

The Relationship Between Supply Chain Strategies and Supply Chain Responsiveness among Manufacturing Industries in Selangor, Malaysia

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DOI: <https://doi.org/10.30880/rmtb.2025.06.01.015>

Article Info

Received: 31 March 2025

Accepted: 30 April 2025

Available online: 30 June 2025

Keywords

Lean and agile supply chain, postponement, strategic supplier, supply chain responsiveness, manufacturing industry

Abstract

The manufacturing sector plays a crucial role in Malaysia's economy, contributing significantly to the country's Gross Domestic Product (GDP). However, manufacturing industries face challenges in maintaining supply chain responsiveness due to issues such as late raw material deliveries, production delays, and inefficient collaboration with suppliers. Therefore, the research aims to identify the level of supply chain responsiveness, the level of supply chain strategies, and the relationship between these variables. A quantitative approach was applied, using a survey questionnaire distributed to 317 managerial-level employees in manufacturing companies, with only 257 valid responses. The data was analyzed using Statistical Package for Social Sciences (SPSS) software, which included descriptive and Spearman's correlation analysis. The results indicated that lean supply chain, agile supply chain, strategic supplier partnerships, and postponement strategies were implemented at a high level, with agile supply chain strategy showing the strongest influence on supply chain responsiveness. The analysis revealed that supply chain responsiveness (operations system, logistics process, and supplier network responsiveness) were positively correlated with the supply chain strategies. These findings suggest that adopting comprehensive supply chain strategies can significantly enhance the ability of manufacturing industries to respond to market demands and uncertainties. The study contributes to the body of knowledge on supply chain strategy and supply responsiveness, providing a valuable reference for future researchers interested in this field. Additionally, it offers practical insights for supply chain managers aiming to strengthen supplier collaboration, optimize inventory management, and improve operational efficiency, thereby enhancing overall performance and competitiveness in the global market.

1. Introduction

Malaysia's economy has experienced significant growth and development, particularly in the manufacturing sector, which remains a core area for sustainable growth under the 11th Malaysia Plan (CEDAR, 2018). The country's openness to trade and investment has been a key driver of job creation and income growth, with export activities contributing to over 40% of jobs (World Bank, 2022). The manufacturing sector plays a crucial role in

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the Malaysian economy, exemplified by the expansion of Mattel Malaysia. Celebrating its 40th anniversary, Mattel Malaysia announced plans to increase production capacity by 20% by 2025 (Mattel Malaysia, 2022). The supply chain responsiveness of the manufacturing industry relies on the supply chain strategies. Supply chain strategy is defined as the strategic goals and objectives of the supply chain, it integrates industry processes across the value chain to provide optimal value to customers (Qrunfleh & Tarafdar, 2013). The critical objective of supply chain strategy is to improve the manufacturer's supply chain responsiveness to their customers (Melnik *et al.*, 2010). Therefore, supply chain strategy plays a central role in enhancing supply chain responsiveness (Al-Shboul *et al.*, 2017). Supply chain strategies include lean supply chain strategy, agile supply chain strategy, strategic supplier partnership, and postponement (Qrunfleh & Tarafdar, 2013; Rajagopal *et al.*, 2016; Christopher & Towill, 2000; Owens & Levary, 2002; Qi *et al.*, 2009; Islami, 2023; Prativiera *et al.*, 2020). Supply chain strategies will influence supply chain responsiveness as it is crucial for the manufacturing industry to adapt to the unstable and volatile demands in dynamic environments. Supply chain responsiveness is defined as the ability of a supply chain to adapt quickly to changes in customer demand and market conditions (Nenavani & Jain, 2023). Supply chain responsiveness is measured through three dimensions which are operations system responsiveness, logistics process responsiveness, and supplier network responsiveness (Asamoah *et al.*, 2021; Ibrahim N. A. *et al.*, 2020; Thatte, 2013; Amedofu *et al.*, 2019). Supply chain responsiveness is a critical indicator of how supply chain strategies within the manufacturing industry and its operations fulfill its objectives because it indicates the ability to adapt to the rapidly changing customer behaviour for their requirements and essentially lead to enhanced their supply chains (Yang *et al.*, 2019a,b; Aggarwal, 2018). Additionally, high levels of supply chain responsiveness contribute to better overall manufacturing performance (Mandal *et al.*, 2010; Kim *et al.*, 2013). Companies with high reliability, flexibility, and speed in their supply chains can better meet customer requirements, reduce order returns, and optimize costs (Inoue *et al.*, 2020). Therefore, implementing effective supply chain strategies is essential for achieving high levels of responsiveness, which in turn enhances manufacturing performance and competitive advantages (Tarafdar Mayoub *et al.*, 2017; HF *et al.*, 2019; Tuna AK *et al.*, 2023).

Supply chain responsiveness, defined as the ability of a supply chain to respond to changes in demand and supply conditions quickly and efficiently, is crucial to the success of manufacturing industries. However, several issues influence manufacturers' supply chain responsiveness. According to Putri and Prabowo (2023), late raw material deliveries contribute to production delays, negatively impacting overall supply chain responsiveness. Lehyani *et al.* (2021) support that factors such as production delays, transportation issues, inventory management inefficiencies, and inaccurate demand forecasting contribute to delays in product delivery that will influence the overall supply chain responsiveness. It is also support by Yang *et al.* (2022), ineffective collaboration with suppliers and partners leads to delays and inefficiencies, thereby reducing supply chain responsiveness. Furthermore, globalization and a volatile economy have resulted in shorter product life cycles, making it difficult for manufacturers to maintain efficient and responsive supply chains (Anwer AL-Shboul, 2022). It is suggested by Seyedan, M.*et al.* (2020), rapid changes in customer demand often lead to inaccurate demand predictions, causing overstock or stockouts, which further affect supply chain responsiveness.

