MEDIATING EFFECT OF SUPPLY CHAIN RISK MANAGEMENT AND INFORMATION SHARING ON THE RELATIONSHIP BETWEEN SUPPLY CHAIN INTEGRATION AND PERFORMANCE IN MALAYSIAN SMALL AND MEDIUM ENTERPRISES

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STATUS CONFIRMATION FOR DOCTORAL THESIS

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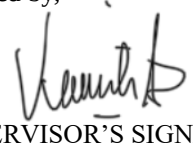

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AVLYIN JAY BINTI SUMAYONG

A thesis submitted in
Fulfilment of the requirement for the award of the
Doctor of Philosophy in Technology Management

Faculty of Technology Management and Business
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DEDICATION

To my beloved parents, who have always supported me and encouraged me to pursue my dreams. You have been my constant source of inspiration and guidance, and I owe all my success to your unwavering love and care.

To my loving family especially my siblings, who have been my pillars of strength and a source of happiness. Your presence in my life has made all the difference, and I am forever grateful for your unconditional love and support.

To the love of my life, who has been my partner in all my joys and sorrows. Your unwavering support and understanding have made my life complete, and I cannot imagine a life without you.

To my dear friends, who has been my confidante and partner in all my adventures. Your companionship and support have made my life more meaningful, and I am blessed to have you in my life.

Thank you for being a part of my journey, and for always standing by my side. I dedicate all my achievements to you, my dear ones, with love and gratitude.

ACKNOWLEDGEMENT

When it comes to this part, the words become scarce because mush as we try to thank everyone involved, some will be unintentional left out, or the words are simply not enough to convey what is in our minds.

It gives me great pleasure in expressing my gratitude to all those people who have supported me in making this thesis possible. First and for most, I must acknowledge and thank you to The Almighty God for His blessing, protection, and guidance throughout my enlightenment journey. I express my profound sense of reverence to my supervisor Dr. Wan Nurul Karimah Wan Ahmad and to my previous supervisor Dr. Ng Kim Soon for their constant guidance, motivation, support, and untiring help during my PhD. Their ultimate support and friendly treatment have taken a place in my heart and give me all the reason to not give up on this project. I will always remember their calm and relaxed nature. I would like to thank Agnes, Khairul, Ivy Deirdre, Noryantie, Francisa William, Vaniel, Adib Farhan and Roger David Shaw for being a constant source of motivation and encouragement thanks for to them to be with me, my prayer may God protect them.

I want to dedicate this work to my beloved parents especially my mother who have been supportive, motivating and inspiring all the way. My mother and my father, no words can describe how much I love you. I would like to deeply thank to my sibling who were always ready to help when I am in need.

Avlyin Jay

ABSTRACT

Small and medium enterprises (SMEs) play a crucial role as the backbone of the Malaysian economy. The integration of supply chain activities is an important aspect of a firm to enhance its supply chain performance. However, there is still much to explore about the role of supply chain integration in the performance of SMEs. Furthermore, there is a lack of literature that has studied the mediating role of supply chain risk and information sharing in the relationship between supply chain integration and supply chain performance. Therefore, this study aims to address the research gaps through a quantitative study. Random sampling technique was used to collect the data from respondents. A total of 242 responses were collected via a questionnaire from SMEs listed in Federation of Malaysian Manufacturers' directory. SPSS and SmartPLS software were used to analyse the collected data. Findings revealed that there is a significant relationship between supply chain integration and supply chain performance. Similarly, a significant relationship between supply chain integration and supply chain risk management as well as supply chain integration and information sharing were found. In addition, information sharing had a significant relationship with supply chain performance. However, insignificant relationship is found between supply chain risk management and supply chain performance. The findings showed that supply chain risk management did not mediate the relationship between supply chain integration and supply chain performance, whereas information sharing did mediate the relationship between supply chain integration and supply chain performance. This implies that to enhance the performance of SMEs supply chain, it is important to emphasise on supply chain integration and information sharing.

ABSTRAK

Perusahaan Kecil and Sederhana (PKS) memainkan peranan penting sebagai tulang belakang ekonomi Malaysia. Integrasi aktiviti rantaian bekalan adalah aspek penting bagi firma meningkatkan prestasi rantaian bekalan. Walaubagaimanapun, terdapat jurang pengetahuan tentang peranan integrasi rantaian bekalan dalam prestasi PKS dalam kajian sedia ada. Selain itu, kajian mengenai peranan risiko rantaian bekalan dan perkongsian maklumat sebagai perantara dalam hubungan di antara integrasi rantaian bekalan dan prestasi rantaian bekalan masih kurang. Oleh itu, kajian ini bertujuan untuk menangani jurang pengetahuan dan penyelidikan ini melalui kajian kuantitatif. Teknik persampelan rawak digunakan untuk mengumpul data dari responden. Sebanyak 242 maklum balas telah dikumpul melalui soal selidik dalam kalangan PKS yang tersenarai dalam direktori *Federation of Malaysian Manufacturers*. Perisian SPSS dan SmartPLS digunakan untuk menganalisis data yang dikumpul. Hasil kajian menunjukkan bahawa terdapat hubungan yang signifikan antara integrasi rantaian bekalan dan prestasi rantaian bekalan. Dapatan yang signifikan turut diperolehi bagi hubungan diantara integrasi rantaian bekalan dan pengurusan risiko rantaian bekalan serta integrasi rantaian bekalan dengan perkongsian maklumat. Selain itu, perkongsian maklumat mempunyai hubungan yang signifikan dengan prestasi rantaian bekalan. Walaubagaimanapun, hubungan yang tidak signifikan diperolehi antara pengurusan risiko rantaian bekalan dan prestasi rantaian bekalan. Hasil dapatan menunjukkan bahawa pengurusan risiko rantaian bekalan tidak memainkan peranan sebagai perantara dalam hubungan antara integrasi rantaian bekalan dan prestasi rantaian bekalan. Sementara itu, perkongsian maklumat memainkan peranan sebagai perantara dalam hubungan antara integrasi rantaian bekalan dan prestasi rantaian bekalan. Ini bermakna adalah penting untuk PKS menekankan aspek integrasi rantaian bekalan dan perkongsian maklumat bagi meningkatkan prestasi rantaian bekalan sektor tersebut.

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FMM	-	Federation of Malaysian Manufacturing
GDP	-	Gross Domestic Product
SCOM		Supply Chain Operations Model
SCOR	-	Supply Chain Operations Reference
SEM	-	Structural Equation Modelling
SMEs	-	Small Medium Enterprises

CHAPTER 1

INTRODUCTION

1.1 Introduction

Supply chain integration is important part in Small and Medium Enterprises (SMEs) facilitate the provision of products and services to the end consumer. The integration can improve the performance of firms' supply chain, especially in today's highly competitive business environment and economic condition. Furthermore, globalisation and information technology can affect the world economy by creating healthy, sustainable, and rapid supply chain management (Xu *et al.*, 2014). The pressures of lowering trade barriers while progressing in transportation, information, and communication technology must be addressed to expand companies supply chain beyond the national level (Golini & Kalchschmidt, 2011).

Modern firms are increasingly dependent in complex networks of supply chain partners to deliver goods and services in the accurate quantity at the right time and place under persistent cost and quality pressures (Munir *et al.*, 2020). The fast changing and complex environment as well as complicated operational strategies of firms contribute to the high level of vulnerability in supply chain. Effective supply chain management through integration, collaboration and risk management is therefore necessary for firms enhance their competitive performance. The need to overcome these challenges in managing supply chain are especially important for SMEs as they make up the largest proportion of industry sector in Malaysia, which will have a direct impact on the country's economy.

The supply chain consists of firm collaboration in order to improve the overall operating efficiency. There is still much to explore in the role of supply chain risk management and information sharing in enhancing supply chain performance. In addition, there is a lack of literature that has incorporated supply chain risk management and information sharing as a mediating variable in understanding the relationship between supply chain integration and supply chain performance. As a result, in this study, supply chain integration, supply chain risk, and information sharing are examined as independent variables, while supply chain performance is examined as a dependent variable. This chapter is intended to give an overview of the background, the problem statement, the research questions, research objectives, scope, definition of key terms used in this study, and the organisation of this thesis.

1.2 Background of study

In Malaysia, SMEs play an essential role in economic development where 90% of the businesses are formed by SMEs and about 32% of the SMEs contribute to the gross domestic product (Gunto & Alias, 2013). SMEs are considered as the national economic backbone that helps to improve the country's social and political stability and serve as a crucial growth engine in many countries (Al Barwani *et al.*, 2014). Malaysian SMEs have great potential to develop significant domestic sourcing by integrating the supply chain to support the nation's economy (Ha *et al.*, 2016). Prime Minister Datuk Seri Anwar Ibrahim also stress that the government policy focus on the improving the capability of the SMEs sector (Ying & Adilla, 2023). Furthermore, SMEs are essential in developing countries because they aid economic growth and income distribution and improve economic structure during the country's downturns (Hassen, Abd Rahim, Shah, 2019).

SMEs is very important to the development of the country where the SMEs provide the opportunities in term of job and in directly it helps to increase the economy of the country. According to Claire (2022) the Prime Minister Datuk Seri Ismail Sabri Yaakob mentioned that the government plan for SMEs by 2025 SMEs will contribute 45% to the Malaysian gross domestic product (GDP) which is in line with the 12th

Malaysian Plan. In 2019 the Malaysian SMEs contributed 39% of the Malaysia GDP before it was affected by the covid-19 pandemic. The Malaysian GDP in 2020 contracted by 5.6%, as compared to in 2019, when the GDP was 4.3%. In March 2020, the government implemented the Movement Control Order (MCO) phases to contain the outbreak of the Covid-19 (Mahidin, 2021). Thus, the performance of economic activities such as domestic supply and demand factors was affected and influenced the external sector, which led to the Malaysian economy recording negative growth in the year 2020. The private sector drove the domestic demand. Despite the challenging external environment, Malaysian SMEs have remained resilient in their contribution to the GDP and can maintain a respectable growth economy in 2020 (Mahidin, 2021). The GDP of 2020 shown in Figure 1.1.

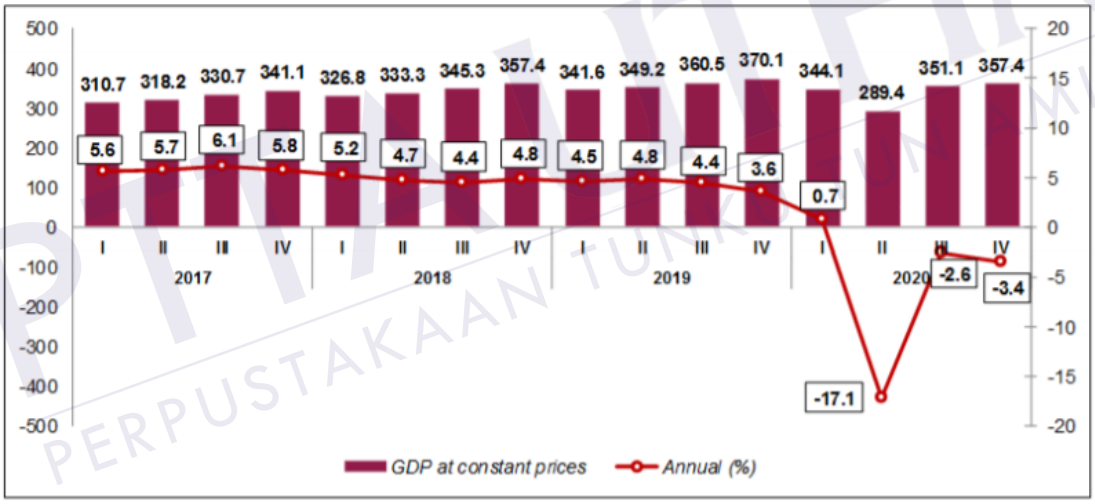

Figure 1.1: Malaysia GDP (RM billion) and annual percentage change (%) (DOSM, 2020)

As shown in Figure 1.1 from year 2017 to year 2020, it shows the decline of the economy, especially in the year 2020. In 2020, the service sector recorded a negative growth of 5.5%, followed by the manufacturing sector, which contracted 2.6%, the agriculture sector, which recorded a decline of 2.2%, the construction sector, which decreased to 19.4%, and mining and quarrying at negative 10% (Mahidin, 2021). The implications of the COVID-19 pandemic have affected the economy, disposable income, which indicates a slowdown, and decreased the Gross National

Income (GNI) per capita from RM45, 212 in 2019 to RM42, 531 in 2020, which led to a reduction in domestic consumption expenditure (Mahidin, 2021).

Figure 1.2: Contribution of SMEs in Malaysian Economy (DOSM, 2018)

Malaysian SMEs contributed 38.9% of RM552.3 billion to GDP in 2019, a slight increase from the previous year's contribution of 38.3% of RM522.1 billion. SMEs contributed to GDP through domestic demand, investment activities, particularly consumption, and additional financial assistance (Mahidin, 2021). Although SMEs are smaller in size, they still have an advantage in management flexibility, resilience, strong reactive ability, and vitality to compete with local and international enterprises (Jaharuddin, Mansor & Yaakob, 2016). Still there are many challenges faced by the SMEs due to the Covid-19 pandemic such as higher operating costs caused by the increase in fuel price as well as unstable political condition. Unstable political causes the delay of the investment inflows and its detriment the SMEs (Vaghefi & Jo-Yee, 2021). In addition, SME Corp Malaysia & Huawei (2018) stated that the smaller firms tend to lack resources and funding needed to upskill and reskill their workers.

There is an important benefit of supply chain integration in firm in term of flexibility it allows different parties to step in to help each other to maintain efficiency and productivity levels (Morrow, 2020). The supply chain that is not integrated are more likely to perform tasks unnecessary and redundant tasks. With the supply chain integration, it can help the organisation to work efficient and productively in short term and long term. Supply chain integration also centralised the data which to ensure the different third-party participants in supply chain are working with the same

information. The short term and long-term benefits of data centralisation include the ability to pinpoint areas of inefficiency and improving both sale and demand forecast accuracy. Besides that, supply chain integration boosts transparency capabilities, which in turn increase the efficiency, effectiveness, and productivity in businesses where the supply chain can clearly view in real time the activities and processes that one another doing. Supply chain integration can also provide a significant benefit to profit margins for all third-party businesses involved (Morrow, 2020). In addition, when the businesses work together, they are more likely to gain competitive advantage by discovering innovative solutions. The creative solutions can translate into substantial financial rewards that benefits all third-party participants within the supply chain (Morrow, 2020).

According to Tehseen and Ramayah (2015), the Malaysian economy is mainly dependent on the manufacturing and service sector. The Malaysian manufacturing sector is ranked 23rd in the world and 17th in the world's largest export (Tehseen & Ramayah, 2015). Malaysian manufacturing ranked 7th in the year 2021 with $87.55 billion, which is an increase of 16.61% from 2020. In the year of 2022 Malaysia ranked 39th in the world. The growth in sales value for each manufacturing sector in Malaysia are as follows: Electricals & Electronics Product (24.7%), Petroleum, Chemical, Rubber & Plastic Product (27.2%), Transport Equipment & Other Manufactures (21.6%), Wood, Furniture, Paper Products & Printing (12%), Textile, Wearing, Apparel, Leather & Footwear (9.7%), Non-Metallic Mineral Products, Basic Metal & Fabricated Metal (9.5%) and Food, Beverages & Tobacco Products (7.1%) subsectors (DOSM, 2022). Tehseen and Ramayah (2015) stated that Malaysia's manufacturing and service sector has a problem maintaining quality, fast delivery of products, and sustaining competitiveness. The SMEs' other challenges are the limitations posed by their low competitiveness, financial performance, insufficient agility, low productivity, and low-quality output of the product. This caused a lack of capability to meet the globalisation requirement standard (Jahharuddin *et. al.,* 2016; Smith, & Ulu 2017).

