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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.

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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) Advancing Supply Chain Operation and Management Education Through Simulation-Based Teaching Systems

(2) Global Economic Dynamics: Exploring the Evolving ASEAN Industrial Supply Chain Post iPhone-Huawei Competition

(3) A Study on the Impact of China-Laos Railway on ASEAN Supply Chain

(4) Sustainability Challenges and Opportunities in the Semiconductor Supply Chain

(5) Analysis of the Influencing Factors of Green Collaborative Development between Enterprises and Industrial Parks in Industrial Undertaking Regions: A Case Study of Guangdong Province from 2006 to 2019

(6) Sustainable Development Education in Primary and Secondary Schools of Minority Areas in China: A Multicultural Perspective

In addition, we would like to inform you about our next issues (Volume 2 No.1,…) in 2024. 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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Advancing Supply Chain Operation and Management Education Through Simulation-Based Teaching Systems

Michael Chan*

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Abstract

For many students studying supply chain management, managing a well-established supply chain is the direction of their efforts. However, the current supply chain education pays more attention to the cultivation of professional skills and lacks training in overall planning. In view of this, this study developed the "Supply Chain Operation Management Simulation Software", which takes supply chain management as the background, presents marketing strategies, manpower planning, price setting, inventory management, promotional activities, and other business management concepts using network software, and cooperates with learning plans to carry out case simulation lesson plans, so as to make classroom learning more lively through games to improve the lack of traditional static teaching and combine theory and practice, so that students can "learn by doing" Under the training, the business management skills of supply chain management are repeatedly practiced, so that students can experience the fun and hardships of supply chain management, and then evaluate whether they have the characteristics and abilities of entrepreneurship.

Keywords: Supply Chain Management, Operation Management, Simulation Competition.

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Introduction

Creative concept

Due to the impact of the global financial turmoil, the unemployment rate has soared, many graduates have no way to find a job, and Chinese people have always liked to be their own bosses, which has unexpectedly set off a wave of entrepreneurship, among which "supply chain management" is the hottest. For many students studying supply chain management, managing a well-established supply chain is the direction of their efforts. However, operating a supply chain management requires not only professional technology but also high-level management factors. However, the current supply chain management education pays more attention to the cultivation of professional skills and lacks training in overall planning. Therefore, this project attempts to transform the existing ordinary classrooms into supply chain management types, build a supply chain operation and management simulation laboratory, and develop supply chain operation and management simulation software to simulate actual business situations through teaching plan production, situational teaching, role-playing, business competitions, etc., so as to cultivate students' practical management ability.

The learning method of the business simulation competition is to train the participants by simulating the situation of business management and the problems arising from and deriving it, so as to inspire the students' ability to analyze environmental information, deal with group relations, and make decisions. This kind of teaching system that emphasizes interactive learning and self-growth is quite different from most current digital learning products, although combined with multimedia or network applications, its essence is still static teaching content, which is quite different (Crookall et al., 1986).

The business simulation competition teaching system is widely used in a variety of courses, including strategic management, production, marketing, innovation management, supply chain management, financial accounting, and agricultural economics. In the United States, more than at al., quarter of management professors use business simulation competitions in various types of courses; at least more than 60% of large companies use business simulation as an in-house training course; Deloitte & Touché's research shows that business simulation learning can enhance learning outcomes more than traditional business management teaching methods (Van, 2003 ; Thavikulwat, 1990)

Research Background

After the gradual popularization of online learning (e-learning), the management chain subject course has also kept up with the trend of the times, providing various types of business management learning materials on the Internet, especially the simulation business competition teaching system(Business simulation and gaming system) has the rich connotation, close to the real business environment, can be based on interactive learning and experiential learning without the limitation of time and space conditions, so that teachers and students have more hands-on experience (learning by doing) in the way of learning; compared with the current more used in ERP (enterprise resource planning) Or SCM (supply chain management) process or flat teaching content, simulation management is more evaluated.

The online simulation is an internet-based game that allows students to perform tasks such as overseeing the operational management of a virtual factory serving as CEO of a virtual business and networking with other executives (Raia, 1966). Professors can track students' every move in these online games and use this data to grade students and provide feedback on specific skills. Online simulations tend to be closer to reality than lectures and direct theories and force students to figure out how to put textbook theory into practice (Wolfe, 1978). Some of these simulations take up a day or two in class and replace lectures. Others are assigned homework that can last the entire semester without taking up a lot of class time. Students sign in to make changes and check progress on their clock. Professors have access to in-depth data showing each student's every move. This can then be raised in class discussions to motivate students, show them their mistakes, celebrate their successes, and inspire competition between classmates and teams (Cohen & Rhenman, 1961). The simulation competition system in China is shown in Table 1.

Table 1 Business simulation competition system in China (partial)

Product name	Major topics	Creator/Developer	Country of origin
Capsim	Business operations (Corporate strategy)	CAPSIM	USA
Cesim	Business operations (Corporate strategy)	Cesim	Finland
Decision-making	Business operations (Corporate strategy)	Wang Qiwen	China / USA
GMC	Business operations	GMC	Portugal
Mark Strat	Marketing management	StratX	France
Marketing Winner	Marketing management	IBT	Japan / Taiwan
Marketplace	Marketing management*	Innovative Learning Solutions	USA
MBS	Business operations (Corporate strategy)	Top-BOSS	Singapore
SRM	Chain operation	Li Mengxi	Taiwan

Research Objectives

This study has several objectives, including :

1) Management students learn the truly competitive world of international business. In the beginning, students must obtain information about the countries in which they trade, such as environmental and economic data.

2) The emphasis is placed on international marketing and logistics, helping students learn concepts and practices in business classes.

3) Promote lectures by professors who pay attention to international business education.

4) Encourage interaction between professors and students with knowledge and information in the classroom. For example, how to develop an international business strategy and teachers focus on student performance and activities.

Subject Content

Theory contained in the simulation game

The theory included in the online game should include the following theory from the previous researchers.

The first approach discussed is the five forces analysis introduced by the American scholar Michael Porter, which primarily focuses on market competitiveness (Porter, 2011). The second perspective is the concept of dynamic competition, proposed by American scholar Rebstein as well as Chinese scholar Chen Mingzhe (Rebstein et al., 1993; Hu et al., 2020). Dynamic competition emphasizes adaptive competitive strategies. The third perspective involves the 3C model introduced by Japanese scholar Kenichi Ohmae, which concentrates on corporate consultancy theories (Ward, 2005). Lastly, the business model canvas, proposed by Swiss scholar Alexander Osterwalder, explores the theory of new-generation business models. (Osterwalder et al., 2011)

Table 2 The important theories should be considered in a business simulation.

No	Indicator Master	Related works	Theory (model)
1	five forces analysis	United States Michael Porter	Competitiveness
2	dynamic competition	United States Rebstein	dynamic competitive strategy
		China Chen Mingzhe	dynamic competition
3	3C model	Japan Kenichi Ohmae	Corporate consultant
4	business model canvas	Switzerland Alexander Osterwalder	New generation of business models

Build a simulated teaching environment for supply chain operation and management

The existing general teaching classroom was commissioned to be renovated and decorated into a supply chain management real field to create a simulated teaching situation of supply chain operation and management so that students can experience the situation.

This is an online competitive game, so each industry must have at least 3 companies to compete with each other. There is no upper limit. Each team may have 5 members. A company can also have 1 person, but we recommend 5 people per team. A typical class will consist of 10 to 20 teams.

Supply Chain Management Cycle

There are four cycles in a year, usually 12 cycles per round. We provide quarterly and annual reports, including market share, financial, marketing, and HR reports. Since environmental events occur sequentially, we set variables such as inflation, changes in interest rate exchanges, business cycles, or R&D effects. We provide a default model and a free model that professors can use to change the defaults. Presenters can choose more complex and difficult environments, such as increased utility and transportation costs, poor cash budgets, and higher quality standards. Each month requires a number of important core activities, as described below

Figure 1 Example of the management decision support system in the on-line game

(Source: Top Boss MBS, https://www.top-boss.com.tw/singapore/products/mbs/)

Supply Chain Management Procedures

Supply chain management includes all the movement and storage of raw materials, work-in-process inventory, and finished goods from origin to the point of consumption. Effective supply chain management can provide enterprise marketers with a significant competitive advantage by coordinating operations with all companies involved in the entire supplier sequence.

1) Emerging markets
2) Location decisions
3) Transaction costs
4) Cultural distance
5) International Retail
6) Emerging markets
7) Location decisions
8) free trade area

Human resource management of the supply line

Human resource management is also an important matter of supply chain operation and management. Humans and the potential they possess drive an organization. The Human Resources (HR) department will specialize in seven management functions: staffing, performance evaluation, compensation and benefits, training and development, employee and industrial relations, safety and health, and human resources research. In addition, due to the city's international market, special consideration is given to the staffing and recruitment of expatriate managers and international staffing.

Financial management of supply chains

Corporate or business finance is basically the method of allocating financial resources with financial value in the best way to maximize the wealth of a business enterprise. There are three main decisions in this distribution process: capital budgeting, financing, and dividend policy.

1) International financial markets
2) Foreign exchange management
3) Cost of capital and financial structure
4) Investment evaluation
5) Capital budget
6) Transfer pricing
7) International financial reporting
8) Performance evaluation and control
9) International Taxation

Programming

Research and development of supply chain operation and management simulation software

Cooperate with manufacturers to jointly develop supply chain operation and management simulation software, the main development process is as follows: (Graham & Gray, 1969)

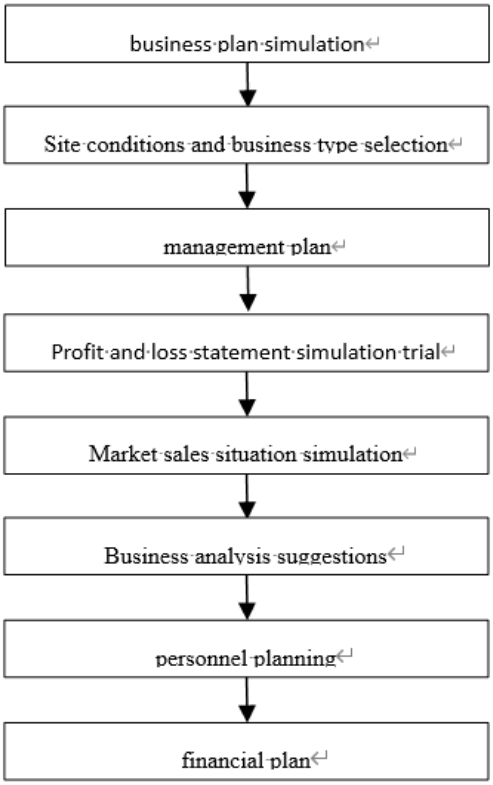

Figure 2 Flow chart of simulation management system development

1. Business plan simulation

1) Set business hours

2) Market settings

3) Capital amount setting

4) Set and calculate the average unit price of each different customer layer

5) Set the gross profit margin of visitors according to the fourth point, and then calculate the gross profit amount on a trial basis

6) Different business districts will have different consumption suggestions

7) Preliminary planning trial calculation of single-day turnover.

2. Site conditions and business district selection

Dozens of different business districts are available for owners to select, and the operating costs are calculated according to the selected business districts; According to the selected business district, further analyze the competitors of the commercial district; According to the above two points, the system automatically produces analysis data and business district selection suggestions.

3. Business plan

After selecting the above business districts, you can set up the trial calculation of fees in different regions, and after selection, the system will automatically calculate the monthly fixed costs and expenses, as well as the cost analysis of different regions.

4. Profit and loss statement simulation trial

According to the previous settings and selection, run out of the corresponding business circle profit and loss statement simulation; In addition to the existing profit and loss table simulation, the system can respond to the resulting values generated by different settings in a timely manner.

5. Simulation of market sales conditions

According to the business plan, site area, supply chain type, competitor status, and other conditions, the daily sales status analysis table is simulated, and the market sales-related charts are further depicted according to the sales status analysis table.

6. Business analysis suggestions

In view of the above conditions, make business analysis and suggestions.

7. Personnel plans

According to the manpower hired by the simulation plan, the system automatically calculates the total salary of the average manpower in the market; According to the simulation plan to hire manpower, the system automatically runs out of recommendations and manpower structure diagrams.

8. Financial plans

Calculate the monthly simulated turnover on a trial basis, calculate the profit and loss turnover on a trial basis according to the turnover, and automatically draw the profit and loss statement graph.

Description of script examples

Take the script as an example: in the environment of competition between multiple groups of companies in the oligopolistic market, the management team uses the operation mode of division of rights and responsibilities, through the discussion of team members, gives full play to the different site conditions of the three chain stores, and adopts different marketing strategies, management tactics, analysis methods and other operational techniques for five commodity groups with different attributes, so as to exert the overall synergy. In order to obtain competitive advantages in the market, grasp the foundation of operating profits, and make use of this successful business model as the basis for the subsequent development of chain operation, so as to expand the scale of operation and market territory. The market size of each company in the zero period is about 20 million, and the benchmark value is set based on the number of participating groups, and the working capital available to each company is 15 million yuan in the initial stage, and the fixed cost of the head office is 450,000 yuan. The fixed costs of each quarter of the three stores are 1.2 million yuan, 1.05 million yuan, and 900,000 yuan, and the other variable expense rate of each store is 5%, and the advertising and promotion fee and service training fee are the decision-making values, which are entered into the system at the discretion of the participants. The income tax rate of a profit-making business is 25%, and the bank interest rate is 5%, due

to the different environments and customer layers of the three stores, the sales structure and profit situation of the goods are naturally different, and the strong and weak transformation of the competitive situation is gradually formed. This paragraph describes a part of the scenario, considering the simulation close to the real world and the individual needs of teaching, most of the aforementioned numbers can be changed to a limited extent through the teacher's settings.

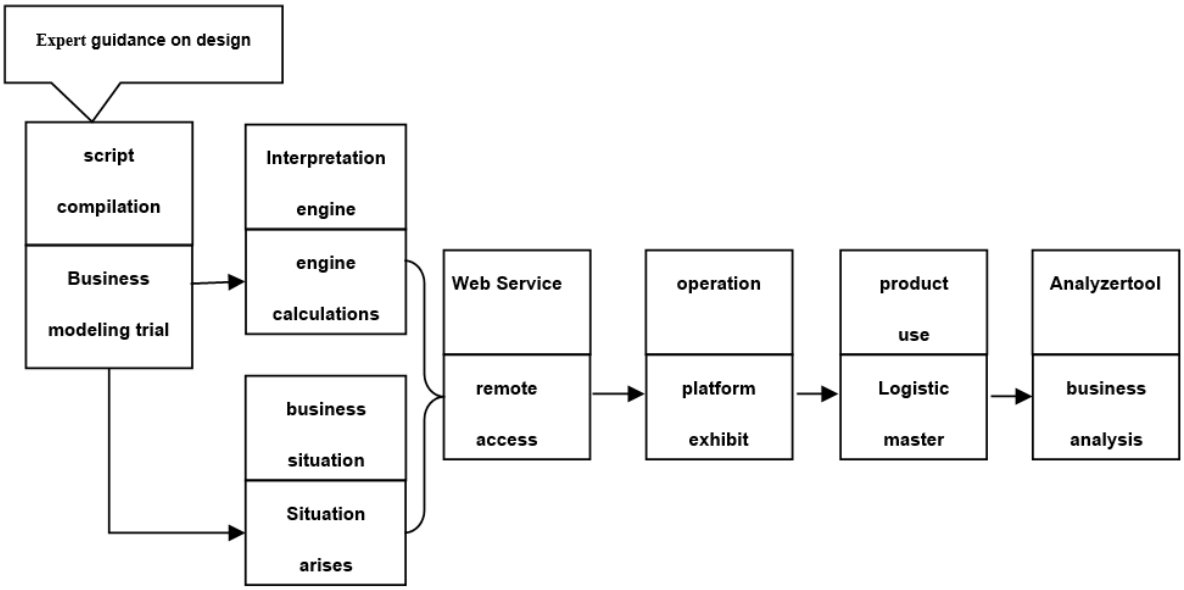

Figure 3 Example script

Hold Supply Chain Operation and Management Simulation Competitions

After completing the research and development of supply chain operation and management simulation software, hold supply chain management simulation competitions to stimulate students' willingness to learn and depth of learning, learn the practical experience of shopping malls through competing competition theories, experience the pressure of operating a supply chain, racing against time, how to make correct decisions in a limited time, learn cost and profit estimation and sustainable operation methods, personally experience the fun and hardships of entrepreneurship, so that students can be more practical in realizing entrepreneurial dreams. Have a deeper understanding and understanding of future career planning, and then evaluate whether you have the characteristics and abilities to start a business.

Scoring issues should be paid special attention to in this game to avoid unfair associations among participants. When using simulation scoring, methods vary widely. There are three alternatives that can provide some ideas on how to score to best meet your own goals. Most professors will use a combination of these alternatives to weigh in a way that supports your goals. Few academics will measure only bottom-line performance without some subjective material. Similarly, the purpose of mock scoring is to encourage integrated long-term thinking in a team environment.

A more subjective approach requires students to prepare essays and/or presentations, including an analysis of admission decisions, a market plan at the beginning and after, and a final presentation focusing on lessons learned. Here are some examples. (1) Your initial regional marketing strategy. Ensure that this includes the countries entered, the target markets served, and the positioning and portfolio strategies for those countries; (2) Any significant changes to your initial strategy and the rationale for those changes. (3) Your company's performance targets and actual performance; (4) key strategic initiatives that led to your success (or demise); (5) how you can leave the company and prepare for the future; (6) Important lessons learned from the simulation experience

Results and Discussion

New supply chain markets

The competition is based on countries representing major trading countries in Asia, such as Japan, China, Indonesia, South Korea, Thailand, Vietnam, Singapore, Malaysia, India and Taiwan. There are some factors in this game. With regard to geographical regions, we select the main members of ASEAN+3 (Association of Southeast Asian Nations, see Figure 2), but do not include countries that are less international or technology-oriented. Therefore, we have selected Japan, China, Indonesia, South Korea, Thailand, Vietnam, Singapore, and Malaysia from the ASEAN+3 list. Moreover, since the IT industry is the focus of this game, we must focus on India and Taiwan. India is an important outsourcing destination for multinationals and a major exporter of software and financial, research, and technology services. The same applies to Taiwan. Some of these countries are developed countries, such as Japan, while others are developing countries. Regardless of education level and GDP, in this era of globalization, all countries need foreign trade to transfer toilets, food, products, etc.

Figure 4 Logistic supply chain area, Site selection under the global consideration in the online simulation system

(Source: Top Boss MBS, https://www.top-boss.com.tw/singapore/products/mbs/)

Monetary considerations

The reason we consider different currencies is that the real world is not so fixed in Asia. Many countries in Asia are developing countries, and the economic situation is facing dramatic changes in both depression and prosperity. Some cause serious inflationary problems, while others are more stable. For these reasons, we consider currency and monetary interest, and Asian marketing can be a game focused on international financial strategy. We distinguish between importing and exporting countries. There are three importing countries, namely Japan, China, and Indonesia. So, there are four currencies such as USD, JPY, Chinese CND, and Indonesian Rupiah.

Consumer Market

Let's take the industrial and consumer markets as examples, with chips (microprocessors) and mini laptops as their respective products. Chips are traded between countries, with Japan (higher cost and product quality) and China (lower cost and product quality) being the only countries of origin. After that, the company chooses the location where to produce the laptop. Players must choose at least one of the eight countries (China, Indonesia, South Korea, Thailand, Vietnam, Singapore, Malaysia, and India). Therefore, players must choose between air freight (higher cost and product quality) or sea freight (lower cost and product quality). Finally, the company sells mini laptops from the countries of production to at least one country of purchase (Indonesia, Japan, and China). Purchased items will be listed in the customer's inventory for the next time period. The same applies to the choice of air or sea freight (Thavikulwat, 1989 ; 1990).

Of course, for example, the management of the cold chain is another matter, and in the future, we will also consider the details of this type of supply chain.

Features of the Game Learning

1. Flexible business environment. The game administrator can decide the number of products to be manufactured and sold, and control the economic parameters of the relevant economy, as well as the country and registration country of the relevant industry.

2. Common and business-level strategies. Players can design and implement the most complete strategy any game has to offer.

3. International dynamics. Students can experience currency fluctuations, VAT, dividend taxes, technology transfer, joint ventures, product patent cross-licensing, different labor wage rates, culturally relevant productivity and absenteeism, and offshore manufacturing opportunities.

4. Network-based. The surface of the coil is simple

5. Major events. Game moderators can invoke up to ten critical events during gameplay. These events come in the form of small cases that highlight the "soft" side of the strategic manager's decision-making situation.

6. Based on reality. Real-world data is available for each country in which it operates and the various financial markets in which it operates.

Features of the Game

1. Improve teachers' ability to teach supply chain operation and management practices In advanced countries in Europe and the United States, simulation and gaming teaching It is widely used in all walks of life as a new generation of management teaching methods. However, in supply chain operation and management, although practical teaching is emphasized, the classroom teachers may not have practical experience in supply chain operation and management and are also proficient in production, marketing, personnel, finance, research and development, and other management functions. Therefore, through the organization of business simulation teaching teacher study, teachers are taught how to use the "Supply Chain Management Simulation Lab" to operate various enterprise operations and management simulation software, so as to enhance the practical teaching ability of supply chain operation and management (Keys, 1987).

2. Enhance students' willingness to actively learn supply chain operation and management Modern young people like games, willing to use the computer or the Internet, for entertainment, dating, or business (online shooting), in line with this trend, the use of simulation business laboratories, hold business simulation competitions, so that students enjoy learning, enhance students' willingness to actively learn the operation and management of the catering supply chain. Therefore, with a background in supply chain operation and management, marketing strategies, manpower planning, price setting, inventory management, promotional activities, and other business management concepts are presented using network software, and case simulation lesson plans are carried out with learning plans, so as to make classroom learning livelier through games, so as to improve the lack of traditional static teaching.

3. Strengthen students' entrepreneurial investment and supply chain operation and management capabilities Supply chain operation and management requires enterprise-oriented management ability, so the theory and practice are combined into one, and the supply chain operation and management simulation laboratory is used to put students in a close to real environment, through role play for teaching, discussion and competition, using written and oral methods, repeatedly practicing the understanding, analysis and decision-making of supply chain operation and management, so that students can repeatedly practice supply chain operation and management skills under the honing of learning, and strengthen students' ability to venture capital and supply chain operation and management.

4. Strengthen industry-university cooperation and promote exchanges between academia and industry Cooperate with manufacturers to convert the implicit experience of supply chain operation and management into explicit system knowledge, and jointly develop supply chain operation and management simulation software, in addition to providing schools at all levels with practical teaching, and can collect technology transfer funds from manufacturers through technology transfer to increase the income of the school fund.

5. Improve the quality of practical teaching of supply chain operation and management education Through the research and development of supply chain management simulation software and the holding of supply chain operation and management simulation competitions, the R&D results will be promoted to promote

observation and exchange, and the quality of practical teaching of supply chain operation and management technical and vocational education will be improved.

Conclusions and Recommendations

1. In this study, a set of methodologies and a series of platforms/tools are developed to combine academic theory, technology, and professionals in various fields of business, management, mathematics, and information technology to develop a diversified simulation competition teaching system, which can meet the needs of future management teaching.