Hence, based on the discussion above, there is a need to overcome these issues to ensure the effectiveness and efficiency of supply chain responsiveness. Supply chain strategies play an important role in the manufacturing industry (Kleab Candidate, 2017). Supply chain strategies such as lean supply chain strategies can minimize waste and improve efficiency, while agile supply chain strategies enhance flexibility and responsiveness to customer and market demand. Strategic supplier partnerships and postponement strategies also play significant roles in improving supply chain performance and responsiveness (Istimaroh *et al.*, 2023; Anwer AL-Shboul, 2022; Kevin Letsoin *et al.*, 2023). However, there are limited studies between the relationship between supply chain strategies and supply chain responsiveness among manufacturing industries, most studies have been conducted in foreign contexts (Anwer AL-Shboul, 2022; Barhmi, 2019; Islami, 2023; Kim *et al.*, 2013; Kevin Letsoin *et al.*, 2023; Pandiyan Kaliani Sundram *et al.*, 2018; Weerathunga A, 2024). Therefore, this study aims to explore the relationship between supply chain strategies and supply chain responsiveness among manufacturing industries in Selangor, Malaysia. By investigating this relationship, the study seeks to provide insights that can help manufacturing industries enhance their supply chain responsiveness.

In this study, the researcher selected the manufacturing sector as the population due to this sector is the second highest contributor to Gross Domestic Product (GDP) to Malaysia's economy (Yeow *et al.*, 2020). This study was selected for inclusion in the state of Selangor because manufacturing industries in Selangor contributed the highest Gross Domestic Product (GDP) in Malaysia, which is RM 117,207 million (Official Portal of Ministry of Economy, 2022). The target population in this research are manufacturing industries in Selangor, Malaysia. The population consists of 1,814 manufacturing companies established in Malaysia (Federation of Malaysian Manufacturers, 2023).

2. Literature Review

2.1 Supply Chain Responsiveness (SCR)

In this study, the definition of SCR is adapted from the study of Nenavani & Jain (2023). SCR is regarded as a crucial aspect of the industry, adapting to changing market demands and enhancing overall efficiency. According to Nenavani & Jain (2023) supply chain's responsiveness is ability to change quickly in response to consumer demand or supply chain uncertainty, and thus improving operational performance. SCR plays an important role in the manufacturing industry to adapt to the volatile demands in industrial environments (Nenavani & Jain, 2023). Thus, Industry companies must quickly respond to client demands and preferences. Companies are believed that they must leverage their competitive edge in the dynamic market in order to maintain their position (Singh, R. K., 2015). To achieve this, the company must able to adopt organizational responsiveness. According to prior studies, SCR can be defined in many ways. This study adopts Nenavani & Jain (2023) definition because it is more comprehensive and suitable to use in this study. As Nenavani & Jain (2023) explained that SCR is most relevant amid turbulence in the market, changing consumer needs, and shortening product lifecycles.

According to Rajagopal *et al.* (2016) and Qrunfleh & Tarafdar (2013), companies are looking for ways to become more responsive to the market environment. However, developing strategies for a responsive supply chain shows a challenge because it requires a thorough examination of the interactions between all the factors that determine responsiveness. Asamoah *et al.* (2021) explained that SCR is the fastness with which a supply chain responds to changes in the dynamic marketplace and the rate at which it responds to the consumer's changing needs, which in terms of operations systems responsiveness (OSR), which involves swiftly reconfiguring manufacturing processes to meet customer needs; logistics process responsiveness (LPR), which focuses on the flexibility and speed of distribution and transportation systems; and supplier network responsiveness (SNR), which depends on the ability of major suppliers to adapt to changes in demand (Asamoah *et al.*, 2021). According to (Asamoah *et al.*, 2021), SCR is measured through three dimensions which are OSR, LPR, and SNR. These three dimensions will be discussed in the following subtopic.

2.1.1 Operations System Responsiveness (OSR)

Based on Asamoah *et al.* (2021), OSR is one of the measurements of SCR. Operational system responsiveness is the ability of an operations system to react very quickly to changes in the volume of products that customers require, efficiently expedite urgent customer orders, quickly reorganize equipment to meet demand changes, quickly reallocate people to meet demand changes, and quickly customize capacity to meet demand changes (Ibrahim N. A. *et al.*, 2020). This kind of responsiveness is one of the main valuable parts of the supply chain as it allows companies to quickly and effectively modify the level and mix of their manufacturing or production to meet the changes in the operations environment and the changing requirements of customers (Asamoah *et al.*, 2021). According to Amedofu *et al.* (2019), supply chain strategies have the potential to impact a company's ability to satisfy maintain customers through enabling company to modify its operations in response to their demands. Thatte (2013) state that flexibility and quick response times are critical elements of a company's production system and that operations responsiveness is an important part of a successful supply chain strategy.

