THE EFFECT OF LEAN SUPPLY CHAIN STRATEGY, AGILE SUPPLY CHAIN STRATEGY, AND SUPPLY CHAIN RESPONSIVENESS ON SUSTAINABLE FIRM PERFORMANCE OF MANUFACTURING INDUSTRIES IN MALAYSIA

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ABSTRACT

Presently, the issues of production disruption, supply disruption, and major environmental that all caused unsustainable performance in the manufacturing sector. Moreover, carbon dioxide (CO_2) emission has increased rapidly over the past few decades resulting in harmful outcomes such as global warming, climate change, water, and air pollution, and degrading environmental performance. Hence, the lack of empirical studies providing insights into how supply chain strategies and supply chain responsiveness can provide sustainable performance for further research. This study aimed to analyze the supply chain responsiveness mediating effect on lean supply chain strategy, agile supply chain strategy, and sustainable performance relationships. The data collection instrument used was a questionnaire administered to a total sample of 231 manufacturers in Malaysia. The response rate was 66% while 51% were usable questionnaires. Sample selection was based on a purposive sampling technique. Smart-PLS analyses revealed that three dimensions of supply chain responsiveness, namely operating system, logistics process, and supplier network have impacted the practices between lean supply chain strategy, agile supply chain strategy, and sustainable performance relationships with partial mediation. Supply chain responsiveness mediated the relationship between the lean supply chain strategy and sustainable firm performance. Supply chain responsiveness also mediated the relationship between agile supply chain strategy and sustainable firm performance. Furthermore, both of them have a partially positive and significant influence on the relationships between lean supply chain strategy, agile supply chain strategy, and, sustainable firm performance. The study contributes firstly, to the body of knowledge by examining the mediating roles of supply chain responsiveness. Secondly, it complements the resource-based view (RBV) theory regarding the interrelationships between firm resources, routines, capabilities, and performance. Thirdly, practitioners benefit from being aware of the Strategies outlined in this study for overcoming expected business issues. Lastly, the study confirms the idea that every practice and capability established within the firm will eventually affect a certain area of performance.

ABSTRAK

Isu gangguan pengeluaran, gangguan bekalan, dan persekitaran utama telah menyebabkan prestasi yang tidak mampan dalam sektor pembuatan. Ianya ditambah pula dengan peningkatan pelepasan gas karbon dioksida (CO_2) tanpa kawalan sejak beberapa dekad lalu yang mengakibatkan pemanasan global, perubahan iklim, pencemaran air dan udara, serta merosakkan alam sekitar. Oleh itu, kurangnya kajian empirikal yang memberikan pandangan tentang bagaimana strategi supply chain dan supply chain responsiveness (SCR) boleh menghasilkan prestasi yang mampan memerlukan penyelidikan lanjut. Kajian ini bertujuan untuk menganalisis kesan pengantaraan SCR ke atas lean supply chain strategy (LSC), agile supply chain strategy (ASC) dan hubungan prestasi yang mampan. Instrumen pengumpulan data yang digunakan ialah soal selidik yang ditadbirkan kepada sampel berjumlah 231 pengeluar di Malaysia. Kadar maklum balas yang diterima adalah sebanyak 66% manakala hanya 51% soal selidik yang boleh digunakan. Pemilihan sampel adalah berdasarkan teknik persampelan bertujuan. Analisis Smart-PLS menunjukkan bahawa tiga dimensi responsif rantaian bekalan, iaitu sistem pengendalian, proses logistik dan rangkaian pembekal telah memberi kesan kepada amalan antara LSC, ASC dan hubungan prestasi mampan dengan pengantaraan separa. SCR menjadi pengantara hubungan antara LSC dengan sustainable firm performance (SFP). SCR juga menjadi pengantara hubungan antara ASC dan SFP. Selain itu, kedua-duanya mempunyai pengaruh yang separa positif dan signifikan terhadap hubungan antara LSC, ASC dan SFP. Kajian ini mempunyai beberapa sumbangan iaitu yang pertamanya, kajian ini menyumbang kepada badan ilmu dengan mengkaji peranan pengantara SCR. Keduanya, ia melengkapkan Teori Pandangan Berasaskan Sumber (Resource-Based View, RBV) mengenai perkaitan antara sumber firma, rutin, keupayaan dan prestasi. Ketiga, pengamal mendapat manfaat dengan mengetahui strategi-strategi yang digariskan dalam kajian ini untuk mengatasi isu perniagaan yang dijangkakan. Akhir sekali, kajian itu mengesahkan idea bahawa setiap amalan dan keupayaan yang diwujudkan dalam firma akhirnya akan mempengaruhi bidang prestasi tertentu.