2. Study Limitations

First, the difficulty of cross-field professional integration

At present, there is a lack of cross-field product development experience in China, and when staff in different fields work together, there will inevitably be communication problems caused by unclear goals or different positions and backgrounds. The research and development of a supply chain operation and management simulation teaching system involve supply chain operation and management professional knowledge, information technology application, teaching, and administrative homework, who does not understand the computer who understands supply chain operation and management,coupled with the cumbersome administrative operation specifications of public institutions, cross-field professional integration is not easy.

Second, the gap between the real world, models, and software technology

This project attempts to transform the subjective experience implicit in the supply chain operation and management industry into explicit objective knowledge from the academic community, which should not only conform to the practical operation of the industry but also meet the teaching needs of the academic community. Therefore, how to refine and simplify the huge and complex real world into an abstract conceptual model, and then transform it into a software program performance, there is an insurmountable gap between the real world, theoretical models and software technology, and researchers at all stages need further efforts to smoothly transfer the results to the next stage.

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Global Economic Dynamics: Exploring the Evolving ASEAN Industrial Supply Chain Post iPhone-Huawei Competition

Chii-Huei Jean *

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Abstract

Manufacturers and suppliers in ASEAN countries are constantly improving their technology, reducing costs, and seeking diversified markets to adapt to the new situation in the world. The potential positive impact on economic growth and technological innovation in the ASEAN region is expected. After the baptism of the New Crown Epidemic, the US-China trade war, and the global supply chain transfer, ASEAN countries have reshuffled their economies, where the top three ASEAN economies in 2023 remained Indonesia, Thailand, and Singapore; while Vietnam has overtaken the Philippines in the past two years to become the fourth largest economy in ASEAN.

Among them, Vietnam and Malaysia will become the leaders of the electronics and semiconductor industries respectively. Thanks to the signing of numerous FTAs by the Vietnamese government and the support for the development of the electronics industry, Vietnam's smartphone has ranked as the top export in 2023. Meanwhile, Thailand and Indonesia have become the twin growth engines of the electric vehicle industry.

In conclusion, the competition between the iPhone and Huawei is driving the further development and diversification of the ASEAN industry chain.

Keywords: ASEAN, US-Sino trade war, iPhone & Huawei

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Introduction

Research background

In September 2021, Apple released the iPhone 13 series, including the iPhone 13, iPhone 13 mini, iPhone 13 Pro, and iPhone 13 Pro Max. These new iPhones introduce new features such as a more powerful A15 Bionic chip, an improved camera system, and longer battery life. Actively promoting integration between software and hardware, in the meanwhile, Apple also launched the iOS 15 operating system, introducing many new features, including enhancements to FaceTime, notification management, and more privacy control options. Apple continues to expand its ecosystem to include Apple Watch, Air Pods, and services such as Apple Music, Apple TV+, and Apple Arcade.

Since 2019, the US government has imposed a series of sanctions on Huawei, including prohibiting US companies from providing key technologies and products to Huawei, which has had a significant impact on Huawei's international business. The new operating system, Harmony OS, launched by Huawei, is designed to replace Android, not only suitable for smartphones but also for other Huawei devices such as smart TVs and smart home devices. Due to US sanctions, the pressure on Huawei's smartphone business in the international market was intensified, in particular, when suffering from the problem of not being able to access Google services.

The rollout of Huawei's Mate 60 Pro series is applauded as a triumph against the US sanctions. The battle between Huawei's and Apple's new machine has become the focus of heated discussion in mobile markets. It can be said that the Sino-US science and technology game has penetrated into the level of popular competition (Schneider-Petsinger et al., 2019)

Mobile phone is a representative of high technology, with the Sino-US trade war's evolvement, the world industrial chain has been reshaped, and the strategic alliance of countries has changed as well. This article mainly discusses the changes in the industrial chain of ASEAN countries in recent years.

Economic situation of ASEAN countries

Since 2018, ASEAN has experienced events such as the US-China confrontation, the New Crown Epidemic, inflation, and the recession of the European economies. The differentiation of economic performance in each ASEAN country has led to a reshuffle of economic scale in this region. The industrial chain in the ASEAN region has been developing and evolving rapidly over the past few years. For example, if viewed in terms of GDP, the top three ASEAN economies in 2023 were still Indonesia, Thailand, and Singapore. Vietnam has overtaken the Philippines in the past two years to become the fourth-largest economy in ASEAN. Vietnam and Malaysia will become the leaders of the electronics and semiconductor industries respectively, while Thailand and Indonesia will become the dual growth engines of the electric vehicle industry.

It is worth noting that there are sectors related to digital transformation, including the application of technologies such as the Internet of Things (IoT), big data analytics, and artificial intelligence, which are also important for ASEAN countries. According to the "2022 ASEAN Investment Report" of the ASEAN Secretariat,

the amount of foreign investment absorbed by the ASEAN as a whole and flowed into the electronics and semiconductor industries in 2021 was US$140 billion and US$160 billion, accounting for 1.7% and 0.5% of the total foreign investment of ASEAN, soaring to 21.5% and 25.2%, becoming the two major investment hotspots

Literature review

Current situation and trend of the ASEAN industrial chain

Here are some of the current status and trends of the ASEAN industrial chain (Setiawan, 2020).

(1) Multinational companies come to invest

Many multinational companies have set up production bases and supply chains in the ASEAN region to take advantage of the region's low-cost labor and strategic location.

(2) Diverse supply chain

These multinational companies often disperse their supply chains to different ASEAN countries to reduce the risk of sensibility. ASEAN has also actively promoted industrial upgrading and transformation in recent years, and a new industrial map is emerging under the epidemic and the wave of global supply chain restructuring and transfer.

(3) Signing international trade agreements

ASEAN countries actively participate in international trade agreements, which help promote the development of transnational supply chains. For example: the ASEAN Free Trade Area (AFTA) and the Regional Comprehensive Economic Partnership (RCEP).

(4) The economy continues to evolve

Because the economy and supply chain in the ASEAN region are still growing steadily, this is very important for the development of the global economy and is of great significance for the stability of the global supply chain.

(5) Focus on digital transformation

The ASEAN region is increasingly focusing on digital transformation to improve production efficiency and supply chain visibility.

Main industrial chain

The multinational companies investing in ASEAN are mainly concentrated on investing in automobile manufacturing, electronics, textiles, food processing, and other fields. Vietnam and Malaysia are becoming the emerging leaders of the electronics and semiconductor industries respectively, while Thailand and Indonesia will become the dual growth engines of the electric vehicle industry.

In addition, two major supply chains- electronics and semiconductors, and electric vehicles and batteries- being invested mainly by ASEAN local enterprises and foreign-funded enterprises have become two major industry engines to drive the ASEAN economy; even during the epidemic, the pace of investment by international electric vehicle manufacturers in ASEAN has not been interrupted.

Since 2019, ASEAN has invested in nearly 30 important foreign investment cases in the electric vehicle and battery industry, including 7 cases with investment amounts of more than US$1 billion, while the major investments are in Thailand and Indonesia, a total of 18 cases. The layout of electric vehicle supply chains by multinational enterprises in ASEAN has driven a conspicuous development, in particular, in India and Thailand.

Traditional industrial chain

COVID-19 had an impact on the traditional industrial chain in the ASEAN region, leading to some changes, including supply chain restructuring, digital transformation, investment promotion, cross-border collaboration, and talent development evolving to respond to the new situation.

The global supply chain was shocked by the pandemic. In ASEAN countries, the manufacturing industry was impacted seriously. The supply chains are regrouped, and in order to reduce risk, some companies are reevaluating the supply chain strategies, looking for more local or regional suppliers, and reducing their dependence on a single country. As in high-tech, biotechnology, electronics manufacturing, etc. ASEAN countries offer tax or other incentives to attract multinational companies to set up production bases to help traditional industries weather the storm.

The digital economy and digital transformation will be driven in the ASEAN region to adapt to the new business environment. Growth in areas such as e-commerce, telecommuting, and digital payments will also change the way traditional industry chains operate.

Issues related to the development of the industrial chain

To maintain the continued development of the industrial chain, it is necessary to pay attention to the complexity and risks of the supply chain. Since the beginning of this year, there have been problems such as a lack of work power in Vietnam, and foreign investment has been suspended to observe.

Natural disasters and epidemics also need to be considered. Due to the COVID-19 pandemic, global trade has fluctuated dramatically. Effective supply chain management and risk management are critical factors in reducing inefficiency and loss. The possible scenario might be that a company produce electronic components in Vietnam, assemble the components in Thailand, and package and distribute them in Malaysia.

Research methods

This study employs qualitative and quantitative research methods to analyze the literature discussing mobile phone supply chains. It then investigates potential differences in supply chains between ASEAN countries and China, as well as the new dynamics in the supply chain landscape among different countries following the aftermath of the US-China trade war.

Results and discussion

Changes in the industrial chain of the four leading groups

Thailand

Thailand, once known as the "Detroit of the East," is the major car exporting country and plays an important vehicle manufacturing role in ASEAN countries. Thailand's automobile production mainly exports to international markets, especially Southeast Asia, Europe, and Australia (Lhakard, 2021).

Not only does Thailand produce a considerable amount of vehicles, ranging from small cars, and trucks to SUVs, it also provides an important base for manufacturing auto parts, where many international component suppliers have factories to supply parts for both local and international markets.

The modern automotive production facilities in Thailand attract a number of international car manufacturers, e.g., Toyota, Honda, Nissan, Ford, BMW, Mercedes-Benz, etc., to set up production sites there. In addition, Thai government also supports the sustainable development of the automotive industry and encourages manufacturers to develop green technologies and electric vehicles. In order to stimulate domestic car sales, Thai government has also implemented policies such as tax cuts and loan support programs to increase the domestic car sales.

Malaysia

Malaysia provides a long-established electronics industry base in ASEAN with exports of more than US$100 billion in electronics in 2022. Malaysia and Singapore are the only two countries in ASEAN that have established a semiconductor industry chain. Malaysia plays a pivotal role in the semiconductor packaging and testing industry chain (Moeller, 2019). Recently, manufacturers in Europe, the United States, South Korea and Taiwan have been competing to add or expand semiconductor manufacturing and packaging and testing capacity in Malaysia, where Intel announced in December 2021 that it will invest US$7.1 billion to build new packaging and test plants in Penang and Kedah and upgrade the advanced wafer packaging capacity of existing plants, the construction of which is expected to start in 2024; while Honghai, a Taiwan company, also announced that it will lay out a monthly production capacity of 40,000 pieces of 28nm and 40nm, 12-inch wafer fabs in Malaysia, and ASE also held a groundbreaking ceremony for the new factory, which is expected to invest 300 million US dollars in five years (Tripathi & Jain, 2016)

Indonesia

Indonesia has nickel mines, a key mineral for manufacturing electric vehicle batteries, making it an indispensable player in the electric vehicle industry. (Mudd, 2010) Due to Indonesia's abundant mineral resources for key battery materials such as nickel, lithium, and tin. These resources make Indonesia a potentially huge player in the global EV battery manufacturing industry. Many international battery manufacturers have invested in Indonesia to build modern battery production facilities. These investments help boost Indonesia's manufacturing capacity and provide potential for export markets.

However, Indonesia's EV battery manufacturing industry is still facing competitive pressure from international competitors, such as large battery manufacturers in countries e.g., China, South Korea, and Japan.

Whereas Indonesia's EV battery manufacturing industry is growing rapidly and has great potential, the country's abundant raw material resources, growing domestic demand, and attractiveness of international investment make it an important player in the EV battery production industry.

Philippines

The economic situation of the Philippines post-US-China trade war has been affected by multiple factors. The Philippines' economy is largely dependent on exports, including exports to the United States and China. The US-China trade war could have some impact on the country's exports, especially in areas such as electronics and agricultural products. The business process outsourcing (BPO) industry in the Philippines is globally competitive and generates substantial jobs and foreign exchange earnings for the country. The sector has continued to grow steadily after the US-China trade war, supporting the Philippine economy (Li et al., 2018).

While the US-China trade war may have some impact on Philippine exports, the government and businesses are taking steps to address the challenges, boost domestic consumption, diversify economic activities, and enhance the infrastructure. The future economic outlook will depend on global economic and trade dynamics, as well as the Philippine government's policy initiatives and market opportunities.

Changes in the four small countries

Vietnam

Vietnam's nominal GDP has overpassed the Philippines' and Malaysia's to jump to ASEAN's fourth-largest economy in 2023. Contributing to Vietnam's political stability and rapid economic rise in recent years, the Vietnamese government has actively supported the electronics industry, and more major electronics manufacturers have set up production bases in Vietnam after the trade war (Tien & Anh, 2019). South Korea's major Samsung set up a factory, driving smartphone exports in 2013, Vietnam's largest export product jumped, and Vietnam's exports of electronic products exceeded US$100 billion in 2022 (Dhar et al., 2023).

Cambodia

The COVID-19 pandemic has had a severe impact on Cambodia's economy, but Cambodia's economic situation is gradually improving as the pandemic eases. Cambodia is highly dependent on tourism, especially tourists from China and other countries. After the outbreak of the epidemic, international tourism has been greatly reduced, which has dealt a huge blow to the Cambodian economy (Guo et al., 2018).

Cambodia is a production base for many garment and textile products that are exported to international markets. Despite the difficulties the pandemic has caused to global supply chains, the country's exports have increased after the pandemic, thanks in part to improvements to production facilities and an increase in orders. Due to the low labor costs, it is expected that the future will be transferred from China and other countries with increased labor costs along with the development of industries.

Laos

Laos is highly dependent on international trade, especially exports to China and other neighboring countries. The COVID-19 pandemic has had a certain impact on the economy of Laos (Laos), whereas the

agriculture and mining sectors have been relatively stable during the pandemic, continuously supporting the country's economy. These industries contribute significantly to Laos' gross domestic product (GDP) (Pangestu, 2019). Laos has been actively attracting foreign investment, especially in sectors such as agriculture, mining, and energy. International investment helps improve the country's infrastructure for production and provides opportunities for economic diversification.

The opening of the China-Laos Railway brings large-scale infrastructure development opportunities, which improves the efficiency of transportation and also strengthens international trade in the country, apparently helping improve its competitiveness in the region. In particular, the China-Laos Railway connects Laos with China's southern Yunnan province, facilitating trade between the two countries, helping facilitate the cross-border flow of goods and services, and creating more trade opportunities for Laos. On the other hand, with the opening of the railway, it will be easier for tourists to travel to Laos and explore its beautiful natural landscapes and cultural heritage. This is expected to boost the growth of tourism in Laos and increase the number of domestic and foreign tourists (Rowedder, 2020).

Myanmar

Myanmar's economic situation after the US-China trade war has been affected by multiple factors, but it does not seem to have benefited much from the restructuring of global supply chains. This idea is due to political instability in Myanmar. Myanmar has long faced problems such as political instability and military coups, which have adversely affected the economy. Political instability makes the investment environment uncertain and affects the business operations of domestic and foreign companies. Due to political problems in Myanmar and international sanctions, the country's international trade has been restricted to some extent (Yang et al., 2021).

China is one of Myanmar's largest trading partners and plays a key role in the country's infrastructure and energy projects. After the US-China trade war, China's influence on Myanmar remains significant, especially in investment and infrastructure construction. However, the Myanmar government is also working to promote economic development, attract foreign investment, and improve the business environment. As rich in natural resources, including energy, minerals, and agricultural products, the country has much potential for economic development and a future role in ASEAN's supply chain.

Changes in Singapore and Brunei

Singapore

Singapore’s economic situation has been relatively stable following the US-China trade war, and has been a key hub for international trade and logistics, benefiting from the growth of global trade. While the US-China trade war has had some impact on some of Singapore's export industries, the country's diversified economic structure and strong trade network allow it to flexibly respond to market volatility (Iqbal et al., 2019). Singapore is also one of the global financial hubs, attracting a large number of financial institutions and innovative fintech companies. After the US-China trade war, some companies may move their operations to Singapore to avoid potential trade risks and uncertainties. The Government of Canada actively promotes the

development of the digital economy and encourages digital innovation and digital transformation, which makes Singapore more competitive in emerging areas such as cloud computing, blockchain, and artificial intelligence. A diversified economic structure, strengths in the financial and digital economy, and active regional cooperation all contribute to Singapore's steady economic growth.

Brunei

Brunei's economy has been relatively stable after the US-China trade war and has relied on oil and gas exports as its main source of income. While the US-China trade war has had an impact on global energy markets, Brunei's oil and gas industry is relatively stable, and the Brunei government has been working to diversify its economy and reduce its dependence on energy, e.g., promoting the development of non-oil sectors such as finance, tourism and agriculture to increase the diversification of gross domestic product (GDP). The Brunei government encourages foreign investment, especially in the infrastructure and tourism sectors. They are improving infrastructure to support future economic growth (Mahadevan & Nugroho, 2019).

Conclusions and recommendations

The competition between iPhone and Huawei has created a new situation in the Southeast Asian (ASEAN) industrial chain. The rivalry between these two leading global smartphone manufacturers has had a profound impact on the electronics, manufacturing, and supply chain industries in the ASEAN region. With the upgrading of this competition, the ASEAN industrial chain has created a new situation.

Overall, the current situation of the ASEAN industrial chain is full of vitality, continuous development and evolution, attracting the attention of global investors. Competition between Apple and Huawei has prompted manufacturers in the ASEAN region to improve production efficiency and seek a more competitive cost structure, which will allow the ASEAN region to remain competitive in the global market and attract more business.

Some manufacturers and suppliers in ASEAN countries have begun to diversify their customer base and reduce their dependence on a single customer, such as Apple or Huawei. In order to attract orders from large smartphone manufacturers such as Apple and Huawei, manufacturers in the ASEAN region continue to improve their technical level and production capacity. This means that the ASEAN region is gradually increasing its strength in electronics manufacturing and R&D, which is expected to drive innovation and technological progress.

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A Study on the Impact of China-Laos Railway on ASEAN Supply Chain

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Abstract

This study examines the impact of the China-Laos Railway construction project on the economic and industrial supply chains of the two countries. The collected data was analyzed through journal articles, official government websites, institutional statistical reports, and in-depth interviews. Research and discussion show that the China-Laos Railway will effectively reduce logistics costs and enhance the convenience of land transportation. It can promote the development of Laos' economy and science and technology. The China-Laos Railway will also drive the accelerated transformation and upgrading of Laos' domestic industrial structure, promote the integration of Laos' domestic economy and the coordinated development of the regional economy of mainland Southeast Asia. However, some results show that the China-Laos Railway may also bring some negative impacts, which deserve special prevention by the competent unit.

Keywords: China-Laos railway, supply chain, social impact, ASEAN countries

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Introduction

Research background

The railway economic effect refers to a new economic form that relies on the comparative advantages of railways to achieve optimal allocation of resources and market agglomeration development. It can accelerate the free and orderly flow of production factors such as capital, technology, and manpower along the railway, as well as the close combination of consumer groups, consumer materials, service enterprises, and other consumption factors, and can be between stations along the railway. The economic effects generated by this and the optimization of the transportation network system in the region. It can play an important role in promoting the development of regional economic integration such as regional industrial structure division of labor and linkage of economic sectors along the route (Lingaitis & SinkeviČius , 2014).

Laos is a small landlocked country with an area of 236,800 square kilometers, two-thirds of which are mountainous (north); As a result, its geographical environment limits the quantity and quality of agriculture and creates difficulties for the development of trade, social infrastructure, and transport and communication links. Located in the heart of Southeast Asia's vibrant and prosperous region, Laos has great potential for strategic resource bases, bordering five neighboring countries: China, Cambodia, Vietnam, Thailand, and Myanmar. The country is divided into 3 main regions: Northern, Central, and Southern. In 2009, Laos had a total population of 6.26 million, most of whom lived in the valley region of the Mekong River and its tributaries, with a population density of only 27 people per square kilometer. Vientiane is the capital and largest city with about 799,000 inhabitants. As the only landlocked country in Southeast Asia, Laos' geographical features of numerous mountains and mountains and rivers restrict the construction and development of rail transit such as railways. (Hatthachan, 2012)

The China-Laos Railway is a cross-border transportation route from China to Southeast Asia, connecting Vientiane, the capital of Laos, and Kunming, an important city in southwest China, and will also drive other countries in the Indochina Peninsula such as Thailand, Myanmar, Cambodia and Vietnam. (Kyophilavong et al., 2017)

Modern rail transit such as railways is a product of economic globalization and a new type of national foreign development policy carrier. By connecting different regions, exchanges and communication between different countries and people can be promoted, mutual understanding and awareness can be enhanced, so as to achieve multiple goals such as international cooperation, social development and people's benefits. (Melissen, 2005)

Due to the spatial distribution of resources and the imbalance in economic development, Laos has a great demand for the cross-regional movement of people and materials. On the other hand, Laos' transportation infrastructure is backward, making it impossible for transportation capacity to adapt to the long-term development of the national economy. Due to the concentration of passenger flow, transportation capacity is more limited. In recent years, with the rapid development of urbanization, urban agglomerations in Laos have continued to emerge. Therefore, the demand for passenger transport in central cities and urban agglomerations

is increasing, and people's requirements for the carrying capacity of transportation infrastructure are getting higher and higher.

Since the beginning of the 21st century, high-speed railways, railways and other tracks have gradually become the key projects of international economic cooperation, and cross-border cooperation in large-scale infrastructure projects has further enriched the economic effect of railway projects. Many researchers have turned their attention to related issues, including overseas infrastructure research on China's high-speed rail. So far, much of the literature on high-speed rail has covered the application of related technologies, policies, risk management, operational management, and program evaluation.

With the smooth development of the China-Laos Railway project, the research literature on the China-Laos Railway is also increasing, but its research focuses mainly on the economic fields such as freight value, tourism potential, investment mode, and debt problem of the China-Laos Railway. The research perspective of railways is too single. According to our review of the relevant literature on the China-Laos Railway, it is confirmed that so far there is no comprehensive overview of the supply chain management of the China-Laos Railway. This study therefore attempts to fill this research gap.

Research Objectives

1. The most important goal of this study is to analyze the economic effects of the China-Laos Railway, as well as the derived scientific and technological effects and related positive and negative effects.
2. The industrial supply chain effect of the China-Laos Railway after its operation includes logistics efficiency, industrial structure transformation, and micro and macroeconomic changes.

Research Questions

1. Investigate the current construction status of the China-Laos Railway
2. The impact of the China-Laos Railway on the ASEAN supply chain

Literature review

The value of high-speed rail

About 40 years ago, the Shinkansen high-speed train service between Tokyo and Osaka in Japan was opened, with a maximum running speed of 210 km/h, marking the re-emergence of trains as an important mode of passenger transportation. Since then, many countries have introduced high-speed train (HST) services, and more countries are planning, and trains once again becoming the main mode of transport on many routes. High-speed rail is best designed to replace traditional rail service on routes that require higher capacity, and to reduce travel times, further improving rail service, also relative to other modes, resulting in model substitution. However, based on its economic development benefits, it is worth noting whether the high investment in high-speed rail infrastructure is reasonable because these economic and social benefits are uncertain and need to be more carefully evaluated (Givoni, 2006)

After the Second Industrial Revolution, technological development and the global flow of capital also promoted the rapid upgrading of rail vehicles, which also made Germany, Germany, Countries such as France and Japan make a lot of theoretical and practical innovations in the field of high-speed rail (Hood, 2006).

Nakamura and Ueda (1989) pointed out through the study of the Japanese Shinkansen that railway lines represented by high-speed railways can accelerate the flow of population between regions and have a strong attraction and pulling effect on the population of the surrounding areas of the railway, thereby promoting the reorganization of the population size and number between different regions along the railway line, and then providing human resource support for the economic belt formed by the railway trunk line.