2.1.2 Logistics Process Responsiveness (LPR)

Another way to measure SCR is through LPR. The capacity of a company's outward transportation, distribution, and warehousing system to adapt to changes in consumer demand is known as LPR (Thatte, 2013). According to Ibrahim N. A. *et al.* (2020), a logistics system known as LPR, can effectively deliver expedited products, quickly adjust warehouse capacity to meet unpredictable changes in demand, and fast switch carriers to meet those changes. The processes of transportation of products from suppliers to manufacturers, distribution centers, and final destinations of consumption are all included in logistics and distribution management. These tasks include order tracking and delivery, inventory management, transportation planning and management, warehousing, packaging, and shipping, as well as reverse logistics (Ibrahim N. A. *et al.*, 2020). Creating value for organization's customers is about ensure that logistics procedures are flexible and speed within the supply chain to satisfy every specific customer's needs (Asamoah *et al.*, 2021). The logistics system's responsiveness components include choosing logistics components, handling a variety of products, choosing different transportation providers, packing products in transit to satisfy customers, and adjusting products near the customer (i.e., postponement). All of these activities must be completed quickly to ensure that a firm's logistics system remains flexible and responsive so that it can quickly adjust its logistics resources to meet market demands (Ibrahim N. A. *et al.*, 2020). The responsiveness in the logistic processes is an essential element in the achievement of a flexible supply chain strategy (Asamoah *et al.*, 2021).

2.1.3 Supplier Network Responsiveness (SNR)

SNR is an essential measure of SCR, and it is described as an organization's main supplier's ability to adapt to and satisfy changes in the company's demand. According to (Ibrahim N. A. *et al.*, 2020), suppliers' response times for

volume adjustments affect how quickly companies can respond to customer demand. A network of flexible and responsive partnerships both upstream and downstream of the main company is essential to responsiveness. Consequently, the company's network of suppliers can become more responsive by fostering effective relationships with them through social capital with suppliers (Asamoah *et al.*, 2021). Firm performance is improved when businesses with highly responsive supplier networks respond to consumer demands more quickly and effectively (Amedofu *et al.*, 2019). Based on Ibrahim N. A. *et al.* (2020) had conducted a few interviews with operational managers at the European automobile manufacturing operations of Volvo showed that the lack of supplier network flexibility hampered the company's responsiveness. The reactivity of the supply chain is significantly influenced by the flexibility and responsiveness of the supplier network. Therefore, in order to gain increased SNR, which eventually leads to improved firm performance, companies may leverage relational and structural resources like friendship, trust, and social interaction relationships and network position (Acquah *et al.*, 2024).

2.2 Supply Chain Strategies (SCS)

Based on the previous research, the responsiveness of supply chain depends strongly on the integration with significant variables such as SCS, the act of postponement and relationship with suppliers. SCS is highly influences to SCR in manufacturing company (Qrunfleh & Tarafdar, 2013). Therefore, SCS play an important role in manufacturing companies because they contribute to any company's success and customer satisfaction and also have the power to enhance customer service, minimize operating costs, and improve the responsiveness of a company (Kleab Candidate, 2017). In addition, SCS of the company refers to the strategic goals and objectives of the supply chain (Qrunfleh & Tarafdar 2013). SCS can be described in some ways to help with a deeper understanding of the concept.

Thus, in this study the definition of SCS was employed from Ross (2015), who stated that SCS are the physical setup and capabilities of the supply chain network, combining supply and demand planning to optimize business value while day-to-day operations assure low costs, efficiency, and customer responsiveness. According to Rajagopal *et al.* (2016), SCS is measured through four dimensions which are lean supply chain (LSC), agile supply chain (ASC), strategic supplier partnership (SSP) and postponement (POS). These four dimensions will be discussed in the following subtopic.

2.2.1 Lean Supply Chain Strategy (LSC)

According to Christopher & Towill (2000); Owens & Levary, (2002), LSC was defined as the strategy mainly focus on reduce supply chain costs through effectively managing inventory, improving quality, and eliminating waste. This research also found that applying LSC enhances the efficiency and effectiveness of supply chain companies by eliminating waste and optimizing resource use across all processes, including planning, sourcing, manufacturing, inventory management, delivery, and returns. LSC strategies increase overall profitability as well as performance with lower prices, shorter delivery times, and decreased waste (Cvetić *et al.* 2021). Furthermore, Khorasani *et al.*, (2020) suggest that the goal of a LSC strategy is to ensure that products, services, and technology flow from suppliers to customers with eliminated waste. Eliminating waste in processes and operations, the SCR of the manufacturing industry will be improved. (Ince *et al.*, 2023). Therefore, LSC strategy is one of the factors that influences the responsiveness of supply chain and it plays an important role in measuring the responsiveness of the supply chain (Pandiyani Kaliani Sundram *et al.*, 2018).

2.2.2 Agile Supply Chain Strategy (ASC)

Based on the Rajagopal *et al.* (2016), ASC strategy was defined as the supply chain's ability to help companies in rapidly sensing and responding to changes in customer demand. An agile strategy requires the supply chain to have greater capacity buffer in order to respond to the changing market (Qi *et al.*, 2009). Based on the prior studies, ASC strategy defined as the ability to react quickly to changes in demand involves flexible organizational designs, efficient information systems, and streamlined logistics processes, taken in part from flexible manufacturing systems that utilize automation for rapid changeovers and reduced time to setup, enhancing responsiveness to product mix or volume changes (Pandiyani Kaliani Sundram *et al.*, 2018). In addition, according to (Gawade, 2023), ASC focus on responsiveness, cost-effectiveness, flexibility, and increasing the productivity of products and services. Therefore, companies that follow agile characteristics will always become present with satisfying customers' needs, leading to potentially sustained competitive advantage and it is an indispensable strategy to conserve SCR (Rajagopal *et al.*, 2016).