Rapid changes in environments, technological advancements, and market globalisation shape companies' awareness to optimise the overall performance of the supply chain rather than the individual organisation (Manfredi & Capik, 2022).

Costantino *et al.* (2015) reported the lack of coordination between each partner in an organisation without considering other partners' effect, thereby negatively affecting the supply chain activities and the performance. Many studies have shown that supply chain integration can improve the supply chain performance of firms related to operations, profit, finance, and customer service (Flynn *et al.*, 2010; Cao, Hou & Zhao, 2015; Alshurideh *et al.,* 2022). Abdallah *et al*. (2021) found no consensus on effect supply chain integration on the supply chain performance. The lack of coordination in the supply chain can cause various inefficiencies, like the bullwhip effect and inventory instability (Costantino *et al.,* 2014).

Wong *et al.* (2015) pointed out that 60% of companies cannot achieve their expected return on investment from the supply chain's technological expenses. Chibba, (2015) argue that the measures do not capture the overall performance of the supply chain, nor do they indicate opportunities for increasing the competitiveness of customer value and the value of each actor in the supply chain. Moreover, Duffy *et al.* (2015) claimed that the lack of information infrastructure makes it difficult for firms to collect information from collaborating partners. Information sharing is a critical part of supply chain management because it guides firms to increase effectiveness (Spaho, 2016). Therefore, this research aims to investigate the role of supply chain risk management, information sharing and supply chain integration on the performance of Malaysian SMEs.

1.3 Problem statement

There are a few research that have investigated the role of various factor of supply chain integration. The research found that the supply chain integration offers numerous benefits to firms, suppliers, and customers as it enhances effectiveness and efficiencies of the supply chain operation. Supply chain integration is a critical factor in the success of business, particularly in SMEs. The integration of the supply chain in Malaysian SMEs has been crucial for enhancing the competitiveness and productivity of the businesses. According to the Dahlan & Rahman (2022), the effectiveness of the supply chain integration has been identified as a significant driver for SMEs to achieve the

sustainability of their competitive advantage. The integration process involves the synchronisation of the activities across all stages of the supply chain which can lead to better coordination, communication, and collaboration among supplier, manufacturers, distributors, and retailers. However, the supply chain integration in Malaysian SMEs is often hampered by the various challenges. It is crucial to implement the supply chain integration in firm to enhance the performance of firm. Some researchers tried to investigate the implementation of supply chain integration in Malaysian SMEs but the effectiveness of supply chain integration as a core function on the organisation is still questionable. This is due to the lack of appreciation of how supply chain integration drive changes in the business processes for better quality service, efficiency, and cost reduction in SMEs (Setyaningsih, & Kelle, 2021). Besides, the other issues in supply chain integration for Malaysian SMEs is the lack of collaboration and communication among supply chain partners. Abdul Rahman *et al.* (2022) stated the Malaysian SMEs facing a challenge in integrating with their partners due to the differences in culture, communication barriers, and limited resources. This causes to the lack of transparency, leading to delays, misunderstanding, and supply chain disruptions.

Supply chain risk management is also crucial for firm to address the risk faced by companies and identify the potential risks that might arise from the various events (Mustafa & Yaakub, 2020). The risk of covid-19 pandemic impact on the SMEs firm has been immense (Vaghefi & Jo-Yee, 2021). According to Vaghefi and Jo-Yee (2021) in year 2021, the performance of business 21% expecting poor and 25% are optimistic. Lim and Ng (2022) stated most of the common risks faced by the SMEs includes quality issues, delivery delays, financial risks, and supply chain disruptions. The risks can have severe consequences, such as increased costs, reputational damage, and the loss of customers. According to the study by Fauzi *et al.* (2022), they found the SMEs in Malaysia often focus on the short-terms risks such as price fluctuation and supply chain disruptions, and do not have a long-term strategy to manage the risks such as political instability, natural disasters, and cyber threats. Besides that, SMEs facing the risk of higher operating cost because of higher fuel prices and complications from the pandemic and the political risk that have surfaced is another threat to the Malaysian SMEs. When the ASEAN countries engaged in fierce competition to attract foreign investment the unstable political condition in Malaysia can deter and delay the

investment inflows, which is detriment to the SMEs (Vaghefi & Jo-Yee, 2021). Therefore, it is important to strengthen the integration of the local firms into the global value and supply chain for the SMEs firm to become more competitive on the international stage (Vaghefi & Jo-Yee, 2021). Even from the qualitative studies perspective, factors affecting supply chain integration in Malaysian SMEs had been researched. But there is a little research that examine the precise circumstances surrounding supply chain integration in SMEs.

Budiarto, Prabowo, and Herawan, (2017) stated the firms are unable to appreciate how supply chain integration can change business processes through cost efficiency and service quality due to a lack of knowledge in supply chain management. It also makes firms incapable of using supply chain integration to deal with the financial affairs, fast product delivery, and productivity, thus making them unable to meet the globalisation standards requirement (Setyaningsih, & Kelle, 2021). Besides, the lack of information sharing in firms leads to the inefficiency of the organisation's coordinated action (Lotfi *et al.*, 2013) and not much is known about the supply chain risk faced by Malaysian automotive SMEs (Hudin *et al.*, 2017).

Meanwhile, in supply chain management, information sharing is crucial for improving the performance of the company and critical issue in supply chain integration for Malaysian SMEs. According to Ong and Lim (2022), the lack of information sharing among supply chain partners has been identified as a significant barrier to achieve the effectiveness of the integration. The issue arises due to the lack of trust, communication barriers, and inadequate technology infrastructure. Idris *et al.* (2022) stated the Malaysian SMEs lack trust in their partners which can lead to the reluctance to share the information that hinders supply chain visibility and the coordination. According to Duffy *et al.* (2015), there is a scarcity of studies on supply chain integration methods, particularly in terms of data collection between partners. The lack of information sharing in firms leads to the inefficiency of the organisation coordinated action (Lotfi *et al.*, 2013). In addition, Abdallah *et al.* (2021) stated there was no consensus on the effect of supply chain integration on supply chain performance from existing literature. Further, Chibba (2015) added that the supply chain's overall performance does not show the opportunities in increasing the competitiveness and customer value in supply chain management. On the other hand,

Munir *et al.* (2020) argued that existing literature does not provide conclusive evidence of the association between supply chain integration and supply chain risk management. Furthermore, there is no empirical quantitative study supporting the claim and analysing the supply chain integration as an antecedent of supply chain risk management (Munir *et al.*, 2020).

Based on the gap discussed, this study aims to identify the mediating effect of supply chain risk, information sharing on the relationship between supply chain integration and supply chain performance among Malaysian SMEs. Supply chain integration is a crucial aspect of the firm's performance because it unites business strategies and performance (Huang *et al.*, 2014). The consequences if the issues facing SMEs were ignored will causes negative impact to the growth of the economy, since the Malaysian economy is mainly dependent on SMEs, especially in the manufacturing and service sectors. Therefore, it is crucial to investigate the effect of supply chain integration on the performance of the supply chain in SMEs, which can affect the organisation's sustainability (Tehseen & Ramayah, 2015). Therefore, the study's main goal is to investigate the mediating effect of supply chain risk management and information sharing on the relationship between supply chain integration and supply chain performance among Malaysian SMEs, as listed in FMM.

1.4 Research questions

The research questions for this study are:

i) What is the relationship between supply chain integration, supply chain risk management and information sharing?

ii) What is the relationship between supply chain risk management, information sharing and supply chain performance?

iii) What is the relationship between supply chain integration and supply chain performance?

iv) How do supply chain risk management and information sharing mediate the relationships between supply chain integration and supply chain performance?

1.5 Research objectives

The objectives of the study are:

i) To analyse the relationship between supply chain integration, supply chain risk management and information sharing

ii) To analyse the relationship between supply chain risk management, information sharing and supply chain performance.

iii) To analyse the relationship between supply chain integration and supply chain performance.

iv) To analyse the mediating effects of chain risk management and information sharing on the relationship between supply chain integration and supply chain performance.

1.6 Scope of the study

The variables investigated in this study include supply chain integration, information sharing, supply chain risk, and supply chain performance of the Malaysian SMEs. The conceptual framework for this study was formulated based on the discussion and arguments made in the literature review. The population frame for this study was selected from the Malaysian SMEs listed in the FMM directory. In addition, the study focused on the Malaysian SMEs that are members of the Federation of Malaysian Manufacturers (FMM), such as agricultural, manufacturing, automotive, environmental and waste management, food and beverage, ceramic and tiles, furniture, household product, iron steel and metal products, pharmaceutical, rubber products, automation technology, building materials, chemical and adhesive products, gifts stationery and office supplier, industrial and engineering products, packaging labelling and printing, plastic products and services. The respondents of the study were chief executives, general managers, logistics managers, operations managers and production managers who have knowledge about the supply chain in the organisation.

1.7 Significance of study

A study by Huang *et al.* (2014) stated that supply chain integration is a critical part of supply chain management. Hence, this study provides a significant contribution, especially on the opportunities to increase competitiveness and customer value in supply chain management. According to Arana-Solares *et al.* (2010), supply chain risk management is critical for firms to grow and survive in their business performance. In supply chain activities, information sharing leads to the ultimate improvement in improving the companies' competitiveness advantage and increasing firm performance (Lotfi *et al.*, 2013). This study helps to identify the mediating effect of supply chain risk management and information sharing on the relationship between supply chain integration and supply chain performance among Malaysian SMEs. By understanding the mediating effect and the relationship between supply chain risk management and information sharing, the relationship between supply chain integration and supply chain performance could be developed to improve the performance of firms. Finally, this study could contribute to the development and improvement of the theories and models of supply chain risk management by improving the performance of the supply chain in firms.

1.8 Definitions of key terms

The terminologies used in this research study are listed and defined as follows:

1.8.1 Supply Chain Integration

Supply chain integration is collaboration among firms in managing the internal and external processes for efficiency and effectiveness in the flow of products and services, information, and capital, as well as the decision to provide maximum value to the customer at low cost and high speed (Peng *et al.*, 2016).

1.8.2 Supply chain risk management

Supply chain risk management is referring to the assessing, mitigating, and monitoring the uncertain events or risks (Ganesh & Kalpana, 2022)

1.8.3 Information Sharing

Information sharing is the use of data and information as interchangeable terms, while data can be a source of information, it's used as a synonym for information is misleading (Kembro & Näslund, 2014).

1.8.4 Supply Chain Performance

Supply chain performance represents the measurement and quantify the efficiency and effectiveness of the supply chain process (Maestrini *et al.*, 2018)

1.9 Organisation of thesis

This research is presented in five chapters: an introduction, literature review, methodology, data analyses, discussion, and conclusion. Chapter 1 comprises the research background, followed by the problem statement, research questions and objectives, significance of the study, scope of the study, definitions of terminology and organisation of the thesis. Chapter 2 is titled "Literature Review", explores the existing studies related to the research topic, and reviews studies on supply chain integration, supply chain risk management, information sharing and supply chain performance. After that, Chapter 3 focuses on the research methodologies used for this study and specific theory used for the study. Whereas Chapter 4 presents the discussion regarding the data collection, analyses of the collected data and the outcomes. Finally, Chapter 5 is the discussion. It provides the study's findings, a thorough discussion of each variable, the study's contribution to knowledge and contribution to industry, study limitations, implications, and recommendations for future research.

1.10 Summary

This chapter started with the introduction and continues with background of the study. In addition, problem statement is thoroughly outlined, and different issues related to the research are discussed. Moreover, from the research background and problem statement, the research questions and research objectives were outlined and discussed in detail. The chapter explains the significance of the study and outlines its scope. Definitions of the key terms of this study are also highlighted in this chapter.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter reviews the literature on supply chain integration, supply chain risk management, information sharing, and supply chain performance from previous studies. Furthermore, the chapter outlines the core ideas of supply chain integration, risk management, information sharing, and Malaysian SMEs' supply chain performance. In addition, it presents the research theoretical framework based on the review of the literature and all significant constructs of this research.

2.2 Supply chain management

Supply chain management is one of the strategies that has been considered as a very effective strategy for an organisation to coordinate internal and external activities to improve the performance and competitiveness of a company (Khanuja & Jain, 2019). Nowadays, the competition of organisations in engaging in the field of supply chain management is to provide fast delivery services, a range of innovative and diverse products and services to meet each segment of customers' needs and create value for them. As the development of globalisation and the development of information technology infrastructure has changed the structure of relationships as well as has brought organisations closer, the supply chain has moved forward as a competitive weapon that causes organisations to have limited cooperation and integration with internal partners, but also external partners (Khanuja & Jain, 2019).

Supply chain is a system of individuals, organisations, processes, materials, information, and resources that enable products to travel from supplier to customers. Through supply chain management, the natural resources, or raw materials, and components are transformed into a finished product and provided to the end user (Van Weele & Van Raaij, 2014; Singh & Verma, 2017). In addition, it is a network of entities involved in the many processes and activities that produce value in the form of products and services given to the end customer via internal and external linkages. As part of the supply chain, enterprises that deliver products or services to the market are aligned, including the final clients. It can also be defined as group of three or more entities such as organisations or individuals that are actively involved in the upstream and downstream flows of goods, services, funds, or information from a source to a client.

Supply chain management is the mutual concept of supply chain and involves the management of the flow of goods from upstream to downstream, or from producers to customers, is the upstream concept of supply chain management (Ghassemi *et al.,* 2018). Goods flow in the same manner from producers to consumers. Supply chain management is an essential method, tool, or approach for handling the flow of products, information, and money in an integrated manner involving upstream and downstream parties such as suppliers, factories, distribution networks, and logistics (Ghassemi *et al.*, 2018). Heizer and Rander (2008) define supply chain management as "managing activities in order to obtain raw materials into process goods or semi-finished goods and finished goods then send the product to consumers through a distribution system". This chain includes transport services, planning information, credit or cash transfers, and the exchange of ideas, designs, and materials. Ivanov, Tsipoulanidis and Schonberger (2017) stated the supply chain management as "cross-department and cross-enterprise integration and coordination of material, information and financial flows to transforms and use the supply chain resources in the most rational way along the entire value chain from raw material suppliers to customer". Therefore, the supply chain management one of the important elements in firms to helps the organisations to handle the supply chain activities such as the products and services flows, information related to the products and services provided by the firms which involve the internal, suppliers and the customers.

2.3 Supply chain integration

Supply chain integration is commonly considered as a company's level of alignment of internal and external processes and strategic linkages with their value chain partners. However, this alignment could be taken at different levels at both supplier and customer levels (Erboz and Szegedi, 2020). Steven and Johnson (2016) stated supply chain integration as "an alignment, relationship and coordination of people, information, processes, strategies, communication and knowledge that cross the supply chain between all contact points and make the movement of information, money, materials and knowledge required by customers". Besides that, Somjai *et al.* (2020) stated that supply chain integration represents the degree at which a company can cooperate with its partners and manage processes to achieve flows of products, services, information by offering the maximum value to the final customer. Other than that, supply chain integration integrates the relationships, value-adding activities, functions, processes such as controlling and planning of raw materials and finished goods ranges from manufacturers to suppliers and to final customers (Delic & Mikulic, 2019).