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LIST OF ABBREVIATIONS

ASC	-	Agile Supply Chain Strategy
AVE	-	Average Variance Extracted
CB-SEM	-	Covariance-based
CMV	-	Common method variance
CR	-	Composite Reliability
COPQ	-	Cost of Poor Quality
EMS	-	Environmental Management System
EM	-	Environmental Management
EPA	-	Environmental Protection Agency
EQA	-	Environmental Quality Act
DOE	-	Department of Environmental
DWNP	-	Department of Wildlife and National Parks
FMM	-	Federal Malaysian Manufacturers
GDP	-	Gross Domestic Product
HCM	-	Hierarchical Component Models
HOC	-	High Order Construct
HTMT	-	Heterotrait-Monotrait
IMP	-	Industrial Malaysian Plan
ISO	-	International Standard Organizational
IT	-	Information Technology
LSC	-	Lean Supply Chain Strategy
LCIP	-	Lean Customer Involvement Practices
LCM	-	Lean Cost Management
LIM	-	Lean Inventory Management
LOC	-	Low Order Construct
LSIP	-	Lean Supplier Involvement Practices
LWM	-	Lean Waste Management
MIDA	-	Malaysian Investment Development Authority

MNCs	-	Multi National Corporations
MPC	-	Malaysian Productivity Corporation
MSA	-	Moment Structures Analysis
MOSTE	-	Ministry of Science, Technology, and the Environment
NEP	-	New Economic Policy
NEPA	-	National Environmental Policy Act
NGOs	-	non-governmental organizations
PCA	-	Principal Components Analysis
RBV	-	Resource-Based View
ROA	-	Return on Assets
ROI	-	Return on Investment
ROS	-	Responsiveness Operations System
RLP	-	Responsiveness Logistics Process
PLS-SEM	-	Partial Least Square-Structural Equation Model
RSN	-	Responsiveness Suppliers Network
SCM	-	Supply Chain Management
SCR	-	Supply Chain Responsiveness
SECP	-	Sustainable Economic Performance
SEVP	-	Sustainable Environmental Performance
SPSS	-	Statistical Package for Social Science
SSP	-	Sustainable Social Performance
SFP	-	Sustainable Firm Performance
SWM	-	Solid Waste Municipal
SWPCMC	-	Solid Waste and Public Cleansing Management Corporation
VIF	-	Variance Inflation Factor
WECD	-	World Environment Commission and Development
WEEE	-	Waste Electronical and Electronic Equipment

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CHAPTER 1

INTRODUCTION

1.1 Research background

Sustainable performance is achieved when a company or organization continuously adds value for its shareholders and stakeholders while continuing to be concerned about environmental, social, and economic issues (Atan *et al*., 2018). The establishment of an innovative and healthy corporate culture via integration is an important component of the sustainability transition process (Nikolaou et al., 2019). A healthy culture would be able to improve organizational performance and make the most use of existing assets, resulting in positive economic, environmental, and social performance (Lintukangas *et al*., 2019). In addition, the outcomes of economic, environmental, and social sustainability would provide shareholder, supplier, customer, employee, and social satisfaction. According to the International Energy Agency (2019), manufacturing industries produce a massive quantity of waste and resources globally, and the manufacturing sector accounts for 36% of carbon dioxide emissions into the environment. Therefore, a healthy culture would be able to improve organizational performance and make the most use of existing assets, resulting in positive economic, environmental, and social performance.