2.2.3 Strategic Supplier Partnership (SSP)

According to Li *et al.* (2006), long-term relationships between organizations and their suppliers that impact each participating company's operational and strategic capabilities and enable them to achieve significant continuous

advantages are known as SSP. Enhancing the responsiveness of the supply chain can be achieved by long-term cooperation with suppliers in positive relationships. According to the Qrunfleh & Tarafdar (2013) show the importance of SSP in improving the quality of the supply chain, including products and supplier operations, as well as reducing waste. Furthermore, SSP also means working together for the long-term success and mutual advantage of both collaborators, such as improving the effectiveness and efficiency of the supply chain (Islami, 2023). This means that both the main firm and its suppliers gain from adoption strategies implemented under SSP. However, the success of SSP depends on their level of cooperation. SSP involve a variety of activities, including the selection of a small number of reliable suppliers, shared goals, cooperative planning, and problem-solving (Nenavani & Jain, 2022). Thus, firm that have good relationship with partnership and collaboration with supplier are likely to be more better and effectiveness in SCR through sharing of valuable information and joint improvement activities (Islami, 2023).

2.2.4 Postponement (POS)

According to Prativiera *et al.* (2020) POS was defined as the process of delaying the final disposition or transfer of products for as long as possible, particularly until customer orders are achieved. Qrunfleh & Tarafdar (2013) mentioned that POS defined as the method of deferring one or more operations or activities (implementation, sourcing, and delivery) to a later point in the supply chain by keeping materials undifferentiated for as long as feasible and utilizing flexibility designs. Based on the prior research, this strategy can improve customer satisfaction by increasing flexibility, improving service quality, increasing convenience, and minimizing inventory management costs (Sunhare, 2019). It was also a method for improving efficiency in marketing systems. The aim was to reduce costs related to uncertainty and the physical movement of goods, by delaying changes to either the product's form or the inventory's location to the latest possible moment (Prativiera *et al.*, 2020). Therefore, POS strategy in supply chain can increase SCR and company's flexibility to effectively meet the requirements of the growing varieties of product and quick deliveries.

2.3 Conceptual Research Framework

Fig. 1 shows the research framework and the variables in this study, such as independent variables and dependent variables. According to the model, the independent variable is SCS, which consists of four dimensions such as LSC, ASC, SSP, and POS. The dependent variable for this research is SCR, which consists of three dimensions: OSR, LPR, and SNR.

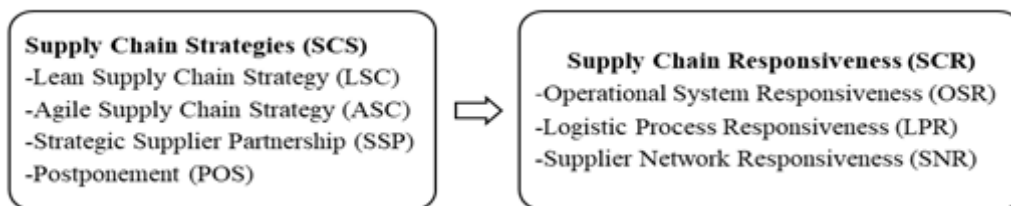


Fig. 1 Conceptual Research Framework

3. Research Methodology

A research design is a comprehensive plan that defines the research objectives and describes in detail how they are to be achieved. In other words, it is a comprehensive strategy for a research study. A research design is a detailed plan that describes how the research will be performed. There are usually three categories of research designs: exploratory, descriptive, and experimental (Jaideep, 2020). Statistical techniques are used to examine the relationships between the dependent and independent variables in the research and to express trends statistically. To determine the relationship between the two variables, it also helps the researcher to decide which of the research hypotheses to accept or reject.

The research design of this study will be a quantitative method. Therefore, the research methodology selected for this study will include a survey questionnaire as an instrument to collect data on the research purpose. After the scales are selected, an online questionnaire will create for managerial level employees in a manufacturing company to collect quantitative data. Questionnaire surveys are a popular and widely used research technique to quickly collect and analyze data from a target population. In addition, descriptive research is use to gather information to form the hypothesis and determine the stated research question and sub-question. Furthermore, this research design included a discussion of the significant variables for data analysis. The approach of the current research aim to collect as many participants as possible among managerial level employees in the manufacturing industry in Selangor, Malaysia.

3.1 Research Population and Sample

A target population is a group of people who are to be study and whose outcomes are to be developed as a result of the intervention. In this study, the target populations are the manufacturing industries in Selangor, Malaysia. For this research, the population is take from the Federation of Malaysian Manufacturers for the year 2023, which lists a total of 1,814 manufacturing companies in Selangor, Malaysia. Nevertheless, a quantitative approach is choose in this study instead of a qualitative approach because the respondents in this study had highly demanding positions, so they were too busy and the researchers may not have had the opportunity to interview them for the data collection process. Therefore, this method is considered easy for managerial level employees to fill out the survey freely because it will not have to spend much time to complete the survey.

The estimation of the number of subjects/units to be included in a study using mathematical formulas is called sample size determination (Bathinda, 2021). The sample size is also the process of determining how many observations or replicates should be included in a statistical sample. In this study, sample size is an important aspect of making population inferences from a sample. Based on Krejcie and Morgan (1970) as shown in Table 1, a sample must be large enough to show the whole population. Based on the population of 1,814 manufacturing companies in Selangor, the results in a sample size of around 317 respondents for this research.

Table 1 Determining sample size method Krejcie and Morgan (1970)

<i>N</i>	<i>S</i>	<i>N</i>	<i>S</i>	<i>N</i>	<i>S</i>
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3200	346
85	70	440	205	4000	351
90	73	460	210	4300	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	100000	384

Note.—*N* is population size. *S* is sample size.
Source: Krejcie & Morgan, 1970

3.2 Sampling Method

Sampling involves determining the number of people who will act as respondents or selecting the sample size for the target population. The sample is intended to enable the researcher to conduct the study on individuals from the population so that the results of the study can be used to draw conclusions that will apply to the entire population. In this study, a non-probability sample technique which is convenience sampling will be used to collect the data of online questionnaire. The convenience sampling method has been used in this study because this method is easy, inexpensive and fast to conduct research. Using convenience sampling method, the researcher sent a link to the online questionnaire which is Google Form to managerial level employees who are working in manufacturing industries in Selangor, Malaysia.