According to Kumar *et al.* (2017) the supply chain integration has emerged as a significant field involving strategy alignment with the organisation's processes and functions to enhance performance. In supply chain integration, the organisation utilises other partners' services and core functions within their supply chain network (Figure 2.1).

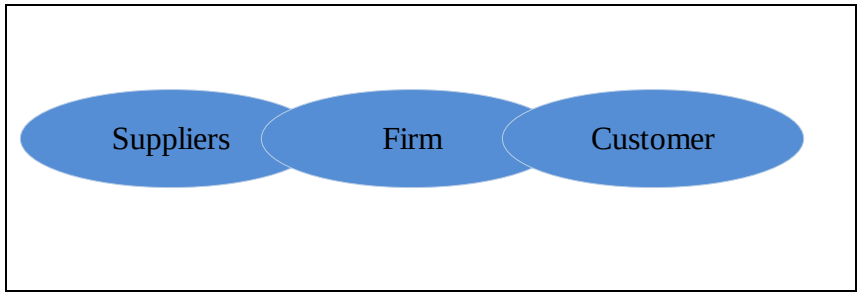

Figure 2.1: Supply chain integration (Kumar *et al.*, 2017)

Lii and Kuo (2016) also mentioned that supply chain integration is defined in many different terms and perspectives of the integration direction, either internal integration

or external integration with suppliers and customers between the departments. Flynn *et al.* (2010) defines of supply chain integration "the degree to which a manufacturer strategically collaborates with its supply chain partners and collaboratively manages intra- and inter-organisation processes. The goal is to achieve effective and efficient flow of products and services, information, money, and decisions to provide maximum value to the customer at low cost and high speed."

Over the last decade, researchers have emphasised the importance of a collaborative relationship between supply chain partners (Palomero & Chalmeta, 2014). It encourages value creation, collaborative planning, and the development of a problem-solving process across firms (Cao *et al.*, 2015; Wu *et al.*, 2016). The benefit of supply chain integration is that it reduces the total cost of logistics, which leads to increased profitability and improves the firm's flexibility in responding to supplier and customer changes in the market (Kumar *et al.*, 2017). Flynn *et al.* (2010) conducted a study demonstrating the positive effects of supply chain integration and its importance to a firm's success. Therefore, supply chain integration important in organisations helps to improve the efficiencies and effectiveness of the products and services flows to enhance to performance of firms.

2.3.1 Dimensions of supply chain integration

Based on supply chain management abstraction, integration is at the root of the supply chain management philosophy: the systems approach sees the chain as a single entity (Khanuja & Jain, 2019). Supply chain management as a management philosophy seeks synchronisation and convergence of internal and external operational and strategic capabilities into a unified, compelling marketplace force (Akdogan & Demirtas, 2014). Khanuja and Jain (2019) also stated that supply chain management is integrative thinking that directs supply chain members to act collaboratively for improving customer value. There are studies that use the supply chain integration dimension based on two approaches identified, namely internal integration and external integration (Duoming & Chin, 2022) where external integration is further categorised into customer integration and supplier integration; second, information sharing,

operational or process coordination and strategic alliance or inter-organisational decision-making (Khanuja & Jain, 2019).

Flynn *et al.* (2010) noted that supply chain integration is a complex part of multi-faceted constructs. Generally, supply chain integration is divided into internal and external integration (Lofti *et al.,* 2013). Supplier and customer integration form the external integration of the arcs of integration strategies (Munir *et al.*, 2020). In addition, Kamble *et al.* (2021) stated that the external integration is divided into supplier integration and customer integration. It is the level at which the firm partners with its key suppliers and customers to build their inter-organisational processes, policies, collaborations, and synchronised processes for mutual value. External integration is a significant feature across firms because it develops a relationship between the supplier and customer (Tehseen & Ramayah, 2015). Overall, supply chain integration was mostly characterised as internal integration and external integration (supplier and customer integration). Many researchers, such as Danese *et al.* (2020); Kim, (2013), and Flynn *et al.* (2010) divided the supply chain integration into three dimensions namely:

i) Internal integration (within the firm).
ii) Upstream integration (with the suppliers).
iii) Downstream integration (with the customers).

The literature on supply chain integration is comprised of numerous definitions and dimensions that extend into various strategies. However, the inconsistencies in the definitions and study findings are the primary reasons firms face difficulty implementing them across the supply chain. For this reason, recent studies on supply chain integration have limited the dimensions to internal, supplier, and customer integration (Cao *et al.,* 2015; Danese *et al.,* 2020; Feng *et al.,* 2013; Flynn *et al.*, 2010; Kim, 2013). Internal integration, supplier integration, and customer integration each play a different role in the supply chain. Therefore, the supply chain integration variables are important in firms to enhance the performance of supply chain.

2.3.1.1 Internal integration

Internal integration is described as the process of integrating, interacting, collaborating, communicating, and coordinating to create efficiency within an organisation (Flynn *et al.*, 2010). It is defined as the practice of combining and developing internal resources and information to generate know-how and knowledge that exceeds the confines of a single department or function. This is done to support external integration activities and enhance the overall performance of the organisation (Alfalla-Luque *et al.*, 2013; Alshurideh *et al.*, 2022; Leuschner *et al.*, 2013; Zhao *et al.*, 2013). Internal integration is also defined as the degree to which a firm synchronises its strategies and practices to effectively cooperate with suppliers and meet customers' demands (Boon-itt & Wong, 2011). Internal integration is also the firm's ability to decrease functional silos and create cross-functional teams, information sharing, and standardised process (Kim, 2013).

Internal integration focuses on the activities within the firm that result in the delivery of goods to customers. It has been argued that internal integration pushes for intra-firm collaboration across functions (Otchere *et al.*, 2013). This is done with the aid of information sharing, and cross-functional collaboration (Schoenherr & Swink, 2012; Williams *et al.*, 2013). Internal integration establishes cross-functional teams that bring together specialists to share information and make joint simultaneous decisions on products, processes, and manufacturing (Kamble *et al.*, 2021). Internal integrated activities take a holistic look at the performance of the processes across departments, thereby integrating material management to production, distribution, and sales to meet customers' needs at a reduced cost (Basnet, 2013). This is because functional isolation in a firm lessens the potential for creating a value chain of teams working together across organisational boundaries (Kim, 2013).

Internal integration capabilities form the foundation of supply chain integration, and it plays a large role in the level of supplier and customer integration (Kim, 2013; Kamble *et al.*, 2021). From a manufacturing point of view, the internal integration of functional silos and the ability to adapt are crucial to the expansion of suppliers and customers (Stevens & Johnson, 2016). A study by Kumar *et al.* (2017) has found the internal integration process leads to the improvement of the organisation

through proper information sharing with suppliers and customers. Zhao *et al.* (2021) stated that supply chain integration helps in improving performance through quality management.

Table 2.1: Measurement items of internal integration

Items	Authors
The level of linkage with our major customer through information networks. The level of computerization for our major customer's ordering.	Flynn *et al.* (2010)
The level of sharing of market information from our major customer.	
The level of communication with our major customer.	
The establishment of quick ordering systems with our major customer. Follow-up with our major customer for feedback.	
The frequency of period contacts with our major customer.	
Our major customer shares Point of Sales (POS) information with us.	
Our major customer shares demand forecast with us.	
We share our available inventory with our major customer.	
We share our production plan with our major customer.	
We have been able to improve our internal logistics processes to:	De Vass, Shee and Miah (2018)
Improve the integration of data among internal functions.	
Improve real-time communication and linkage among all internal functions.	
Accurately plan and adopt internal processes in collaboration with cross functional teams.	
Make and adopt demand forecasts in collaboration with cross functional teams.	
Improve inventory management in collaboration with cross functional teams.	
Improve real-time searching of the inventory levels.	
Improve real-time searching of logistics-related operating data.	
Employ cross functional teams in process improvement.	
Improve replenishment of shop floor shelves.	
Reduce stock outs in the shop floor shelves.	
Sharing ideas, information, and resources among departments.	Feyissa, Sharma and Lai, (2018)
Conducting joint planning to anticipate and resolve supply chain problem.	
Striving to maintain a good working relationship with each other.	
Interaction with each other through meetings or phones or emails.	
Exchanging form, reports, or documents.	
Their accessibility to each other.	
Consulting each other before making decisions affecting other departments	
Working frequently in informal cross-departmental teams	

Table 2.1 shown the measurement items of internal integration by Flynn *et al.* (2010); De Vass *et al.* (2018); Feyissa *et al.* (2018). Some of the items as listed in Table 2.1 were adopted and used in this research study. As these items have already

been validated by these authors in their respective studies, therefore they are deemed as having high reliability and validity to be adopted in the present study. Therefore, internal integration one of the important elements in supply chain which create the efficiency in term of integrating, collaborating, interacting, communicating, and coordinating within the organisation.

2.3.1.2 Supplier integration

Supplier integration is one of the important elements in supply chain integration that boosts the effectiveness of the supply chain activities to improve firm performance. Shou, Park, and Kang (2018) mentioned that supplier integration plays an important role in improving flexibility, quality, and delivery performance in the organisation. In addition, Danese, (2013) stated that supplier integration is viewed as a pivotal management strategy to enhance firm performance. Supplier integration refers to the collaboration and sharing of financial, operational, and strategic information between a firm and its suppliers (Pakurár *et al.,* 2019). In manufacturing firms, supplier integration is key to successful supply chain integration (So & Sun, 2013). It focuses on the flow of products and information, control and planning, mutually active partnerships, trust and commitment between a firm and its supplier (Jajja *et al.,* 2018). The firm strategically collaborates with key suppliers and develops its managerial and technological capabilities (Jajja *et al.,* 2018).

Therefore, product integration can play an effective role in improving firms' financial performance by providing collaboration with suppliers when faced with demand uncertainty. Given the above, it can be predicted that demand uncertainty can moderate the relationship between external integration, including product and process integration and a firm's operational and financial performance (Hendijani & Saei, 2020).

Several empirical studies have supported these predictions. For example, in the Thai automotive industry, Boon-Itt and Yew Wong (2010) found that demand uncertainty moderated the relationship between external integration with suppliers and customer delivery performance. In addition, Wong *et al.* (2011) found in the auto parts

manufacturing industry in Thailand, that the relationship between external integration with suppliers and customers and the firm's operational performance was strengthened in high-uncertainty environments. In the context of China's automotive supply chain, Ding *et al.* (2017) found that demand uncertainty had a positive effect on the relationship between external integration with customers and the firm's operational performance. Therefore, supplier integration one of the crucial parts in supply chain activities which to improve the quality of products and services, improving the flexibility and the delivery performance in the organisations and in directly the supplier integration improve the performance of firms.

Table 2.2 outline the measurement items adopted from the study of Flynn *et al.* (2010); De Vass *et al.* (2018) and Feyissa *et al.* (2018), which are adapted for this study due to their reliability and validity.

Table 2.2: Measurement items for supplier integration

Items	Authors
The level of information exchange with our major supplier through information networks.	Flynn *et al.*, (2010)
The level of strategic partnership with our major supplier.	
The level of strategic partnership with our major supplier.	
Stable procurement through network with our major supplier.	
The participation level of our major supplier in the process of procurement and production.	
The participation level of our major supplier in the design stage.	
Our major supplier shares their production schedule with us.	
The establishment of quick ordering systems with our major supplier.	
Our major supplier shares their production capacity with us	
Our major supplier shares available inventory with us.	
We share our production plans with our major supplier.	
We share our demand forecasts with our major supplier.	
We share our inventory levels with our major supplier.	
We help our major supplier to improve its process to better meet our needs.	
We have been able to improve the business processes with our suppliers to:	De Vass *et al.* (2018)
Improve information exchange with our suppliers.	
Establish a quick ordering of inventory from our suppliers.	
Accurately plan and adopt the procurement process in collaboration with our suppliers.	
Stabilize procurement with our suppliers.	
Share real-time demand forecasts with our suppliers.	
Improve strategic partnerships with our suppliers.	
Help suppliers improve their processes to better meet our needs.	
Improve the account payable processes for suppliers.	
Improve the transport/logistics processes of logistics partners to deliver orders just in time.	
Improve our receiving processes for delivered goods.	

Table 2.2 (continued)

Working as a partner with suppliers, rather than having an adversarial relationship.	Feyissa *et al.* (2018)
Linking your systems to the systems of your key suppliers through web-based information system.	
Real-time cooperative planning.	

2.3.1.3 Customer Integration

Customers are the final receivers of the product. The customers are important because they indicate if the supply chain performance has improved. Also, customers provide information on preferences and demand, which is obtained through customer integration. According to Tehseen and Ramayah (2015), customer integration refers to the responses to the requirements and needs of the customer. According to Shou *et al.* (2018), customer integration significantly contributes to the flexibility, cost, quality, and delivery performance. In addition, Flynn *et al.* (2010) mentioned customer integration, referring to the level of firms' strategy in cooperating and adapting to the activities of firms such as coordinating, harmonising, and information sharing with customers.

Strong supplier and customer integration can lead to high market share and profitability. Supplier integration helps firms develop production plans, offer products and services on time, and thus increase delivery speed that improves firm performance (Flynn *et al.*, 2010). Supplier integration can reduce purchase costs by developing close relationships with suppliers, which also helps firm performance (Zhao *et al.*, 2015). In addition, firms can leverage information embedded in collaborative processes through customer integration, allowing them to fully understand market expectations and opportunities (Flynn *et al.*, 2010; Zhao *et al.*, 2015). As a result, firms can respond accurately and quickly to customer needs and requirements, improve service levels for customer needs, and reduce stock-holding costs, thereby improving firm profitability. Market turbulence's role in moderating market turbulence is generated by frequent changes in customer mix as well as continually changing preferences and wants (Wilden & Gudergan, 2015).

Customer integration is important for attaining high performance in the supply chain (Alshurideh, Alsharari, & Al Kurdi, 2019). Generally, customer integration refers to the activities that involve collaboration and information sharing with customers that give firms access to insights on market expectations and opportunities (Saberi *et al.*, 2019). Successful supply chain integration is dependent on business knowledge that pertains to customer demands, requirements, and expectations (Tehseen & Ramayah, 2015). Fundamentally, customer and supplier integration refer to the extent to which a company collaborates with its key suppliers and customers to structure inter-organisational strategies, practices, and processes in a synchronised and collaborative manner to create mutual value (Flynn *et al.*, 2010). Therefore, firms are constantly developing and adopting new approaches to engage and understand their customers during product and process development (Khanuja & Jain, 2019). This allows firms to build a collaborative relationship with key customers and leverage each other's capabilities to enhance value (Jajja *et al.*, 2018). Hence, the customer integration in one of the important elements in supply chain where the roles of customer integration in supply chain is providing the information on the preferences and demand towards products and services provided by the firms.

Table 2.3: Measurement items for customer integration

Items	Authors
The level of linkage with our major customer through information networks.	Flynn *et al.* (2010)
The level of computerization for our major customer's ordering.	
The level of sharing of market information from our major customer.	
The level of communication with our major customer.	
The establishment of quick ordering systems with our major customer.	
Follow-up with our major customer for feedback.	
The frequency of period contacts with our major customer.	
Our major customer shares Point of Sales (POS) information with us.	
Our major customer shares demand forecast with us.	
We share our available inventory with our major customer.	
We share our production plan with our major customer.	
We have been able to improve the business processes with our customers to:	De Vass *et al.* (2018)
Improve the strength of linkages with our customers.	
Improve regular contacts with our customers.	
Improve communication with our customers on products and promotions.	
Make and adopt demand forecasts with a real-time understanding of market trends.	