The China-Laos Railway is an important part of the Trans-Asian Railway Central Line and an important connecting passage between China and the Indochina Peninsula Economic Corridor. The construction of the China-Laos Railway is of great significance to Laos' economic upgrading such as rapid cross-border transportation, domestic industrial structure upgrading, and economic growth power conversion. According to the World Bank report, once the China-Laos Railway is completed and operated, it will have a huge driving effect on the development of regional economic integration in China, Laos, and even the entire Indochina Peninsula, and the China-Laos Railway extending vertically from north to south will build a land economic corridor between Kunming, China and Vientiane, Laos, which can not only reduce the cost of cargo transportation between China and Laos4 0-50%, on the basis of which it is possible to further reduce the domestic transport cost of Laos by 2 0-40%, The World Bank (2020) will provide development opportunities for the upgrading of industrial structure and economic momentum transformation in Laos.

Bai et al. (2012) believe that the current analysis perspective of overseas infrastructure projects such as high-speed rail can no longer fully apply the original classical theoretical framework, and the 21st century has undergone profound changes compared with the era of Mackinder more than 100 years ago, and the geoeconomics method displayed by China in the world in the past 30 years has gradually replaced the traditional geopolitical method. The Eurasian economic corridors connecting Southeast Asia, Central Asia, East Asia and Central and Eastern Europe connected by China's high-speed rail not only help prevent the reversal of globalization and promote the development of global free trade but also provide a relatively moderate transition period for China's transition to a domestic demand-oriented economy.

Rostow (1960) believes that railway transportation has a strong economic driving force in the field of public transportation, which will have three main impacts on countries in the economic take-off stage, one is to reduce transportation costs and expand the market hinterland for new producers and new products, the other is to further enrich and expand the industrial structure and form of the transportation industry, thereby deriving more new industries, and the third is that railway transportation will be a regional coal, Commodities such as non-ferrous metals, iron ore and agricultural products provide faster and more efficient modes of transportation, leading to rapid industrialization.

Geopolitics and supply chains

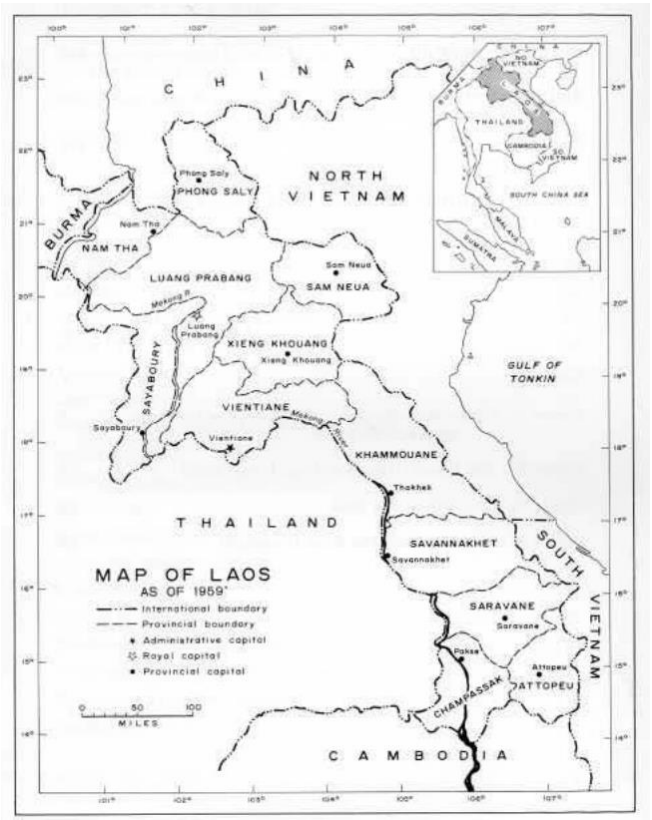

Figure 1 The map of Laos

The industrial supply chain in economics is a product of geopolitics. In the early twentieth century, the British geopolitician Mackinder put forward the "heartland theory", believing that the heart of Eurasia has an important role in the development of world politics and economy, and the railway trunk line has served as a "supply line for ocean-going commerce" since the steam age, especially in the heart of Eurasia (Mackinder, 1904).

In the forties of the twentieth century, Spykman (2017) further proposed the "marginal zone theory" on the basis of Mackinder, pointing out that the periphery of Eurasia will have an important impact on the overall global pattern, and the modern transportation system dominated by railway trunk lines, highways, and shipping will further aggravate this geopolitical distribution feature.

Zoellner (2016) pointed out that the new mode of transportation represented by high-speed rail is of great significance at the geo-economic and geopolitical levels, and the investment and construction of China's high-speed rail in Southeast Asia and other regions not only sends a large number of production factors such as capital, technology, and manpower to local countries but also provides development support for China to shape its international image and enhance its regional discourse power.

The China-Laos Railway can ease the pressure of domestic and cross-border transportation in Laos, change the single mode of transportation based on road transportation, and enrich the travel mode options between different regions of Laos, to form a comprehensive transportation system in Laos together with existing highway lines such as Vientiane Expressway (Vientiane-Vang Vieng) and Laos NR13 Highway. At present, road transport is still the main mode of transportation in Laos, and from 2012 to 2017, the road mileage in Laos has increased from more than 44,000 kilometers to 2017 (51,000 km), but only a few roads are asphalted, and the rest are highly vulnerable to climate change and natural disasters (Ministry of Public Works and Transport of Lao PDR, 2013; Asian Infrastructure Investment Bank, 2019)

At the same time, the World Bank further pointed out in its report that Laos accounts for more than 9.8% of total road passenger traffic and 8.6% of total road freight transport %, the single mode of transportation has seriously restricted the travel choices and cargo transportation efficiency of the Lao people. (The World Bank, 2020)

Rowedder (2020) critically examines the geo-economic win-win thesis of China's "Belt and Road" connectivity construction in line with Laos' development strategy of "land-locked countries becoming land-linked countries", and also examines the financial mechanism and potential economic benefits of the China-Laos Railway project and evaluates the sustainable long-term development model and future revenue mechanism of the China-Laos Railway. The stable operation of the China-Laos Railway requires China to assume corresponding social responsibilities along the railway to receive more support from the local people for the railway project.

Overseas infrastructure projects represented by the China-Laos Railway, China-Thailand Railway, Malaysia's East Coast Railway and Yawan High-Speed Railway are important carriers of the "Belt and Road" connectivity, which can accelerate the full flow of energy, capital, population, technology and other production factors between China and Southeast Asian countries. Based on this, the transnational transportation network built by the railway trunk line can not only drive the economic development of China and the countries along the route, but also form an interregional economic corridor, and then produce large-scale economic benefits.

Status and prospects of ASEAN supply chains

At the end of 2015, the Association of Southeast Asian Nations (ASEAN) officially announced the establishment of the ASEAN Economic Community (AEC), marking a new step in the integration process. This chapter discusses the characteristics, challenges and responses of ASEAN integration. The birth of the ASEAN Economic Community is often considered a clear outcome of ASEAN integration, as the ASEAN Economic Community's zero-tariff policy is very different from other economic frameworks under negotiation, such as the Trans-Pacific Strategic Economic Partnership (TPP) and the Regional Comprehensive Economic Partnership (Regional Comprehensive Economic Partnership). ASEAN has many opportunities, such as good economic development, large population, expanding consumer market, developed regional infrastructure and well-developed supply supply network. However, ASEAN faces challenges such as the end of the demographic

dividend, aging, domestic wealth gap, weak business competitiveness, rapid urbanization, expanding food and energy demand, and increasing disaster risk (Sakane, 2017).

Following the U.S.-China trade war and the COVID-19 pandemic, the restructuring of global supply chains has accelerated, with the ICT industry being the most active, with the proximity to Chinese mainland and strategically at the heart of the Indo-Pacific region, highlighting the advantages of ASEAN, which is adjacent to and strategically located in the Indo-Pacific region, and has undergone a major shift in its role and position in the East Asian and global ICT supply chains (Yang, 2022).

As Sino-US trade has led to the transfer of supply chains to Southeast Asia and other countries, as well as the emergence of the global minimum tax system, it is necessary to understand the global minimum tax system, the current situation of Sino-US trade, and then conduct a summary analysis of the tax environment in Singapore, Malaysia, Thailand, the Philippines, Vietnam, Indonesia, Myanmar, Cambodia, Laos and India. (He, 2022).

It will be interesting to see the trade frictions between the United States and China, and whether these frictions have an impact on ASEAN's trade relations with these countries. There has been friction between the two countries since the early 90s of the 20th centuries, with the United States blaming the Chinese government for the trade deficit and pointing to the depreciation of the yuan against the dollar as the culprit. While previous U.S. presidents have taken a softer approach to China on the issue, they have taken a hard line since President Donald Trump. President Trump's starting point was to correct U.S. economic imbalances, and he made good on his promise to impose high tariffs on Chinese products. Because there are many American companies that operate in China and export a large number of products to their domestic market. This trade friction will undoubtedly have a spillover effect on ASEAN, the trading partner of the two countries (Aslam, 2019).

The US-China trade war and technological confrontation have led to the restructuring of global industrial supply chains, and the new crown epidemic has brought major enlightenment to the global economy, highlighting the risk that many countries around the world are highly dependent on China's supply chain, and the importance of improving supply chain resilience and risk diversification, especially the serious shipping congestion, port congestion, and soaring freight rates since 2020, which has highlighted the risks and uncertainties of cross-continental and transnational production. In order to diversify risks, companies hit hard by the epidemic will have to consider sourcing strategies and supply chain adjustments to wean themselves off dependence on the Chinese market or imports. Under this trend, supply chains need to be more diversified and fragmented, and developed countries have promoted manufacturing reshoring) and reindustrialization), which will further accelerate the phenomenon of global supply chain restructuring.

With the US-China trade conflict, the trend of global supply chain restructuring has accelerated, moving towards decentralization, diversification, regionalization, and short-chain. Countries around the world have begun to face up to the risk of too single supply chains and dependence on imports, and have adjusted their industrial, foreign investment, and trade policies to strengthen the goal of promoting the localization of key manufacturing industries, hoping to avoid serious chain or material disruption when major external risks occur.

Among the trends of supply chain restructuring and mobility, the shift to ASEAN is the most obvious, which has led to ASEAN's rising position in the global supply chain. According to the International Monetary Fund (IMF), the overall gross domestic product (GDP) of the 10 ASEAN countries reached US$3.36 trillion in 2021, ranking the fifth largest economy in the world, and in recent years, it has jumped to the world's attention for new factories in Asia. After the outbreak of the US-China trade conflict, the interest of multinational companies and Taiwanese companies in ASEAN investment and markets has increased, and after the outbreak of the new crown epidemic in 2020, the risk and vulnerability of supply chains concentrated in a single country Chinese mainland have been further highlighted, thus further stimulating the pace of diversification of investment and production capacity from China. In order to win foreign investment and establish supply chains, ASEAN has also successively proposed new industrial and foreign investment policies, hoping to seize opportunities under the current trend of supply chain migration and enhance the localization of key manufacturing industries.

Research methods

This paper uses qualitative comparative analysis, logical reasoning, and in-depth interviews to compare the different impacts of the China-Laos Railway on economic growth.

Literature analysis

This study is based on a comprehensive review of all publicly available materials and data on the China-Laos Railway, including articles in English journals, and English newspapers, as well as United Nations reports, World Bank reports, and Chinese and Lao government documents. The resulting information can inform a more efficient and rational China-Southeast Asia transportation network.

In-depth interviews

This article uses in-depth interviews to interview government officials, people, etc. in Laos. The topics of the interview are as follows.

1. What do you think of the China-Laos Railway?
2. What kind of positive impact will the China-Laos Railway have on Laos?
3. What kind of negative impact will the China-Laos Railway have on Laos?
4. Can the China-Laos Railway contribute to the development of a more sound industrial supply chain in Laos?
5. What kind of policy should the government adopt to welcome the opening and operation of the China-Laos Railway?

Results and discussion

The current economic situation in Laos

Laos is the poorest and most backward agricultural country in Southeast Asia. Affected by war for a long time, political turmoil, and economic backwardness; The other is inland and has a weak foundation. Therefore, both countries are now taking economic construction as their main task in the future and attach particular importance to agricultural development. Since the implementation of the policy of opening in Laos in the mid-80s, the political and economic environment has greatly improved. In 2001, a medium- and long-term development plan was formulated with the goal of narrowing the gap with other ASEAN countries, but there are many problems (Bourdet, 2001).

After more than 20 years of economic policy adjustment and economic reform, the Lao economy has made great progress, but it is also facing many problems. First, the main problems of the Lao economy are that the economic foundation is weak, and the infrastructure and education have not yet come to the forefront of development. Second, the key to accelerating the development of Laos' economy lies in vigorously developing education and infrastructure construction and making good use of its comparative advantages. Third, the geographical advantage and the population resource ratio advantage of the small country model determine that the Lao economy will be able to develop well in the long run (Phimphanthavong, 2014).

After the establishment of the Lao People's Democratic Republic, a communist economic attempt to implement the agricultural collective system ended in failure. In the late 80s of the 20th century, under the dual influence of domestic difficulties and foreign pressure, Laos began market-oriented reforms, and the ownership policy, economic operation mechanism, and foreign economic policy underwent fundamental adjustments. In the early 90s, Laos proposed a principled comprehensive reform of the economy and the implementation of the policy of opening up to the outside world, the poverty situation in the country has been improved to a certain extent, and the living standards of the people have been improved, and the regional status has gradually been valued. However, due to the special political culture in Laos and the excessive dependence on the resources of foreign and international organizations, the development prospects of Laos' reform and opening up routes still a long way to go (Dana, 1995).

Economic globalization is an inevitable trend in the development of the world economy today, and economic globalization is a double-edged sword, which not only brings benefits and opportunities but also has great risks, especially for developing countries. As a developing country with a lagging economy, Laos has to join the operation of the big machine of economic globalization, whether willingly or unwillingly, so as to make strategic choices that suit the national conditions (Evans, 1998).

After Laos' independence in 1975, the country implemented a socialist system, and the government determined and controlled what was produced, how it was produced, and who received the final product (in contrast, in a market economy, individuals owned property and property freely traded such property and received income from the exchange of property, and the price of goods was determined in a free market system, where demand determined the content of production). In the early 80s of the 20th century, this system

did not meet its goals due to economic performance that could not meet the expected goals, the population became increasingly poor, and the economic system was weak. These problems confirmed that a separate centrally planned economic system was not suitable for Laos, which led to economic reforms. The transition from a centrally planned economy to a market economy was initiated in 1986 with the aim of promoting economic activity, including economic activity. Various assessments of systemic and macroeconomic characteristics, which are grouped into four main headings: first, all the features of the microeconomic view, aimed at improving the structure of intensification and encouraging the growth of private production. The second is trade liberalization, which aims to bring into play the country's professional advantages and integrate into the international economy, especially the Southeast Asian economy. The third is less accommodative macroeconomic policies to ensure price stability and reap the growth benefits of economic liberalization. The last one is the legal and institutional measures necessary for the functioning of the market economy.

Vongpraseuth and Choi's (2015) research focuses on the conflict between urban growth management (UGM) in urban planning policy and the growing impact of globalization and foreign direct investment (FDI) on Vientiane, the capital of Laos. He posed the question, "Does FDI affect UGM in Vientiane, the capital of Laos?" Important decrees, tasks, technical reports, field investigations, and interviews are also explored in his articles. The results show that FDI has been an important tool for promoting economic development and supporting urban development in Vientiane. On the other hand, a core conflict has emerged between government growth management policies and the spatial impact of FDI on land use, the natural environment, socio-cultural values, and the transformation of cooperation stages. Moreover, globalization and FDI affect not only economic growth but also the implementation of UGM in Vientiane. Although the urban planning sector has been fairly strict, the investment sector prefers to encourage FDI and domestic investment by giving incentives. Therefore, in order for the "least developed country" to achieve more balanced development, cooperation between similar institutions (such as planning, investment, and land management) should be seen as a necessary long-term strategy. The China-Laos Railway is the concrete realization of his thesis.

Regarding Laos' economic problems, respondents have high hopes for the completion of the China-Laos Railway.

Interviewee (number A003) had a very positive opinion of the China-Laos Railway. He spoke

This is "*the most convenient railway, I myself have ridden the China-Laos Railway many times, it is very fast, cheap and therefore very competitive", as China expands investment in Laos through the China-Laos Railway, many Laos "people can gain considerable benefits from this*".

Impact of the China-Laos Railway on the Lao Economy

To improve the level of domestic transportation infrastructure, Laos has adopted the "Eighth Five-Year Plan for Socio-Economic Development (2016-2020)" and "Ten-Year Socio-Economic Development Strategy (2016-2025)" and other plans to speed up the process of infrastructure construction (Jasmina, 2017).

According to the construction plan, the China-Laos Railway is divided into two sections, the total mileage of the Laos section (Boten-Vientiane) is about 414 kilometers of passenger and freight co-line railway line, of which the total length of the tunnel reaches about 198 km, the total length of the bridge reaches about 62 km, the design speed for passenger transport is 160 km / h (the maximum speed is 200 km / h), and the freight speed is 120 km / h (Taejun, 2020).

Tai (2021) pointed out that the China-Laos Economic Corridor (C LEC) constructed by the China-Laos RailwayAs an important part of the "Belt and Road" initiative, the China-Laos Railway will transform Laos from a landlocked country into a land-linked country, connecting important seaports, gateway cities and regional economic centers in the Indochina Peninsula such as China, Laos, Cambodia, Thailand and Vietnam through railways, thereby driving the rapid development of Laos' tourism, labor, goods trade, service trade and cross-border logistics, which is of great significance to Laos' economic improvement.

Gao and Zhen (2020) pointed out that the international railway transportation network built by high-speed rail and railway rail transit overseas infrastructure projects represented by China-Laos Railway, China-Thailand Railway, Yawan High-speed Railway, and Hungary-Serbian Railway will accelerate economic cooperation across Eurasia, thereby creating new economic cooperation opportunities between China and countries along the Belt and Road. In turn, the countries of Eurasia, which are on the margins of traffic congestion and economic globalization, have reintegrated into global economic development.

The China-Laos Railway strengthens the coordinated development of the China-Indochina Peninsula Economic Corridor, which is mainly reflected in the fact that the China-Laos Railway and the future China-Thailand Railway will become an important part of the Trans-Asian Railway Central Line, thereby revitalizing the regional economic development of the entire Indochina Peninsula. Therefore, the economic effect of the China-Laos Railway in the construction process not only meets the social and economic development needs of Southeast Asian countries, but also establishes China's image as a responsible major country in the international community, and its economic effects are also transmitted from China and Laos to the entire Southeast Asian region.

The China-Laos Railway has accelerated the transformation and upgrading of Laos' domestic industrial structure, which is mainly manifested in the upgrading and optimization of Laos' domestic industrial and service industrial structure. During the construction of the China-Laos Railway, a large amount of technology spillover will occur, which can accelerate the transfer of science and technology to Southeast Asian countries such as Laos, and at the same time, these countries gradually expand from railway transportation to other related industries such as steel production, power transmission and spare parts manufacturing through the way of "learning by doing", thereby enhancing the technical element endowment of their domestic industrial manufacturing industry. Give its products and services more technical content.

As the export of the whole industrial chain of China's high-speed railway technology, the China-Laos Railway can provide Laos and other Southeast Asian countries with technical manufacturing technology and technical management experience in many fields such as railway, electric power, and bridge construction, thereby providing an industrial development foundation for the social and economic development of Laos. The

China-Laos Railway will build a rapid transportation network system between Southwest China and Indochina Peninsula countries, accelerate the high-speed flow and effective allocation of scientific and technological resources between China and Southeast Asian countries, not only accelerate the export of China's complete sets of technical equipment and complete industrial chain of technical products, enhance the added value and scientific and technological competitiveness of China's manufacturing industry, but also fully meet the market demand for transportation infrastructure upgrading in Laos and other Southeast Asian countries, and inject more industrial technology into its industrialization process. Industrial science and technology and industrial equipment and other scientific and technological production factors, so as to achieve a win-win situation between China and Laos and a win-win situation between China and Southeast Asian countries in the field of science and technology

From the in-depth interview, we find the interviewee has the opinion.

Interviewee (number A012) says:

"China accounts for more than 80% of Laos' agricultural exports, funds at least 800 projects, and has a total value of more than US$16 billion, so the opening of the China-Laos Railway will further promote the common cooperation and development between the two countries, and can also promote smoother adjustment of logistics supply chains".

Interviewee (No. 004) suggested the Lao government's response to the China-Laos Railway, saying.

Laos, a latecomer to ASEAN in the 'CLMV' (Cambodia, Laos, Myanmar, and Vietnam), is certainly more pronounced in the face of this vulnerability to the inducements of such powers. The establishment of closer political, economic, and cultural ties between Laos and these countries in the region has shaped Laos' independent system of diplomatic relations".

The impact of the China-Laos Railway on the logistics industry in Laos

On December 3, 2021, the China-Laos Railway (CLR), which has been under construction since 2016, launched its first operation between the two terminals in Kunming, the capital of southwestern Yunnan Province. Vientiane, the capital of China and Laos. In many ways, CLR is an unprecedented cross-border rail project in terms of size, length, connection location, type of construction, and potentially significant regional impact. Chen's (2022) study analyzes the China-Laos Railway (CLR), drawing on evidence from its late construction and early operation. It explores CLR's connectivity effects, highlighting the broader impact of "corridorization" on the region.

Launched in 2016 and scheduled for completion by the end of 2021, the China-Laos Railway, which has been proposed within a number of regional multilateral frameworks, will provide Laos with unprecedented rail infrastructure to connect its capital Vientiane to China through the northern border town of Boten.

After the completion and operation of the China-Laos Railway, it will build an economic corridor connecting different regions in the north and south of Laos, alleviating many problems faced by road transportation, such as excessive traffic flow, serious overload of goods and many restrictive conditions, and improve the investment environment and residential traffic conditions along the railway. The China-Laos Railway

will form a comprehensive transportation system with complementary advantages with different levels of highways such as Wanwan Expressway and NR13 Highway, especially can undertake the transportation of bulk commodities such as coal, non-ferrous metals, and grain, as well as agricultural products with a short shelf life such as vegetables and fruits, so as to form a coordinated transportation mode between highways, expressways and ordinary highways, and alleviate the transportation pressure of domestic road traffic in Laos. Provide important support for the industrialization process and the creation of characteristic service industries in Laos.

The means of transportation represented by modern rail transit such as high-speed rail and railway can significantly accelerate the flow of scientific and technological elements along the railway line, form a concentration of scientific and technological elements with railway trunk lines and stations as key nodes, and thus provide a better platform for the sharing and development of scientific and technological elements in cities along the route (Chen & Hall, 2011). The China-Laos Railway has promoted the economic layout of regional economic integration in Laos, which is mainly reflected in the fact that different provinces, key cities and economic development zones in Laos are located in the hinterland of the China-Laos Railway.

The impact of infrastructure investment on the economy is clear, and the route and mode of transportation from Bangkok, Thailand to Kunming, China generally has (1) road mode, and (2) road and rail mode. The China-Laos Railway can affect the transportation of logistics services, and we can analyze from the four main functions, namely logistics, economy, tourism, and safety. In addition, the time cost distance can also be analyzed using the moving cost and time composition, and the same results can be obtained.

Southeast Asia has made many efforts to improve multimodal transport connectivity. The strategic location of logistics centers facilitates the transportation, handling, storage, and transshipment of goods in international trade. Various evaluation criteria for logistics center site selection analysis. Using analytic hierarchy and target planning methods, Laos' logistics center location was analyzed, with Laos aiming to transform from a landlocked to a land-linked country. Developed based on primary data collected from public and private sector transport stakeholders. The findings indicate that the China-Laos Railway will undoubtedly exert a substantial influence on Laos' logistics in the coming years.