3.3 Data Collection

The process of collecting, measuring and analyzing correct findings for a study using established, recognized procedures is known as data collection. Based on the collected findings, a researcher can evaluate the hypothesis. Regardless of the subject of the study, data collection is usually the first and most important phase in the research

process. Depending on what information is needed, different approaches to data collection are used in different fields of study. In this study, the researcher uses primary data.

Primary data is material collected first-hand by researchers using both quantitative and qualitative techniques, such as surveys, interviews or experiments. The data was collected directly from the original sources with regard to a research project (Stephanie, 2018). Primary data that was collected with a specific objective to be achieved has also provided unbiased, accurate and appropriate information. The primary data for this study was collected using an online questionnaire research method to collect the required data. The questionnaires was distribute to managerial level employees among the manufacturing industries in Selangor. Additionally, a Google Form is use to distribute the questionnaire to the respondents through an online survey. This method will help the data collection as the population is concentrated in Selangor.

3.4 Pilot Study

The aim of the pilot study is to identify potential problems and the insignificance of research instruments to improve the questionnaire so that respondents can understand and respond to the questions (Zailinawati Abu Hassan, 2006). Kumar (2011) stated that a pilot study should be conducted before collecting the actual data to ensure the quality of the research discussion and the accuracy of the data. In this study, the reliability test is used as a pilot test to ensure that the research instrument is reliable. The test should always be conducted using the same set of research instruments on a group of individuals from the study population (Kumar, 2011). Kumar defines reliability as the degree of measurement accuracy; the higher the degree of accuracy, the higher the degree of reliability. In addition, this study has selected 30 manufacturing industries in Selangor, Malaysia as the respondents in the pilot study.

3.5 Research Instrument

The research instrument refers to the tools use to collect data in order to answer and achieve the research questions and objectives. Research instruments can be used to collect both qualitative and quantitative data. In this research, a questionnaire is used to collect qualitative data. A questionnaire is a data collection instrument that consists of a series of questions to collect information from respondents. A questionnaire is one of the research instruments that consists of a set of questions and sub-questions or other types of prompts aimed at collecting information data from a respondent. In addition, this questionnaire survey is typically a mixture of closed and open-ended questions. This questionnaire aims to collect relevant data from respondents that can be used for a variety of purposes. In this study, the questionnaire survey consists of three sections; Section A, Section B and Section C. Section A deals with the personal data of the respondents, such as job title, job function, industrial types, and others. Section B consists of 21 questions related to the independent variable of the research (SCS: LSC, ASC, SSP, and POS). Section C consists of 17 dependent variable questions (SCR: OSR, LPR, and SNR).

3.6 Data Analysis

3.6.1 Descriptive Analysis

According to Sekaran and Boogie (2016), descriptive analysis consists of the simple analysis of minimum, maximum, mean, variance and standard deviation. The mean or average resulting from the collected data should be between one and five, as it is respectively according to the Likert scale used. This analysis is obtained from the responses from the interval questions of the survey that were distributed to the respondents. The analysis can be conducted using the Statistical Package for Social Science (SPSS), which tabulates the collected data in detail.

3.6.2 Correlation Analysis

The correlation coefficient as shown in Table 2, which provides information about the relationship between two variables, is used for correlation analysis (Senthilnathan, 2019). A high correlation shows a strong relationship between two or more variables, while a low correlation represents a weak relationship between the variables. Pearson's and Spearman's correlation are two types of correlations study frequently used in science. In this study, Spearman's correlation coefficient is used, which is known as a non-parametric measure of the degree and direction of interaction between two variables. This study examines the relationship between the independent variables (lean and agile supply chain strategies, strategic supplier partnerships, and postponement) and the dependent variables (operations system responsiveness, logistics process responsiveness, and supplier network responsiveness). The nominal degree of relationship was used to examine the results.

Table 2 *Correlation coefficient*

Correlation Coefficient	Strength Description
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0.8 to 1.0	Very Strong
0.6 to 0.8	Strong
0.4 to 0.6	Moderate
0.2 to 0.4	Weak
0.0 to 0.2	Very Weak

3.7 Research Flow Chart

Fig. 2 portrays the research flowchart. The research flowchart outlines the steps involved in this study to ensure a clear understanding of the research process. The first step is identifying the research problem and selecting a title based on these issues. After identifying the problem, the researcher defines the research questions, which in turn help to determine the research objectives. This study focuses on three main objectives: identifying the level of supply chain strategies and responsiveness among manufacturing industries, and investigating the relationship between the two.

The next step involves reviewing the literature on supply chain responsiveness and strategies, such as lean, agile, and postponement strategies, as well as strategic supplier partnerships. Primary data is collected using questionnaires, which are developed and tested for reliability and validity through a pilot test. Once the questionnaire is finalised, it is distributed to the respondents. Data analysis is conducted using SPSS software, and the results are presented in the form of pie charts, bar charts, and tables. Finally, the discussion and conclusions are made based on the study's objectives, and recommendations for future research are provided, along with addressing the limitations of the study.

