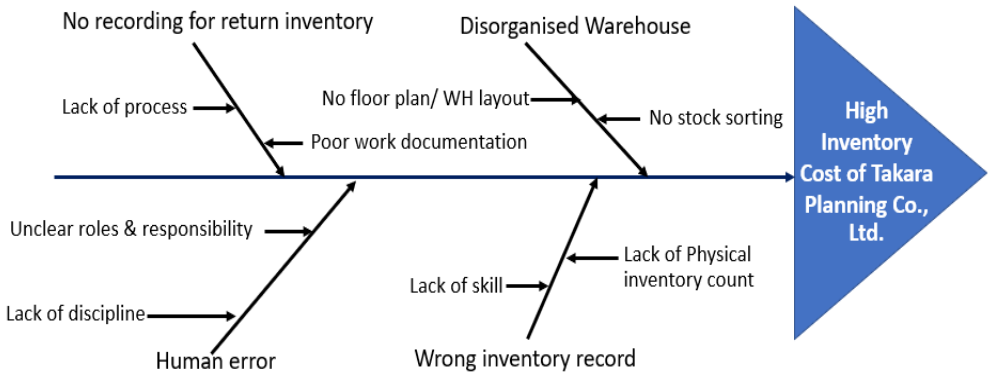

Figure 1 Fishbone Diagram

At “Improve” step of the Six Sigma (DMAIC), the 5S Method and Lean (ECRS Principle) were applied to improve the above problems related to warehouse disorganization.

The 5S Method was applied in this study in the following steps.

1) Sort (seiri) By exploring the area where raw materials are stored and sort all the company's raw materials, which are divided into 2 groups, viz.: (1) a group of raw materials that can be used in production, and (2) a group of raw materials that cannot be used in production.

2) Set in order (seiton) After finishing the tidy up process, determined the storage area for both groups of raw materials by the following steps: (1) Determined the area of raw materials that cannot be used in production in the same area. (2) Determined the area of raw materials that can be used for production according to the types of raw materials that have been defined, i.e., main raw materials and spare parts. (3) Located the raw materials with a high turnover rate in the areas that are convenient for storage and retrieval. (4) Provided labels showing details of raw materials to be clear and convenient to use.

3) Shine (seiso) This step is part of cleaning the warehouse/ raw material storage area and work area which were used by all employees within Takara Planning Company Limited.

4) Standardize (seiketsu) After completing all 3 steps above, it was considered that the company had achieved a hygienic storage environment. In addition, since the company's employees had to keep social distance according to the national standard procedure under COVID-19 situation, all employees were strictly required to wear masks and wear gloves for health safety and to prevent danger that may happen during work.

5) Sustain (shitsuke) Created a schedule of 5S activities in the workplace area of each employee and in the raw material storage area. This was meant to create work habits for employees. It was done by assigning duties, caregivers and responsible for cleaning, storing, and counting raw materials on a regular basis.

The ECRS Principle

In this study, the ECRS principle was applied to reduce the inventory cost in the following steps:

1) Eliminate : Eliminating the waste space in the warehouse.

2) Combine : Grouping materials type; RM, FG, Others

3) Rearrange : Rearrange is the organization of the items in an orderly manner to be easy to use.

4) Simplify : Simplify the process for staff to record and control the inventory quantity in the warehouse.

At “Control” step of the “DMAIC”, the following activities to ensure that the above improvement are maintained continually were conducted. They were (1) training staff to understand the process and act. (2) training staff to do the physical inventory counting. (3) preparing inventory physical counts and recorded them in the system. (4) performing the physical inventory count.

Results

After improvement with 5S Method, the warehouse area was organized and cleaner and tidier. Items in the warehouse were categorised and grouped to be stored in the same area, for example, finished goods were stored together in separate areas and not mixed-up with raw material. The unpacked raw materials were grouped and stored tidily. The packed raw materials were grouped and stored separately. The use of pallet-based to store the items that were in the same categories to facilitate the moving activities when using the MHE (machine handling equipment). This helps to make the place tidy and easy to access, instead of leaving them on the floor. After improvement with ECRS activities, the results of implementing the ECRS principle to improve the warehouse can be summarised in the table below.

Table 2 Applying ECRS Principle for Warehouse Improvement.