The article in Rowedder (2020) critically examines the potential geoeconomics win-win narrative of combining China's BRI regional ambitions with Laos' national vision of transforming into a land-linked country. In the context of the more enduring neoliberal development trajectory in Laos and the region, the authors learn about the latest BRI infrastructure connectivity label, examine the financial mechanisms of railway projects and the calculation of different spatial and temporal scales of potential benefits in Laos and China. These juxtapose with the empirical reality of the already visible dynamics and impacts of Chinese investment along the railway. The plan's promoters paint a picture of a future that will reap Chinese profits at the expense of Laos' sustainable long-term development. In order to contribute to the much-needed basic description of the large-scale projects supported by China as they unfold on the ground, the authors also pay special attention to local discourse and experience to fully understand the nature, process, and impact of BRI financing. This argument is something

we should be particularly concerned about when we are concerned about the benefits of the China-Laos Railway.

Interviewee (number A006) says

"The quality of Lao coffee is very good, we have started to export coffee beans to China, and it will be more convenient to export coffee when a train opens in the future. Investment opportunities will grow in the future, and I believe that the Chinese will choose Lao coffee as the first choice for beverages".

Interviewee (number A002) says

"The opening of the China-Laos Railway will create good conditions for trade relations and cooperation between Laos and China. It can create a lot of convenience, especially in terms of production cost reduction, will greatly promote the development of the Lao economy".

Analysis of the negative impact of the China-Laos Railway on the Lao economy

Economic globalization has promoted the economic development of underdeveloped areas, but it has also affected the ecological environment of these areas, such as the degradation of natural forests. For inland development areas with underdeveloped transportation, is the impact on the ecological environment equally obvious?

Chan (2017) proposed in his book that China's high-speed rail "going global" is a kind of geo-development, and the geo-economic value generated by China's high-speed rail overseas infrastructure projects will largely reshape the traditional political and economic pattern of Eurasia, forming a new international political and economic order dominated by East Asia. This is also a footnote to the "China threat theory" currently being put forward in this post.

Freeman (2019) discusses the debt impact that the China-Laos railway project has been facing for Laos and the economic significance of the railway project for Laos. The issue of debt has always been a concern of Laos. Under the premise of the Chinese threat, the scramble for overseas high-speed rail projects has become a prominent feature of Chinese diplomacy in recent years, including in Southeast Asia. These efforts are widely described as part of Beijing's agenda to change the balance of power in Southeast Asia at the expense of the economic, political, and security well-being of countries in the region. But in the article PavliĆeviĆ and Kratz (2018), this interpretation is questioned and argues that these are 'high-speed railways' The project has neither the intention nor the capacity to pursue such a hostile and far-reaching agenda.

Vörös and Somsack (2020), analyze China's growing direct investment and construction projects in Laos, especially the China-Laos railway construction project linking China and Laos. The completion of the China-Laos Railway will help reduce transportation and logistics costs and can even drive the rapid development of Laos' tourism industry, thereby benefiting the domestic economy of Laos. But some scholars have questioned who will benefit the most from the railway project and how Laos can avoid the so-called "debt trap".

Tengyuan et al. (2019) discuss the political and economic risks of international high-speed rail construction projects, with financing and cost, social support, and government attitudes as determinants of managing the political and economic risks of projects, and point out that overseas infrastructure projects need to fully understand the political and economic risks involved in the project in order to implement more effective response strategies.

Dragan (2017). used the Jakarta-Bandung high-speed rail project in Indonesia as a case study to analyze the fierce competition between China and Japan in the infrastructure sector in Southeast Asia, pointing out that the zero-sum game between China and Japan in the infrastructure sector in Southeast Asia will lead to a lose-lose situation, and the resulting negative economic effects will lead to unsustainable development of the infrastructure market in Southeast Asia.

In order to reveal the characteristics of the response of the ecological environment of landlocked developing countries to globalization, Laos as an example, land use/cover change data and import and export data were used to analyze ecological environment changes over the past thousand years. The analysis of the land use transfer matrix shows that from 2000 to 2017, 14.43% of the natural forests in Laos were converted to plantations, and 5.94% of the natural forests were degraded into shrublands and grasslands. Landscape pattern analysis shows that these changes are the main causes of ecological patch fragmentation, which in turn leads to biodiversity loss. In addition, topographic analysis further shows that degradation of natural forests occurs mainly at high altitudes and large slopes, which may increase the likelihood of natural disasters such as flooding. The coupling analysis with its import and export data shows that although Laos is a landlocked developing country, economic globalization still has a significant impact on its ecological environment. Laos should strengthen the supervision of renewable resources such as forests and water resources to avoid losing the renewable resources market while enjoying the dividends of economic globalization. At the same time, it is necessary to accurately assess the indirect impact of development on neighboring countries to ensure sustainable development (Vongpraseuth & Choi, 2015).

Interviewee (number A009) says:

"Chinese do whatever they want, they bring their people to work here, which puts the local area out of work." They do not respect the people and regulations we have here. We are also unable to communicate with the Chinese, which has also become a problem brought to us by the China-Laos Railway."

Interviewee (number A002) says

"China is building more and more hydropower dams on the Mekong, and we are very worried that it will destroy or affect environmental security and people's livelihoods, or have a social impact on downstream countries, so I am worried that the China-Laos railway will also be another dam or power plant."

Conclusions and recommendations

1. The China-Laos Railway effectively enables Laos to realize the development strategy of "turning a land-locked country into a land-linked country" and is an important carrier for international economic

cooperation and regional production capacity coordination between China and Laos, and its connotation and extension have been greatly expanded.

2. As a new passage of the China-Indochina Peninsula Economic Corridor, the China-Laos Railway not only plays an important role in promoting economic development, regional industrial division of labor and deep integration of urbanization along the line, but also accelerates the export of technical standards and intellectual property rights related to railway infrastructure projects such as survey, design, construction and operation, while providing regional public goods and sharing development dividends for Laos and other countries in the Indochina Peninsula.

3. The China-Laos Railway can promote the effective development of Laos' industrial supply chain, thus having a very positive impact on the economy, but after the opening of the train, appropriate measures should be taken to minimize its negative impact.

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Sustainability Challenges and Opportunities in the Semiconductor Supply Chain

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Abstract

In this article, we discuss the challenges of sustainable development faced by the semiconductor industry, including resource constraints, environmental impacts, worker protection, and ethical issues. The main challenges faced by the semiconductor industry are the increasing demands from environmental regulators and consumers to be more environmentally and socially responsible, to reduce the use of energy and water resources, and to reduce waste emissions.

The demand for such development has also created many opportunities for the semiconductor industry supply chain, including the use of green engineering technologies, more efficient use of resources and circular economy. Therefore, in this paper we will discuss in detail some of the sustainability issues faced by the semiconductor industry, including ethics, environment, labor protection and resource constraints, as well as environmental damage and impact. Finally, we provide various recommendations in this article regarding the sustainable development of the semiconductor industry and the opportunities it can encounter.

After a brief overview of the current status of the semiconductor supply chain, we pointed out the challenge faced by and strategies that were be deployed by the key companies, such as TSMC and Intel. And finally, the conclusions were drawn.

Keywords: Sustainability, Semiconductor Industry, Supply Chain, Corporate Social Responsibility, environmental impact, labor rights, ethical practices

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Introduction

Research background

The sustainable development of the semiconductor industry supply chain has received a lot of attention in recent years. As the popularity of semiconductor products continues to grow and market demand continues to increase, the environmental and social issues associated with the semiconductor industry supply chain have become increasingly important. In this article, we discuss the sustainable development of the semiconductor supply chain and analyze the challenges it faces and the direction it will take in the future.

As noted by Kang et al. (2015), the semiconductor manufacturing process requires a substantial amount of energy and water, particularly during the wafer and chip manufacturing process. Additionally, the manufacturing and usage of semiconductor products generate considerable emissions and waste, which could pose significant environmental and social impacts. Hence, the sustainable development of the semiconductor industry supply chain is mainly reflected in two aspects: 1) energy and resource consumption and 2) environmental and social impact. Addressing these aspects is critical to ensuring the long-term sustainability of the semiconductor industry supply chain. Another features of semiconductor supply chain brought up by Harland et al. (2008) is the fast pace of technological innovation and short product cycles, which could result in adverse effects to our environment, such as pollution caused by waste gas, waste water, and solid waste generated during the manufacturing process. The energy- and resource-demanding manufacturing processes of the semiconductor industry are therefore in desperate need of sustainable and environmentally friendly practices to minimize its impact on the environment. According to Lee et al. (2011), to achieve sustainable development, measures need to be taken to reduce energy and resource consumption, mitigate environmental impact, and promote green production. One strategy is to promote energy-saving and emission-reduction technologies through process improvement, energy management, and recycling. Another approach is to adopt a green supply chain that incorporates eco-friendly practices across the entire product lifecycle, including product design, material selection, and end-of-life product recycling. Finally, collaboration and information sharing among all supply chain stakeholders are essential to enhance the overall efficiency and sustainability of the semiconductor industry supply chain.

In achieving sustainable development in the semiconductor industry supply chain, another important driving force would be the involvement of governments. Policy and legal support have been shown to encourage companies to adopt green production practices by creating relevant laws, regulations, and policy measures (Santharm & Ramanathan, 2017). In essence, sustainable development in the semiconductor industry is tied with environmental protection issues. Strengthening environmental protection measures and promoting environmental management across the entire supply chain are critical to achieving sustainable development in the semiconductor industry.

Purpose of the study

The lockdown due to the outbreak of the pandemic since 2019 has revealed the complexity and uncertainty of the semiconductor industry supply chain, and yet the increasing demand for the semiconductor industry globally has posed many challenges and therefore urged the thorough examination in detail for a more sustainable and vulnerable development of the supply chain in order to withstand problems it might face in the future, which will be discussed in the following part of this paper.

The sustainable development of the semiconductor supply chain has been a critical research issue. This is due to the increasing complexity and diversity of the global semiconductor industry. According to Felsberger and Reiner (2020), the sustainability challenges of the semiconductor supply chain are multifaceted. The processes of its manufacturing generate substantial amount of waste and pollution thereby emitted, posing a severe environmental challenge. Similarly, social issues, such as labor rights, working hours, salaries, and welfare, highlight the need for social responsibility in the semiconductor supply chain. Moreover, the geographic concentration and reliance of the semiconductor supply chain pose significant challenges to risk management and disaster resilience. This study aims to cover the above-mentioned aspects and investigate the sustainability challenges of the semiconductor supply chain comprehensively. Specifically, the interactions between suppliers, manufacturers, foundries, packaging and test plants, and other stakeholders involved in the semiconductor supply chain will be explored.

Meanwhile, this study will point out the opportunities accompanying the sustainable development of the semiconductor supply chain. For example, continuous innovation and upgrading of semiconductor manufacturing technology can improve production efficiency, reduce energy and resource consumption, and reduce environmental impact, promoting supplier social responsibility and improving the working environment.

Research Questions

The most important aspect of this study is to discuss the challenges and opportunities for the sustainable development of the semiconductor supply chain. The major issues discussed in this article are listed as follows.

1. Environmental sustainability challenges: The environmental impact of waste generated during semiconductor manufacturing, energy and water consumption, and emissions of hazardous substances are significant sustainability challenges for the semiconductor industry. This study will explore the challenges faced by the semiconductor supply chain in achieving environmental sustainability goals and examine the corresponding strategies and practices to address them.
2. Social responsibility challenges: The semiconductor supply chain involves multiple countries and regions, including many workers and communities. Social issues such as labor rights, working hour management, and salary and welfare require the semiconductor industry to demonstrate social responsibility. This research will explore the difficulties and challenges of the semiconductor supply chain in achieving social responsibility and identify related solutions and best practices.

3. Risk management challenges: The geographic concentration and single dependency of semiconductor supply chains pose challenges to supply chain risk management and resilience. For instance, the global semiconductor supply chain may be at risk of production disruptions in situations such as natural disasters, political instability, or trade frictions. This research will explore the dilemmas and challenges of risk management in the semiconductor supply chain and propose corresponding solutions.

4. Sustainability opportunities: With the increasing global focus on sustainable development and related regulations, the semiconductor supply chain is also facing potential sustainability opportunities. For example, the application and innovation of new technologies can improve the environmental benefits of semiconductor manufacturing and promote innovation and effective management of the supply chain.

In the various research questions presented above, we have analyzed the semiconductor industry supply chain and the challenges and opportunities for its sustainable development, and only by solving these problems can we promote the sustainable development of the semiconductor industry. This study provides potential approach to the future development strategy of the semiconductor industry

Research methods

This research aims to explore the sustainability challenges and opportunities of the semiconductor supply chain using a hybrid research methodology that includes a literature review and field research. Firstly, a comprehensive literature review will be conducted by collecting relevant academic journals, research reports, government documents, and industry reports. The literature review will focus on topics such as environmental sustainability, social responsibility, risk management, and sustainability opportunities, providing insight into the challenges and opportunities that semiconductor supply chain encountered. In the literature review, we have included quantitative, qualitative, and mixed research to discuss the challenges and opportunities for sustainable development of the semiconductor supply chain. Firstly, we have looked at various journals, government reports, industry reports and research reports from academic institutions. The focus of the literature is on environmental sustainability, social responsibility, and risk management, as well as opportunities for sustainable development, in order to fully understand the challenges facing the semiconductor industry.

Secondly, on-site investigations will be conducted to select representative semiconductor supply chain enterprises and stakeholders. In-depth interviews and questionnaire surveys will be conducted to understand their sustainable development operations and experiences. The survey will focus on corporate environmental management practices, social responsibility policies and implementations, risk management measures, and sustainability opportunities. As a result of our combined qualitative and quantitative approach and the data obtained from the literature review and field surveys, we compare the differences between the different levels of the semiconductor supply chain in different regions of the world and at different company sizes. Through these analyses, we will understand the diversity and different characteristics of the semiconductor industry given its orderly development history.

Literature review

Previous study

There exist many research exploring the concept of sustainable development in the semiconductor industry from different perspectives. For instance, Lu et al. (2013) reviewed corporate social responsibility practices in the semiconductor industry. Wang and Chiu (2014) conducted a systematic literature review of sustainability in the semiconductor supply chain. Ejsmont et al. (2020) also conducted a systematic literature review on sustainable supply chain management strategies for the semiconductor industry. In addition, Chang (2009) focused on the shift in the semiconductor industry's corporate social responsibility from environmental issues to labor and human rights issues, and Ntabe et al. (2015) examined sustainability strategies in the semiconductor supply chain. Furthermore, Cheng and Ahmad (2010), Curry et al. (2012)., and Price (2015) analyzed Intel Corporation's sustainability practices. Finally, Huang and Huang (2022) explored the factors influencing corporate sustainability in Taiwan's semiconductor industry.

The development of the semiconductor supply chain

The semiconductor industry has been a driving force for innovation in the modern world, with its widespread applications in computing, telecommunications, and consumer electronics. However, the increasing demand for high-performance semiconductors has also led to environmental and social concerns that must be addressed. The semiconductor supply chain is a complex process that involves several stages of manufacturing and assembly across various countries and regions. Concerns have been raised about the environmental impact of the industry, including the generation of hazardous waste, high energy consumption, and water pollution. Additionally, the industry has faced criticism for labor practices, such as low wages and poor working conditions, especially in developing countries where many semiconductor manufacturing plants are located (Lin et al., 2019).

To mitigate the environmental and social impact of the semiconductor industry, sustainability initiatives have been implemented. Green manufacturing practices, renewable energy use, and the development of a loopback economy model are some of the initiatives taken to reduce waste and promote recycling. The industry has also focused on responsible sourcing of raw materials, such as conflict minerals and rare earth metals, by working with suppliers to ensure that these materials are ethically and sustainably sourced (Van Den Brink et al., 2019).

Overall, the semiconductor industry has brought significant benefits to society but has also created environmental and social challenges. By implementing sustainability programs and responsible sourcing practices, the industry can work towards a more sustainable future for all.

Characteristics of the semiconductor supply chain

The semiconductor industry supply chain is a complex yet integrated system that encompasses the entire process from raw materials to finished (Park, 2016). This supply chain is composed of numerous companies and organizations, including wafer foundries, equipment manufacturers, material suppliers, packaging and test plants, and others. One of the characteristics of the semiconductor supply chain is its high level of specialization and division of labor, where each link has a dedicated company and facility responsible for specific processes and technologies.

Another notable feature of the semiconductor supply chain is its rapid pace of technological innovation and short product cycles (Frieske & Stieler, 2022). Due to changes in market demand and technological advancements, product cycles are often only a few months, and companies in the supply chain must quickly adapt and upgrade their technologies and products. In addition, there are high risks and uncertainties in the semiconductor supply chain, including market demand fluctuations, uncertainty in technological innovation, natural disasters, etc.

The semiconductor supply chain also faces several environmental challenges, including pollution caused by exhaust gas, wastewater, and solid waste generated during the equipment manufacturing process (Panwar et al., 2022). In addition, the production of semiconductor products requires a large amount of energy and water resources, which puts great pressure on the supply and consumption of water and energy. Therefore, it is very important for the semiconductor supply chain to achieve sustainable development goals. It is necessary to adopt a series of effective environmental protection measures and technological innovations to reduce the impact on the environment, improve resource utilization, and promote the sustainable development of the semiconductor industry.

Semiconductors play an important role in modern technology as they are used in the production of various high-tech products such as smartphones, computers, tablets, wearables, and automobiles. The development of the semiconductor industry is crucial because of its wide range of applications in modern society. However, the complex and extensive supply chain required for semiconductor production is critical to the stability and efficiency of the industry. The importance of the semiconductor supply chain is reflected in several ways. First, the supply chain's stability directly affects the product quality and market competitiveness. A delay or disruption in any part of the supply chain can lead to production delays or substandard product quality, affecting the industry's market competitiveness. Secondly, the supply chain's efficiency and cost allocation are important factors in the industry's development. Semiconductor manufacturing processes are complex and require significant investment and technical support. A well-managed supply chain can significantly reduce production costs, improve product profit margins, and promote the industry's development. Finally, the sustainability of the semiconductor supply chain is also critical to be considered. The production process has a significant environmental impact, necessitating the adoption of more environmentally friendly production methods and materials. All suppliers at every stage of the semiconductor supply chain must collaborate to achieve sustainable development in the industry. According to the article " Supply Chain Risk Management:

Literature Review and Future Research." by Vanany et al. (2009), efficient risk management practices in the semiconductor supply chain can significantly contribute to the industry's stability and development.

Challenges of semiconductor supply chain and sustainable development

Environmental impact of semiconductor supply chains

The semiconductor industry plays a crucial role in the development of modern high-tech products, such as smartphones, computers, and wearable devices. However, the semiconductor supply chain also raises significant environmental concerns. Semiconductor manufacturing requires large amounts of water, electricity, and various chemicals that release harmful substances during the manufacturing process, which have negative environmental impacts. In addition, semiconductor production also requires a considerable amount of energy consumption, which further deteriorates to its environmental impact.

The environmental impact of the semiconductor supply chain can be categorized into three main aspects. Firstly, waste disposal is a significant challenge. Semiconductor production generates a large amount of chemical and solid waste, which if not disposed of appropriately, can cause severe environmental pollution. Secondly, energy consumption poses a serious environmental issue. The semiconductor manufacturing process requires vast amounts of electricity, which if sourced from non-renewable energy sources such as fossil fuels, can lead to significant carbon emissions. Finally, water resources are a crucial environmental concern, as semiconductor production requires large amounts of water, which can lead to water shortages and pollution if not managed sustainably.

To mitigate the negative environmental impacts of the semiconductor supply chain, a series of environmental protection measures should be implemented. These measures include the use of more environmentally friendly materials and manufacturing processes to achieve green production, the strengthening of waste treatment and resource recycling, the replacement of fossil fuels with renewable energy sources to reduce carbon emissions, and the management and conservation of water resources. Furthermore, policy guidance and supervision should be strengthened to promote the environmental awareness and actions of semiconductor enterprises, and jointly promote the green development of the semiconductor supply chain.

According to Harland et al. (2008), the semiconductor supply chain's rapid pace of technological innovation and short product cycles also poses environmental challenges, such as pollution caused by exhaust gas, wastewater, and solid waste generated during the equipment manufacturing process. Therefore, it is essential to adopt more sustainable and environmentally friendly practices across the entire semiconductor supply chain to minimize its environmental impact.

Social responsibility in the semiconductor supply chain

The semiconductor industry is increasingly aware of its social and environmental responsibilities. A study by Liu et al. (2010) investigated the environmental impact of China's semiconductor industry and found that the industry had a significant impact on water resources and greenhouse gas emissions. In response, the industry has implemented various environmentally friendly measures, such as the use of green manufacturing processes and the adoption of renewable energy sources. Additionally, semiconductor companies have been

working to ensure that labor rights are protected in their supply chains. This is reflected in the initiatives taken by companies such as Intel and Apple, which work to improve working conditions in their supply chains and ensure that their products are produced responsibly. Overall, the semiconductor industry is moving towards a more sustainable and socially responsible future, and it is important for companies to continue to prioritize these issues in their operations.

Economic sustainability of the semiconductor supply chain

The semiconductor supply chain is a critical component of the modern electronics industry, with semiconductor devices being used in a wide range of products. The demand for these products has fueled the continuous development of the semiconductor industry, making the economic sustainability of the semiconductor supply chain and essential part of the industry's health.

To maintain the economic sustainability of the semiconductor supply chain, it is necessary to ensure effective coordination and cooperation between the upstream and downstream sectors of the industry. The production process of the semiconductor industry is complex, and close collaboration between all links is required to ensure the stability of production efficiency and quality (Knoblich et al., 2015). Moreover, in achieving the economic sustainability of the semiconductor supply chain, the environmental protection and social responsibility should be considered as well. The production process of the semiconductor industry involves significant consumption of resources such as water, electricity, and chemicals, leading to environmental concerns. To achieve a balance between sustainable economic development and environmental protection, enterprises need to implement environmental protection measures such as reducing wastewater discharge, energy conservation, and minimizing pollutant (Huang & Liu, 1999).

Finally, the economic sustainability of the semiconductor supply chain should also take into account talent development and technological innovation. The semiconductor industry is a high-tech industry that requires a large number of high-quality talents to support its development. Therefore, enterprises need to focus on talent training and technological innovation to improve their core competitiveness and ensure the long-term stability and sustainable development of the semiconductor supply (Lou et al., 2010). In summary, ensuring the economic sustainability of the semiconductor supply chain is crucial for the development and growth of the entire semiconductor industry. Effective coordination and cooperation, environmental protection, social responsibility, talent development, and technological innovation are all essential components for achieving this goal.

Sustainability strategies for semiconductor supply chains

Environmental protection strategy

In recent years, the sustainable development of the semiconductor industry has become the focus of international attention. Among them, environmental protection strategy is one of the important aspects of sustainable development of semiconductor supply chain. In order to solve the environmental problems of the semiconductor supply chain, the following aspects should be discussed.

First of all, research and development of green technology is an important way to reduce environmental pollution in the semiconductor supply chain. The development of green technologies not only helps to reduce the exhaust gas, waste water and waste discharge in the production process, but also improves production efficiency and reduces production costs. For example, for some harmful gases generated in the semiconductor production process, new treatment technologies can be developed or more environmentally friendly production materials can be used to reduce their emissions (Chien et al., 2022).