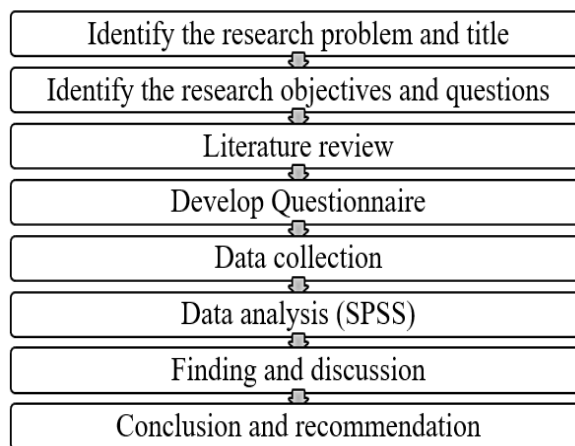


Fig. 2 Flow chart of this study

4. Results and Discussion

4.1 Survey Return Rate

In this research, the researcher was focused on the manufacturing companies in Selangor, Malaysia in which the targeted segment of respondents will be referred to as the managerial level employees. According to the Federation of Malaysian Manufacturers (FMM,2023), they have mentioned that there were 1814 manufacturing companies listed in Malaysia.

Based on Krejcie and Morgan’s table (1970), with the population of 1,814, the sample size for this study is 317. Therefore, 317 questionnaires were distributed. As a result, only 257 respondents were able to take their time and answer the questionnaire which was lower than the expected outcome of 317 respondents. This was because the targeted respondents were not regular respondents but they were managers of the manufacturing companies. Therefore, the survey return rate was 81.07%. the results was shown in Table 3.

Table 3 Survey return rate

Population	Sample Size	Questionnaire Distribute	Questionnaire Returned	Percentage
1814	317	317	257	81.07%

4.2 Reliability and Validity Analysis of Pilot Study

A reliability analysis for pilot study was conducted to test the validity and reliability of Section B, supply chain strategies, and Section C, supply chain responsiveness. According to Table 4, there were a total of 38 questions and a total of 30 respondents who took part in this pilot study. The Cronbach's Alpha value for supply chain strategies was 0.912 which means that the design of the questionnaire was excellent and understandable by the respondents who participated. For supply chain responsiveness, Cronbach's Alpha value s 0.943 which it was excellent for internal consistency. This showed that the questions were high in reliability and validity and allow use in the real study. The result of reliability analysis on pilot study were shown in the Table 4.

Table 4 Reliability test for pilot study

No	Variables	Number of items	Cronbach's Alpha (α)
1.	Supply chain strategies	21	0.912
2.	Supply chain responsiveness	17	0.943

4.3 Reliability Analysis on Real Study

There were total of 257 respondents participated in the data collection. The items in this questionnaire were subjected to reliability analysis. In Section B, supply chain strategies are represented by lean supply chain strategy, agile supply chain strategy, strategic supplier partnership, and postponement. In Section C, supply chain responsiveness is represented by operations system responsiveness, logistics process responsiveness, and supplier network responsiveness. The supply chain strategies obtained 0.949 of Cronbach's Alpha value, while supply chain responsiveness obtained 0.948 of Cronbach's Alpha value. Both results were excellent. That proved the collected data from the research were very valid and reliable; therefore, the questions used in this study are appropriate for the topic. Table 5 shows the reliability test for this study.

Table 5 Reliability test for real data

No	Variables	Number of items	Cronbach's Alpha (α)
1.	Supply chain strategies	21	0.949
2.	Supply chain responsiveness	17	0.948

4.4 Demographic Analysis

Demographic analysis was used to explain the pattern of the respondents' backgrounds who were involved in the survey. A total of 257 respondents participated in this survey. This section analysed the category of manufacturing companies involved, Gender, Job title, Types of industry, Year in business, and number. of employees. All the data from the questionnaire answered has been analysed, and the results were summarised in the table and pie charts, which contain frequency and percentage.

Table 6 showed the number of male respondents a total of 123 respondents, 47.9% while the total number of female respondents was 134 respondents, 52.1% out of 257. Next, the majority of respondent were senior manager with the highest percentage of 38.1% (98 respondents).

There was a total of 50 respondents (31.4%) in the food and beverages industry. In addition, the second highest contributor was the metal processing and textile/clothes manufacturing, which were 27 respondents (10.5%) followed by the electrical/IT manufacturing with 24 respondents (9.3%). There were 23 respondents (8.9%) for Chemical/Cosmetics Production, Furniture/Wood Manufacturing and Plastic/Rubber Processes. While there were 22 respondents for paper/tissues/packaging processing (11.6%), 17 respondents (6.6%) for the pharmaceutical/medical industry and 21 respondents (8.2%) for another type of industry, such as aluminium, agriculture, car accessories and utilities.

Furthermore, most of the manufacturing companies have been established for more than 10 years. There was a total of 134, or 52.1% of manufacturing firms that were established 10 years or more. On the other hand, there were 54 respondents from manufacturing companies that were established between 3 to 6 years, with the percentage of 21% and 48 respondents from manufacturing companies that were established between 7-10 years. Lastly, there were only 21 respondents from the manufacturing companies that were established less than 3 years. The table also shown the number of employees in the manufacturing companies. The highest response was from the manufacturing companies with between 101 - 200 employees, with 106 responses or 41.2% of returned questionnaires.