	Action taken	Results
E	Eliminate the waste space in the warehouse after implementing 5S method.	Eliminating waste items, non-use tools, scraped RMs, damaged packaging, damaged FGs. This results in warehouse space optimization. Resulting in gaining warehouse space available of 26% (Before - After: 92% - 66% = 26%). This is determined from the difference between space occupied before improvement (see Table 3) and the space occupied after improvement.
C	- Categorizing the items i.e., RMs, FGs, tools, supplies, sundries, office stationery. - Grouping the items by category. - Defining the code for location and item i.e., Location-ID# for stored items by item-type.	- The clean and organized warehouse made it easy to access location for inventory physical counting. - This results in inventory accuracy.
R	Rearranging the layout of the warehouse. Arrangement of the RMs, FGs, tools, supplies, and office stationery in an orderly manner to be easy for physical inventory counting.	Re-arranging the warehouse layout made it properly organized, easy to pick up the RMs, FGs and smooth workflow, easy access to tools. Resulting in an increase in productivity. Gain more space for production line. This results in an increase in the safe working environment for staff.

	Action taken	Results
		A comparison of the re-arranged warehouse layout of Floor-1, Floor-2, Floor-3, and Floor-4 Before – After improvement gained more available space by 26% (92% - 66%).
S	Placing the noticeable sign and tag to identify the location. Simplify the process of picking raw material from the storage location by defining the document to be used for recording the quantity of picking raw material from the warehouse. Established a form to be used to record the returning raw material back to the warehouse.	This results in reducing mistakes in picking wrong RMs or FGs. This results an increasing of inventory accuracy rate from 7.69% (before improvement) to be more than 80%.

After improvement, the warehouse space utilisation can be presented in the table below.

Table 3 Warehouse space occupancy (After improvement)

Floor	Total Space (Sq.m.)	Used by*			Total Used (Sq.m.)	% Total Used
		RM**	FG***	Office/Utilities Production		
1	300	52	120	12	184	23%
2	300	0	150	30	180	23%
3	300	80	80	80	240	31%
4	300	170	0	12	182	23%
Total	**1,200**	***302***	***350***	***134***	***786***	**66%**
		25%	29%	11%		

**The proportion of used space is estimated by a holistic survey.*
*** RM = Raw Material *** FG = Finished Goods*

From the table above, the result of using principle of ECRS (Eliminate, Combine, Re-arrange, Simple), the available space gained from eliminating ('E') was rearranged ('R') to utilise the space of 134 Sq. m. for office area, utilities area, production & WIP area. This is equal to 11% efficiently utilised for operation purpose.

After improvement, total occupancy in the warehouse was reduced to 786 Sq. m. (= 66% used up in total). The total space in the warehouse that was used to store RMs (raw material) was reduced to 302 Sq. m. This is equal to 25% used-up by raw material. After improvement, the total space in the warehouse that was used to store FGs (finish goods) was 350 Sq. m. This is equal to 29% used-up by finished goods.

Conclusion, Discussion and Recommendations

Based on the research process conducted for the study of Applying Lean and Six Sigma concept to reduce inventory cost of Takara Planning Company Limited, the SMEs in Thailand after COVID-9 crisis by applying one of the Six Sigma models, DMAIC and by analysing with the cause-effect diagram to determine the causes of problems, the researcher can conclude that the causes of high inventory costs of the company are (1) Disorganised warehouse (2) Wrong inventory record (3) Human Error and (4) No recording for return inventory. The researcher reviewed the related literature and determined that DMAIC was a suitable model for identifying the root causes, solving, or mitigating those problems, and proposing sustainable solutions. The major causes of the high inventory cost of the company discovered during the research using DMAIC model were disorganised warehouse due to poor warehouse layout, and inaccurate inventory value due to invalid process of inventory control leading to lack of discipline. All of these contributed to the increasing inventory cost. The corrective actions were devised by the researcher to improve the working process and resolve problems using the 5S method and ECRS principle for Lean in combining with Six Sigma (DMAIC). These included the design of the new warehouse layout, implementation of storage allocations, employees training in inventory control using material dispatching / returning form, and physical inventory count. The data analysis results of the performance comparison before and after the improvement in terms of the warehouse space utilisation are shown in Table 4.