Second, establishing an environmental management system is the key to achieve sustainable development of the semiconductor supply chain. By establishing a sound environmental management system, enterprises can control the environmental impact of products from the source and effectively reduce environmental pollution and waste. At the same time, the environmental management system also helps enterprises to achieve compliance with environmental regulations and enhance corporate image and brand value. The environmental management system needs to include environmental monitoring, environmental risk assessment, environmental compliance, etc., and ensure its effective implementation through internal and external audit mechanisms. Finally, strengthening the construction of environmental protection culture of enterprises is also an important way to achieve sustainable development of semiconductor supply chain. Businesses should start with leadership, emphasize the importance of an environmental culture, and build environmental awareness and behavior among employees. Enterprises can stimulate the enthusiasm and initiative of employees to participate in environmental protection through environmental protection training and environmental protection incentives (Hwang et al., 2016).

Social responsibility strategy

The semiconductor industry plays a crucial role in the global economy and with increasing social awareness, the importance of social responsibility strategies in this industry has become a critical issue. To ensure the sustainability of the semiconductor supply chain, companies must focus on implementing social responsibility strategies. In order to reduce environmental impact and ensure legal compliance, semiconductor companies need to implement corporate social responsibility in their production processes, by reducing waste and carbon dioxide emissions, and using environmentally friendly materials (Ip, 2008). Moreover, semiconductor companies should prioritize employee welfare and social contributions by ensuring their employees work in a safe and comfortable environment, and providing reasonable welfare benefits for them.

To establish a sustainable supply chain, semiconductor companies should also collaborate with other companies and institutions. This includes ensuring the sustainability of products in the production process, reducing natural resource overexploitation by semiconductor companies, and minimizing pollution and emissions during production and transportation (MariĆ & Opazo-Basáez, 2019).

In summary, to achieve sustainable development in the semiconductor industry, companies must prioritize their social responsibility strategies. This includes focusing on environmental protection, employee welfare, and social contributions, as well as building sustainable supply chains through collaboration with other companies and institutions.

Economic sustainability strategies

The semiconductor industry plays a significant role in the modern economy, and the sustainability of its supply chain is crucial for the development of the entire industry and the economy's sustainability. Economic sustainability is an essential aspect of the semiconductor supply chain, including resource efficiency, cost control, revenue growth, and product innovation (Haapala et al., 2013).

First, resource efficiency is a key factor in achieving economic sustainability in the semiconductor industry. The semiconductor industry requires a lot of raw materials and energy, so every link in the supply chain should minimize waste, including recovering and reusing materials from the production process, reducing energy consumption (Shang et al., 2010). Moreover, enhancing production efficiency and reducing resource waste are vital means to achieve economic sustainability (Mullen & Morris, 2021).

Secondly, controlling cost is also essential for achieving the economic sustainability of the semiconductor supply chain. Cost reduction can be achieved through the optimization of design and production processes, as well as mass production and procurement. In addition, the semiconductor industry needs to adopt flexible supply chain strategies to cope with the risks caused by fluctuating market demand (Knoblich et al., 2011).

Additionally, revenue growth is another key factor in achieving economic sustainability in the semiconductor supply chain. In a modern economic system, consistent profitability is critical to economic sustainability. In the semiconductor industry, profitability can be achieved by increasing product value, developing new products, and entering new markets (Macher et al., 2002). Furthermore, efficient value creation can be achieved by synergizing all links in the semiconductor supply chain (Aelker et al., 2013).

In conclusion, achieving economic sustainability is crucial for the semiconductor industry's long-term development. The semiconductor supply chain should focus on resource efficiency, cost control, revenue growth, and product innovation to achieve economic sustainability and maintain a competitive advantage in the market.

TSMC's sustainable development practice

In recent years, TSMC has emerged as one of the leading companies in the semiconductor industry to implement sustainable development strategies. TSMC's sustainability strategy encompasses four core goals, which include carbon neutrality, efficient resource utilization, circular economy, and a happy enterprise (TSMC, 2022). To achieve these goals, TSMC has implemented several actions to reduce carbon emissions, save water resources, and promote recycling and reuse.

First of all, TSMC is actively promoting carbon neutrality in the production process, and the company has promised to achieve global carbon neutrality by 2050 (TSMC, 2022). To achieve this goal, TSMC has employed numerous renewable energy sources in the production process, such as solar and wind energy, and adopted high-efficiency equipment and technologies to minimize energy waste. Moreover, TSMC is also committed to reducing the carbon emissions of other companies in the supply chain and conducts carbon footprint management and disclosure to ensure the overall environmental benefits of the company.

Secondly, TSMC has made considerable efforts in the effective use of resources. The company has carried out energy-saving retrofits, improved energy efficiency in the production process, recycled and reused water resources, and reduced water consumption. In addition, TSMC has also actively promoted the recycling of waste materials in the manufacturing process to achieve the goal of a circular economy.

Thirdly, TSMC has promoted the practice of circular economy by putting forth the concept of a circular economy and actively promoting the recycling of various resources. Many of the waste generated by TSMC's production process have been treated and transformed to reuse in production, achieving the effect of recycling (TSMC, 2022). TSMC also actively participates in the construction of the recycling industry chain, cooperates with manufacturers to develop the renewable resource market, and promotes the formation of a green supply chain. The company carries out energy-saving renovations to improve the energy efficiency of the production process, recycle and reuse water resources, and reduce water consumption. In addition, TSMC also actively promotes the recycling of waste materials in the manufacturing process to achieve the goal of circular economy.

In summary, TSMC's sustainability strategy has made considerable strides in achieving the company's four core goals of carbon neutrality, efficient resource utilization, circular economy, and a happy enterprise. As a result, TSMC has set an example for other companies in the semiconductor industry to pursue sustainable development practices. Table 1 is the SWOT analysis of TSMC in sustainable development.

Table 1 SWOT analysis of TSMC in sustainable development

• Strength	• Weakness
***Leading technology: TSMC is one of the world's largest chip foundries. It has a large technology research and development team, which can promote innovation and improvement in environmental protection and sustainable development. ***Environmental protection management: TSMC has always been committed to environmental protection and sustainable development and has achieved a series of achievements in environmental monitoring, energy conservation and emission reduction, and waste disposal. ***Corporate Culture: TSMC has a corporate culture that attaches great importance to employee health, safety, and the environment, which is also the basis for its long-term sustainable development.	***Supply chain management: TSMC's supply chain is complex and needs to coordinate multiple suppliers and subcontractors, so there are greater risks in supply chain management. ***Energy dependence: Chip manufacturing requires a lot of electricity and water resources, and TSMC's energy consumption is high. Therefore, measures such as energy conservation and emission reduction need to be strengthened to reduce energy dependence.

• Opportunity	• Threaten
***Market demand: With the rise of the green economy and the increasing focus on sustainable development, TSMC can meet market demand by providing environmentally friendly and energy-saving products. ***Policy support: The government's support for environmental protection and sustainable development also provides TSMC with development opportunities, such as the government's green industry subsidies and emission reduction policies.	***Competitive pressure: The chip manufacturing industry is highly competitive, and the distribution of market share is very uneven. As competition intensifies, TSMC may face pressure. ***International trade environment: Changes in the international trade environment and the rise of trade protectionism pose threats to TSMC's exports and market expansion.

Intel's Sustainability Practices

Intel Corporation is recognized as a leading semiconductor manufacturer that has made significant strides in sustainability. Sustainability is at the core of Intel's corporate social responsibility, and the company is committed to driving economic, environmental, and social sustainability. Intel invests heavily in innovative technologies and new product development to enhance economic growth and job creation. The company operates research and development centers and production sites across the world, working with suppliers to improve efficiency and sustainability throughout the supply chain (Intel, 2022a).

Intel's environmental sustainability strategy includes reducing carbon emissions and water consumption, promoting the use of renewable energy, reducing waste and eliminating hazardous materials from production processes. Intel has set ambitious goals to reduce greenhouse gas emissions and aims to become carbon neutral by 2050. The company is also investing heavily in renewable energy sources such as wind and solar power to reduce its carbon footprint. Intel is committed to zero waste going to landfill and reducing our water footprint. The company has been successful in implementing circular economy principles, promoting product recycling and reuse, and supporting the transition to a circular economy (Intel, 2022b).

Intel is also committed to promoting social justice and responsibility. The company is focused on employee benefits, education, cultural diversity, and community engagement. Intel's Diversity and Inclusion initiative is designed to create a diverse and inclusive workplace that enables all employees to reach their full potential. The company supports STEM education programs and is dedicated to driving technological innovation and digital adoption to increase access to technology. Intel is also committed to advancing the United Nations' Sustainable Development Goals (Intel, 2022c).

In conclusion, Intel Corporation is a model for other companies in its economic, environmental, and social sustainability practices. Its efforts provide successful experiences and models for other companies to learn from, while also contributing to the achievement of global sustainable development goals. The SWOT analysis of INTEL in sustainable development is shown in Table 2.

Table 2 SWOT analysis of INTEL in sustainable development

• Strength	• Weakness
***Invested funds: INTEL has invested heavily in sustainable development, using projects such as the development of renewable energy, water resource management, and carbon emission reduction. ***Environmental Goals: INTEL has set several environmental goals, such as achieving carbon neutrality by 2030, and publishes regular environmental progress reports. ***Product Design: INTEL considers environmental factors in product design, such as producing more energy-efficient and efficient products.	***Risk Management: INTEL needs to better manage social and environmental risks associated with its supply chain, such as ensuring suppliers comply with environmental regulations. ***Energy consumption: INTEL's chip production requires a lot of energy, so it is necessary to find more environmentally friendly energy sources. ***Circular economy: INTEL's practice in circular economy is not mature enough, and more investment and innovation are needed to achieve sustainable development.
• Opportunity	• Threaten
***Technological innovation: INTEL can further explore green technologies such as using renewable energy sources such as solar and wind to drive production. ***Public Image: Through environmental protection and sustainable development practices, INTEL can enhance public recognition and reputation of its corporate image. ***Government policy: The government's encouragement and support for green energy also provides opportunities for INTEL, such as through policies such as green subsidies.	***Affected by market competition, INTEL needs to continuously improve product quality and shorten production cycle, which may increase environmental risks. ***Regulatory Environment: Changes in environmental regulations and policies may negatively impact INTEL's production and operations, such as the imposition of stricter emission standards and limits

The sustainable development practice of MediaTek Technology

MediaTek, a Taiwan-based semiconductor company specializing in the design and manufacture of communications semiconductors, is committed to promoting sustainability in order to achieve a balance between economic, social, and environmental benefits. In line with this commitment, the company's sustainability strategy includes three main aspects: economic responsibility, social responsibility, and environmental protection. To achieve economic sustainability, MediaTek focuses on increasing efficiency, reducing costs, and developing innovative products. The company also places a strong emphasis on supply chain sustainability, as evidenced by its efforts to improve supply chain transparency and management quality (MediaTek, 2022a).

In terms of social responsibility, MediaTek prioritizes the safety, health, and welfare of its employees, providing a fair and healthy working environment and offering diversified training and development opportunities. Additionally, the company actively participates in philanthropic causes and supports the development of local communities through initiatives that promote education and environmental projects. Moreover, MediaTek integrates green environmental protection into all aspects of its enterprise and works towards environmental protection goals through energy conservation and emission reduction, waste reduction, and the promotion of green products. The company has also obtained ISO14001 environmental management system certification and OHSAS18001 occupational health and safety management system certification to ensure the company's environmental and occupational health and safety management level (MediaTek, 2022b).

To sum up, MediaTek's sustainable development practices promote corporate sustainable development through economic responsibility, social responsibility and environmental protection, setting an example for other companies to pursue a sustainable future. The SWOT analysis of MediaTek in sustainable development is shown in Table 3.

Table 3 SWOT analysis of MediaTek in sustainable development

• Strength	• Weakness
Actively participate in the green supply chain plan, promote the green transformation of suppliers, and strengthen environmental monitoring and energy saving and carbon reduction measures. ***Combining smart manufacturing and digital technology to improve production efficiency while reducing environmental burdens is in line with the concept of sustainable development. ***The board of directors established a sustainable development committee to strengthen the company's internal sustainable development management and further expand relevant practices and policies. ***Actively participate in social welfare activities to support the development of multiculturalism and human rights.	***The transparency of the supply chain needs to be strengthened, and more transparency and communication are needed to ensure that all partners comply with MediaTek's environmental and social responsibility requirements. ***Compared with other semiconductor companies in Taiwan, MediaTek's public information and transparency in terms of sustainable development are relatively low, and it is necessary to strengthen publicity and communication in this regard.
• Opportunity	• Threaten
***The promotion of the global sustainable development agenda provides more opportunities for MediaTek, such as investing in green technology research and development and promotion, and developing environmentally friendly products.	***The accelerated promotion of the sustainable development trend will make the company face greater pressure and challenges in terms of environmental protection and social responsibility.

***Develop new technologies and products, such as smart cities, Internet of Things, green energy, etc., which are in line with sustainable development trends and bring more business opportunities to the company. ***Further strengthen the green supply chain and environmental protection measures to increase the added value and competitiveness of products.	***Competitors' increased investment in sustainable development will pose a threat to MediaTek's market share and brand image. ***Constant changes in environmental regulations and policies may bring risks and uncertainties to MediaTek's production and sales.

Conclusion

The study found

The sustainability challenges and opportunities in the semiconductor supply chain were investigated in this research paper. The findings reveal that the semiconductor industry is facing various sustainability challenges, such as resource depletion, high energy consumption, water usage, and hazardous waste generation. However, there are also opportunities for the industry to address these challenges and promote sustainability in the supply chain. The findings show that implementing resource efficiency measures, adopting circular economy practices, and developing green technologies are effective ways to mitigate the environmental impact and reduce the use of natural resources.

Additionally, the findings suggest that corporate social responsibility, including ethical practices and labor rights, can improve the industry's sustainability performance. While the research highlights the potential for sustainability in the semiconductor supply chain, it also acknowledges the limitations of the study, such as the sample size and data sources used. Overall, the research findings contribute to the understanding of sustainability challenges and opportunities in the semiconductor supply chain and provide recommendations for future actions towards a more sustainable industry.

Research contribution

The research paper on sustainability challenges and opportunities in the semiconductor supply chain contributes to the academic field by identifying the sustainability challenges faced by the semiconductor industry and exploring opportunities for sustainability. The paper presents a clear statement of how the research fills a knowledge gap and contributes to the need for environmentally and socially responsible practices in the semiconductor industry. The study offers a comparison with previous research by highlighting the unique advantages and contributions of the research in developing green technologies, resource efficiency, and circular economy practices. Specific results of the research are presented, including a comprehensive overview of the sustainability challenges and opportunities in the semiconductor supply chain. The research contribution section emphasizes the significance of the research to practice by offering recommendations for how the semiconductor industry can address sustainability challenges and capitalize on the opportunities for a more sustainable future. This research differs from the others in that two important companies were selected as examples to

demonstrate the idea of implementing strategies that were brought up. To the knowledge of the authors, this makes it the pioneering paper to do so. Overall, the paper offers a valuable contribution to the academic field by providing insights into the sustainability challenges and opportunities in the semiconductor industry and highlighting the need for more sustainable practices in the semiconductor supply chain.

Study limitations

The sustainability challenges and opportunities in the semiconductor supply chain have been extensively studied, and research findings have been presented. The research contribution of this study is that it fills the knowledge gap by identifying sustainability challenges and opportunities in the semiconductor supply chain, which is a crucial aspect of sustainability in the technology industry. This study provides theoretical insights into how sustainable practices can be incorporated into the semiconductor supply chain, which can help solve existing problems related to sustainability. Furthermore, this study offers a comparison with previous research by highlighting the unique contributions it makes in identifying the sustainability challenges and opportunities specific to the semiconductor supply chain. The research limitation section of this study acknowledges the limitations of this research, such as the limited scope of the study and the potential bias of the data sources. However, it also provides direction for future research by suggesting expanding the sample size and using more research methods to increase the reliability and validity of the findings. Overall, this study contributes to the academic field by providing a better understanding of the sustainability challenges and opportunities in the semiconductor supply chain and offers suggestions for future research and improvements.

Recommendations for future research

It is of imperative meaning to establish linkages with existing research and suggest appropriate research methods while maintaining a moderate range. For the topic of sustainability challenges and opportunities in the semiconductor supply chain, future research could focus on exploring the impact of emerging technologies, such as artificial intelligence and blockchain, on sustainability practices in the industry. Additionally, research could investigate how to optimize sustainable sourcing strategies and supply chain management to reduce environmental impacts and ensure social responsibility. By identifying these potential research directions and emphasizing their contribution to the field, future researchers can build on the existing knowledge and make meaningful advancements towards a more sustainable semiconductor supply chain.

In conclusion, the semiconductor industry is facing significant sustainability challenges due to its complex and global supply chain, including the sourcing of raw materials, energy consumption, and waste management. However, there are also opportunities for sustainability improvements through collaboration among stakeholders, technological innovations, and supply chain management practices. This paper has explored the sustainability challenges and opportunities in the semiconductor supply chain and provided recommendations for future research. Further research could explore specific technological solutions, policy interventions, and industry initiatives to address sustainability challenges in the semiconductor supply chain.

Overall, a comprehensive and integrated approach involving all stakeholders is necessary to achieve sustainable development in the semiconductor industry.

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Analysis of the Influencing Factors of Green Collaborative Development between Enterprises and Industrial Parks in Industrial Undertaking Regions: A Case Study of Guangdong Province from 2006 to 2019

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Abstract

Against the backdrop of global industrial transfer, industrial parks undertake environmentally polluting industries and promote rapid development of regional economies. With the mature development of industrial parks and the restriction of resources and energy, green transformation of industrial parks has become particularly important. This study uses panel data from Guangdong Province from 2006 to 2019 as a sample. It adopts a grey correlation analysis method to analyze the factors influencing green collaborative development between enterprises and industrial parks. The results show that (1) the coordinated development of industry and the ecological environment in industrial parks must rely on active participation from relevant governance entities, including enterprises and the park itself. (2) The factors that influence enterprises and parks to jointly promote green development include capital investment, technological progress, and industrial structure adjustment. However, capital investment has the most significant impact on green development. Based on these findings, we propose that the government should increase green capital investment on the one hand. On the other hand, positive and effective measures should be taken to promote enterprises' green technology innovation and industrial structure adjustment and upgrading to achieve a win-win situation for both environmental protection and economic development.

Keywords: Green Collaborative Development, Influencing Factors, Grey Correlation Analysis, Industrial Parks

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Introduction

Research background

Currently, the world has witnessed five international industrial transfers with clear demarcation lines. With the development of industrial transfers, the economies of numerous countries have experienced rapid growth, accompanied by the optimization and upgrading of their industrial structures. With its economic progress and rapid development of the global economy, China has become one of the largest transfer places. Since the 1990s, certain more developed regions in eastern China have made significant economic progress over the past two decades, serving as destinations and hosts for industrial relocation, thereby exerting considerable influence on a global scale. Economic prosperity in China's eastern regions owes much to international industrial relocation, while the central and western regions, although not matching the scale of the east, have achieved certain levels of growth through such relocation (Hong-guan,2014). Industrial parks, represented by development zones and high-tech zones, have become the main spatial carriers of the industrial undertaking, and play a significant role in promoting regional economic development. Industrial parks characterized by industrial clusters have become significant vehicles for China's participation in the global manufacturing value chain division of labor, as well as a powerful driving force for promoting the synergistic development of the regional economy.

However, an agglomeration economy with industrial parks as the spatial carrier will also generate a "crowding effect," which is a major source of carbon emissions as well as wastewater, waste gas, and waste residue emissions, resulting in environmental pollution and unsustainable development problems. Economically developed areas of industrial parks are often areas where the ecological environment is seriously damaged. Simultaneously, as the development of industrial zones matures and the availability of exploitable incremental spatial resources gradually tightens, the development trend of industrial parks has shifted away from the earlier concept of a single industrial enterprise cluster, but towards ecological industrial parks and science parks with a closer relationship between enterprises, such as Kalundborg Eco-Industrial Park in Denmark. Consequently, the green development transformation of industrial parks after the industrial undertaking is of great significance to the green and sustainable development of the whole industry, as well as for China's pursuit of ecological civilization.

The establishment of industrial parks in industrial undertaking areas differs from the conventional approach of constructing pre-existing industrial parks. Owing to the intricate interplay of interests among various corporate entities, the earlier "pollute first, mitigate later" pollution control model, primarily driven by governmental intervention, no longer meets the needs of green transformation in industrial parks. Ideally, a park's green development should achieve a symbiotic relationship between the economic advancement of diverse industries within it and the park's own ecological progress. However, in practice, disparities emerge between the collective interests of the park and the individual interests of enterprises as well as between short-term gains and long-term benefits, resulting in strategic maneuvering and choices. Industrial parks often seek to enhance overall competitiveness by driving industrial upgrades and phasing out "backward capacity."

However, they remain path-dependent on existing pillar industries that are incongruent with future developmental demands. However, enterprises, particularly those operating profitably, tend to assume the risks associated with green transformation and upgrading. In the case of poor financial performance, effective transformation and upgrading are even more challenging. These constraints contribute to a lack of clarity in the roles and responsibilities of enterprises and industrial parks in the context of green development coupled with inadequate governance mechanisms. Consequently, a dichotomy emerges between industrial development and environmental protection within the park, leading to situations where, if higher departments of environmental protection inspection are encountered, the park lets enterprises with environmental problems suspend production, and once the “storm” passes, the enterprise returns to the “same old” circle. The phenomenon of enterprises and parks perfunctorily inspecting each other is serious. Taking Guangdong Province as an example, although advancements have been made in green development in recent years, some obstacles and problems still exist, particularly reflected in the uncoordinated development between parks and enterprises. In some places, during the remediation process, industrial parks often have a single remediation goal, without considering local economic development and other factors, which can easily lead to a "cliff-like" decline in the local economy and unstable employment. Some industrial parks often simply demand that enterprises with pollution problems shut down directly, rather than adopting market-oriented means, such as increasing pollution control, which damages the interests of enterprises. Some industrial parks continuously raise emission standards in the short term, leaving enterprises at a loss(Kostka & Mol, 2017). Therefore, it is of great significance to study the influencing factors of the green collaborative development of enterprises and parks in industrial undertaking areas and evaluate their effects to propose corresponding countermeasures and suggestions that will promote the green and sustainable development of industrial undertaking parks.

Using Guangdong Province as the research subject, this study aims to analyze the factors influencing green collaborative development in Guangdong Province and assess the degree of correlation between these factors and green collaborative development. Beyond these, this study also aims to offer specific policy recommendations to foster green development in Guangdong Province.

Literature review

The factors influencing green collaborative development between enterprises and industrial parks in industrial undertaking areas have been extensively studied in terms of industrial agglomeration and environmental governance. Scholars have proposed three main perspectives on this matter.