Table 6 Summary of demographic analysis

Demographic	Classification	Frequency (N)	Percentage (%)
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Gender	Male	123	47.9
	Female	134	52.1
Job Title	Junior manager	75	29.2
	Senior manager	98	38.1
	Director	42	16.3
	CEO/President	23	8.9
	Others	19	7.5
Types of Industrial	Electrical/IT Manufacturing	24	9.3
	Food and Beverage Processing	50	19.5
	Chemical/Cosmetics Production	23	8.9
	Metal Processing	27	10.5
	Pharmaceutical/Medical	17	6.6
	Textile/Clothes Manufacturing	27	10.5
	Paper/Tissues/Packing Processing	22	8.6
	Furniture/Wood Manufacturing	23	8.9
	Plastic/Rubber Processes	23	8.9
	Others types	21	8.3
Years in Business	Less than 3 years	21	8.2
	3-6 years	54	21.0
	7-10 years	48	18.7
	More than 10 years	134	52.1
Number of employees	Below 100	81	31.5
	101-200	106	41.3
	201 and above	70	27.2

4.5 Descriptive Analysis for the Average Mean Score for SCS and SCR.

Based on Table 7, the results showed that the level of the mean of independent variables and dependent variables were in the category of high interpretation. For independent variable (supply chain strategies) the overall mean was 3.9969. This indicated a high level of agreement, as the mean was close to the upper range of the scale. This suggests that most respondents perceive supply chain strategies to be strong. However, in dependent variables (supply chain responsiveness) the overall mean was 4.0323, indicating that respondents rated the responsiveness as high. This suggests that supply chains were seen as very responsive in meeting demands or handling changes.

The standard deviation measures the spread of the data points around the mean. A lower standard deviation (in this case, 0.69102) indicated that the responses were fairly close to the mean, meaning there's less variability in how respondents view supply chain strategies. This implies consistency in the responses, reinforcing the idea of a high level of agreement. Next, the standard deviation for supply chain responsiveness (0.70375) was also low, meaning responses for supply chain responsiveness were similarly clustered around the mean of 4.0323, indicating consistency and less disagreement among respondents. This further supports the high level of agreement, as the scores were not widely spread out.

Both the mean and standard deviation values suggest that respondents rate both supply chain strategies and responsiveness as high and that their opinions were consistent. Hence, means that most respondents agree that the supply chain strategies were effective and the responsiveness was high, with minimal disagreement among them, indicated there was a high level of agreement among respondents on supply chain strategies and supply chain responsiveness. In nutshell, these findings indicated that the level of supply chain strategies and supply chain responsiveness among manufacturing industries in Selangor, Malaysia were categorized in "High" level of central tendency.

Table 7 Summary analysis of average mean

Variables	Mean	Standard Deviation
Supply Chain Strategies	3.9969	0.69102
Supply Chain Responsiveness	4.0323	0.70375

4.6 Normality Test

According to Mohamad (2016), most statistical tests have to evaluate data normality since it was the basic hypothesis in parametric testing. The Kolmogorov-Smirnov Test and the Shapiro-Wilk Test have been used to determine the normality of data. If the sample size exceeds 50, the Kolmogorov-Smirnov test should be used. If the p-value was more than 0.05, the data can be considered normal, and a parametric test may be carried out

(Mohamad, 2016). The normality of the data was essential since it determines the type of analysis required, whether parametric or nonparametric

This data analysis includes 257 respondents, and the Kolmogorov-Smirnov test has been taken since the number of respondents exceeds 50. The results indicated that the significant value of the variables for supply chain strategies and supply chain responsiveness was $p < 0.05$, meaning that the data was not normally distributed. Table 8 showed the normality test analysis, indicating that all variable values have p -values < 0.05 , namely supply chain strategies (<0.001) and supply chain responsiveness (<0.001). To achieve the research objectives, the researcher was required to use the Spearman correlation test for both independent and dependent variables. Table 8 shows the result of the normality test.

Table 8 Result of normality test - kolmogorov-smirnova

Variables	Statistic	df	Sig.	Result
Supply Chain Strategies	.143	257	<0.001	Non-normal
Supply Chain Responsiveness	.181	257	<0.001	Non-normal

4.7 Correlation Coefficient Analysis

The Spearman's correlation analysis was conducted to explore the relationship between supply chain strategies and supply chain responsiveness as shown in Table 9. In Table 9 the correlation coefficient value was 0.834, and the significance value was 0.000 for this test. The positive value of coefficient indicated that there was a strong relationship between supply chain strategies and supply chain responsiveness. The significant value between two variables was 0.000 ($p < 0.01$), indicating that supply chain strategies were significantly related to supply chain responsiveness. The correlation analysis supports a strong and significant positive relationship between supply chain strategies and supply chain responsiveness.

Table 9 Result of Spearman's correlation

		IV supply chain strategies	DV supply chain responsiveness
Spearman's rho	IV Supply Chain Strategies	Correlation Coefficient	1.000
		Sig. (2-tailed)	.834**
	DV Supply Chain Responsiveness	Correlation Coefficient	.834**
		Sig. (2-tailed)	1.000

** . Correlation is significant at the 0.01 level (2-tailed).

5. Conclusion

The first research objective aimed to determine the level of supply chain responsiveness among manufacturing firms in Selangor, Malaysia, and revealed an overall high level of responsiveness, with a mean score of 4.0323 and a standard deviation of 0.70375, indicating consistent responses. Among the key dimensions assessed, operations system responsiveness achieved the highest score (mean = 4.0830, SD = 0.74231), reflecting the strong capability of these firms to adapt promptly to demand changes, such as emergency orders and fluctuations. This aligns with Asamoah *et al.* (2021), who emphasized that the ability to reconfigure resources efficiently enhances customer satisfaction and provides a competitive edge. Logistics process responsiveness also recorded a high level, highlighting the firms' efficiency in managing transportation and inventory adjustments, consistent with findings by Al-Shboul (2017), who noted that high logistics responsiveness supports efficiency in dynamic and volatile markets. However, supplier network responsiveness scored the lowest (mean = 3.9896, SD = 0.72312), indicating a need for improved supplier collaboration and adaptability. This finding aligns with Ibrahim N. A. *et al.* (2020), who identified supplier responsiveness as critical for competitive advantage and effective supply chain dynamics. Overall, the high level of supply chain responsiveness in Selangor's manufacturing industries reflects their ability to meet market demands effectively, but further enhancing supplier network responsiveness could boost overall performance. These insights support Thatte *et al.* (2013), who identified operations system, logistics process, and supplier network responsiveness as essential for improving manufacturing efficiency.