On the contrary, the manufacturing industry plays a critical role in facilitating and contributing to sustainability (Cai *et al*., 2019). The rapidly growing number of industrial environmental regulations and escalating consumer concerns highlighted the role of industrial performance in the context of environmental management (Çankaya and Sezen, 2019). In response to these rapidly increasing issues, manufacturing companies are significantly increasingly adopting green practices in their operations (Macchion *et al*., 2018) and are encouraged to participate and contribute to ecological

management to fulfill the need for sustainable development (Svensson and Glob, 2019). Organizations must now make greater efforts to balance their economic, social, and environmental performance, especially those with community, competitive, and environmental regulations (Ali *et al*., 2019). Obtaining this appropriate balance is supposed to be a complicated and, in some contexts, complex and controversial problem to solve (Haffar and Searcy, 2017).

Therefore, the Malaysian economy and industry are concerned about the issue of balancing economic, social and environmental performance, especially in the manufacturing sectors, which would allow for an expansion of energy demand and production without negative impacts on the environment (Annual Report, 2018). Moreover, in Malaysia, the manufacturing industry contributes significantly to the GDP (22.8%), exports (37.3%), and foreign investment (69.5%), and become a critical source of job creation (59,294 new jobs) (Annual Report, 2018; Department of Statistics Malaysia, 2019). On the other hand, the imbalance between economic and environmental performance has become the root cause of environmental problems. the growing demand for energy and manufacturing for a sustainable Malaysian economy, it is a requirement for the manufacturing industry to implement the 11th Malaysian Plan (EMP) Sustainability Strategy (2016-2020).

As a result, Malaysian manufacturing companies have adopted green practices along with the application of the Environmental Management System (EMS) to promote green growth, improve sustainable performance (economic, environmental and social) and reduce carbon emissions. CO_2 emissions from manufacturing in order to respond to 9/11 MP must meet its targets in 2020 (Malaysia, 2019). Green practices primarily focus on reducing environmental impact, while sustainable performance aims to balance environmental, social, and economic considerations to ensure the long-term viability of an organization or system. For example, Malaysia's 11^{th} plan (2016-2020) committed to increasing sustainability performance and implementing manufacturing processes.

Furthermore, the standards-based Malaysian EMS applies to all organizations regardless of size, type or type and encourages companies to establish ISO 14000 standard. Therefore, based on the standards of the Department of Standards Malaysia (2018), ISO 14001 EMS helps companies improve their environmental performance,

meet their compliance responsibilities and achieve their environmental goals. ISO 14001 EMS can help Malaysian businesses improve their environmental performance, comply with environmental regulations, achieve cost savings, gain competitive advantage and continuously improve their sustainability practices. By implementing the ISO 14001 EMS, companies can demonstrate their commitment to environmental sustainability and responsible business practices, which can enhance their reputation and contribute to their sustainable performance.

Moreover, the industry plays a key role in the development of economic and social well-being in Malaysian society and is the largest contributor to the country's environmental pollution issues that need to be assessed, monitored, and rectified (Yusliza *et al*., 2020). The negative impact manufacturing organizations have on the environment leads to demands for sustainable practices to meet environmental, economic, and social needs. Furthermore, the twelfth Malaysia Plan (12MP) also prefers economic, environmental and social aspects (MIDA, 2020). This new strategy addresses issues such as economic growth, environmental protection, pollution reduction, and the aging of society.

In terms of economic performance, the government aimed to increase the economic growth of the manufacturing sector to 5.6% per year and contribute to 28.5% of GDP by 2020. Thus, the government's target to improve the Global competitiveness is reflected, as shown in Table 1.1, in national GDP growth from 2010 to 2021, a slight decline from 5.9% in 2017 to 3.13% in 2021 (Arkib Ekonomi, 2022). Although the share of manufacturing in GDP appears to have declined between 2010 and 2021, this also suggests that manufacturing has emerged as an important sector after services, which contributed about 24.3% to Malaysia's GDP (Department of Statistics Malaysia, 2021). However, as the MITI Bulletin (2019) plotted the manufacturing sector's contribution to national GDP, total exports (37.3%) and jobs (59,294 new jobs) are increasing, measured by their share in output.