The first, industrial agglomeration promotes environmental governance. Firstly, industrial agglomeration promotes spillover of environmental protection and energy-saving knowledge among enterprises, leading to improved eco-friendly technologies and innovation. This reduces individual firms' pollution control costs, optimizing the regional ecological development environment (Hosoe & Naito, 2006; Wu et al., 2022). Secondly, industrial agglomeration generates economies of scale in environmental resource consumption, resulting in reduced resource use and lower pollution emissions per unit of industrial output (Brownstone &

Golob, 2009; Holden & Norland, 2005; Shen & Peng, 2021). Thirdly, industrial agglomeration can realize scale effects in environmental governance, leading to lower governance costs (Andreoni & Levinson, 2001). Fourthly, industrial agglomeration promotes internal resource recycling within agglomerated regions, thus decreasing pollution emissions (Bressanelli et al, 2022). Fifthly, industrial agglomeration enhances production efficiency, subsequently raising local residents' income and fiscal revenue. The improved material living standards of residents inevitably lead to heightened demands for a pristine ecological environment, compelling governments to intensify environmental governance efforts, implement stricter environmental regulatory systems, and encourage enterprises to engage in green technological innovation and adopt clean production measures, ultimately leading to improved ecological conditions (Cheng, 2016; Feng et al., 2022)

Secondly, industrial agglomeration exacerbates environmental pollution. Scholars advocating this view argue that excessive agglomeration can lead to overcrowding, resulting in intensified environmental pollution. The localized expansion of production capacity and increased energy consumption owing to industrial agglomeration can lead to higher overall pollutant emissions, thereby increasing the difficulty of regional environmental governance. Although industrial agglomeration can promote technological improvements in enterprises, if these improvements focus on enhancing output efficiency, they may lead to increased unit output within the region and, paradoxically, worsen environmental pollution. Various studies have supported the reality of environmental pollution caused by industrial agglomeration. For instance, Virkanen (1998) empirically analyzed industrial agglomeration in southern Finland and concluded that manufacturing agglomeration exacerbates air and water pollution. De Leeuw et al. (2001) and Verhoef and Nijkamp (2002) employed empirical analyses using data from 200 European cities and European urban data, respectively, both arriving at a significant positive correlation between industrial agglomeration and environmental pollution. Cheng (2016) conducted empirical analysis using data from 285 Chinese cities at the prefecture level and above, concluding that economic agglomeration exacerbates environmental pollution; conversely, environmental pollution also inhibits further economic agglomeration.

Thirdly, there is a complex relationship between industrial agglomeration and environmental pollution. Tan et al. (2022) proposed an "N-shaped" relationship curve between manufacturing agglomeration, air pollution, and energy conservation and emission reduction. Zhu and Xia (2018) argued that there is an inverted U-shaped relationship between industrial agglomeration and environmental pollution, with marketization being a crucial determining factor for this relationship. Ren-f (2015) suggested a threshold feature in the relationship between industrial agglomeration and environmental pollution. Pang et al. (2021) posited that industrial agglomeration may act as a "resistance" to environmental governance in the short term, primarily due to the "concentrated emission" of polluting enterprises within a spatial area. The mechanism underlying this complex relationship can be summarized as follows. Influenced by external factors, such as the environment, geographical conditions, technological levels, and environmental regulations, the impact of industrial agglomeration on environmental pollution is characterized by instability (Zeng & Zhao, 2009). The combined effects of the positive and negative externalities from industrial agglomeration contribute to environmental

pollution. When negative externalities dominate the agglomeration's environmental impact, they intensify pollution; conversely, the opposite is true (Chen et al., 2020).

Research on multi-participatory environmental governance systems is as follows: Earlier, environmental governance adopted an administrative-oriented management system that combined unified supervision and management with hierarchical and sectoral management. This management system was mainly based on the assumption that environmental problem makers would transfer the costs of environmental management to society (Mu & Liu, 2008). With the development of the social economy, deteriorating ecological and environmental problems are increasingly related to people's immediate interests, which even cause social conflicts to intensify (Dominelli, 2012). Since the administrative-oriented environmental governance system cannot effectively coordinate the environmental interests of enterprises and society, its shortcomings have gradually emerged. The latest research on environmental governance has begun to turn to a pluralistic co-governance system, in which the public, government, enterprises, and NGOs cooperate to achieve environmental governance. This value lies in the ability to achieve a consensual scale of public goods that cannot be provided by a single entity (Agranoff & McGuire, 2001). Ha et al. (2016) examined the factors affecting private sector participation in environmental co-governance in different regions. Provan and Kenis (2008) proposed the structural characteristics of a network of co-governance systems in the public sphere and their influencing factors. Feiock and Scholz (2010) systematically explored how factors characteristic of metropolitan areas (e.g., geographic space, population size, industrial structure and institutional base) influence collective institutional action in regional environmental governance.

There have been extensive and in-depth studies on the relationship between industrial agglomeration and environmental quality, and on the multiple environmental governance system, but there are few studies on the relationship between industrial agglomeration and environmental pollution in provinces, cities, and industrial parks, and fewer studies on the role played by governance bodies in the coordinated development of industrial agglomeration and the ecological environment. This study intends to address the shortcomings in the research to propose the key factors affecting the green coordinated development between enterprises and parks and put forward corresponding policy suggestions for promoting the green transformation development of industrial parks. The paper contributes to the existing literature as follows. First, to the best of our knowledge, this is the first study to employ grey correlation analysis to evaluate the factors influencing green development in Guangdong Province, offering a new methodological direction for future studies in this domain. Second, this study expands the existing literature and provides evidence of green coordinated development using a sample from Guangdong Province. Finally, this study provides practical recommendations for policymakers to improve their green development management practices.

Research Methodology

Based on relevant data from Guangdong Province, China, spanning the years 2006 to 2019, this study employs grey relational analysis as an assessment index to analyze the factors influencing the green

collaborative development of enterprises and industrial parks in the industrial undertaking regions. A gray system refers to an incomplete information system with partial information known and partial information unknown. Gray correlation analysis, which measures the degree of correlation between factors based on the similarity of the development trend between factors, reveals the characteristics and degree of dynamic correlation between factors. The measure of the correlation between two factors is called the grey correlation degree. When the relative changes in the two factors have basically the same trend of change, the two factors have a greater degree of gray correlation; otherwise, they have a smaller degree of gray correlation (Wu, 2002). In this study, green collaborative development was selected as the reference sequence, and various influencing factors were considered as subsequences. The correlation between each subsequence and the parent sequence was calculated to analyze the degree of influence of each factor on the results.

Simultaneously, China's Guangdong Province has become a major industrial undertaking in international industrial transfer by virtue of its coastal geographical advantage, undertaking many international industries, and achieving the leapfrog development of the economy. However, in recent years, through various modes of cooperation, such as industrial transfer and joint construction of parks, industries in Guangdong Province have completed upgrades, where low value-added industries have been removed to high value-added industries, promoting industrial transformation and upgrading and further upgrading of park capacity, improving the level of green development. According to the national industrial park provincial evaluation of the green dimension index value from 2012 to 2018, the green dimension index of national industrial parks in Guangdong province exceeded 0.4, which is at the leading level of the country (Shi, 2021).

Establishment of indicators

Determine the parameters

According to the policy guidance document of the 14th Five-Year Plan, the evaluation indicators of green collaborative development are as follows (Meng & Chi, 2018; Liu & Forrest, 2007).

Table 1 Evaluation indicators of green collaborative development

Indicator	Meaning	Indicator Function	Nature
Decrease in Unit GDP Energy Consumption	Reduction in energy consumption per unit of GDP compared to the base period	Enhances energy efficiency and transformation, driving industrial transition	Positive
Decrease in Unit GDP Carbon Dioxide Emissions	Reduction in carbon dioxide emissions per unit of GDP compared to the base period	Guides clean and efficient energy use, controls peak carbon emissions	Positive
Ratio of Good and Excellen Air Quality Days in Cities at or above Prefecture Level	Number of days with Air Quality Index (AQI) < 100 / Total days *100%	Reflects overall improvement in air quality	Positive

Proportion of Surface Wate Reaching or Exceeding Grade III	Number of nationally monitored surface water sections reaching or exceeding Grade III water quality / Total sections *100%	Strengthens water quality monitoring, reduces water pollution	Positive
Forest Coverage Rate	Forest area/Total land area *100%	Reflects forest resource abundance, land greening, and carbon sink capacity	Positive

Note: jAQI refers to the ambient air quality index of cities at prefecture level and above. kthe positive index refers to the value of the set index in the same direction as the level of green development; inverse index refers to index value opposite to green development (Liang & Luo, 2023).

This study employs the indicator of "Decrease in Unit GDP Energy Consumption" to represent the level of green collaborative development. According to the definition, relevant data on "Annual Energy Consumption in Guangdong Province" and "Annual Regional GDP of Guangdong Province" were extracted from the "China Energy Statistical Yearbook" and the "National Bureau of Statistics." By conducting calculations, the indicator of "Energy Consumption per Unit of Regional Gross Domestic Product (GDP)" was derived.

Furthermore, by utilizing the initial year (2006) as the baseline for "Energy Consumption per Unit of GDP," the data for "Decrease in Unit GDP Energy Consumption" were computed.

Table 2 Green Collaborative Development Data for Guangdong Province (2006-2019)

year	Total energy consumption (10,000tons/standard coal)	Annual Regional GDP of Guangdong Province (100 million yuan)	Energy Consumption per Unit of Regional GDP (Equivalent) (tons of standard coal/10,000	Decrease in energy consumption per unit of GDP
2006	19971	25961.2	0.7693	Base year
2007	22217	31742.6	0.6999	9.02%
2008	23476	36704.2	0.6396	16.86%
2009	24654	39464.7	0.6247	18.79%
2010	26908	45944.6	0.5857	23.87%
2011	28480	53072.8	0.5366	30.24%
2012	29144	57007.7	0.5112	33.54%
2013	28480	62503.4	0.4557	40.77%
2014	29593	68173.0	0.4341	43.57%
2015	30145	74732.4	0.4034	47.56%
2016	31241	82163.2	0.3802	50.57%
2017	32342	91648.7	0.3529	54.13%
2018	33330	99945.2	0.3335	56.65%
2019	34142	107986.9	0.3162	58.90%

Identification of variables

In line with Lin and Zhou (2022) study on green development, this study conducted an analysis of key influencing factors. The selected variables for the critical influencing factors are listed in the following table:

Table 3 Selection of Influencing Factors in Green Development

Influencing factors	Key references
Investment in Capital	Wang et al. (2020) ; Jianhua (2014)
Industrial structure	Du et al. (2021) ; Zhu et al. (2019)
Technological progress	Magnani and Tubb (2012) ; Wen and Dai (2021)

Investment in Capital: Represented by local fiscal expenditure on environmental protection. China is currently in a period of transition from rapid economic development to high-quality development. The government has shown considerable commitment to green fiscal expenditures to promote regional economic coordination and green development. Environmental pollution leads to serious negative externalities, which require the government to play a central role in environmental management. Fiscal environmental expenditure can address environmental pollution at the source, promptly identify environmental issues, and carry out effective management. However, it also induces social investment in environmental protection. An increased fiscal environmental expenditure indicates the government's preference for the environment, and social capital reflects this preference, thereby achieving the goal of industrial green development.

Industrial Structure: Indicated by the proportion of the value-added of the secondary industry to GDP and the proportion of the value-added of the tertiary industry to GDP. Based on existing research, industrial structure, particularly the composition of the industrial sector, directly influences the green development of industrial parks. This influence was observed during both the production and pollution treatment stages. Industries with high pollution, high energy consumption, and high emissions contribute to increased regional environmental pollution and substantial pollutant emissions. An increased proportion of such industries in the sector intensifies environmental pollution. Therefore, promoting the upgrading of the industrial structure to the tertiary sector or facilitating the transition of resource-intensive industries to knowledge- and technology-intensive industries aids the green development of industries.

Technological Progress: Selected indicators include annual patent authorizations and the annual volume of technological market transactions. Technological progress is a pivotal factor in enhancing economic development efficiency and positively driving green development, to some extent. It provides crucial resources and reserves for supporting green development in industrial parks. Increasingly stringent environmental protection requirements have led producers to incorporate ecological protection costs into production costs, resulting in an increased demand for clean production technology and green technology equipment by enterprises. Technological advancements make the production process cleaner, more environmentally friendly, and intelligent, subsequently driving various industries towards environmentally friendly production,

management, and services. Therefore, technological progress fosters green development of industries. The annual number of patent authorizations serves as the primary output of an enterprise's innovative knowledge production process, measuring the potential market benefits and output efficiency of technological innovation. As patents do not accurately reflect the conversion efficiency of technological innovation achievements, the annual technology market transaction volume was additionally chosen as an indicator to measure the economic benefits of technological innovation.

The three major influencing factors and their indicators are specifically shown in Figure 1.

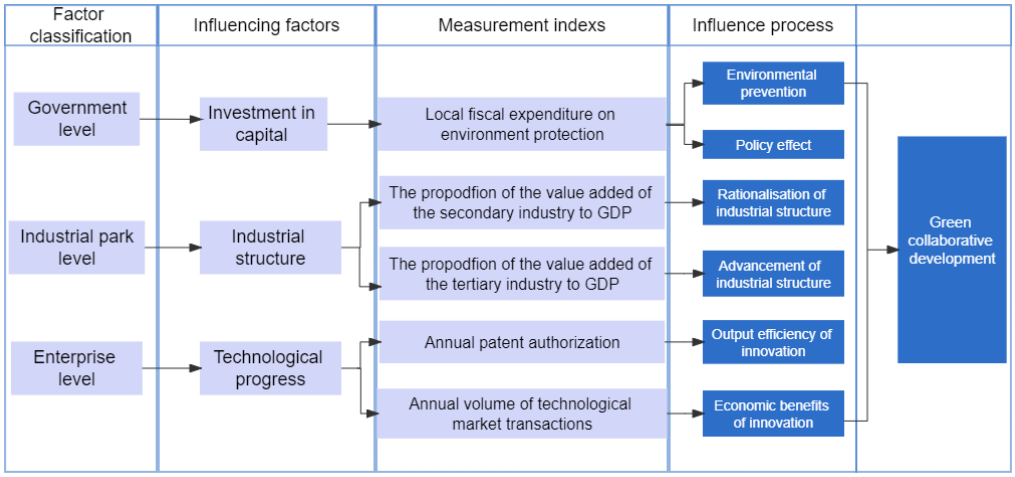

Figure 1 Establishment of Influencing Factor Indicators

Given the establishment of environmental protection fiscal expenditure by the Ministry of Finance starting in 2007, indicator data related to "Factors influencing the Green Collaborative Development between Enterprises and Industrial Parks in industrial undertaking areas" have been selected from 2007.

Data processing

Dimensionless

Table 4 Parametric data

Year	Reduction in Energy Consumption per	Annual patent authorizations (Influencing	Annual volume of technological market transactions	Proportion of secondary industry to GDP	Proportion of tertiary industry to GDP	Local fiscal expenditure on environmental
	X0	X1	X2	X3	X4	X5
2007	0.0902	56451	132.84	0.5048	0.4428	26.71
2008	0.1686	62031	201.63	0.5046	0.4431	47.09
2009	0.1879	83621	170.98	0.4926	0.4581	100.8
2010	0.2387	119343	235.89	0.4988	0.4533	239.16

2011	0.3024	128413	275.06	0.4929	0.4590	232.62
2012	0.3354	153598	364.94	0.4797	0.4727	235.44
2013	0.4077	170430	529.39	0.4695	0.4845	307.78
2014	0.4357	179953	413.25	0.4684	0.4871	259.04
2015	0.4756	241176	662.58	0.4538	0.5035	322.33
2016	0.5057	259032	758.17	0.4321	0.5253	297.45
2017	0.5413	332652	937.08	0.4205	0.5401	433.23
2018	0.5665	478082	1365.42	0.4142	0.5474	567.41
2019	0.5890	527390	2223.08	0.4016	0.5581	747.44

Following the steps of gray correlation analysis, the reference sequence was selected as X0, and the remaining variables were comparison sequences. Because the data in the columns of the factors in the system may differ in magnitude and size of the values, it is not easy to compare, or it is difficult to obtain the correct conclusion when comparing. Therefore, dimensionless processing of the data was performed.

Table 5 Data after homogenization process

year	X0	X1	X2	X3	X4	X5
2007	0.2419	0.2628	0.2088	1.0876	0.9030	0.0910
2008	0.4523	0.2888	0.3169	1.0872	0.9036	0.1604
2009	0.5042	0.3893	0.2688	1.0614	0.9342	0.3434
2010	0.6404	0.5556	0.3708	1.0748	0.9244	0.8146
2011	0.8115	0.5979	0.4324	1.0621	0.9359	0.7924
2012	0.9001	0.7151	0.5736	1.0336	0.9640	0.8020
2013	1.0939	0.7935	0.8321	1.0115	0.9880	1.0484
2014	1.1692	0.8378	0.6496	1.0092	0.9932	0.8824
2015	1.2763	1.1229	1.0415	0.9778	1.0268	1.0979
2016	1.3570	1.2060	1.1918	0.9310	1.0713	1.0132
2017	1.4524	1.5488	1.4730	0.9060	1.1014	1.4757
2018	1.5201	2.2259	2.1463	0.8925	1.1163	1.9327
2019	1.5805	2.4555	3.4944	0.8653	1.1381	2.5460

Absolute difference sequence

The ABS function was used to calculate the absolute differences between each variable indicator in each row, and X0. Subsequently, the minimum and maximum values of the absolute difference sequence were determined, which yielded the following data:

Table 6 Data after absolute difference processing

Year	Minimum of Absolute Difference Sequence	Maximum of Absolute Difference Sequence	Absolute Difference Sequence				
			Δ_1	Δ_2	Δ_3	Δ_4	Δ_5
2007	0.0209	0.8457	0.0209	0.0331	0.8457	0.6611	0.1509
2008	0.1354	0.6349	0.1635	0.1354	0.6349	0.4513	0.2919
2009	0.1149	0.5571	0.1149	0.2355	0.5571	0.4299	0.1609
2010	0.0848	0.4343	0.0848	0.2697	0.4343	0.2840	0.1742
2011	0.0191	0.3791	0.2136	0.3791	0.2506	0.1244	0.0191
2012	0.0639	0.3264	0.1850	0.3264	0.1335	0.0639	0.0981
2013	0.0456	0.3004	0.3004	0.2618	0.0824	0.1059	0.0456
2014	0.1600	0.5196	0.3313	0.5196	0.1600	0.1760	0.2868
2015	0.1534	0.2985	0.1534	0.2348	0.2985	0.2496	0.1784
2016	0.1510	0.4261	0.1510	0.1653	0.4261	0.2858	0.3438
2017	0.0206	0.5464	0.0964	0.0206	0.54	0.35	0.02
2018	0.4039	0.7058	0.7058	0.6262	0.62	0.40	0.41
2019	0.4424	1.9139	0.8750	1.9139	0.71	0.44	0.96

Find the minimum value of the "Minimum of Absolute Difference Sequence" column and the maximum value of the "Maximum of Absolute Difference Sequence" column and obtain the following data.

Table 7 Minimum value of the column "Minimum of Absolute Difference Sequence" and maximum value of the column "Maximum of Absolute Difference Sequence"

Minimum value of the "Minimum of Absolute Difference Sequence"	Maximum value of the "Maximum of Absolute Difference Sequence"
0.0191	1.9139

Calculated correlation coefficient

$$\zeta_i(k)=\frac{\min\limits_i\min\limits_k\left|x_0(k)-x_i(k)\right|+\rho\cdot\max\limits_i\max\limits_k\left|x_0(k)-x_i(k)\right|}{\left|x_0(k)-x_i(k)\right|+\rho\cdot\max\limits_i\max\limits_k\left|x_0(k)-x_i(k)\right|}$$

The formula above was applied to the absolute difference sequence to calculate the correlation coefficient. Resolution coefficient ρ = 0.5.

Table 8 Calculation of correlation coefficient ξ i

Year	Δ1	Δ2	Δ3	Δ4	Δ5
2007	0.9982	0.9859	0.5415	0.6033	0.8810
2008	0.8712	0.8936	0.6132	0.6931	0.7816
2009	0.9107	0.8186	0.6447	0.7038	0.8732
2010	0.9370	0.7958	0.7016	0.7866	0.8629
2011	0.8339	0.7306	0.8083	0.9027	1.0000
2012	0.8548	0.7606	0.8951	0.9561	0.9252
2013	0.7763	0.8009	0.9391	0.9184	0.9737
2014	0.8791	0.8190	0.7775	0.8090	0.8598
2015	0.8810	0.8698	0.7058	0.7854	0.7504
2016	0.9267	0.9985	0.6493	0.7463	0.9958
2017	0.5870	0.6166	0.6160	0.7173	0.7127
2018	0.5328	0.3400	0.5838	0.6975	0.5077
2019	0.5224	0.3333	0.5723	0.6838	0.4978

Correlation degree

The degree of correlation was computed as the arithmetic mean of all the correlation coefficients within each variable. The resulting degrees of correlation for the various indicators are presented in Table 9.

Table 9 Correlation Degrees of different indicators ξ i

Variables	X1	X2	X3	X4	X5
ξi	0.8266	0.7762	0.7192	0.7832	0.8391
Rank	2	4	5	3	1

Results and Discussion

The calculated degrees of correlation, arranged from highest to lowest, are as follows: X5 > X1 > X4 > X2 > X3. This implies that: Local fiscal expenditure on environmental protection> Annual patent authorizations> Proportion of tertiary industry to GDP > Annual volume of technological market transactions > Proportion of secondary industry to GDP. By summing up the relevant variables and computing their average, the magnitude of the correlation of the relevant first-level indicators (technological progress, industrial structure, and capital investment factors) can be obtained.

Table 10 Correlation degree for Primary Indicators

Variables	Sub-variables	ξ i for secondar	ξ i for primary indicators	Rank
Technological Progress	Annual patent authorizations	0.8266	0.8014	2
	Annual volume of technological market transactions	0.7762		
Industrial Structure	the proportion of the value added of the secondary industry to GDP	0.7192	0.7512	3
	the proportion of the value added of the tertiary industry to GDP	0.7832		
Investment in Capital	Local fiscal expenditure on environmental protection	0.8391	0.8391	1

Consequently, the sequential order of influencing factors is as follows: Investment in Capital > Technological Progress > Industrial Structure. In other words, Investment in Capital is the most crucial factor affecting green collaborative development of enterprises and parks in the region.

According to Table 10, it is evident that collaborative green development varies in terms of the gray correlation degrees with each primary indicator, yet the correlations are consistently strong, primarily ranging between 0.75 and 0.85. The sequence of descending degrees of correlation between each primary indicator and green collaborative development is as follows: funding input, technological progress, and industrial structure. Each secondary indicator demonstrated a correlation exceeding 0.7, predominantly distributed within the range of 0.7 to 0.9. This shows that these five indicators play an important role in green coordinated development and have a strong influence on the green coordinated development of an industry. Among these, local fiscal expenditure on environmental protection had the greatest impact on the green collaborative development of enterprises and parks in the industrial undertaking area, with a correlation degree of 0.83913. Subsequently, in descending order, the annual number of patent grants, proportion of value-added of the tertiary industry to GDP, proportion of annual technology market transactions, and proportion of value-added of the

secondary industry to GDP. The effect of the proportion of secondary industry value-added to GDP on green collaborative development is relatively minor, yet its correlation remains noteworthy at 0.7192. These five influencing factors were positively correlated with green collaborative development.

Financial support for environmental protection has the most significant influence on green collaboration, underscoring the indispensability of financial funding for the collaborative development of enterprises and parks in pursuit of eco-friendly goals. Particularly within industrial undertaking areas, where initial financial support might have been limited, a shift towards increased funding to facilitate the transformation of traditional industries and the growth of emerging sectors suggests a gradual reallocation of financial resources in favor of the green industry. Industries characterized by high energy consumption and pollution are compelled to undergo green transformation; otherwise, they risk obsolescence due to the continual outflow of funds.