Table 2.3 (continued)

Improve the customer shopping experience/time/ordering/customising processes.	
Accurately plan and adopt the checkout/dispatch/delivery processes through a better understanding of market trends.	
Improve the check-out/dispatch/delivery process of goods.	
Improve and simplify the payment receivable process from our customers.	
Improve customer feedback process.	
Frequent and close contact with customers.	Feyissa *et al.* (2018)
Feedback from customer on organization's quality and delivery performance.	
Effort to be highly responsive to customers' needs.	

2.4 Supply chain risk management

The main goal of supply chain management is to maintain an uninterrupted supply of goods and services through their networks. However, despite their efforts, supply chain risks are inevitable. Risk is the occurrence of uncertain events, causes of damage and loss which affect the achievement of objectives (Tummala & Schoenherr, 2011). A supply chain includes all parties involved in realising customer demand (Duoming & Chin, 2022). In addition to the manufacturer and suppliers, supply chain includes distributers, wholesalers, retailers, and the end customers (Duoming & Chin, 2022). Inside the organisation, supply chain includes the functions related to receiving and fulfilling customer order. Some of these functions are operations, new product development, marketing, finance, distribution, and customer service (Chopra & Meindl, 2013).

The definition of supply chain risk is described as an unexpected and abnormal situation, such as interruption of raw material supply, which leads to inefficiency operations, high cost, or disruptions of the supply chain (Baryannis *et al.*, 2018). Taking a recent supply chain disruption as an example, according to the British Broadcasting Corporation's report, the 2021 Suez Canal obstruction has disrupted approximately 9.6 billion US dollars' worth of goods every day (Harper, 2021). The Suez Canal is an important channel for the global energy and commodity supply chain, and the blockage of the Suez Canal has caused the world crude oil prices to rose by 4% on the second day of the incident (Bodt *et al.*, 2021; Lee and Wong, 2021).

Globalisation and supply chain integration, especially external integration, has expanded the supply chain network and increased the supply chain's complexity. Global sourcing and international logistics lead the supply chain to take risks, implying that the global supply chain structure has become more vulnerable to risks with low supply chain performance (Munir *et al.*, 2020).

In the global market, the disruption of the supply chain is both problematic and beneficial for business continuity (Tummala & Schoenherr, 2011). Risk refers to factors that can potentially disrupt the distribution network and affect performance. In present times, businesses are becoming risky because of the increase in outsourcing, short product shelf life, and globalisation of the supply chain (Barry, 2004; Christopher *et al.*, 2011; Waters, 2007; Zhao *et al.*, 2013). Risk increases due to uncertainty, and it creates a gap in what the firm has planned (Abdel-Basset *et al.*, 2019). The existence of risk complicates the supply chain, leading firms to enhance their supply chain by collaborating with key suppliers and customers (Flynn *et al.*, 2010; Nakandala, Lau, & Zhao, 2017).

In the supply chain, risk is described as the financial or competitive disadvantage that is a result of a failure to implement best practice (Khan & Zsidisin, 2012). In addition, Jajja *et al.* (2018) define supply chain risk as a combination of probability and impact associated with the disruption of the supply chain internal-manufacturing and delivery operations. In simpler terms, supply chain risk is the probability of a risk event happening in the supply line when the product is put on sale. Moreover, risk sources are the main causes of risk events, and they are organisational, environmental or supply chain variables that cannot be predicted with certainty. Therefore, it affects the supply chain outcome variables (Jajja *et al.*, 2018).

Some scholars have viewed supply chain risk from the demand and supply perspective, such as Hallikas, Virolainen, and Tuominen (2002); Sharma and Bhat (2012), and grouped supply chain risk into demand and supply risk (Jiang, Li, & Shen, 2018). Other scholars assessed risk based on the supply chain structure such as Ghadge, Dani, and Kalawsky (2012) and Musa (2012), and classified supply chain risk into capital, logistics, and information flow. Mandal (2012) observed that supply chain risk mostly originates from the uncertainty of the supply chain demand and the imperfections of the supply chain.

Many strategies have been recommended for firms to use supply chain risk to their advantage. While some authors have suggested that firms use the impact of possible disruptions to measure supply chain risk, others have suggested using probability or a combination of probability and impact to measure supply chain risk (Aminbakhsh, Gunduz, & Sonmez, 2013; Ho *et al.*, 2015; Wagner & Bode, 2008; Zsidisin, 2003).

Of the many definitions of supply chain risk, the common factors that set a firm's supply chain at risk are the disruption of a firm's supply sources, internal operations, and delivery means (Ellis *et al.*, 2010; Tummala & Schoenherr, 2011; Ravindran *et al.*, 2010). The increase in outsourcing activities, demand for on-time delivery, rapid change in technology, and short product shelf-life call for supply chain risk management (Olson & Wu, 2011). Supply chain risk management is a risk management discipline that looks to identify possible disruptions to manufacturing production and financial performance.

Kauppi *et al.* (2016) stated the supply chain risk management as the identification and management of supply chain risk, using a coordinated approach with supply chain members to reduce vulnerability to the supply chain network. According to Fan *et el.* (2017), supply chain risk management is an information-intensive process involving the acquisition and timely utilisation of the relevant information, necessitating attention to the information aspect of managing risk. Shou *et al.* (2018) state that supply chain risk management is complemented with supplier integration to access reliable, timely information. Thun and Hoenig (2011) defined it as identifying and reducing risks at the firm level and the entire supply chain. From the definitions, supply chain risk management aims to reduce the vulnerability of the supply chain using a coordinated, holistic approach that involves supply chain members identifying and analysing the risk of failure points within the supply chain.

Supply chain risk management has become challenging because of two factors. The first factor is the environment in which the supply chain operates, which has become increasingly dynamic and disaster-prone. According to Glendon and Bird (2013), the major environmental disruptions are natural disasters, IT outages, and supplier service issues. The increasing competitive pressure, outsourcing, and offshoring form the second factor that challenges supply chain risk management

(Blackhurst, Dunn, & Craighead, 2011). The increase makes monitoring and engaging the supplier more difficult. These combined factors make the supply chain networks susceptible to disruptions (Kim, Chen, & Linderman, 2015). To understand more about supply chain risk, there are several other researchers who put forward definitions related to supply chain risk. Table 2.4 shows the definitions that have been used in such research.

Table 2.4: Definitions of supply chain risk management

No.	References	Definitions
1	Zsidin, Panelli and Upton (2000)	"The transpiration of significant and/or disappointing failures with inbound goods and services."
2	Juttner, Peek and Christopher (2003)	"Probability of disruption in any part of supply chain caused by internal or external sources that can impact objective of network negatively."
3	Zsidisin (2003)	"Supply chain risk is probability of an event in supply chain due to supplier failure or any market issue that result of inability to meet customer satisfaction."
4	Giunipero and Eltantawy (2004)	This study has described supply chain risk management as formal process and explain that it includes identification of potential damages, understand their chance of accordance and suggest a proper strategy to manage it.
5	Norrman and Jansson (2004)	Supply chain risk management aim is to apply tools, in collaboration with their fellows that deal with logistic related risks.
6	Choi and Krause (2006)	"Combination of probability or frequency of occurrence of a defined hazard and magnitude of the occurrence."
7	Faisal, Banwet, and Shankar (2006)	"Supply chain risk management is a process to mitigate the risks through coordination, collaboration, and application of SCRM techniques to ensure the long-term continuity and profitability of all partners."
8	Gaonkar and Viswanadham, (2007)	Variation in possible outcome in supply chain, its chance of occurrence and level of effect.
9	Gaonkar and Viswanadham, (2007)	The book "supply chain risk management minimising disruptions in global sourcing" describes the definition of supply chain risk management in the perspectives of customer, supplier, and company. According to it supply chain risk is identification of disruption in operation or production that also affect the other parts of supply chain.
10	Goh, Lim and Meng (2007)	"Supply chain risk management is defined as the identification and management of risks within the supply network and externally through a coordinated approach amongst supply chain members to reduce supply chain vulnerability as a whole."
11	Shahbaz, Rasi, Ahmad and Rehman (2017)	"Global supply chain risk management is the identification and evaluation of risks and consequent losses in the global supply chain, and implementation of appropriate strategies through a coordinated approach among supply chain members with the objective of reducing one or more of the following—losses, probability, speed of event, speed of losses, the time for detection of the events, frequency, or exposure—for supply chain outcomes that in turn lead to close matching of actual cost savings and profitability with those desired".

Table 2.4 (continued)

12	Carter and Rogers (2008)	The capability of the organization to realize and manage its environmental, economic, and social risks.
13	Oehmen, Ziegenbein, Alard and Schönsleben (2009)	The difference in the dissemination of potential supply chain outcome, its possibility, and its individual values.
14	Kumar, Tiwari and Babiceanu (2010)	The potential variation from the primary objective, the ultimately decrease the values at different stages of supply chain.
15	Yang and Yang (2010)	The unexpected result from different operations of supply chain.
16	Tummala and Schoenherr (2011)	"Supply chain risk management process is a tool to provide management with useful and strategic information concerning the supply chain risk profiles associated with a given situation. This is in contrast to the traditional approach based on single point estimates."
17	Lavastre, Gunasekaran, and Spalanzani (2012)	"supply chain risk management refers to risks that can modify or prevent part of the movement and efficient flow of information, materials and products between the actors of a supply chain within an organization, or among actors in a global supply chain (from the supplier's supplier to the customer's customer). Supply chain risk management can be seen as the capacity to be agile."
18	Ganesh and Kalpana (2022)	Supply chain risk management referring to the encompassing identification of mitigating, assessing and monitoring the risk or unexpected events.

Table 2.4 indicates the definition of the supply chain risk management, it can be concluded that the supply chain risk management is to manage, control and prevent the risk in supply chain. Ganesh and Kalpana (2022) stated that the supply chain risk management is referring to the mitigating, assessing, and monitoring the uncertainty events or risk either internal or external risk. Managing the supply chain become a challenging task due to the increasingly market uncertainties in supply chain demand, increasing of vulnerability risk (Rangel *et al.*, 2015). Firms need to apply the risk management in the organisations to keep the risk under control. With current situation of covid-19 global pandemic, managing the risk is become a vital in supply chain. Procurement teams faced a difficulty in seeking a supplier and shipping availability to enables the supply chain responsiveness (Jessop, 2020). Jessop (2020) state that there is no on size-fits- all metric approach to managing the risk during disruption. However, with risk management it can reduce the risk and enable smooth product flows. In managing the risk in supply chain, the involvement of parties in supply chain management plays an important role in measuring, monitoring, and mitigating the risk. Tummala and Schoenherr (2011) and Ganesh and Kalpana (2022) stated there is three

phases in managing the risk which is phase 1 to identify, measure and assess the risk, phase 2 is to evaluate, mitigate and plan contingency the risk, and the last phase is to control, monitoring the progress of action plan for the risk.

Supply chain management team involvement in managing the supply chain risk playing an important role to maintain the uninterrupted supply of good and services in firms and it helps to reduce the vulnerability of the supply chain. The team involvement in managing the risk is important in supply chain risk to helps the organisations to reducing the vulnerability and disruptions of risk in supply chain management improves the efficiency and effectiveness of the performance in firms. Therefore, it is crucial to implement the supply chain risk management in firm to prevent and control any risk happens in supply chain activities which can negatively affect the performance of firms. With the existence of the supply chain risk management, helps in handling any risks in future either internal risk or external risk and enhancing the performance of firms.

2.4.1 Dimension of supply chain risk management

The understanding of risk is universal because it involves several activities in each level of management such as finance, strategy, production, marketing, and accounting (Lavastre *et al.,* 2014). Various risks can be seen through a variety of perspectives in the supply chain (Christopher & Peck, 2004). Risk management is a key part for every enterprise that the owner must deal with. Proper risk management in all departments of an organisation is one of the guarantees of success. Risk is one of the factors that the owner must bear in every type of businesses. It is possible that how often something unprofitable will happen, and how much loss is likely to happen when the risk is not manageable and prevented (Yang-Ngam, Chankoson & Aodton, 2019). Top managers need to be aware of every risk faced. If neglected, it will involve long-term problems because in each management related to each other.

Supply chain risk management is critical in dealing with the challenges of today's dynamic and uncertain business environment and is widely used by firms to address rising risks (Lavastre *et al.,* 2014; Manuj *et al.,* 2014). Supply chain risk has

also been divided into dimensions, namely disruption risk and operational risk. Disruption risk refers to events caused by bankruptcy, attacks, and natural disasters, and operational risks refer to supply and demand coordination, such as uncertain demand and supply. Disruption risks are rare but difficult to manage, while operational risk is reduced through supply chain management.

From the various dimensions identified by the authors, supply chain risks can be classified into two. The first one is internal risks that consist of process and control risks caused by the capabilities of the supply chain and strategies and management decisions. The second is external risks that are outside the supply chain. It includes risk from demand variability because of the unstable market, an increase in the price of resources, reputation harm by social responsibility (Munir *et al.*, 2020; Wieland *et al.*, 2013). Vishnu *et al.*, (2019) classify the risk into five part which is supply risk, demand risk, control risk, information risk, process risk and environmental risk which is causes to the disruption in supply chain flows. Therefore, in this study the researcher classifies the risk into two part which is internal risk and external risk.

2.4.2.1 Internal risk

In the supply chain, the internal risk is described as a management risk. According to Abdel-Basset *et al.* (2019), internal risk is the summation of manufacturing risks, business risks, planning and control risks, mitigation and contingency risks, and cultural risks. Manufacturing risks occur due to the disturbance within the operation; business risks are from alterations to the key structures, planning and control risks are caused by inappropriate estimation and planning, which lead to ineffective management, mitigation, and contingency planning. Cultural risks arise when contingencies and alternative solutions are not implemented in the event of a disruption, and cultural risks arise because the business culture tends to bury or postpone negative information (Abdel-Basset *et al.*, 2019). Internal driven supply chain risk by Bode, Kemmerling and Wagner (2013) explains three types of push which are push from demand side risk, supply side risk, and infrastructure risk. Demand-side risk refers to supply chain disruptions that can emerge from downstream

supply chain operations. For the supply-side risk, supplier business risks relate to disruptions that affect the continuity of the supplier and result in the interruption or the termination of the buyer-supplier relationship. Lastly, infrastructure risk was included potential disruptions that evolve from the infrastructure that a firm maintains for its supply chain operations. Therefore, the internal risk needs more attention especially managing and controlling the risk in order to prevent the disruption happens in the organisation especially in the supply chain activities.