Table 1.1 Malaysian GDP Growth and Share by Sector
(Adopted from Gross Domestic Product Reports 2010-2021, Department of Statistics Malaysia, 2021)

Year	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
GDP	7.5	5.3	5.5	4.7	6.0	5.1	4.5	5.9	4.8	4.4	-5.6	3.1
Agriculture	7.6	7.6	7.3	7.1	6.9	8.8	8,1	8.1	7.9	7.5	7.4	6.0
Construction	3.2	3.2	3.5	3.8	3.9	4.5	4.5	8.4	4.2	4.5	4.4	5.2
Manufacturing	**25.2**	**25.0**	**24.8**	**24.5**	**24.6**	**23.0**	**23.0**	**23.0**	**22.8**	**22.1**	**22.9**	**24.3**
Mining and quarrying	9.8	8.8	8.4	8.1	7.9	8.8	8.8	4.6	7.9	7.3	6.8	7.1
Services	53.2	54.2	54.6	55.2	55.3	53.8	54.2	54.5	56.0	56.7	57.7	57.0

According to the annual report (2018), the development of economic globalization under uncertain conditions was to include higher costs in the production process and a slight increase in sales, which affected the overall development of the company. While financial measures such as return on investment (ROI), return on assets (ROA) (Fernando *et al*., 2019), market share and profit growth are used to assess economic performance (Hourneaux *et al*., 2018). Although the share of manufacturing in GDP seems to have decreased between 2010 and 2021, this also suggests that manufacturing has become an important sector after services.

However, as the MITI Bulletin (2019) recorded the contribution of the manufacturing industry to the national GDP, total exports (37.3%) and jobs (59,294 new jobs) are increasing. By understanding all the economic factors above that impact sustainability, adopting sustainable business models, engaging with stakeholders, and advocating for favorable government policies, firms can position themselves for sustainable performance in a rapidly changing business landscape.

Therefore, Economic performance is comprised of the following components: operating income, sales growth, return on investment, and return on equity, cash flow from operations, cost per unit manufactured, stock exchange, timely delivery, time to respond to customers, the total number of warranty claims, the total number of customer complaints, survey of customer satisfaction, variation in material efficiency, materials with a high scrap loss rate, production lead time, variety in labour efficiency, the number of new product launches; the time it takes for new products to reach the market, satisfaction employee.

In term of environmental, Iranmanesh *et al.* (2019) stated the manufacturing industry is a major cause of environmental concerns all around the world. As a result,

the relevance of sustainability strategy for the manufacturing industry has grown unavoidable as the EMS is emerging. According to the International Energy Agency (IEA), manufacturing industries contribute almost 36.8 % of CO_2 emissions to the global environment (IEA, 2019). Even though the Malaysian manufacturing industry contributes around 23 % of GDP to supporting economic growth and development (Malaysia, 2019). However, analysis indicates that the manufacturing industry is responsible for around 53 million metric tons of total CO_2 emissions.

In addition, the statistic shows that Malaysia's manufacturing sector is the third-largest contributor to CO_2 emissions, accounting for 26.26 percent of total emissions behind transportation, power, and energy generation. Manufacturing sector emissions come mostly from the electronics, chemical, and rubber sectors (IEA, 2019). According to the Business-As-Usual (BAU) research assessment, CO_2 emissions would rise to 285.73 million tons by 2020 due to rising energy and industrial production demands (National Energy Balance, 2018). According to Anwar and Rahman (2017), the manufacturing sector's increasing CO_2 emissions cause considerable air pollution and solid waste, Similarly to Compendium of Environment Statistic (2019) that stated also decreasing environmental performance. So, according to the Business-As-Usual (BAU) research assessment, CO_2 emissions would rise to 285.73 million tons by 2020.