The correlation of the proportion of secondary industry value-added to GDP is relatively modest, in alignment with the Pedi-Clark theorem. With the further development of the economy, people's pursuit of quality of life, including the improvement of environmental quality, makes the relative proportion of value-added of the secondary industry in GDP decline, while the relative proportion of value-added of the tertiary industry in GDP begins to rise.

Conclusion and Recommendations

Conclusion

After undertaking polluting industries, industrial parks require green transformation to meet the needs of sustainable development. The green transformation of parks requires the cooperation and coordination of enterprises, industrial parks, and governments in many aspects. The key variables affecting the degree of enterprise-park collaboration are capital input, technological progress, and industrial structure. Capital investment has the greatest impact, followed by technological progress and the industrial structure. This study emphasizes the concept of green collaborative governance and explores its influencing factors in three dimensions: enterprises, industrial parks, and the government.

Policy Recommendations

The findings of this study indicate that capital input, technological progress, and industrial structure have notable positive impacts on the sustainable development of industrial parks in industrial undertakings. To strengthen these effects, the government should play an active role in providing policy support.

Firstly, Implement the concept of green ecology and provide green financial support. Financial support can play a guiding role of the government and bring about the effect of attracting social capital. The concept of green ecology will be carried out throughout, and the guiding role of the government will be launched to promote the green transformation of the park. Learn from the experience and lessons of green development of foreign industrial parks, actively encourage parks that carry out green transformation to participate in

domestic carbon market trading, formulate fiscal and tax incentive policies, and promote the development of green finance, thereby providing financial support and facilitation. Comprehensively consider the tax types and tax rates of energy, environment, and carbon emissions, guide the behavior of enterprises and parks, and develop a long-term mechanism for the green development of parks.

Secondly, increase scientific and technological support to promote technological progress of enterprises. Advancements in technology can lead to cleaner and more energy-efficient production, thereby reducing pollution and energy consumption. Technological innovation is the core, promoting the research and development and promotion of high energy efficiency and low emission technologies in the fields of production and consumption; gradually establishing a diversified green technology chain system, such as energy conservation and consumption reduction, clean energy, renewable energy and new energy, and carbon sequestration; and carrying out relevant technical research in the fields of intensive land use, sustainable energy use, low-carbon buildings, and low-carbon transportation. Support the development of green parks at a technical level.

Finally, adjust the industrial structure and promote the ecological development of enterprises. The advancement and rationalization of industrial structure can lead to green modes of production. Build "industrial chain, product chain, waste chain" to create a clean and efficient green industrial system. Upgrade existing pillar industries, encourage enterprises to carry out ecological management, improve the circular economy industrial chain of pillar industries, and build an industrial symbiotic network. Promote green development of enterprises and parks.

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Sustainable Development Education in Primary and Secondary Schools of Minority Areas in China: A Multicultural Perspective

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Abstract

Lianshan Zhuang and Yao Autonomous County in Guangdong Province "old, less, side, and poor areas, is considered to be outside the" wild land ". In the new China before the establishment of education is very backward, due to various reasons, Zhuang, Yao people are illiterate. Therefore, also known as the "uncivilized people". After the founding of new China, under the care of the national policy of the party and state, the county, the county government a clear understanding of the education on the economy role in promoting, therefore, increasing investment in education funding, against all odds, improved education, making education vigorous development.

This paper explores the education problems of Lianshan minority areas in multi perspectives, and gives useful suggestions. It points out the multi-national education problems existing in our country. Thus, it suggests properly treating the education problems in the ethnic minority areas according to the actual situation, and taking a national education road with Chinese characteristics, national characteristics and time characteristics. On the basis of analysis and synthesis, giving Hill education improvement suggestions, hope to be able to as the development and improve the education of useful advice, so that the hill region of the national education more get attention, let hill as a model of education in ethnic minority areas, improve even mountain area of influence, through the development of education, continue to catch up with the Pearl River Delta area of education and economy. At the same time, on the other "old, less, side, and poor ethnic minority areas as positive impact, give them a reference template, can learn from each other and absorb the experience, of other slightly backward minority areas of education have a positive role in promoting.

Keywords: Multicultural Education, Yao nationality, Zhuang nationality, National Education

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Introduction

Research background

Through two years of professional training in Marxist ethnic theory and policy, and continuous study of works related to ethnology and anthropology, under the premise of fieldwork in Lianshan Zhuang and Yao Autonomous County in January and February 2015, I became deeply interested in ethnic education, and believed that ethnic education profoundly affects the political and economic development of ethnic areas According to CNKI's published papers, there are quite a few scholars who study the education of ethnic minorities, the Yao, and the Zhuang nationality, but there are very few articles on the education of Lianshan Zhuang and Yao Autonomous County, so the author believes that there is a need for research.

Furthermore, my fieldwork in January-February 2015 found that Lianshan Zhuang and Yao Autonomous County seemed to attach great importance to education on the surface, and made great progress in recent years;between 2012 and 2014, Lianshan's Yonghe Town, Jitian Town, Xiaosanjiang Town, Futang Town, Taibao Town, Hedong Town, and Shangshuai Town all passed the Guangdong Province Education Strong Town Inspection. On December 25, 2014, Lianshan met the national assessment and recognition standards for balanced development of compulsory education. On 30 December 2014, the Provincial Department of Education awarded Lianshan the title of "Guangdong Province Education Strong Town". However, according to the field visit to the school, there are still the following problems in Lianshan's education: first, the age structure of teachers in some rural schools, the number of teachers specializing in music, physical education, art, foreign languages, and other subjects are insufficient, and there are structural shortages and other problems. Second, At the present stage, China still uses Western diversified education theories to guide the education of ethnic minorities in China, but in the end, whether the Western education model is suitable for China's ethnic minority areas, or in other words, from the perspective of diversified education, China's ethnic minority areas can finally blaze a trail of education for ethnic minorities with Chinese characteristics.

In the article "The American View of Multicultural Education and China's National Education", the author analyzes the background, meaning, and proposition of the rise of multiculturalism in the United States, and puts forward the American concept of multicultural education: "multiculturalism" is an educational idea and method; It is a view of history; is a theory of cultural criticism; It is a theory of the new world order after the Cold War.In "On the Development and Dilemma of Multicultural Education", first analyze the background of the era of multicultural education, so as to put forward the multicultural education in the United States and Canada, compare the similarities and differences between them, in the United States, multicultural education mainly refers to the acceptance of students of different identities, races, cultures, economies, regions, education should meet the learning needs of each race, region, and culture of the population, provide students of different cultures with multicultural skills and knowledge, and the composition of teachers should have different cultures, Representation of race, etc. In the article "The Development Trend of Ethnic Education from the Perspective of Cultural Symbiosis", he puts forward the concept of cultural symbiosis as a cultural form of heterogeneous coexistence, mutual exchange, and inclusiveness of different ethnic groups and different cultures. In "The

Contemporary Western Theory of Multicultural Education and Its Enlightenment to the Education of Ethnic Minorities in China," he proposed that some multi-ethnic countries in the West allow the common and equal development of all ethnic cultures in those countries that are multi-ethnic and multicultural coexist, so as to ensure the coexistence of multi-ethnic and multicultural education and enrich the education of the entire national culture.

Literature review

The factors influencing green collaborative development between enterprises and industrial parks in industrial undertaking areas have been extensively studied in terms of industrial agglomeration and environmental governance. Scholars have proposed three main perspectives on this matter.

The first, industrial agglomeration promotes environmental governance. Firstly, industrial agglomeration promotes spillover of environmental protection and energy-saving knowledge among enterprises, leading to improved eco-friendly technologies and innovation. This reduces individual firms' pollution control costs, optimizing the regional ecological development environment (Hosoe & Naito, 2006; Wu et al., 2022). Secondly, industrial agglomeration generates economies of scale in environmental resource consumption, resulting in reduced resource use and lower pollution emissions per unit of industrial output (Brownstone & Golob, 2009; Holden & Norland, 2005; Shen & Peng, 2021). Thirdly, industrial agglomeration can realize scale effects in environmental governance, leading to lower governance costs (Andreoni & Levinson, 2001). Fourthly, industrial agglomeration promotes internal resource recycling within agglomerated regions, thus decreasing pollution emissions (Bressanelli et al, 2022). Fifthly, industrial agglomeration enhances production efficiency, subsequently raising local residents' income and fiscal revenue. The improved material living standards of residents inevitably lead to heightened demands for a pristine ecological environment, compelling governments to intensify environmental governance efforts, implement stricter environmental regulatory systems, and encourage enterprises to engage in green technological innovation and adopt clean production measures, ultimately leading to improved ecological conditions (Cheng, 2016; Feng et al., 2022)

Secondly, industrial agglomeration exacerbates environmental pollution. Scholars advocating this view argue that excessive agglomeration can lead to overcrowding, resulting in intensified environmental pollution. The localized expansion of production capacity and increased energy consumption owing to industrial agglomeration can lead to higher overall pollutant emissions, thereby increasing the difficulty of regional environmental governance. Although industrial agglomeration can promote technological improvements in enterprises, if these improvements focus on enhancing output efficiency, they may lead to increased unit output within the region and, paradoxically, worsen environmental pollution. Various studies have supported the reality of environmental pollution caused by industrial agglomeration. For instance, Virkanen (1998) empirically analyzed industrial agglomeration in southern Finland and concluded that manufacturing agglomeration exacerbates air and water pollution. De Leeuw et al. (2001) and Verhoef and Nijkamp (2002) employed empirical analyses using data from 200 European cities and European urban data, respectively, both arriving

at a significant positive correlation between industrial agglomeration and environmental pollution. Cheng (2016) conducted empirical analysis using data from 285 Chinese cities at the prefecture level and above, concluding that economic agglomeration exacerbates environmental pollution; conversely, environmental pollution also inhibits further economic agglomeration.

Thirdly, there is a complex relationship between industrial agglomeration and environmental pollution. Tan et al. (2022) proposed an "N-shaped" relationship curve between manufacturing agglomeration, air pollution, and energy conservation and emission reduction. Zhu and Xia (2018) argued that there is an inverted U-shaped relationship between industrial agglomeration and environmental pollution, with marketization being a crucial determining factor for this relationship. Ren-f (2015) suggested a threshold feature in the relationship between industrial agglomeration and environmental pollution. Pang et al. (2021) posited that industrial agglomeration may act as a "resistance" to environmental governance in the short term, primarily due to the "concentrated emission" of polluting enterprises within a spatial area. The mechanism underlying this complex relationship can be summarized as follows. Influenced by external factors, such as the environment, geographical conditions, technological levels, and environmental regulations, the impact of industrial agglomeration on environmental pollution is characterized by instability (Zeng & Zhao, 2009). The combined effects of the positive and negative externalities from industrial agglomeration contribute to environmental pollution. When negative externalities dominate the agglomeration's environmental impact, they intensify pollution; conversely, the opposite is true (Chen et al., 2020).

Research on multi-participatory environmental governance systems is as follows: Earlier, environmental governance adopted an administrative-oriented management system that combined unified supervision and management with hierarchical and sectoral management. This management system was mainly based on the assumption that environmental problem makers would transfer the costs of environmental management to society (Mu & Liu, 2008). With the development of the social economy, deteriorating ecological and environmental problems are increasingly related to people's immediate interests, which even cause social conflicts to intensify (Dominelli, 2012). Since the administrative-oriented environmental governance system cannot effectively coordinate the environmental interests of enterprises and society, its shortcomings have gradually emerged. The latest research on environmental governance has begun to turn to a pluralistic co-governance system, in which the public, government, enterprises, and NGOs cooperate to achieve environmental governance. This value lies in the ability to achieve a consensual scale of public goods that cannot be provided by a single entity (Agranoff & McGuire, 2001). Ha et al. (2016) examined the factors affecting private sector participation in environmental co-governance in different regions. Provan and Kenis (2008) proposed the structural characteristics of a network of co-governance systems in the public sphere and their influencing factors. Feiock and Scholz (2010) systematically explored how factors characteristic of metropolitan areas (e.g., geographic space, population size, industrial structure and institutional base) influence collective institutional action in regional environmental governance.

There have been extensive and in-depth studies on the relationship between industrial agglomeration and environmental quality, and on the multiple environmental governance system, but there are few studies on

the relationship between industrial agglomeration and environmental pollution in provinces, cities, and industrial parks, and fewer studies on the role played by governance bodies in the coordinated development of industrial agglomeration and the ecological environment. This study intends to address the shortcomings in the research to propose the key factors affecting the green coordinated development between enterprises and parks and put forward corresponding policy suggestions for promoting the green transformation development of industrial parks. The paper contributes to the existing literature as follows. First, to the best of our knowledge, this is the first study to employ grey correlation analysis to evaluate the factors influencing green development in Guangdong Province, offering a new methodological direction for future studies in this domain. Second, this study expands the existing literature and provides evidence of green coordinated development using a sample from Guangdong Province. Finally, this study provides practical recommendations for policymakers to improve their green development management practices.

The Objective of This Study

By exploring the educational problems in Lianshan ethnic areas from a pluralistic perspective, this article gives useful suggestions to point out the existing problems in China-led education in multi-ethnic areas, and thus suggests that ethnic minority areas should treat the education problem in minority areas in light of actual conditions and seeking truth from facts, and should follow a road of ethnic education with Chinese characteristics, national characteristics, and highlighting the characteristics of the times.

Literature Review

In the article "The American View of Multicultural Education and China's National Education", the author analyzes the background, meaning, and proposition of the rise of multiculturalism in the United States, and puts forward the American concept of multicultural education: "multiculturalism" is an educational idea and method; It is a view of history; is a theory of cultural criticism; It is a theory of the new world order after the Cold War (Zhang & Dai, 2009). It means that multicultural education is to let students continue to learn American history is the process of symbiotic coexistence and integration and exchange of various races, recognizing cultural differences, equality and influence, and American culture has become the current American culture under the role of continuous integration and mutual influence of the cultures of various nationalities, the purpose is to help American students understand and respect other ethnic groups and cultures, reduce racial prejudice, and pursue the equality of each ethnic group in political, economic, and cultural resources. The ultimate goal of cultural pluralism is not only to pursue "equality in culture and education," but also "equality in social status, rights, power, etc.," and the equality of different groups in the United States in sharing political, economic, and cultural resources in American society. He put forward the enlightenment of the American concept of multicultural education to the education of ethnic minorities, and finally used the model of pluralism

and integration to explain that China's national education cannot copy the model of multicultural education in the United States, and should be guided by a harmonious.

In "The Contemporary Western Theory of Multicultural Education and Its Enlightenment to the Education of Ethnic Minorities in China," the concept of multicultural education is proposed that some multi-ethnic countries in the West allow all ethnic cultures to develop together on an equal footing in those countries that coexist with multiple ethnic and multicultural cultures, so as to ensure the coexistence of multi-ethnic and multicultural education and enrich the education of the entire national culture (Bao & Ding, 2008). In the text, it is shown that the social context in which the theory of multicultural education arose was the product of the failure of cultural assimilation and the "civil rights movement". The revelation mentions the need to attach importance to women's education, the education of students from poor families, strict control of curriculum settings, emphasis on teacher training, enactment of laws, absorption of the concept of multicultural education, enhancement of educational sustainability, and enhancement of the harmonious development concept of multicultural education.

In the article "The Development Trend of Ethnic Education from the Perspective of Cultural Symbiosis", he puts forward the concept of cultural symbiosis as a cultural form of heterogeneous coexistence, mutual exchange, and inclusiveness of different ethnic groups and different cultures (Sun, 2011). It is a concept of cultural coexistence, emphasizing the coexistence, harmony and integration among various ethnic elements, emphasizing the role of national education and culture in promoting exchanges and cooperation among human groups, and emphasizing the role of blending and symbiosis between traditional and modern cultures. The article emphasizes that although we recognize that there are differences and conflicts in national culture in education, there is an inherent consistency between national identity and national identity. can be developed through curriculum that combines mainstream and local cultures; Reform the in-school education and out-of-school education system to resolve conflicts and contradictions. The concept and connotation of cultural symbiosis mentioned here are actually similar to the concept of multicultural education.

In "On the Development and Dilemma of Multicultural Education", they analyze the background of the era of multicultural education, so as to put forward the multicultural education in the United States and Canada, compare the similarities and differences between them, in the United States, multicultural education mainly refers to the acceptance of students of different identities, races, cultures, economies, regions, education should meet the learning needs of each race, region, and culture of the population, provide students of different cultures with multicultural skills and knowledge, and the composition of teachers should have different cultures, Representation of race, etc. Multicultural education in Canada points to the need for all races to preserve their cultural identity in multi-ethnic, multicultural countries (Zhang & Dai, 2009).

In "New Analysis of the Concept of Ethnic Education," Professor Teng Xing first proposed that ethnic education in a narrow sense, also known as ethnic minority education, refers to the implementation of composite ethnic education for members of ethnic minorities in a multi-ethnic country (Teng,1998), that is, multicultural education.Then, according to the concept of ethnic education, the theoretical concept of "pluralistic and integrated education" was put forward, and the main connotation is: In the education of a multi-ethnic country,

education not only undertakes the function of transmitting the achievements of the common culture of mankind, but also shoulders the role of conveying the excellent traditional culture of the country's outstanding ethnic minorities and the excellent traditional culture of the country's ethnic minorities.

In the article "Exploration of Ethnic Minority Education from the Perspective of Ethnology", the author believes that ethnic minority education is a kind of multicultural education, which refers to the implementation of composite ethnic education for ethnic minorities in a multi-ethnic country (Lei, 2011). In the implementation of education, it is necessary to respect the differences in the educational and cultural backgrounds of ethnic minorities, and take into account the diversity of minority cultures when formulating policies and regulations.

In the article "Legislation: Ensuring the Development of Education for Ethnic Minorities", the concept of ethnic education is mentioned as: "In terms of its scope, it refers to the education of members of 55 ethnic minorities other than the Han nationality (Xiong, 2003)." The article argues: In order to ensure the development and implementation of minority education, it is necessary to use laws to enforce development in the early stage of development, and only after everyone attaches importance to minority education can we use customary law to bind them. At present, however, education for ethnic minorities in our country is not listed separately at the legal level, and it requires continuous and in-depth investigation and study before a special law on minority education can be formulated.

Research Methodology

The research methods I have adopted include fieldwork, literature research, and group interviews. The location of the fieldwork was selected in Lianshan Zhuang and Yao Autonomous County, and they visited five schools, Lianshan Senior High School, Lianshan Nationalities Middle School, Shatin Primary School, Lianshan Vocational and Technical School, and Xiaosanjiang Middle School, including different types of schools, including high schools, vocational middle schools, junior high schools, and primary schools, and interviewed officials of the local education bureau and school principals or officials to discuss the development and planning of schools. The main problems and dilemmas we are facing; Students, parents and school staff have gained some insight into several representative schools in the area. In terms of literature, the yearbooks and county chronicles I obtained from my fieldwork have enabled me to have a certain understanding of the general situation of education in Lianshan, the current situation of primary and secondary schools in Lianshan, the major measures adopted in recent years, the awards won in education, and the efforts made by all parties in running schools, and obtained the materials needed for writing papers.

Discussion and findings

Current situation of education in Lianshan Zhuang and Yao Autonomous County

According to Deputy Section Chief Wei of the Education Bureau said in Current situation of education in Lianshan Zhuang and Yao Autonomous County: "Among the education population in Lianshan, if the total number of education is divided into 10, then the number of Zhuang students accounts for 5, Yao accounts for 3, and Han accounts for 2." Therefore, in Lianshan, the Han nationality belongs to the ethnic minority, and in terms of counting the students' promotion rate and dropout rate, Lianshan will not only count the Zhuang Yao nationality, but all students together, because the proportion of Han nationality is really too small. Lianshan popularized nine-year compulsory education in 1996-1997 and belongs to the area of Guangdong Province where nine-year compulsory education was implemented relatively early. In 2011, the "Pugao" was implemented. At present, the accommodation of primary and secondary schools in Lianshan's is free of charge. Recently, Lianshan County was rated as "a county with a basic balance of compulsory education in the country."But not every town is educationally strong. At the same time, it was rated as "Guangdong Province Education Strong County". Lianshan's policy on minority nationalities has given an annual scholarship of 10,000 yuan to those admitted to universities (including undergraduates and junior colleges); this is a great good thing for college students from poor families to solve their living problems. He also mentioned that at present, high schools in Lianshan County do not divide score lines in vocational schools, because the number of births has decreased, the number of students is relatively small, and the number of places exceeds the number of students, so there is no need to divide the score line. At present, it is rare to drop out of school, because parents can pay for a year's living and study expenses for students after a few months of part-time work, unless there are some family problems, such as the death of parents, divorce, etc., and it will be difficult to pay students' living expenses, but this situation is not much. In recent years, the rate of high school admission of minority nationalities has been about 70 percent, and the number of people admitted to junior colleges is higher than the number of undergraduates. He believes that at present, the county's education funds are still relatively sufficient, the equipment is completely updated, and people attach more importance to education. There are special vocational schools that can participate in agriculture and skills training, so that peasant workers can obtain certain skill certificates and acquire a skill that can at least solve the problem of survival, and it is also conducive to Lianshan attracting talented people to developed areas, so as to prevent people with low education from living on the streets and becoming a social problem. On the ethnic issue in Lianshan, he held that in Lianshan, ethnic minority students, teachers and students still get along relatively harmoniously, and there is no great discrimination or contradiction. However, when it comes to the problem of talent returning to their hometowns, he frankly said that the brain drain is very serious now, and students are still more inclined to majors with better employment in terms of major selection for university entrance examinations, such as economics majors. Everyone's first consideration is personal economic problems, which are more utilitarian than service and returning to the countryside, so college students are less inclined to return to their relatively poor and backward hometowns. In fact, in the final analysis, all these are problems of the economic

development of Lianshan, and if the economy of Lianshan, there is no need to worry about the problem of bringing in qualified personnel and losing talent."

Education problems and countermeasures in Lianshan Zhuang and Yao Autonomous County from multiple perspectives.

In the long course of history, ethnic minorities have constantly coexisted and exchanged with the mainstream ethnic group, the Han nationality, and have constantly absorbed and integrated cultures; therefore, the ethnic composition and origin of China and the West are different. Moreover, the ethnic groups in the West are not like the "large mixed and small gathering" living pattern of ethnic minorities in China, but the distribution of mainstream ethnic groups and minority nationalities is uneven; many of them live in the same area, and even students of different religions, races, cultures, and social classes will be in the same classroom; therefore, the problems are very complex and diverse. At present, there are several educational problems in Lianshan Zhuang and Yao Autonomous County, namely, the problem of setting up the curriculum system in Lianshan, the problem of teachers in Lianshan, the problem of the environment for rational education in Lianshan, the problem of Lianshan's educational goals, positioning, and philosophy, and the problem of Lianshan's educational guarantee mechanism.

1. The problem of curriculum system setting in Lianshan and its countermeasures according to Banksy's multicultural education philosophy, two important aspects are: the first, the integration of curriculum content; The second is to respect the construction of knowledge based on culture. This means that from the knowledge of different cultures, nationalities, and backgrounds, we should find knowledge content that can be compatible with mainstream culture to fill in the content of teaching materials and teaching methods, and the education and teaching of ethnic minorities is not only the knowledge content of mainstream culture, but also pays more attention to the humanistic achievements of non-mainstream culture.