Table 4 Warehouse space utilisation comparison (Before-After the improvement)

Floor	Total Space (Sq.m.)	[BEFORE] Used by*						[AFTER] Used by*					
		RM**	FG***	Others	Total Used (Sq.m.)	COST valuation****	% Total Used	RM**	FG***	Office/ Utilities Production	Total Used (Sq.m.)	COST valuation****	% Total Used
1	300	104	104	52	260	฿1,924,000	24%	52	120	12	184	฿1,361,600	23%
2	300	56	140	84	280	฿2,072,000	25%	0	150	30	180	฿1,332,000	23%
3	300	135	81	54	270	฿1,998,000	25%	80	80	80	240	฿1,776,000	31%
4	300	145	58	87	290	฿2,146,000	26%	170	0	12	182	฿1,346,800	23%
Total	**1,200**	***440***	***383***	***277***	***1,100***	**฿8,140,000**	**92%**	***302***	***350***	***134***	***786***	**฿5,816,400**	**66%**
											Total Cost Reduction =>	**฿2,323,600**	

**The proportion of used space is estimated by a holistic survey.*
*** RM = Raw Material *** FG = Finished Goods*
*****Valuation cost calcualted by the Price value of the space at the warehouse located is 7,400 Baht / Sq.m. (Source:Property Valuation Standard Division, 2021).*

In conclusion, applying Lean Six Sigma concept has successfully achieved the purpose to reduce inventory holding cost, which played part of the inventory cost of the company. The application of Lean Six Sigma concept carried out in this study eliminated waste of space and gained more available space in the warehouse. The reducing of inventory cost of the company shown in the table that the space occupancy in total reduced from 92% to 62%, which means the available space in the warehouse increasing by 26%. In terms of space dimensions, the total used-up space was reduced from 1,100 Sq. m. to 786 Sq. m. It means the improvement using Lean Six Sigma technique and tools improved to gain more available space by 314 Sq. m. In terms of cost saving, the improvement reduced the inventory cost by saving the warehouse space value of 2,323,600 Baht.

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Author Guidelines

For Paper Submission and Manuscript Preparation

General Instructions

The Journal of Supply Chain and Sustainability Research (SCSR) accepts research papers, academic articles, and review articles written in Standard British or American English, not a mixture. Poorly written English may result in rejection or return of the submission for language editing. The articles must fall within the aim and scope of the journal, that is, science, social science, technology, management, and related issues (see about Journal).

Please note that papers in these areas in order to be published in the SCSR journal Research or academic papers must be 15-20 pages in length inclusive of references, tables, graphs, charts, and figures.

For research papers, the author is advised to include all elements of the structure below:

- **Title** of paper must be clear, concise, and informative, all in uppercase within three typeset lines.
- **Abstract** (150-250 words) Abstracts must include sufficient information for readers to judge the nature and significance of the topic, the adequacy of the investigative strategy, the research results and conclusions. The abstract should summarize the major results of the work and not merely list topics to be discussed. It is an outline or brief summary of your paper in a well-developed paragraph, should be exact in wording, and understandable to a wide audience.
- **Keywords** (3-5)**,** immediately after the abstract**,** keywords are for indexing purposes, and should be different from the title.
- **Introduction** This section provides necessary background of the paper and a brief review the existing knowledge, and importance of the problem.
- **Objectives**
- **Literature Review, Conceptual Framework (**Discussion of the research work of others in the field or topic area and how your work will enhance and contribute to the field. Citation of work by others should follow APA (7th edition) style e.g.

Example: Maslow (1970) asserts that……; ……. (Maslow, 1970)

Wang and Pettit (2021).....; ..... (Wang & Pettit, 2021)

Hisrich et al. (2020)…….;…… (Hisrich et al., 2020)

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Novack et al. (2018)……..; ……. (Novack et al., 2018)

- **Research Methodology** This section indicates clear research objectives, conceptual framework(s) (if any), research question(s), hypotheses, population and sample, research instruments, and the data collection process. This section provides clear steps used in conducting your research. It means all procedures need to be described in sufficient detail to allow someone to replicate it.
- **Results and Discussion** This section covers the analysis of the data**.** It should include statistics in tables, charts, graphs, or pictures analyzed against hypotheses or in answering the research question(s) in quantitative research, or descriptive analyses of categories in qualitative research. **Results** is purely descriptive. **Discussion** describes and interprets the findings, placing them in a bigger context, relating them to other work(s) and issues outlined in the Introduction.
- **Research Benefits**
- **Conclusion and Recommendations** This section summarizes your study's key findings and implications. It should not be long and repetitive, but capture the essence of the study discussed in all previous sections. It should briefly cover the limitations of your research and suggested future direction for further research.