2.4.2.2 External risk

External risks refer to uncontrolled risks in the supply chain. It is categorized into demand risks, supply risks, environmental risks, business risks, and physical plant risks (Abdel-Basset *et al.*, 2019). Demand risks occur due to unexpected customer demand; supply risks are due to obstruction of product flow (be it materials or parts of the supply chain). Environmental risk is usually influenced by governmental, social, economic, and climatic factors Abdel-Basset *et al.* (2019). Business risks are a result of factors like the stability of supplier finance or management and the purchase-sale of supplier companies. Physical plant risks are caused by the condition of the supplier's physical facility and regulatory compliance (Abdel-Basset *et al.*, 2019). Based on research by Bode, Kemmerling and Wagner (2013), two types of external risks was regulatory, legal, and bureaucratic risk and catastrophic risk. Regulatory, legal, and bureaucratic risk refers to law enforcement and the implementation of supply chain-related laws, regulations, rulings or policies such as trade and transport laws and the extent and frequency of changes in these regulations. Such sudden changes may lead to violations or non-compliance of laws, rules, regulations, or ethical standards. Catastrophic risk is one of the unexpected risks.

Disaster defined as critical disruption effects on the society causes on the human loses, environmental damage that cannot be local communities using their own resources and the natural disaster causes by the geographical, climate, weather, biological and hydrological (Miguel, Brito & Pereira, 2015). Ivanov and Wendler (2019) stated the impact of disaster in the supply chain can be tremendous scale

depending on the extent of the disaster on the physical, economic, social, and ecological aspects. The natural disaster such as floods, earthquakes, hurricanes, volcanic eruption and the extremely climate change of the weather affecting on the economic development and business operational (Kwok, 2018). Disasters can strike at any time and without warning or sign. Where, a large number of people are exposed to dangerous events. With the passage of time, the incidence and severity of disasters is increasing. Disasters can have serious implications for poor households because they do not have enough resources to protect themselves from disasters.

Geopolitical risk referring to the risk associated with the terrorist acts, wars, unstable of the political in country, tension between states which is effect on the peaceful of the international relations (Baur & Smales, 2018). Geopolitical risk brought to the climate changes which is lead to the conflict and effect on the performance of firms (Sekiyama 2022). The numerous threaten even force the firms to build the resilience which can effect on the continuity of the business processes (Sahebjamnia *et al.,* 2018) with the covid-19 pandemic urged the firms to operating in a new was and to look for the solution to face the interruption in supply chain, the changes of customer demand and the work-force health risk (Margherita & Heikkila, 2021; Kosieradzka *et al.,* 2022). Exchange rate risk is consistently as a top concern of the supply chain manager (Liu & Nagurney, 2011: Ogunranti *et al.,* 2021). The concern in human resource factors which is impact on the employee behaviour, belief, attitude, and intention involve in supply chain process (Shah *et al.,* 2017; Jaouadi 2022). Due to the disruptions of many reasons such as covid-19 pandemics causes to the labour shortages in firm where the illnesses, death and mitigation risk and the travel restriction happened, and it impact on the performance of firm (Nagurney 2021). Therefore, firms need to manage the supply chain risk to enhance the performance of firm.

Table 2.5: Supply chain risk items

Items	Authors
Natural disaster	Ivanov and Wendler (2019), Kwok (2018)
Geopolitical risks	Baur and Smales (2018), Sekiyama (2022)
Infrastructure outage risks	Pala and Schrum (2018)
Manufacturing risks	Faehnlel and Livshits (2021)
Theft and shrinkage	Hamdaoui *et al.* (2022), Ye, Duan and Peng (2021)

Table 2.5 (continued)

Counterfeits	Ghadge *et al.* (2021)
Business continuity policies and practices	Margherita and Heikkila (2021), Kosieradzka *et al.* (2022)
Commodity price volatility	Pellegrino *et al.* (2019)
Economic cycle	Baur and Smales (2018), Sekiyama (2022)
Demand forecast	Nia *et al.* (2021)
Exchange rate	Ogunranti *et al.* (2021) and Liu and Nagurney (2011)
Human resources risk	Shah *et al.* (2017) and Jaouadi (2022)
Labour dispute/stoppage risk	Nagurney (2021)
Data / IT Security	Raka and Liangrokapart, (2015) and Shahbaz *et al.* (2019)
Product design flow	Raka and Liangrokapart, (2015) and Shahbaz *et al.* (2019)
Sustainability and corporate social responsibility compliance	Raka and Liangrokapart, (2015) and Shahbaz *et al.* (2019)

Table 2.5 shows the items of supply chain risk that were used in this study. Each item of this study was used by the other research such as for natural disaster is by Ivanov and Wendler (2019) and Kwok (2018), where the authors investigate the natural disaster in their research in supply chain disruption management. Items of geopolitical risks were adapted from Baur and Smales (2018) and Sekiyama (2022) used in the climate change of mitigation in their study. The items of infrastructure outage risks used by Pala and Schrum (2018), manufacturing risks by Faehnlel and Livshits (2021), item of theft and shrinkage by Hamdaoui *et al.* (2022), Ye, Duan and Peng (2021), the item of counterfeits by Ghadge *et al.* (2021), the items of business continuity policies and practices by Margherita and Heikkila (2021), Kosieradzka *et al.* (2022), the item of commodity price volatility is from Pellegrino *et al.* (2019), economic cycle by Baur and Smales (2018), Sekiyama (2022), the item of demand forecast is from Nia *et al.* (2021), exchange rate is from Ogunranti *et al.* (2021), Liu and Nagurney (2011), human resources risk was from Shah *et al.* (2017), Jaouadi (2022), labour dispute/stoppage risk was from Nagurney (2021) and the items of data/IT Security, product design flow, and Sustainability and corporate social responsibility compliance was from Raka and Liangrokapart, (2015), Shahbaz *et al.* (2019). All the items of supply chain risk were adapted from the previous researcher and apply in this study.

2.5 Information sharing

Kembro and Näslund (2014) questioned the use of data and information as interchangeable terms. The authors stated that while data can be a source of information, its use as a synonym for information is misleading. This is because data is processed into contextual information, so information is regarded as a data outcome (Kembro and Näslund, 2014). Studies have linked information sharing to the improvement of the supply chain and firm performance (Pooe, Mafini, & Loury-Okoumba, 2015; Voigt & Inderfurth, 2012). The supply chain is composed of many departments and functions that require information flow to enable the synchronisation of activities (Xue, Dou, & Shang, 2020). According to Yu, Zhou, and Shi (2020), the supply chain network aims at improving circulation efficiency and adds value to the business network through the flow of information, logistics, and capital flow. Information is vital to supply chain management because it is needed for effective supply chain integration and to improve supply chain performance (Li *et al.*, 2006; Sahin & Robinson, 2002). Information sharing is also considered an essential capability to enhance supply risk management (Doetzer & Pflaum, 2021). However, it requires the firm to be prepared to efficiently utilise it (Riley *et al.*, 2016). In order to survive the post-disruptive phases, the firm needs to establish channels for information sharing in the pre-disruptive phases (Doetzer & Pflaum, 2021).

Information sharing is also responsible for product movement from manufacturer to customer (Wang *et al.*, 2018). This makes information sharing between the upstream and downstream of the supply chain important. Xue *et al.* (2020) stated that the orders in the supply chain are subject to change. These changes to customer orders create a ripple effect that can increase the order variation as the information passes through the upstream supply chain. describe this as the bullwhip effect. There is also the worry about shortages in products from the downstream supply chain, which will lead to information on more demand that distorts the upstream demand (Devika *et al.*, 2016). The information irregularities cause an endogenous shock to the supply chain, thereby resulting in the bullwhip effect (Udenio, Fransoo, & Peels, 2015). Therefore, to eliminate the bullwhip effect, information sharing is important in the supply chain (Hussain, Drake, & Lee, 2012).

Xue *et al.* (2020) noted that the traditional supply chain network has the customer in the spotlight instead of the whole supply chain. Additionally, the members of the supply chain exclusively focus on their own interests without taking the value of the entire supply chain into consideration. This makes it difficult for the old supply chain process to attain the current customer demands and technological standards. With the rapid development of information technology, a decentralised system is needed to solve the challenges in decentralised value increment of the supply chain network (Xue *et al.,* 2020). This decentralised system is only possible through information sharing. By developing an information-sharing platform, inventory, scheduling, and distributed information are possible. This will aid in the provision of high-quality services at a low cost through a peer-to-peer manner. As much as information is important, the poor quality of data generated can lead to operational challenges (Wang *et al.,* 2020).

Kembro and Näslund (2014) noticed that when defining information sharing, most studies focused on specific information like lead times and demand while others used a more general viewpoint on the information. Therefore, it is important to engage in the following with shared content (Doetzer & Pflaum, 2021). In addition, Busagara *et al.* (2020) stated that existing studies have mostly stressed insights rather than accurate customer demand as the primary goal for information sharing. Jia *et al.* (2020) provided a broader perspective for shared content by differentiating between operational and strategic data. These authors noted that strategic data is mostly shared in a closer and more trusting relationship and mainly focuses on outbound-related data. The reluctance of supply chain partners to share strategic information is not uncommon (Jia *et al.*, 2020). The practice of strategic information sharing involves risks and costs, so firms mostly resort to hoarding information and being opportunistic among their supply chain partners (Nogues, 2014). In addition, the unwillingness of a firm to share its strategic information occurs after receiving information from other supply chain partners and using that information to the detriment of the disclosing partner (Dittmann, 2013). The act of information hoarding can smear the reputation of the firm as well as decrease its profitability (Doetzer & Pflaum, 2021). Therefore, the members of the supply chain need to resist information hoarding among themselves (Dittmann, 2013). Therefore, the information sharing is one of the important elements in supply

chain activities to helps firms to interacting with the third parties such as suppliers and the customers to fulfil the customers' demands. Besides that, with information sharing its helps to enhance the efficiency and effectiveness of the interaction between internal, suppliers and the customers and in directly it achieved the performance of supply chain in firms.

2.6 Supply chain performance

Most of the researchers have done an extensive literature review on supply chain performance for last two decades (Jagan, *et al.,* 2019). Supply chain performance represents the measurement and quantify the efficiency and effectiveness of the supply chain process (Maestrini *et al.,* 2018). Maestrini *et al.* (2018) state that supply chain managers are seeking to improve organisational performance through effectiveness by using resources and capabilities to enhance the performance of the supply chain. Therefore, the appropriate performance measurement enables us to improve the efficacy and success of the supply chain (Maestrini *et al.*, 2018). Different performance measurement approaches have been developed in recent decades to assess the performance of the supply chain from different perspectives (Ramezankhani *et al.,* 2018). The improvements in efficiency in the supply chain led to a decrease in the operation and production costs (Wu *et al.,* 2016). A competitive advantage adds to a firm's profitability and guarantees business survival. It reflects the significance of supply chain performance to the economic value of members of the supply chain (Wu *et al.,* 2016).

Supply chain performance is described as the overall effectiveness and efficiency of the supply chain (Qrunfleh & Tarafdar, 2014; Shafiee, Lotfi, & Saleh, 2014). Ryoo and Kim (2015) defined supply chain performance as the benefits gained from cooperation within the supply chain, including cost reduction, efficiency improvements and enhancing cycle time. Performance is vital for evaluating operating results because it assesses business operations over some time (Chen & Yano, 2010). That is why firms must measure their performance to detect a change, be it negative or positive (Jakhar & Barua, 2014). Yeh, Pai, and Wu (2020) state that there are many

ways to measure performance and selecting the appropriate measure of supply chain performance is challenging because of the complexity and dependent characteristics of the supply chain.

According to Leuschner *et al.* (2013), performance of firm has three components: financial, non-financial, and operational performance. While financial measures involve market share, return on investments, and return on assets, non-financial measures cover fulfilling customers' needs and expectations (Chakraborty, Bhattacharya, & Dobrzykowski, 2014). The operational measure primarily focuses on identifying a firm's development capabilities in quality, flexibility, and delivery (Leuschner *et al.,* 2013). Recently, environmental performance has gained interest as a performance measure (Chakraborty *et al.,* 2014). Supply chain management is confronted with urgent challenges such as short lead time and fast delivery (Dai *et al.,* 2015). Hence, the supply chain performance one of the important elements in firms which describes the effectiveness and efficiency of the supply chain in firms, where its helps to reducing the cost involve in supply chain and in directly it improves the performance.

2.6.1 Measurement of supply chain performance

A business should have the advantage to compete in similar industries so that the company is able to capture market share and make a profit in the business it conducts. The same business pattern but different competitive strategies are differences that lie in the way companies execute processes in producing products or services that are better, cheaper, and faster than their competitors. Therefore, in the face of business competition in various industries, strategies in the form of efficiency and effectiveness are essential. In the era of globalisation requires companies to start revolutionising supply chain performance measurement system. Supply chain performance measurement is a measurement system that is able to evaluate supply chain performance holistically (Putri *et al.,* 2019). Integration of all elements contained in the supply chain performance for a firm to meet the customer demand, namely unity in terms of suppliers, manufacturing, delivery processes and customers. This is

something that is very complex because so many parties are involved and combined in the supply chain management chain (Darojat & Wuryaningtyas, 2017).

In designing a performance measurement system based on the process, the critical step that must be done is to define the core processes in the supply chain, describe the core processes into smaller parts, and calculate the resources involved in each of these process elements. Supply chain performance can benefit from supply chain integration (Li, 2015; Tarifa-Fernandez & De Burgos, 2017). Supply chain integration, according to information processing theory, can improve communication between the firm's employees and external partners, resulting in higher quality and more informed decision making. Furthermore, supply chain integration enables firms to obtain critical information about demand, technology, and strategy in a timely manner (Li, 2015). This can aid in better aligning and coordinating activities among supply chain partners, reducing waste, and providing products to customers at a faster and lower cost (Li, 2015).

Since supply chains are becoming much more complex, there is also an expanding need for measuring and evaluation of the performance of those systems to obtain important insights for supply chain optimisation. Some researchers highlight that measuring the performance of supply chains is a difficult task due to the fact that supply chains include multiple actors who collaborate to achieve both logistical and strategic goals. Nonetheless, performance assessment of the production process is critical when managing and working to develop the supply chain, and it becomes especially important in contexts where supply chain operations are regarded as a key factor in corporate success (Olugu *et al.*, 2011, Papakiriakopoulos *et al.*, 2010). Furthermore, once designing a new performance measurement system, companies operating in supply chain networks must synchronise existing business processes and data. Choosing the measures and the measurement method is not an easy task. Important challenges emerge when dealing with underlying data, business processes, and the evaluation method of a performance measurement system in supply chains (Papakiriakopoulos *et al.*, 2010).

The adoption of appropriate metrics capable of capturing the entire essence of the supply chain process is required for successful supply chain performance measurement (Estampe *et al.*, 2013). In this regard, performance measurement metrics

should enable evaluating and controlling resource performance, providing information for internal and external stakeholders, and enabling continuous performance improvement (Estampe *et al.,* 2013). Among these metrics, "cost" has long been recognised as an important metric for assessing the efficiency of the supply chain, as achieving the lowest total supply chain cost is one of the goals of supply chain management (Estampe *et al.*, 2013). Additional supply chain performance metrics can be used to assess customer satisfaction, which is widely regarded as the ultimate measure of the value generated by the supply chain (Estampe *et al.,* 2013). Gunasekaran *et al.* (2004) develop a framework that includes numerous metrics and measures related to the following supply chain performance processes: (1) plan, (2) source, (3) make/assemble, and (4) delivery/customer. Furthermore, depending on the specific research conducted, different or additional supply chain performance measures may be considered and implemented.