Moreover, previous studies have dealt with an increasingly strategic problem of environmental performance that was calculated in terms of energy consumption, usage of toxic chemicals, and waste (Jurado and Fuentes, 2014; Suryanto *et al.*, 2018; López and Ruiz-Benítez, 2020). CO_2 emissions must be reduced because they have a negative influence on the environment (e.g., global warming, changes in weather patterns, acid rain generation, and air pollution), which affects human health and upsets the natural balance of the ecosystem (Mallak *et al*., 2018). Both underlined the need for waste reduction throughout manufacturing processes. Similarly, the economic outcomes are financial gains that represent the entire firm, and they are typically tied to a decrease in manufacturing costs.

In addition, Haseeb *et al.* (2019) stated the companies that focus on increasing environmental performance by lowering undesired outputs (such as CO_2 emissions, contaminants, and wastes) from manufacturing processes will increase their economic

performance. Previous studies have dealt with an increasingly strategic problem of environmental performance. CO_2 emissions must be reduced because they have a negative influence on the environment. Hence, Environmental Performance includes: (1) waste water reduction, (2) emissions, waste, and waste reduction, (3) cost reduction for environmental aspects of products and services, (4) environmental compliance, and (5) cost reduction for general environmental problems.

In terms of social issues, he argued that many manufacturing companies must respond to the successful implementation of the strategy to achieve sustainable performance for the protection of ecosystem and human beings. Based on the sustainable development strategies continued in the Twelve Malaysia Plan 2020-2025, they are clearly spelled out in the strategy to improve the standard and sustainability of quality of life. The quality of life of Malaysians will be improved by ensuring efficient energy supply and distribution. In addition, steps have been taken to foster a caring society and increase community welfare (Twelfth Malaysia Plan, 2021). Thus, social performance includes: social commitment, environmental preservation, increasing employee job satisfaction, training and education, and product and service compliance. Finally, environmental performance aims to minimize ecological damage and limit the occurrence of resource exploitation, while economic performance is all about financial performance. The well-being of staff, customers and stakeholders is at the heart of the latest social achievements.

Due to developing countries producing and consuming significant amounts of waste, waste management is crucial to the work of eco-cycles (Kang *et al*., 2020). This includes preventing waste, improving consumption patterns, using more effective production processes, and managing waste properly with an increased emphasis on recycling. The sustainability goal primary motivators are, in essence, public health, environmental issues, and resource value, with the more recent additions of climate change and inclusivity.

According to Qi *et al.* (2017) waste minimization is the foundation of the lean supply chain concept. It is put into effect by employing a bundle of strategies that focus on obtaining the highest levels of system efficiency by minimizing non-value-added processes. Additionally, the agile supply chain strategy has developed in response to time becoming a marketing tool for competitors. Waste management is essential for

eco-cycles, with sustainability goals such as public health, environmental issues, and resource value. Lean supply chain strategies focus on minimizing non-value-added processes.

To achieve sustainable performance, the manufacturing sector has promoted a lean supply chain strategy and an agile supply chain strategy (Ariadi *et al*., 2021). Lean supply chain is the strategy to minimize waste in all production areas of the manufacturing industry (Carvalho *et al*., 2017). A lean supply chain strategy helps companies consume less of everything, e.g. from packaging, raw materials and energy (Alves *et al*., 2015; Nieuwenhuis and Katsifou, 2015). The entire supply chain (SC) must adapt as consumer buying habits change rapidly (Tarafdar and Qrunfleh, 2017). Similarly, Ciccullo *et al.* (2018) argued that speed, cost and efficiency are the key strengths of an agile supply chain strategy. Sensitivity to changing customer needs is also the foundation of an agile supply chain strategy. The manufacturing sector has encouraged lean supply chain strategy and agile supply chain strategy to reduce waste and adapt to changing customer demands.

On the other hand, the manufacturing sector plays an important role in helping to create a green and environmentally friendly products in manufacturing industry. The Ministry of International Trade and Industry (MITI) of Malaysia has a high concern for playing an important role in encouraging manufacturing industry to take actions aimed at creating a better environment. Several manufacturing industries carry out policies to support a better environment by implementing green manufacturing industry in Malaysia.