Respect for culture-based knowledge construction. That is to say, it is necessary to respect the culture, knowledge, and experience of students of different cultures, backgrounds, and nationalities, and to reflect cultural equality and mutual respect among nations in the construction of knowledge in education. At present, the curriculum and the content of the teaching materials used by Lianshan are basically designed and formulated by the state in a unified manner, without giving ethnic minority areas a certain degree of autonomy and without adapting measures to local conditions. At present, the content of teaching materials and curriculum design are based on mainstream cultural knowledge, which is mainly based on Han culture, and does not take into account the actual situation of ethnic minorities, and there are no relevant personnel to conduct systematic investigation and research on what knowledge and skills ethnic minority students need to learn. In addition, the teaching method and method of the course are single and boring, mainly teachers teach in the classroom, and directly teach the content to students according to the book, which is a cramming teaching method, and does not provide enough second classroom activities to enhance students' communication, understanding and practice.

Therefore, it is easy to cause ethnic minority students not to understand the content of the course, it is difficult to accept, affecting students' ability to accept and enthusiasm for learning, and the learning effect of the classroom, and directly affecting students' interest, and at the same time not allowing the culture and traditions of ethnic minorities to be continuously passed on, so that ethnic minority students lack a sense of identity and honor for their own culture, and students may think that their own culture is useless and worthless, thus causing a lack of national identity. Contempt for one's own national culture and other situations arise.

Another important problem is the difficulty of implementing bilingual education and the limited resources for bilingual education. First of all, when it comes to bilingual education, the problem of bilingual teachers must be mentioned, and the lack of bilingual teachers and low quality is the biggest problem that exists today. At present, there is no special bilingual teacher training institution in China, and the excellent teachers of the local ethnic group are not necessarily willing to return to remote mountainous areas to teach, and even if they are willing to come to teach, they do not know how to teach bilingualism, and there is no relevant institutional training, so the lack of bilingual teachers has led to a shortage of bilingual teachers, and the existing teachers cannot be improved in the field of bilingualism, affecting the quality and level of teaching.

The second is the lack of resources to compile bilingual courses. To implement bilingual teaching, it takes a lot of manpower and material resources to compile a large number of bilingual teaching materials, reference books, extracurricular reading materials, extracurricular reading materials, and teaching aids, and so on. The lack of "bilingual" teachers, the lack of "bilingual" teacher training institutions, and the arrangement of "bilingual" teaching content, teaching methods, methods, experience, etc. have not formed a complete set of systematic and complete teaching plans. In the context of the implementation of bilingualism, some ethnic minority areas use textbooks originally in Chinese to translate into minority languages, and the translation of such textbooks is often limited by the expression mode and level of translators, affecting the ability of ethnic minority students to accept and absorb knowledge. Considering the diversity, difference, and particularity of ethnic minority education in China, combined with the theory of multicultural education, one suggestion can be drawn as follows:

Adapt to local conditions and aptitude, update and improve the content of the curriculum. An important problem in ethnic education today is that the content and teaching methods of ethnic education do not organically combine mainstream cultural knowledge with ethnic minority cultural knowledge and skills, and do not reflect the cultural characteristics and actual conditions of ethnic minority areas. Therefore, it is necessary to integrate the resources of mainstream culture and the culture of ethnic regions, develop local curricula and school-based curricula in depth, and persist in integrating and developing the excellent and progressive parts of traditional culture and modern culture and between national culture and mainstream culture. It is necessary to promote the renewal and reform of the curriculum, change the previous educational methods and contents that mainly focused on mainstream culture, and increase the content of cultural content, values, cultural customs, ethnic crafts, and other skills in ethnic minority areas in terms of curriculum content and teaching methods, so that the cultural traditions of minority areas can be continuously passed on and carried forward, so that the traditional culture of ethnic minorities will not be buried by the mainstream culture, and ethnic

minority students will not have feelings of contempt and contempt for their own cultural traditions. In the process of school study, teachers should understand the cultural traditions, customs and even religious beliefs of students of different nationalities according to the ethnic composition of students, treat each student differently, pay attention to the uniqueness of each student's position, and teachers should have a neutral attitude towards different cultures and nationalities, and should not have any bias, whether it is for things or people. In addition, in terms of teaching strategies, such as asking questions, assigning homework and doing open-ended questions, we must have different but relatively fair evaluation standards, learn to communicate with students of different cultural and ethnic backgrounds, understand their psychological and learning status, understand their mastery of knowledge and skills, and how different the ways of understanding students of different nationalities are, which can help improve their teaching level and improve the effectiveness of teaching.

This article also suggests that the Higher Education Department of the Guangdong Provincial Department of Education and the Guangdong Provincial Ethnic Affairs Commission jointly study and coordinate the formulation of higher education plans for the Zhuang and Yao nationality, and that the State Ethnic Affairs Commission and the Provincial Ethnic Affairs Commission jointly fund the opening of Zhuang and Yao classes at the Guangdong Technical Normal College, and set up special courses to train Zhuang and Yao students so that they can return to work in their own ethnic areas after graduation. These students do not take the unified examination but only take the required courses, and their middle and primary schools do not need to learn English, and they do not need to learn English in universities, and it is sufficient for them to be able to learn Chinese and their own national pronunciation well. Learn more skills in tourism, hotel management and other aspects, so that they can return to Lianshan, develop local tourism resources, and drive local residents out of poverty and become rich. 2. Establish a training mechanism for "bilingual" teachers, and continuously strengthen the training of "bilingual" teachers in ethnic minority areas. This article suggests setting up special "bilingual" teacher training courses in the Nationalities College of Guangdong Technical Normal College, and that excellent "bilingual" teachers can also be recruited from all over the country, with the main focus on allowing ethnic minority college students in their own ethnic groups and regions to return to their hometowns for employment, and establishing the first batch of "bilingual" teachers, and the scientific research group studying how to train foreign teachers to carry out "bilingual" education, turning it into a complete set of training programs, so that the Zhuang and Yao ethnic cultures can be inherited, and the Zhuang and Yao ethnic cultures are the most important resources of Lianshan County's tourism industry. Tourism is also an important part of Lianshan County's economic development.

2. Lianshan's teacher problems and their countermeasures According to an interview with a relevant staff member of the Lianshan County Education Bureau, "Due to the low salaries of teachers, the relatively remote teaching environment, and the poor overall environment in ethnic minority areas, there is a serious brain drain problem for teachers in Lianshan District. Some non-local teachers leave the area after a short period of time after teaching, just as a springboard for upward mobility; Some even hired people with high salaries and gave them treatment such as housing, but due to environmental and other problems, Lianshan still could not retain outstanding teachers. "Secondly, because it takes a lot of mental effort for teachers to

cultivate an excellent student, and because Lianshan's students lack family education and the imbalance between the allocation of teachers and the number of students, the workload of teachers is very large, and in addition to the usual classes, it may be necessary to give students individual special tutoring, so compared with Lianshan's salary level, it is overloaded work, and for teachers, the mental pressure is very great.

Moreover, some outstanding students, who have the conditions at home, go to Qingyuan City to attend junior high and high schools, and the students that Lianshan excellent teachers have worked hard to cultivate will flow to more developed areas, thus causing teachers to have a weak sense of accomplishment. In addition, during field investigations, it was found that in several schools in Lianshan County, the overall age structure of teachers is generally on the large side, and the majors studied do not necessarily correspond to the majors taught. Generally speaking, older teachers have many failing academic qualifications and need to be continuously improved, and they are promoted through self-examination or adult education (electronic university, distance education, etc.). Although older teachers do not have an advantage in age and education, they have rich teaching experience and are the biggest advantage. Among the teachers, the local group in Lianshan County is relatively stable and less mobile. Outsiders are more unstable, mobile, and have no sense of belonging. Although wages and benefits are "comparable," they are still not dominant compared with cities such as Guangzhou in developed areas, but they are still at a good level in the local area. At the salary level of local teachers, the rural teachers' post allowance (implemented in 2013) is more than 1,000 yuan in rural villages than in towns and counties. At present, the brain drain in Lianshan, which is still relatively serious, is still relatively uncompetitive for the city.

In Lianshan, some teachers were recruited through "three supports and one support" and external recruitment, and some teachers from Jiangxi and Hunan were recruited, but after coming to Lianshan, even if they signed service contracts and made housing arrangements, all the teachers and staff of public schools in Lianshan, and the "three supports and one support" personnel who served Lianshan, all had relevant policy preferences when examining the establishment of civil servants and teachers. Even so, these teachers still have to leave the school in Lianshan even if they break their contracts and lose money, and they are not willing to continue to serve here, and some teachers prefer to go to higher levels and larger cities after obtaining qualifications and professional titles. At present, the Education Bureau has recruited some discipline leaders with an annual salary of 200,000 to 300,000 yuan, which is a relatively high salary level in the local area, but it is still unable to retain talent, and people from remote areas are willing to come and work at first, but after working for a few years, their horizons are broader, and they hope to develop in areas with more development prospects. Therefore, recruiting teachers every year is a long-standing problem in Lianshan, and the turnover rate is very high.

Moreover, the development of education in ethnic minority areas has been hampered by the rigidity of teachers' thinking due to the repetition of traditional teaching concepts and methods, and the fact that teachers rarely have access to effective training due to the geographical problems of ethnic minority areas. Therefore, these are all very serious problems, which directly affect the quality of education and teaching in Lianshan. It also affects the morale of teachers.

The loss of teachers in Lianshan, not only a regional problem in Lianshan, but also needs to be optimized and upgraded by the external conditions of higher education. When cultivating high-level talent, colleges and universities should optimize the setting of majors; in particular, colleges and universities of nationalities or colleges and universities that train teacher training students should do a good job in studying the professional needs of the areas they serve, do a good job of tracking and investigating the employment of graduates, and study whether the majors studied by the corresponding training can be used to the fullest; if not, they should optimize the curriculum of colleges and universities and the issue of professional settings. Therefore, this requires universities to make good contact with the region, regularly feedback the situation of graduates, and let the counterparts train graduates to better serve the region. Second, and most importantly, improve Lianshan's economy.

Only when the economy develops can we attract more outstanding personnel to stay in Lianshan to serve, and even local ethnic minorities to engage in the teaching profession; at present, the Lianshan area is not very attractive to outstanding principals and teachers with high education and experience, and this directly leads to the inability to retain talent. The first, Lianshan Prefecture should encourage graduates of ethnic minority universities in their localities to return to their hometowns to engage in education, train local minority teachers to return to their hometowns for employment. The second, we continuously raise teachers' salaries, welfare levels, and social status in their localities, and provide favorable conditions for graduates to return to their hometowns to engage in the teaching profession. The third, it is necessary to continuously apply for targets to higher departments to solve the problem of structural deficiencies in Lianshan. The fourth, in the education curriculum, many students feel that they have not aroused enough interest to cause them to not take the course seriously. Therefore, the curriculum has higher requirements for teachers' teaching methods, and teachers should know how to arouse students' interest, and should ask for quotations, quote current events and short stories, quote ancient and modern times, and explain them in simple terms. In addition, it is necessary to vigorously carry out heuristic teaching, not to impart teaching content in a jam-in way, but to be able to stimulate students' thinking, so as to be more profound. Teachers actively use modern scientific and technological means to constantly update teaching content and make them more grounded; they must also strengthen the combination of classroom teaching and extracurricular practice of theoretical education, and the evaluation standards cannot rely solely on rote memorization "Dead" knowledge, but should be combined with classroom discussions, extracurricular practice and other evaluation standards to make the classroom atmosphere "live". The fifth, in the area of teacher training, it is necessary to normalize the methods of distance education, continuously compile local ethnic minority teaching materials according to actual conditions, and accelerate the process of professionalization of teachers. The sixth, although Lianshan County is economically backward, its beautiful mountains and waters, clean air and water resources are an ideal place for people who hate the hustle and bustle of the city and the dirty air. The Lianshan County government may adopt the method of exchanges to contact some famous schools in major cities in China, and even famous teachers and teachers in Lianshan County to exchange on an equal basis for one year, half a year or more. Middle-aged and elderly teachers in metropolises hate big cities, and teachers in small counties in Lianshan Mountainous Area want to

experience the life of the metropolis for a year and a half, provide convenience to both sides, and achieve a win-win situation in which both sides take what they need. In addition, some retired teachers in large cities who are in good health and willing to exert their residual heat are tempted by the good air, good water, and pure natural and pollution-free food in the mountains; they only need to provide housing and take care of their daily lives; they can welcome many outstanding teachers to teach without salary and welfare.

3. Lian Shan's joint efforts to educate people on environmental problems and their countermeasures. In Lianshan, due to historical, economic, political, cultural, and other reasons, parents' education level is not very high, they have no awareness or relatively low awareness of the impact of family education on their children, they do not attach importance to family education for their children, some only attach importance to children's scores, there are boring and single problems in educational methods and methods, and even some negative and incorrect educational methods and concepts directly affect students' attitude towards learning, and not only do they not promote school education, but they may also think that education is useless Being able to go out early to earn money and work is the best choice.

Another important aspect is that school education has not done enough to create harmonious and harmonious relationships between students from different backgrounds, and how to use different teaching strategies, different evaluation standards, questioning methods, etc. to emphasize that students of various ethnic groups learn to get along with others, and it is important to learn the skills of getting along and competition. However, in terms of promoting family education, the contact between schools and parents is still not frequent enough, and teachers do not pay enough attention to students due to the large number of students. Community awareness of education also needs to be strengthened.

In view of the fact that parents of ethnic minorities in Lianshan do not attach much importance to their children's family education, we should advocate the following aspects: Schools should establish contact channels with parents, emphasizing the trinity of school education, family education, and social education. In schools, a harmonious teaching atmosphere should be created for different ethnic groups, so that students of different nationalities can learn from each other's advantages in a group, exchange and understand each other's living habits, customs and traditions, enhance mutual exchanges, reduce friction and obstacles, break the boundaries of culture, region and ethnic groups, learn how to get along and compete with people from different cultural backgrounds in the group, and improve social adaptability. In addition, it will also help to help members of vulnerable groups in the future, so that they love their own nation and do not despise or contempt for their own culture and status. Modern education requires family education, school education, and social education to be combined with each other to form a joint force in order to achieve better results.

In ethnic minority areas, due to the limited degree of education of parents, the methods of family education are simple or almost non-existent, and there may even be some wrong family education methods such as only scores being supreme, and some beating and scolding because the scores are not high, which may affect students' values of knowledge and education. Schools should actively cooperate with teachers' work, require teachers to get in touch with students' parents, and regularly communicate students' psychological and learning conditions, so that parents can grasp their children's situation, and family education can better

serve school education. Social education, especially community education, should also pay special attention to the growth and development of ethnic minority students; it is necessary to regularly publicize information on national culture on propaganda boards, convey respect for and inheritance of national culture, national education, and national traditions in a positive and positive way, so that ethnic students can identify more with their own nationality, national culture, and traditions, and will no longer have an inferiority complex in their hearts, and all ethnic elements are a part of China's national construction.

4. Lianshan Education Objectives, Positioning, Philosophy and Countermeasures, The dropout rate in ethnic minority areas is high and the quality of teaching is not high. Due to historical, economic, environmental, and other reasons, most of the minority nationalities in our country live in relatively remote, impoverished, and areas with harsh natural conditions; therefore, the conditions for running schools are limited and it is difficult to popularize them. Due to the remoteness, excellent teachers are reluctant to come to teach, resulting in the poor quality of teachers. Rural economic conditions are poor, household incomes are not high, and the cost of sending children to school is limited. Due to the particularities of ethnic minority students' customs, religious beliefs, living backgrounds, language, and so on, if they do not strengthen guidance, they are prone to develop a strong sense of guard, inferiority, national consciousness, and even excessive huddling. Moreover, the knowledge base of ethnic minority students is poor, the school conditions are also rudimentary, the conditions of school buildings are rudimentary, and the teaching equipment is not complete, so the quality of teaching has been not high.

In addition, the teaching methods and methods of the curriculum are single and boring, mainly teachers teach in the classroom, and directly teach the content to students according to the book, which is a cramming teaching method, and there are not enough second classroom activities to enhance students' communication, understanding, and practice, which is undoubtedly not enough to arouse students' interest. In terms of curriculum evaluation methods, there is also a certain degree of unscience; almost all of the primary and secondary school curriculum assessments in Lianshan's are based on examinations, and teachers score students' coursework based on attendance and examination results, and do not comprehensively examine whether students have mastered the knowledge of the course.

At present, there is no teaching model and system specially formed for urban minority students, the research on the individual or group uniqueness of ethnic minority students is not in place, the attention is not enough, and the degree of implementation of education work for ethnic minority students in each region is different. Only after the founding of New China, especially after the first National Conference on Ethnic Education and the third Plenary Session of the 11th CPC Central Committee, did it clearly point out: "Education for ethnic minorities must adopt ethnic forms and take into account national characteristics, so that it can be better integrated with the actual conditions of all nationalities."

In the process of teaching, attention should be paid to the use of diverse models, the use of different teaching strategies, so that students of different ethnic groups can improve their achievements, but also help them reduce prejudice and discrimination against other ethnic groups, men and women, vulnerable groups, and everyone is aware of the need to tolerate the differences of each culture and ethnic group. When setting

up school curricula, special attention should be paid to the use of educational methods suitable for women, the concept of equality between men and women, and the curriculum should reflect the status and role of women in social and family roles. In addition, because poor families have fewer resources than students from middle-class families, and because poor family environment, learning environment, living environment, etc., make their road to education more difficult, special attention should be paid to the education of poor children. Third, in school education, attention should be paid to students' psychological changes, and the educational methods of ethnic minority students should take into account individual differences and cannot be "one-size-fits-all." At the same time, school curricula should reflect the differences between ethnic minority students' cultures, regions, and students, and should continuously promote the reform of basic education curriculum. In addition, teacher training has been continuously carried out to improve the level of teachers in ethnic minority areas; enact relevant laws and regulations to guarantee the right to education of ethnic minority areas and students; In education, we should absorb the concept of multicultural education, and treat every independent individual equally in the process of education; With the concept of sustainable development education, create a harmonious and fair society. Although the origin of the Western theory of multicultural education mentioned in the article is very different from that of China, the experience and enlightenment of the theory of multicultural education have a profound warning effect on our country, which reminds us that we must adapt measures to local conditions, absorb the concept of multicultural education, and respect individuals and groups of different cultures, so that the education of ethnic minorities in our country is fair and of great significance to the construction of a harmonious society.

Recommendation

Funding for education is scarce. Since the beginning of reform and opening up, the state has continuously increased its input in education in minority areas; the education and economic expenses of the central government have been biased towards higher education, while basic education and vocational education in minority areas have been jointly undertaken by local county and township governments, and peasants. Most of China's minority areas are located in backward mountainous areas that are "old, young, marginal, and poor," with backward economic development, and there is a problem of insufficient investment in education. The lack of educational resources and funds has prevented the improvement of the conditions for running schools, the inability to improve the basic facilities, outdated teaching equipment, experimental equipment and book equipment not meeting the regulations of the Ministry of Education, and so on, while the local government can only open up and reduce expenditure, but has not expanded foreign investment and the input of social forces and charitable forces, so funds have always been in a state of scarcity.

We should improve the mechanism for investment in education, increase the effective utilization rate of education funds, increase the input of social forces, and improve the quality of teaching. Limited education funds in minority areas and limited input from outside funds have always been a problem, and we cannot always rely solely on the power of financial payments, but should let the government and schools take the lead

in carrying out multi-channel and multifaceted methods to absorb and accept education funds. According to the "13th Five-Year Plan": it is necessary to implement the integrated development of industry and education, support 100 vocational colleges and 1000 secondary vocational schools to strengthen school-enterprise cooperation, and jointly build vocational education internship training facilities; support undergraduate colleges and universities to improve basic conditions such as teaching and experimental training facilities; Build a number of high-level application-oriented undergraduate universities. Support school-enterprise cooperation to build emerging discipline professional clusters serving the modern industry. In connection with the plan, regions and schools should attract social charity forces to help schools in ethnic minority areas, cooperate with enterprises and institutions to run schools, and entrust the training of some outstanding students, and the units are responsible for the education expenses of the students, so that the students can work in the enterprise for a certain number of years after graduation; organizing university teachers and students to organize volunteer education in ethnic minority areas by organizing counterpart assistance; Organize skilled craftsmen or scientific and technical personnel to teach primary and secondary school students labor skills and scientific and technological knowledge.

We should further establish and improve the management mechanism for education funds, include education input in the road of systematization, formulate standards for the use of each school's education funds, reduce the waste of education funds in schools, and punish the illegal use of education funds according to law. Fully tap the potential of vocational schools and institutions of higher learning, and set up vocational education centers, science and technology centers, etc. in these units to increase students' practice of knowledge.

Primary and secondary education in Lianshan County is the weak link. Take the college entrance examination data of Lianshan County in 2013 as an example: in 2013, 473 people registered for the college entrance examination in Lianshan, and the total population of the county was 100,000, and the proportion of people participating in the college entrance examination was 4.73 per 1,000. The number of people who registered for the college entrance examination nationwide was 9.12 million, and based on a total population of 1.3 billion, the ratio was 7.015 per 1,000. This data tells us that the proportion of people taking the college entrance examination in Lianshan County is 31.8 percent lower than the national average, accounting for only 68 percent of the national average. This is the gap between Lianshan County and the whole country in terms of education, not to mention the gap with developed areas. As mentioned in the previous survey, many parents do not let their children go to school after they have completed nine years of compulsory education, because they urgently need their children to work to earn money, or they cannot pay the fees. To solve this problem, it is necessary to rely on the joint efforts of the provincial, prefectural, and county governments to increase the funding of poor border areas such as Lianshan. Without funding, the backwardness of education will never be solved.

Therefore, in studying the educational problems existing in Lianshan Zhuang and Yao Autonomous County from multiple perspectives, several principles should be followed: the first, education should constantly change with the changes in the country's political economy and the environmental environment of neighboring

countries. The second, the content of education should be constantly enriched and developed with the development of the times. The third, the purpose of education has always been to promote the unity of all nationalities in the country and safeguard the complete unity of the motherland. The fourth, education should reflect the characteristics of different regions and nationalities and adapt measures to local conditions.

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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)

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)

Submission Guide

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.
- **Paper size** Manuscripts must be typed double-spaced on A4 size paper, a single column format.
- **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)
- **Titles** should be no more than three typeset lines.
- **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.
- ***Subheadings*** Italicize the subheadings in the bold type, single-spaced; in 16 point Browallia New font.

SUB-HEADING ONE Bold, Left, UPPERCASE HEADING

Sub-heading Two Bold, Left, Capitalize Each Word

Sub-heading Three Indented, bold, Capitalize Each Word

- Tables, Graphs, Charts, and Figures in 12-point Browallia New font, Bold
- **References** The Journal uses American Psychological Association (APA) style (7th edition).
  - Include only those sources you have cited in your paper.
  - Position the first line of each reference flush left, with subsequent lines wrapping with a ½-inch (hanging) indent.
  - Organize the list in alphabetical order according to the first letter beginning each entry. Usually, the author's last name is the first piece of information in each entry. Use initials for the author's first/middle names.
- Use the following format for your reference list:

Cokins, G., Pohlen, T., & Klammer, T. (2018). *Supply Chain Costing and Performance Management* (2nd ed). New Jersey : Wiley.

Hisrich, R. D., Peter, M. P., & Shepherd, D. A. (2020). *Entrepreneurship* (11th ed). New York : McGraw- Hill.

Heizer, J., Render, B., & Munson, C. (2020). *Operations Management Sustainability and Supply Chain Management* (13rd ed). U.K : Pearson.

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Novack, R. A., Gibson, B. J., Suzuki, Y., & Coyle, J. J. (2018). *Transportation A Global Supply Chain Perspective* (9th ed). Singapore : Cengage.

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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.

1. The manuscript must not have been published or submitted elsewhere for consideration. (A brief explanation will be necessary to clarify this matter.)
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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