Oubrahim, Sefiani and Happonen (2022) stated the supply chain performance evaluation model was divided into two categories which is financial performance model and the non-financial performance model. There are many approaches used to measure performance, such as the measurement matrix suggested by Keegan, Eiler, and Jones (1989), the balanced scorecard suggested by Kapian and Norton (1992), criteria for measurement system design by Globerson (1985), and the performance measurement questionnaire by Dixon, Nanni, and Vollmann (1990). Shepherd and Günter (2010) identified short-termism, lack of strategic focus (not aligning with strategic goals, organisational culture, and reward systems), local optimisation, and providing inadequate information on what competitors through benchmarking are doing as limitations to these measuring systems in the manufacturing industry. Stefanovic (2014) opined that the systems for measuring performance should be comprised of certain features. These features include fulfilling an overall strategy, being simple and easy to use, timely and factual, consistent, and supporting proactive management (instead of reactive).

2.6.2 Supply chain performance model

In supply chain management, there is various models available and can be used in the industries such as Supply Chain Operations Model (SCOM), Supply Chain Operations Reference (SCOR) Model, Supply Chain Process Model and Supply Chain Collaboration Level Model (SCCLM), Activity-Based Costing (ABC), Economic Value Added (EVA), Balanced Scorecard Costing (BSC) Model, Global Supply Chain Forum (GSCF), Interface-Based Performance Evaluation System (IBPMS), Perspective-Based Performance Evaluation System (PBPS), and Knowledge –Based Performance Evaluation System (KBPMS).

The Supply Chain Council developed the SCOR model in 1996 (Sellitto *et al.,* 2015). The SCOR model is a commonly used reference framework in the supply chain sector for improving supply chain diagnosis and design (Ríos *et al.*, 2019). In addition, Ikatrinasari *et al.* (2020) mention that it is also beneficial to assist in quantifying the satisfactory supply chain management control between suppliers, firms, and customers. The SCOR model uses over 250 measurements to assess the performance of a supply chain, such as order fulfilment, order quality, and cost of goods sold (Sellitto *et al.,* 2015). The SCOR model is developed as a cross-industry standard for supply chain management, and it uses a process reference model to explain the supply chain. The reference process of the SCOR model combines business process reengineering, best practice, and benchmarking analysis (Sellitto *et al.,* 2015). Furthermore, Lestari *et al.* (2013) stated that the SCOR model is a valuable tool in supply chain performance and the SCOR model also supports the best practice module.

One criticism of the SCOR model is that it is a static tool that may not be suitable for today's dynamic adaptive supply chains (Long, 2014). Complex adaptive systems are composed of nodes and processes that, while dispersed, are interconnected. They have a nonlinear behaviour, and interactions in one node can cause complexities and uncertainty in another (Sturmberg *et al.*, 2014). However, both Sellito *et al.* (2015) and Kocaoğlu *et al.* (2013) argue that the SCOR model is an adequate performance management framework for assessing an organisation's performance. In addition, the authors mentioned that the SCOR model, with its measurement aspects focusing on incoming raw materials, purchasing price and costs, production and operating aspects, distribution, customer outcomes, rework, and returns, provides a multidimensional viewpoint from which performance can be

monitored, measured, and managed all along today's complex supply chains (Sellito *et al.*, 2015; & Kocaoğlu *et al.*, 2013). Supply chain integration and effectiveness were the goals of the SCOR model, and it provided a platform for multiple supply chain partners to communicate (Kocaoğlu *et al.*, 2013).

In manufacturing and service operations, the SCOR model has proven to be effective. The SCOR model is used to measure, define, and improve the supply chain activity in a company. Level 1 of SCOR consists of five supply chain processes, which are planning, making, sourcing, delivering, and returning (APICS, 2017). However, the return process is not included in this study because it is not among the first four processes. This study only focused on four supply chain processes that are planning, sourcing, making, and delivering, which are commonly adopted by practitioners. Level 2 of the SCOR model describes the core process, and level 3 specifies each of the processes.

Besides SCOR model, there is another supply chain process model that is a linear and nonlinear supply chain process model. The linear supply chain process is commonly used in supply chain management, where information is passed top down from manufacturer down along the bottom off supply chain (NerveWire, 2002). The non-linear supply chain process is the information regarding the supply chain activities being shared non-linearly among supplier and manufacturer.

NerveWire (2002) developed the SCCLM that measures the level of supply chain information integration and partner trading. The information is transmitted through the system, and it reveals the level of information integration of the firm. Based on the model of SCCLM defined in level 1 and level 2, it is best described as the information integration of the company's practising e-commerce or liner supply chain process. NerveWire (2002) stated that level 1 of the supply chain collaboration level model shows the information being exchanged through phone, fax, meetings, email, and mail, are considered as minimal information integration. Whereas Level 2 is the moderate integration of information that indicates information being exchanged through an online view of the information on the database and electronic exchange with limited abilities to change other databases. (NerveWire, 2002). In addition, level 3 represents the information being integrated by the automated transaction between other databases and computer applications, and level 3 is considered to have high

information integration. The 4th level is a very high level of information integration with the trading partner, which indicates the information being integrated through the shared database and the application. The process information integration of level 4 is redesigned, redundancies are eliminated, and the activities of this level are moved to appropriate partners (NerveWire, 2002).

Lambert *et al.* (2005) introduced the Global Supply Chain Form (GSCF) as one of the supply chain management strategy and reference models. The GSCF framework includes eight supply chain management processes, which are customer relationship management, customer service management, demand management, order fulfilment, manufacturing flow management, supplier relationship management, product development and commercialisation, as well as returns management. However, the scope of GSCF in supply chain management is limited to the successful implementation of the macro-business process. The SCOM was develop by Hugos (2006) which is to manage the problem and issues of supply chain operational at micro level of firms. The SCOM model classify to four operational categories which is plan source, make and delivery.

The Activity-Based Costing (ABC) develop by Harvard Business School in 1987 where the model used to analysis the margin and cost. Model of Economic Value Added (EVA) was built by Stern in 1995 to measure the prediction of return on investment in firm. The Balanced Scorecard Model (BSM) was developed by the Kaplan and Norton in 1992 to evaluate the long-term corporation performance from the multi perspective such as financial, internal of business process, growth and learning, and customer perspectives. The model of Global Supply Chain Forum (GSCM) establishes by Ohio State University in 1994 to describe the standards of supply chain processes at different level of decision making. The focus of GSCM is in the supply chain network, supply chain component and in the supply chain processes. In year of 2001 Ohio State University also introduce the Interface-Based Performance Evaluation System (IBMS) aimed to track the customer relationship management and the supplier relationship management system to engage with each stage in supply chain. Perspective-Based Performance Evaluation System (PBPS) was built by Otto and Kotzab (2003) as inter-functional measurement systems to measure six main perspectives which is system dynamics, operations research, marketing, logistics,

organisation, and strategy. The model of Knowledge –Based Performance Evaluation System (KBPMS) developed due to industry 4.0 and digitalisation requirement and the knowledge of decision maker was needed to assess the supply chain performance (Oubrahim *et al.*, 2022).

Table 2.6 summarizes the models that can be used to evaluate supply chain performance in terms of the models' functions, and the strength, weaknesses, opportunity, and threat. Oubrahim *et al.* (2022) stated the models enables traceability and transparency of supply chain activities which are helpful for supply chain decision and evaluate its overall performance. The SCOM model is adopted in this study due to its ability to measure supply chain performance, especially in term of planning, making, sourcing, and delivering of the supply chain performance.

Table 2.6: Summary of supply chain model.

Model		Descriptions	Functions	Strength, Weaknesses, Opportunities, Threat (SWOT)
1	SCOR Model (Supply Chain Council (2008)	Divide into four level which every level has its own operational activities.	Level 1 – five categories of supply chain operation is Plan, Source, Make, Deliver and Return processing. Level 2 – Configure making model. Level 3 – Identify the key business activities. Level 4 - Specific implementation of supply chain management.	S: well, establish, comprehensive framework for supply chain management. W: complex and difficult to implement for smaller companies O: benchmark and compare supply chain performance across difference organisation and industries T: May become outdated or less relevant as supply chain practice evolve.
2	Linear Supply Chain Process	Commonly used in supply chain management where the information is pass from top to down.	The information is passed from top to down which is from manufacturer to down along bottom off supply chain.	S: Provide clear and structured approach to managing supply chain activities W: Can be overly and inflexible, making it difficult to adapt to change in the supply chain environment. O: Can be used as a basis for developing more sophisticated supply chain models that account for the nuances and complexities of modern supply chain. T: May become obsolete as supply chains continue to evolve and become more complex.

Table 2.6 (continued)

3	Global Supply Chain Forum (GSCF) (Lambert *et al.*, 2005)	The key activities are related to the successful implementation of the macro-business process in SCM	The implementation is carried out through three primary elements which are the supply chain network structure, business processes, and the management components.	S: Offers a comprehensive and integrated framework for managing global supply chains. W: Complex and difficult to implement for smaller organisations or less mature supply chains. O: Help the organisations improve their global supply chain management practices and achieve greater efficiencies. T: May become outdated as global supply chain management practices continue to evolve.
4	Supply Chain Collaboration Level Model (SCCLM) (Nerve Wire, 2002)	Takes the level information integration as indication to the supply chain collaboration level.	Level 1 – minimal information integration. Level 2 – moderate information integration Level 3 –high information integration Level 4 – very high information integration.	S: Provides a clear and simple framework for assessing the level of collaboration in supply chain. W: May oversimplify the complex nature of supply chain collaboration and the interdependencies between different elements of the supply chain. O: Used as a starting point for organisations looking to improve their supply chain collaboration practices. T: May become outdated as supply chain collaboration practices continue to evolve.

Table 2.6 (continued)

5	Supply Chain Operation Model (SCOM) (Hugos, 2006)	SCOM manage the issues in the supply chain at a micro level based on the operational category	Has four categories of operational which is plan, sources, make and deliver.	S: provides a comprehensive framework for managing and optimising supply chain operations. W: May require significant investment in technology and infrastructure to implement effectively. O: Help organisations improve their supply chain performance and gain a competitive advantage. T: May be supplanted by newer, more advanced models or frameworks that better account for emerging trend and challenges in supply chain operations.
6	Activity-Based Costing (ABC) (Harvard Business School, 1987).	Analysing the cost and margin	Phase 1: identifying the firm operations and various products to map processes Phase 2: assignment of the workloads and working hours to the various operations Phase 3: Develop performance indicator system for assess the output of cost-generating activities. Phase 4: Identify the number of resources to utilised per product which is related to the expenses Phase 5: Determine the detailed cost by activity.	S: Provides more accurate way of allocating costs to products and services based on their actual consumption of resources. W: Complex and difficult to implement for smaller organisations or less sophisticated cost accounting systems. O: Help the organisations to achieve greater accuracy and precision in their cost accounting practices. T: Become outdated as cost accounting practices continue evolve.

Table 2.6 (continued)

7	Economic Value Added (EVA) (Stern, 1995)	To measure the organisation value which is focusing on the operational profits over the capital employed which is through debt and equity.	Measuring the return on capital.	S: Provides a measure of company true economic profits, taking into account the cost of capital. W: Complex and difficult to implement for smaller organisations or those with less sophisticated financial reporting systems. O: Help the organisations to achieve greater accuracy and precision in their financial performance measurement and reporting. T: Become outdated as financial performance measurement practices continue to evolve.
8	Balanced Scorecard Costing (BSC) Model (Kaplan & Nortan, 1996)	The BSC model includes the traditional financial performance measurement reflected with the past performance and the non-financial operational which is represent the future performance drivers.	Evaluate the long-term team cooperation performance from the multi perspectives such as financial, learning and growth, internal business, and customer perspectives.	S: Provides a balance and integrated approach to performance measurement and management, incorporating financial and non-financial metrics. W: Complex and difficult to implement for smaller organisations or those with less sophisticated performance management systems. O: Use to identify areas for innovation and continuous improvement in performance management. T: supplanted by newer and more advanced models for emerging trends and challenges in performance.

Table 2.6 (continued)

9	Global Supply Chain Forum (GSCF) (Ohio State University, 1994)	Describe the standard supply chain process at different level of decision making.	Eight cores of GSCF are customer service management, customer service relationship management, manage the manufacturing flows, demand management, order fulfilment, product development and marketing, supplier, and relationship management, and returns management.	S: Can be align supply chain strategy with overall business strategy. W: Difficult to implement for the smaller organisations. O: Can facilitate more informed decision making around the supplier selection, logistics, and the inventory management. T: outdated as supply chain management practices continue to evolve.
10	Interface-Based Performance Evaluation System (IBPMS) (Ohio State University, 2001)	IBMS develop to describe the performance of shareholder value which is to maximise shareholder value in supply chain	To keep track the customer and supplier relationship management in supply chain.	S: Focuses on the key interfaces between different entities in the supply chain, such as suppliers, manufacturers, distributors, and customers. W: Complex and difficult to understand for some supply chain participants. O: Help in identify the areas of improvement in supply chain and lead to better decision making. T: Face resistance from supply chain participants who are reluctant to share data or collaborate with other entities.

Table 2.6 (continued)

11	Perspective-Based Performance Evaluation System (PBPS)	Evaluate the supply chain performance in six main perspectives which is system dynamic, operations research, logistics, marketing, organisations, and strategy.	Inter-functional measurement system.	S: Provides comprehensive framework for assessing performance that aligned with the strategy goals of supply chain. W: Require significant resources including time, money, and expertise to implement and maintain. O: Can facilitate collaboration and communication between different entities in supply chain. T: Not effective in complex and dynamic supply chains with high levels of uncertainty.
12	Knowledge –Based Performance Evaluation System (KBPMS)	KBPMS	Evaluate the supply chain performance based on the decision makers knowledge	S: incorporates knowledge-based metrics including knowledge creation, knowledge sharing, and knowledge utilisation, to evaluate supply chain performance. W: Not suitable for the smaller supply chains with limited resources and capabilities. O: Integrated with other supply chain management tools, such as ERP systems and supply chain management software. T: Difficult to understand or to implement for some of the supply chain participatnts.

2.6.2.1 Supply chain operations model (SCOM)

Operational performance can be expressed in five basic elements, which are delivery time, low cost, quality, flexibility, and innovates (Jitpaibon *et al.*, 2016; Gu *et al.*, 2017). Hugos (2006) categorised the supply chain operational model into planning, sourcing, making, and delivering.