The second research objective focused on assess the level of supply chain strategies among manufacturing industries in Selangor, Malaysia, focusing on four key dimensions: lean supply chain strategy, agile supply chain strategy, strategic supplier partnership, and postponement. The findings revealed an overall high level of implementation, with a mean score of 3.9969 and a standard deviation of 0.69102, demonstrating consistent responses. Among these dimensions, the lean supply chain strategy emerged as the most emphasized, with the highest mean score (mean = 4.1990, SD = 0.71659). This highlights the strong focus of manufacturing firms on

minimizing waste, managing inventory, and optimizing operational efficiency, consistent with the principles outlined by Qrunfleh and Tarafdar (2013) and Istimaroh *et al.* (2023), which identify inventory management as central to lean practices. The agile supply chain strategy recorded a mean score of 4.0634 (SD = 0.73429), reflecting the industries' capability to adapt quickly to market changes and uncertainties. This aligns with Gawade (2023), who emphasized agility as essential for enhancing responsiveness and maintaining a competitive edge in dynamic markets. The strategic supplier partnership dimension scored a mean of 4.0208 (SD = 0.86327), underscoring the high level of collaboration and trust between firms and suppliers, which is vital for achieving supply chain goals and improving responsiveness, as supported by Kevin Letsoin *et al.* (2023). Postponement, with a mean score of 3.73 (SD = 0.78), reflected the practice of delaying production and distribution until more accurate demand information was available. Although slightly lower than the other dimensions, this still represented a high level of strategy implementation. Prataviera *et al.* (2020) highlighted the potential of postponement strategies to reduce costs and enhance customer satisfaction when effectively applied. Therefore, Selangor's manufacturing companies demonstrate strong implementation of supply chain strategies enhance the firms' responsiveness and competitiveness in a dynamic market.

The third research objective explored the relationship between supply chain strategies and supply chain responsiveness among manufacturing industries in Selangor, Malaysia, using Spearman correlation analysis. The findings revealed a significant positive relationship, confirming that the adoption of supply chain strategies such as lean and agile supply chain practices, strategic supplier partnerships, and postponement plays a critical role in enhancing supply chain responsiveness. Lean supply chain strategy exhibited a strong correlation with responsiveness, emphasizing its focus on waste elimination, efficient resource utilization, and reduced lead times through just-in-time practices, as supported by Qrunfleh and Tarafdar (2013) and Istimaroh *et al.* (2023). Similarly, agile supply chain strategy demonstrated a strongest positive relationship by enabling firms to swiftly adapt to market changes and customer demands, fostering flexibility and rapid decision-making in dynamic environments, as highlighted by Istimaroh *et al.* (2023) and Rajagopal *et al.* (2016). Strategic supplier partnerships also showed a significant positive impact, as collaborative relationships with suppliers enhance communication, coordination, and trust, which are vital for effectively managing disruptions, consistent with the findings of Kevin Letsoin *et al.* (2023). While postponement strategies showed a positive but slightly lower correlation, they still contributed to responsiveness by delaying production and distribution until precise demand information became available, reducing excess inventory and ensuring on-time delivery. However, Qrunfleh and Tarafdar (2013) noted that the effectiveness of postponement depends on robust information sharing and integration across the supply chain. These strategies collectively enhance the ability of manufacturing firms to align their operations with market dynamics, improve customer satisfaction, and maintain a competitive advantage. Overall, the study concludes that supply chain strategies are indispensable for achieving high levels of responsiveness, supporting the firms' operational performance and global competitiveness.

In summary, this study has provided useful insights into the relationship between supply chain strategies and supply chain responsiveness among manufacturing companies in Selangor, Malaysia. Additionally, this study successfully achieved its three main objectives, which were to identify the level of supply chain strategies and supply chain responsiveness and investigate the relationship between the supply chain strategies and supply chain responsiveness among manufacturing companies in Selangor, Malaysia. The study also showed that the level of supply chain strategies and supply chain responsiveness was at a high level. This indicated the high level of supply chain strategies and the high level of supply chain responsiveness. Furthermore, the supply chain strategies were significantly and positively related to supply chain responsiveness among manufacturing companies in Selangor, Malaysia. This study is valuable and has contributed to future researchers and manufacturing companies who focus on the supply chain. This is because this research discussed the limitations of the study and provided recommendations to future researchers and manufacturing companies, as well as contributing to the current discussion on supply chain, especially in manufacturing companies. Finally, this study aims to pave the way and bring benefits for further studies in the supply chain field and improving the efforts of supply chain managers and employees.

Acknowledgement

The authors would like to thank the Faculty of Technology Management and Business, Universiti Tun Hussein Onn Malaysia for its support.

Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: **study conception and design:** Lim Yee Lin, Nor Kamariah Kamaruddin.; **data collection:** Lim Yee Lin, Nor Kamariah Kamaruddin; **analysis and interpretation of results:** Lim Yee Lin, Nor Kamariah Kamaruddin ; **draft manuscript preparation:** Lim Yee Lin, Nor Kamariah Kamaruddin. All authors reviewed the results and approved the final version of the manuscript.

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