Supply chain responsiveness (SCR) is one of the strategies used by several manufacturing industries, including the food industry, Automotive industry, electric and electronic industry and others. Supply chain responsiveness (SCR) has been shown to positively influence developments in the manufacturing industry (W. Yu et al., 2019). In addition, the supply chain responsiveness (SCR) also has a positive influence on the parameters of Sustainable Firm Performance (SFP), which consists of Economy, Environmental, and Social Performances. The relationship between SCR and SFP for Economic, environmental, and social Performance refers to research conducted by (Edwin Cheng et al., 2022). Based on several previous studies, SCR has a relationship with SFP as the dependent variable. The results of the literature show

that SCR has a positive relationship with sustainable firm performance (SFP) from various types of industries.

Despite the substantial study in the fields of lean supply chain strategy, agile supply chain strategy and supply chain responsiveness, there is still a need for studies on the effects of lean supply chain strategy and agile supply chain strategy while taking stakeholders' needs into consideration. It is also crucial to discuss the role that agile supply chain strategy play in gaining a competitive advantage and improving economic, social, and environmental performance. This study creates a conceptual framework for leveraging lean supply chain strategy and agile supply chain strategy to gain a sustainable performance and competitive advantage based on the resource-based view (RBV) theory.

1.2 Problem Statement

How well government policy maintains its environment will determine how long economic growth can continue and how well people will fare (Minton *et al*., 2018). Sustainability has emerged as a significant area of concern, especially for the manufacturing sector, in order to address pressing environmental issues. Recent decades have seen a large increase in carbon dioxide (CO_2) emissions, which has led to adverse effects like climate change, global warming, air and water pollution, and deterioration of environmental performance (Robertson and Barling, 2013; Al-Mulali *et al*., 2015; IEA, 2019). The manufacturing industry is also essential to the Malaysian economy.

Moreover, the manufacturing industries are now aware of the strategic importance of sustainable performance for a competitive advantage due to the growing stakeholder demand for them to be socially and ecologically responsible (Tachizawa and Wong, 2014; Mallak *et al*., 2018). Therefore, for the welfare of society, the economy, and the environment for current and future undertaken, the Malaysian government is consistently dedicated to tackling concerns related to sustainable performance, especially for the manufacturing industries.

To achieve excellent performance, companies must first identify and determine production performance. Second, companies need to be aware that critical green practices will deliver sustainable performance in terms of economic, environmental, and social performance (Hussain *et al*., 2019). Therefore, strategies, objectives and capabilities must be realigned and updated to meet existing business challenges, outperform competitors and withstand global competitiveness.

For example, in Malaysia current supply chain management practices are not well mapped, leaving the justification and mechanism for the improvements and their impact unclear (Suryanto *et al*., 2018b). Performance strongly depends on the alignment of production and business strategies (Puška *et al*., 2019). According to Sundram *et al.* (2018), once optimized, production performance will improve and reflect business performance. Finally, performance strongly depends on the alignment of production and business strategies.

However, the implementation of lean and agile supply chain strategies is crucial for achieving sustainable performance in the Malaysian manufacturing industry. Galankashi and Helmi (2016) as well as Ahmed and Huma (2018) have emphasized the importance of addressing and implementing these strategies. By optimizing productivity and producing high-quality end products, companies can remain competitive in satisfying the ever-changing requirements of both internal and external customers. However, the lack of focus on production operations advancement among local companies has limited progress in this area (Zimmermann *et al*., 2020). In order to resolve this issue, empirical studies on the practical implementation and performance assessment of these strategies in the actual manufacturing world are still required, as noted by Sharma *et al.* (2021). Therefore, it is essential to conduct further research and apply the concepts of lean and agile supply chain strategies in the Malaysian manufacturing industry to achieve sustainable performance.

In addition, supply chain responsiveness (SCR) is an intangible asset of the firms due to its restriction for imitation by competitors. Because of its restriction, the capability becomes valuable which can lead to improve in eco-friendly products and processes (Ayoub and Abdallah, 2019a). One study highlighted the need for complementary analysis between competitive strategies and supply chain responsiveness towards sustainable firm performance since hypothesis testing of the

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