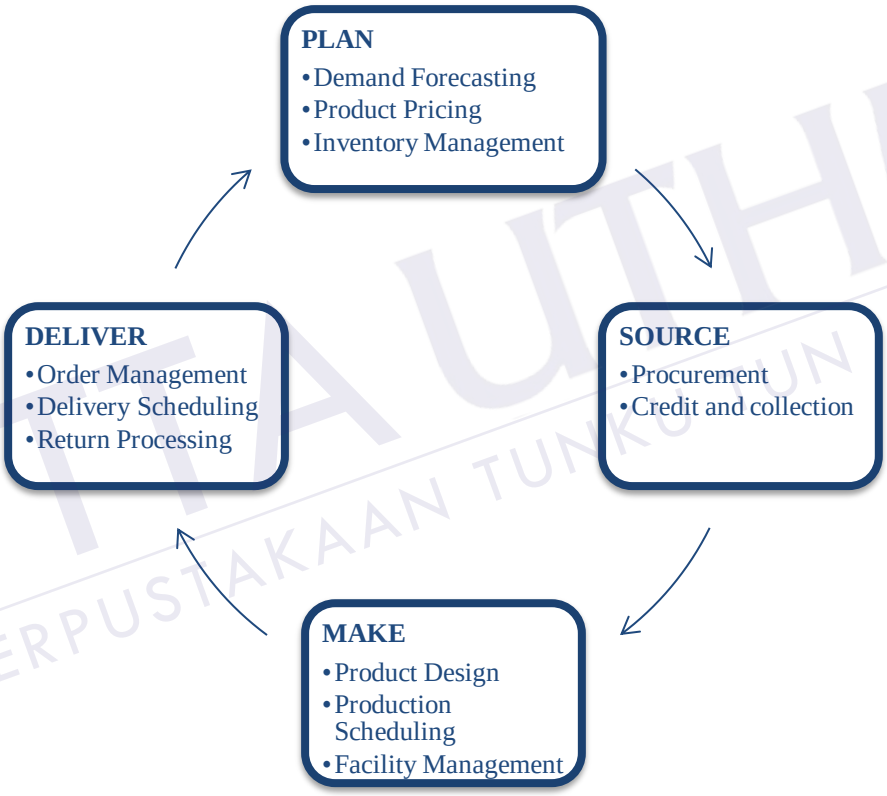

Figure 2.2: Supply Chain Operations Model (Hugos, 2006)

1) Plan

This includes activities carried out to balance the demand and supply aggregate and develop the best course of action for effective sourcing, production, and delivery requirements. It is comprised of three activities, namely demand forecasting, product pricing, and inventory management (Hugos, 2006).

i) Demand Forecasting

Supply chain management itself refer to the management of demand and supply within and across the companies (Chopra, 2019). Demand and supply have the strong relationship and their mismatch could disrupt the functioning of supply chain by intervening the flow of materials, products, or information (Ríos, Duque & Gómez, 2019). Without the good demand from market or customers, there is no necessity for the company to continue the business operation. The demand also influences the company's logistic planning and production operation (Lapinskaitė & Kuckailytė, 2014).

The accurate forecast for the product demand is vital to allow the adjustment for production and stock availability in minimising the loss of product especially when it involves the product with short lifespan such as milk and food products (Barbosa, Christo & Costa, 2015; Puspitorini *et al.*, 2018). There are many methods that can be used for demand forecasting such as the development of mathematical model from the historical data, administrative experience, and customer reviews (Barbosa *et al.*, 2015; Dubey, Chavas & Veeramani, 2018; Mohammed & Jaber, 2017). The selection of forecasting method depends on the amount of time allocated by the planning managers to calculate the actual demand from customers (Barbosa *et al.*, 2015).

ii) Product pricing

The reasonable product pricing is one of the crucial aspects to sustain the company in the competitive market (Lapinskaitė & Kuckailytė, 2014). The decision on product pricing must be made according to the product costing, product quality, customer preference as well as price range set by the competitors for ensuring maximum profit (Li & Chen, 2018). Product costing enables the company to determine which product cost more and which product contribute to the highest yield. The strategy for the timing of the price revelation must also be carefully organised to keep the company at the competitive advantage (Li & Chen, 2018).

iii) Inventory Management

Inventory management is defined as the continuous process which involves the planning, organising, and controlling of inventory to optimise the investment in

inventory while providing balance between supply and demand (Singh & Verma, 2017). This process is the monitoring of supply, storage and accessibility of products to ensure adequate supply and prevent the excessive supply (Singh & Verma, 2017). Inventory management was applied from the beginning of raw materials inventory until the final generation of end-products. Among the scope of inventory management are transportation cost of inventory, asset management, inventory forecasting, replenishment lead time, quality management and available space for the inventory (Kumar, 2016).

2) Source

This system involves the procurement process which include the finding, negotiating, and evaluating and selecting various stakeholders such as supplier, vendor, retailer or distributor (Delipinar & Kocaoglu, 2016). The identification and mapping of stakeholders at the different stages in the supply chain management could be done through the stakeholder analysis (Hugos, 2006).

i) Procurement

Procurement is the application of supply management knowledge which involves the identification, sourcing, access, and management of external sources required by firms to fulfil their strategic goals (Lysons, 2020). According to Beroe Advantage Procurement Inc. (2021), among the important steps in the procurement process are purchasing, consumption management, vendor selection, contract negotiation, and contract management.

a) Purchasing mainly involves transactional and commercial activities such as ordering items with low supply risk, contacting suppliers or vendors, maintaining inventory, issuing, and storing the receipt, and arranging the related payment (Lysons, 2020). Purchasing can be divided into two main categories, which are small and bulk purchases, depending on the volume, product specification, complexity, essentiality, fragility, variability, and economic value (Parikh & Joshi, 2005). A bulk purchase is usually a purchase made for high volume items and often includes the price negotiation process once a year. A small purchase involves an item which is not urgently needed.

b) Consumption management begins with the identification of a potential market, the quantity of products sold, and the leading suppliers (Hugos, 2006). Despite the growing share of purchased services and products, their management is not given much attention when compared to the cost management of direct and indirect goods (Chopra, 2019). To ensure sustainable consumption and production, data coordination and experience must be collected by the industry stakeholders for further optimisation analysis (Govindan, 2018). For instance, in the food industry, failure to understand the quantity of every product purchased by different levels of consumers could lead to food wastage, loss margin, and environmental issues (Govindan, 2018).

c) Vendor selection is critical in the purchasing process and serves as the foundation for all other activities in the supply chain operation (Hugos, 2006). The main objective of good vendor selection is to find the appropriate vendor who can balance between fulfilling the buyer's demand and delivering good product quality (Taherdoost & Brard, 2019). There is a certain time when the number of recognised vendors is not sufficient. Hence, a detailed investigation into the supply market research should be done to tackle this situation (Taherdoost & Brard, 2019). The vendor selection process comprises of four major steps, which are the determination of subcontracting method, construction of preliminary bench marking for the potential vendors or suppliers, preparation of the request for quotation and analysis of the received bids, and finally, the selection of vendors (Van Weele & Van Raaij, 2014).

d) Contract negotiation is the process in which one party intends to reach an agreement with another party (Mohammed & Jaber, 2017). In business negotiations, the company would exchange offers and seek agreement on the contracts from the selected vendors. Among the typical negotiations made are on the product price, quantity, and specifications (Wu & Kersten, 2017). Due to the advancement of digital technologies, contract negotiation through online platforms has been widely applied (Wu & Kersten, 2017). Thus, suppliers must increase the capabilities to set up the desired internet connection and be very responsive towards the customer’s request for efficient negotiation and purchasing process.

e) Contract management contracts act as the basic channel for communication and relationship management between the buyer and supplier (Dubey *et al.*, 2018). If the contract fails to adequately highlight the responsibilities of both the buyer and the supplier, the monetary and human resources invested in the supply chain will be jeopardised (Dubey *et al.*, 2018). In the short term, good contract management would make certain that the product or service is successfully conveyed; in the long term, it would assist in sustaining the business in the supply chain network (Dubey *et al.*, 2018).

ii) Credit and collections

Credit and collection are the process by which a company obtains its money. The company should ensure that the collection of invoices from the customer is made promptly while maintaining a good relationship with the customer (Poot, 2020). The company must start the collection procedure as soon as the invoice is past due to resolve any problems related to delay of credit payment. The management practice for credit and collection is usually evaluated through the financial audit and collection operation, including planning, organisation, and staffing, leadership, and management coordination (Poot, 2020).

3) Make

This stage mainly focuses on the product manufacturing to meet the specified time and quality from the preparation of raw material to the final packaging of product (Delipinar & Kocaoglu, 2016). Three important elements in this stage that are product design, production scheduling, and facility management are discussed below.

i) Product design

The integration of product design into the supply chain could expand the company's competitive capabilities and communication, as well as increase the supply chain's visibility and responsiveness (Khan *et al.*, 2016). Apart from that, the risk related to the supply chain could also be minimised to sustain the business performance. Product design determines the achievement of a company in delivering the right product based on the marketplace and customer needs (Khan *et al.*, 2016). Many new products have

been produced from research and development but are unable to compete in the global market because of several product performance issues such as quality and cost (Ahmad *et al.,* 2018). Some of the new products designed are also not capable of matching the requirements of process design and machine capability (Ahmad *et al.,* 2018). Therefore, it is very important to analyse the markets, customer needs, and competitors to enable the production of on-target products. However, many companies still do not realise the importance of product design towards the performance of new products (Ahmad *et al.,* 2018). In most cases, it is because the upstream focus is more on monetary, material, or order exchanges (Ahmad *et al.,* 2018; Ding *et al.,* 2011).

ii) Production scheduling

Scheduling refers to the short-term execution plan of a production planning model. In production, proper scheduling allows the manufacturing preparation and continuity of the manufacturing process (Lapinskaitė & Kuckailytė, 2014). The exact coordination of production and distribution is important since both are classified as the main business processes in supply chain management (Agnetis *et al.,* 2017). According to Hugos (2018), the purpose of production scheduling is to achieve stability between the three elements, which are high utilisation rates, low inventory levels, and high levels of customer service. High utilisation rates imply that the long production run is carried out using centralised manufacturing and distribution centers, whereas low inventory levels imply that the short production run is carried out precisely at raw material delivery (Hugos. 2018). The short production run is carried out to lessen the assets and cash tied up in inventory. Another element, which is the high levels of customer service, is often applied to provide the customer with a fast delivery of product by maintaining a high inventory level or performing a series of many short production runs (Hugos, 2018).

iii) Facility management

According to Pärn, Edwards and Sing (2017), facility management is an integrated approach to maintain, develop, and adopt the buildings for the fulfilment of core business objectives. Meanwhile, the International Facility Management Association (IFMA) described facility management as a profession that unifies multiple disciplines

to ensure the functionality of the built environment through the integration of people, place, process, and technology (IFMA, 2018). The facilities such as production machines and storage areas must be regularly maintained to ensure efficient production and distribution of products (IFMA, 2018).

4) Deliver

This stage encompasses the activities that convey the product or service produced by the company to meet the actual customer's demand (Delipinar & Kocaoglu, 2016). It includes all activities that are involved in the delivery of trade, services, or finished products from the warehouse to the outlets (Lapinskaitė & Kuckailytė, 2014). The delivery consists of three operations that are order management, delivery scheduling, and the return process. The first activity is order management, in which the order from the customer and the delivery schedule to deliver the product to the customers are sorted and managed (Lapinskaitė & Kuckailytė, 2014). Order management is important to increase the capability of fulfilling customer demand and ensuring their full satisfaction (Lapinskaitė & Kuckailytė, 2014). When the order received is listed and sorted accordingly based on the quantity and final location, it is easier to plan for the delivery schedule (Lapinskaitė & Kuckailytė, 2014).

Next, the delivery scheduling is arranged to convey the desired amount of product to the customers. At this stage, the optimal proportion between the weight and quantity of product and the right transportation mode, including the delivery time restriction, must be taken into consideration (Lapinskaitė & Kuckailytė, 2014). There are two modes of delivery, namely direct deliveries and milk run deliveries. Direct deliveries are those made from one originating location to one receiving location, whereas milk run deliveries are those made via a predetermined route (Puspitorini *et al.,* 2018). The latter mode of delivery originated from the dairy industry, which considered the determination of route, schedule, time, and number of components sent to the customers. This mode of delivery is suitable to reduce transportation costs when fulfilling orders from the low production demand areas (Puspitorini *et al.,* 2018).

The third activity, which is the return process, involves the returning of received products (Delipinar & Kocaoglu, 2016). The delivery of the wrong product, the supply of a defective or damaged product during transit, and the delivery of an

excessive quantity of product are all common reasons for the return process. In certain industries, especially the food and beverage industry, it also includes the returns of components such as pellets or containers (Puspitorini *et al.,* 2018). The frequency and cost for returning process must be monitored so that any precaution could be taken for the next transportation process (Puspitorini *et al.,* 2018).

2.7 Previous research on the relationship between supply chain integration, risk management, information sharing and supply chain performance

There have been tremendous research studying issues related to supply chain aspects and Small Medium Enterprises around the world. This indicates that supply chain is a vast area that can be explored from different aspects in for improvement. Based on the variables of this research, example of past studies has been identified from online search engines. This includes supply chain integration and SMEs, supply chain risk management and SMEs, and supply chain and information sharing. These examples of prior studies primarily provide researchers with an early perspective and state-of-the-art of the supply chain and SMEs, which aids in doing the real research and serves as an early exploration of related issues.

Previously, research related to supply chain integration can be identified revolves around several topic including the impact and effect of the implementation of supply chain integration towards several variables. The variables include impact of supply chain integration on business (Alsadi *et al.,* 2021; Borazon & Supangco, 2020; Suliman & System, 2020; Sutanto & Japutra, 2021), impact of supply chain integration on technology innovation (Abudaqa *et al.,* 2020; Alsadi *et al.,* 2021) and impact of SCI towards the management including Corporate Social Responsibility (Figiel & Michalski, 2018). The studies of impact and effect of supply chain integration towards business and stakeholders provide benefit to the SMEs in determining their business plan especially as they require more flexible cooperative relationship due to their nature of business (Ghofar *et al.,* 2020).

Furthermore, prior research of supply chain integration also shows there are vast research has been done relating supply chain integration and the green technology

as well as the sustainability elements. The term Green Supply Chain Integration has been used by several studies (Effendi *et al.,* 2021; Setyadi, 2019) to indicates the combination of green concept in the supply chain integration. Among the interesting findings from the green supply chain integration research shows that green supply chain integration has a positive and important impact on technology innovation performance (Effendi *et al.,* 2021). Apart from greening supply chain integration, the concept of sustainability also is one of the highest issues research projects in the past studies. The concept of sustainability that has been studied together with supply chain integration includes sustainable development (Sharabati *et al.,* 2020), sustainable supply chain (Junaid *et al.,* 2021; Lee, 2021; Sutrisno & Kumar, 2022) and sustainable advantages (Shou *et al.,* 2022). Other than that, there are also prior studies that focus on the role of various stakeholders in SMEs that relate to the supply chain integration as well as the role of supply chain integration towards the company performances (Erboz *et al.,* 2021; Piprani *et al.,* 2020).

As the world grapples with the Covid-19 epidemic, scholars from all around the world have been working on supply chain integration and Covid-19-related research projects as well. The research is centred on the function of supply chain integration as an enabler of business resilience, flexibility, and innovation in the face of the Covid-19 era's effects on the economy (Fahriyah *et al.,* 2021; Pirmanta *et al.,* 2021; Siagian *et al.,* 2021). This demonstrates the potential of supply chain integration to be employed in an endeavour to improve the economic situation, hence opening a larger range of research options.

Prior research on supply chain risk management and SMEs, on the other hand, shows the breadth of study topics. The majority of the previously found research focuses on conducting a systematic literature review of supply chain risk management (Gurtu & Johny, 2021). The analysis differs depending on the study's objective, such as existing practises (Ting *et al.,* 2020), an integrated approach (Shekarian & Parast, 2021), and the use of Block-Chain Technology and risk management in supply chain management (Rasi *et al.,* 2020). The availability of this kind of articles publication enables researchers to understand issues more easily and quickly. Following that, earlier research indicates an interest in the topic of integrating the use of technologies in supply chain management. This includes the application of artificial intelligence

(Paul,Riaz & Das 2020), the Internet of Things, and Block-Chain Technology (Wang & Wu, 2021), as well as data mining in supply chain risk management (Bonfim *et al.*, 2020; Hao, Lujie & Xiande, 2020). With the advancement of technology, it is possible that this type of study was conducted by researchers all over the world. The following study topic is the supply chain risk management analysis process, which includes supply chain risk management methods and tactics (Al-Ababneh *et al.*, 2020; Awad & Nassar, 2014; Moktadir *et al.*, 2021). Furthermore, there are research relating to Covid-19 for supply chain risk management. The research focuses on risk management measures in the face of the Covid-19 to mitigate its impact (Mcmaster *et al.*, 2020; Woong & Goh, 2021; *Sumarliah et al.*, 2021).