For academic articles, we recommend the structure below:

1. **Introduction**
2. **Discussion**

   2.1 subheading

   2.2 subheading
3. **Conclusion**

The author is advised to follow a logical, understandable point of argument. Break your main argument into sub-headings and present them in an outline at the end of the Introduction.

- **References List** all the sources you have cited in the body of your research. It states the author/s of the source, the material's year of publication, the name or title of the source material, as well as its electronic retrieval information, including the date it was accessed, if these were gathered from the Internet (Research articles, academic articles, reports, academic conferences, references, no later than the last 5 years and Books, unlimited years of reference)

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Authors are welcome to submit their manuscripts.

All submissions will be given an initial check by our editorial team, within **6-8 weeks after submission date** you will be notified of the initial check result on thaijo system. Only the article which passes the initial check will proceed to the review process (6 -8 weeks). The author will be kept informed of the current status of their paper.

Articles being currently considered for publication by other journals will not be accepted by The Journal of Supply Chain and Sustainability Research (SCSR). If the author withdraws or sending a manuscript to other journals any time after the manuscript has been sent to peer review till the final decision, the Journal will charge the author a penalty fee for its time and resources spent. The authors must always pay the page charge even if the withdrawal is permitted.

Specific Instructions:

- **Format** The preferred format for the text and tables of a manuscript are MS Word DOC and PDF.
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- **Margins** Use a 1-inch margin on all sides of each page-left, right, top, and bottom.
- **Spacing** Double space lines throughout the paper including appendices, footnotes. Exceptions: Triple or quadruple spacing can be done around equations. Single or one-and-a-half spacing can be done in tables or figures. Indent the first line of every paragraph a standard Tab key space (½ inch).
- **Font Size and Type**. Browallia New font (20 pts. bold for title; 14 pts. for author(s) and affiliation; 16 pts. bold for headings and 16 pts. bold subheadings; and 14 pts. for text)
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- **Headings** should be in bold type, in 16 point Browallia New font. First-level headings should be aligned to the left with initial caps. One line space should separate headings from the preceding text.
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- Tables, Graphs, Charts, and Figures in 12-point Browallia New font, Bold
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  - Position the first line of each reference flush left, with subsequent lines wrapping with a ½-inch (hanging) indent.
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- Use the following format for your reference list:

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Wang, Y., & Pettit, S. (2021). *E*- Logistics (2nd ed). U.S.A.: Kogan page.

- **Tables and Figures**
  - Line drawings should be of high resolution and high contrast. For color or grayscale photographs (halftones), use a minimum of 300 dpi (.JPG).
  - Provide captions to figures
  - Use the table function of Microsoft Word.
  - Figure and tables should be placed as close as possible to where they are mentioned in the text
- **Page Numbering**: Number all pages of the paper, beginning with the title page. The number is in the bottom right corner (1 inch from right and ½ inch from the bottom page edges).

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Publication Charge

The process of payment will be required to enable an effective and efficient screening process. Fee payment will be due at registration, will be **150 USD for both Thai and international authors. This fee is non-refundable.**

Remark: The fee shall be in effect from October 1, 2026 onward.

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As part of the submission process, authors are required to check off their submission's compliance with all of the following items, and submissions may be returned to authors that do not adhere to these guidelines.

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2. The submitted file is in **Microsoft Word** and **PDF** document file with a single column format.
3. Where available, URLs for the references must be provided.
4. Research or academic papers must be 15-20 pages in length inclusive of references, tables, graphs, charts, and figures.
5. The text must be double-spaced; (a 14-point font Browallia New; italics rather than underlining except for URL addresses); and all illustrations, figures, and

tables must be placed within the text at the appropriate points, rather than at the end.

6. The text adheres to the stylistic and bibliographic requirements outlined in the Author Guidelines.
7. Attached to all submitted articles must be a **150-250 words abstract**, **Keywords** (3-5) and a statement containing the author's present academic or nonacademic position and an address where he or she may be contacted by the editors or interested readers. Authors should place their names on the cover page, but the name should not appear on headers or elsewhere in the body of the article. Full contact details for the corresponding author, including email, mailing address and telephone numbers should also be provided. As the Journal of Supply Chain and Sustainability Research (SCSR) is a peer reviewed journal, the author must be follow the instructions about Ensuring a Blind Review.
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