Finally, studies on information sharing and supply chain can be stated to be less than those on the prior topic because fewer related journal articles emerged in the search results. Nonetheless, existing research reveals several intriguing subjects that have been investigated by past academics. The topic includes studies on modelling and simulation in information sharing and supply chain performance and responsiveness (Abdulameer & Yaacob, 2020; Gouiferda, 2021; Mcmaster *et al.*, 2020; Pirmanta *et al.*, 2021; Siagian *et al.*, 2021), application of technologies in information sharing and supply chain context, including the use of industrial revolution 4.0 technologies such as internet of things, big data, information and communication technology, and genetic algorithm (Abdulameer & Yaacob, 2020; Gouiferda, 2021; Mcmaster *et al.*, 2020; Pirmanta *et al.*, 2021; Siagian *et al.*, 2021). Furthermore, there are numerous research on the influence and effect of information sharing and supply chain as well. The research concentrates on a variety of topics, including flexibility performance (Huo *et al.*, 2021; Sutanto & Utami, 2021) and the impact on customer responsiveness (Fathin *et al.*, 2021; Jen *et al.*, 2022). The customer, as a stakeholder, is also the goal for information sharing. As a result, it's critical that they obtain the proper information at the right moment.

The study mentioned above are all examples of earlier research on supply chain aspects which is integration and risk management and SMEs. Nonetheless, there are additional studies that the researchers did not include here that are relevant, particularly to the body of knowledge. The scarcity of several studies in some areas is especially noticeable, highlighting the necessity for comprehensive investigation. As

a result, the goal of this research was to fill the gaps and to provide new material to the body of knowledge. The research on supply chain and SMEs has been conducted on various aspects to improve the efficiency and effectiveness of the supply chain. Some of the topics covered in the previous studies include supply chain integration, supply chain risk management, information sharing, and supply chain performance. The impact of supply chain integration on businesses, technology innovation, and corporate social responsibility has been studied along with the integration of the green and sustainable elements. With the covid-19 pandemic, research has also focused on how supply chain integration can enable business resilience and flexibility. Additionally, studies on supply chain risk management have explored various area such as systematic literature reviews, integration of technologies, risk management methods and tactics, and risk management in the face of the covid-19 pandemic. Lastly, research on information sharing and supply chain has covered modelling and simulation, application of technologies and performance and responsiveness of the supply chain. The present study focuses on understanding the mediating effect on the supply chain risk management and information sharing on the relationship between supply chain integration and performance among Malaysian SMEs.

2.8 Theoretical foundation

The literature on the supply chain management has various theoretical foundations. Among the theories often used to understand supply chain management are contingency theory and information processing theory. According to Drazin and Van de Ven (1985), the fundamental principle of contingency theory provides a foundation on which to prepare and reduce the degree of disruption to supply chain activities in a company. Whereas the theory of information processing is the fundamental role of corporate strategy by theoretically explaining the effect of the environment on an organisation. Information processing also has a positive influence on performance (Cohen, March & Olsen 1972). The following section provide a detailed literature review on the proposed framework's hypotheses and variables, as well as their correlations in past studies.

2.8.1 Contingency theory

The essential theory underpinning the research is the contingency theory, which provides a platform for anticipating and mitigating supply chain disruptions (Drazin & Van de Ven, 1985). The concept of contingency theory is that the outcome is a fit, or consequence, of the use of various components, and an important part of the framework is that theorist builds bypasses for the disruption to reduce the influence of the disruption (Talluri *et al.,* 2013). In terms of contingency theory, theorists have posited that the appropriateness or effectiveness of risk mitigation strategies is contingent upon the internal and external environments; thus, there is no single strategy for solving a problem (Drazin & Van de Ven, 1985). Moreover, contingency theorists have observed via actual disruptions that when a response is organized and efficient, the effect of the disruption can be minimal (Drazin & Van de Ven, 1985).

Contingency theory has been applied in various areas of management, including the supply chain management. Chiesa & Cagliano (2020) found that the contingency approach is essential for the effectiveness of supply chain management and the contingency theory provided useful framework for improving the supply chain performance and resilience in the complex and dynamic business environment nowadays. Xing, Sun & Gao (2021) applied the contingency theory to examine the impact of dependency on supply chain coordination. They found that the contingency approach is necessary for the effectiveness of the supply chain coordination. Besides that, Jang, Pang & Lee (2021) found the effectiveness of information technology integration in improving the supply chain agility depended on the degree of uncertainty in the supply chain environment.

Similarly, supply chain theorists postulate that by focusing on the management of information linkages, fund flows, and the management of material flows, organisations can achieve sustained competitive advantage and business performance (Talluri *et al.*, 2013). The supply chain disruptions mitigate the damage and alleviate the confusion (Drazin & Van de Ven, 1985). As a result, to effectively manage supply chain disruptions, thus the supply chain risks, managers must plan a response strategy that includes supply chain integration (Ho *et al.*, 2015). Therefore, contingency theory is one of the theories was used in this study, where the contingency theory provides a

platform to mitigate the disruption in supply chain activities and it helps to minimalised the disruption. In directly, contingency theory helps to guide the firms to improve the performance.

2.8.2 Information processing theory

Information processing theory explains the fundamental roles of corporate strategy by theoretically explaining the effect of the environment on organisations (Cohen *et al.*, 1972). The theory focuses on using the possibility of information from managers to improve performance. In addition, the theory treats organisations as a mutually connected structure of decision-making systems. Information is inputted, processed, and outputted into the systems. Managers face various problems when they carry out the corporate strategy, the business unit strategy, and the functional strategy. To solve the problems, managers learn and apply external information and, consequently, performance can be enhanced. The basis of external information is regarded as the market or the environment. The environment reflects all the external factors, and the market can be regarded as a component of the environment. From the viewpoint of focal firms, suppliers and customers can be treated as important environmental factors (Flynn *et al.*, 2010). Information acquired from them is learnt by managers, disseminated to all departments, and applied to firms through proper processing. As a result, firms improve processes and solve problems, followed by improved performance (Tuggle & Gerwin, 1980).

From the viewpoint of information processing theory, internal collaboration is regarded as the process of absorbing and applying information acquired from suppliers and customers in internal processes. In addition, Galbraith (1973), Thompson (1967), and Nadler and Tushman (1977) ascertained that corporate information processing capability has a positive influence on performance. Similarly, Burns and Wholey (1993) asserted that information processing theory explains the behaviour of organisations that generate, adjust, and translate information in decision-making processes. Because organisations cannot possess complete knowledge when they make a decision, the behaviour of organisations means learning by managers of information

acquired from external sources such as suppliers and customers is necessary for advanced decision making (Burns & Wholey, 1993). For better decision-making, managers should secure, absorb, and apply the more detailed and correct information to connect with better performance (Burns & Wholey, 1993).

Galbraith (1973) suggested the structure of information processing theory based on the relationship between the environment and strategy from the viewpoint of information processing suggested by Cohen *et al.* (1972). Various research projects were performed from the perspective of Galbraith (1973). Tuggle and Gerwin (1980) applied strategy to information processing theory. From the internal viewpoint of firms, Gattiker and Goodhue (2004) stressed the role of enterprise resource planning on information processing theory. While from the external viewpoint of firms, Stock and Tatikonda (2004) highlighted the importance of external technology integration on performance. Premkumar, Ramamurthy, and Saunders (2005) analysed the relationships between organisations and Trkman (2010) explained the moderating effect of information systems support on the relationships between business analysis and supply chain performance. In addition, Wong *et al.* (2011) explained the moderating effect of environmental uncertainty on the relationships between integration and performance from the viewpoint of information processing theory and Schoenherr and Swink (2012) analysed the relationships between internal integration and external integration. From these viewpoints, information processing theory explains that the interaction between internal collaboration and external information enhances performance.

Study by Hu, Li and Huang (2018) used the information processing theory to investigate the factors that influence information sharing in supply chain management. They developed a model that included three key variables which is task complexity, information quality, and absorptive capacity. They found all variables have a significant impact on information sharing in supply chains. Besides, Park and Kim (2021) used information processing theory to develop a conceptual framework for understanding the effects of information sharing on supply chain performance. They stated that information sharing can improve supply chain performance by reducing uncertainty and improving decision making. Chen *et al.* (2020) using the information sharing processing theory to investigate the impact of information sharing on supply

chain performance in their context of e-commerce logistics. Their study also found the information sharing has a significant positive impact on supply chain performance and mediated by the information processing capacity. Study by Xiong, Hu and Zhang (2021) examined how the information processing capability affects the relationship between supply chain integration and the green innovation in Chinese manufacturing firms. The study found the information processing capability plays a significant role in enhancing the positive effect of the supply chain integration on the green innovation. These studies provide insights into the way in which information processing theory can be applied to supply chain management and how it can affect the supply chain capabilities and firm performance. Therefore, the information processing theory is applied in this study.

2.9 Research theoretical framework and hypothesis development

The proposed research framework for this study is shown in Figure 2.3. The variable that is "supply chain integration" is used as an independent variable for this study. The dependent variable is the supply chain performance. This study's focus is on enhancing supply chain performance. Supply chain risk and information sharing are treated as mediators in the relationship between supply chain integration and supply chain performance.

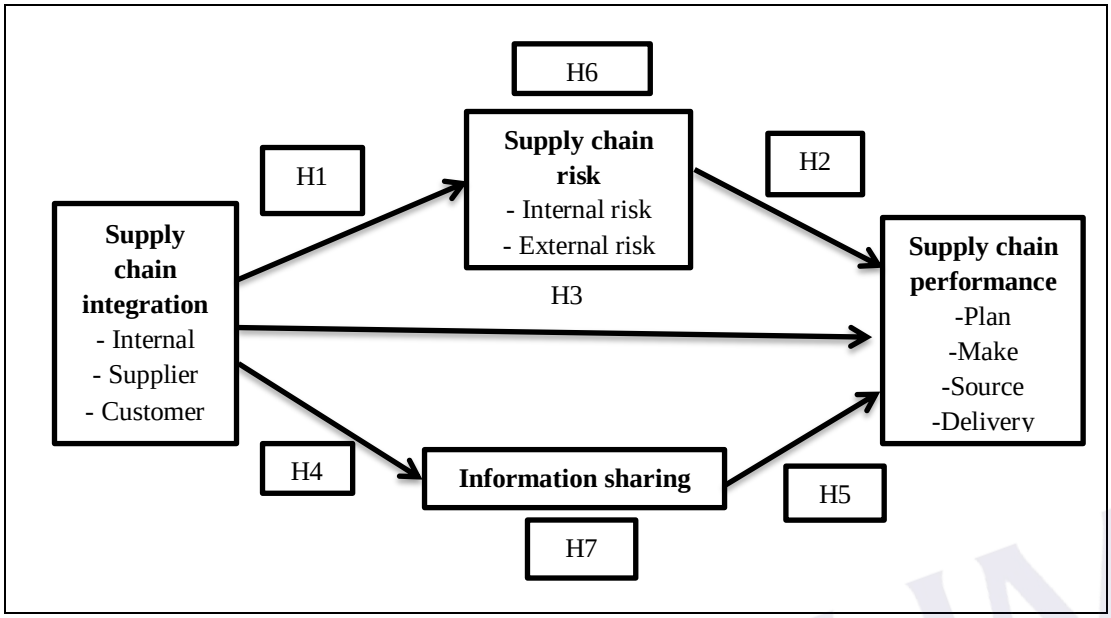

Figure 2.3: Research Framework

2.9.1 Supply chain integration and supply chain risk management

The core elements of supply chain integration are coordinate, combine, configure, and integrate (Jajja *et al.*, 2018). Vickery, Koufteros and Droge (2013) describe supply chain integration as a set of managerial and organizational activities that enables integration, learning, sensing, and coordinating. These activities cut across intra-firm and inter-firm, thus providing a network of partners that are closely linked (Jajja *et al.*, 2018). The close partnerships create a shared understanding of the need to identify and interpret opportunities in the environment efficiently and effectively. The network of partners also feeds a continual stream of new information to enhance the existing supply chain process, as well as develop new ones to respond to opportunities (Allred *et al.*, 2011). For firms to build a competitive advantage in rapid and unpredictable markets, there is a need to integrate, build, and reconfigure the supply chain process both internally and externally (Lee & Whang, 2004). Although arguments have been made for the importance of supply chain integration in a market of uncertainty, there are still limited studies supporting it (Gligor, Holcomb & Feizabadi, 2016; Jajja *et al.*, 2018).

Supply chain risk affects the distribution flow of information, materials, finance, and products within the activities of the supply chain, and it has a wider scope than that of a single firm (Munir *et al.*, 2020). Supply chain risk management literature has revealed that integrative activities can reduce supply chain risk, thereby presenting a relationship between integration and risk (Abrahamsson, Christopher & Stensson, 2015; Faisal, Banwet & Shankar, 2007). As the supply chain network becomes even more complex and competition increases in the global market, it has become critical to implement supply chain integration to mitigate supply chain risk (Jajja *et al.*, 2018). While supply chain integration might provide solutions to mitigate supply chain risk, studies have also revealed that internal and external integration positively affects supply chain agility, which aids in lessening supply chain risk (Braunscheidel & Suresh, 2009).

There is still a lack of empirical studies on the relationship between supply chain integration and supply chain risk. Munir *et al.* (2020) stated that the gap between supply chain integration and supply chain risk should be investigated. Although there are theoretically established studies on supply chain integration aiding in alleviating the risk and improving the supply chain risk, there is no empirical quantitative study to support the claim that supply chain integration is an antecedent to supply chain risk. Additionally, the argument regarding the integration of processes across multiple firms provides economic and competitive advantages, leading to inconsistent results for the relationship between supply chain integration and operational performance. Therefore, this study anticipates that supply chain integration positively influences supply chain risk.

H1: There is a significant relationship between supply chain integration and supply chain risk management among Malaysian SMEs

2.9.2 Supply chain risk management and supply chain performance

Risk is inherent in the supply chain and threatens the effectiveness of the output and indirectly affects performance of the supply chain. Supply chain risk adversely affects

the performance measures such as cost, responsiveness, and service level (Tummala & Schoenherr, 2011). It also affects logistics performance, like delays, damage, and loss (Wang, 2018). To attenuate these effects, supply chain managers will have to implement risk mitigation measures and strategies (Chowdhury & Quaddus, 2017).

El Baz and Ruel, (2021) opined that supply chain risk management can be used as a tool to manage disruptions that have a great impact on the supply chain value and performance. The supply chain risk management is to identify, assessing, mitigating, and monitoring the unexpected events which is causes to the performance of firm (Ganesh & Kaplana, 2022). Chowdhury *et al.* (2021) argued that the disruption of any form leads to loss of revenue and comes at a cost. From a commercial point of view, supply chain disruption can result in lost sales and market shares, as well as an increase in the logistics cost of meeting expedited services. Lower investor risk and cost, faster delivery of items, reduced warehousing, distribution, and transportation costs are all key benefits of a viable supply chain risk management strategy (Chowdhury *et al.*, 2021). The impact of the timely delivery of goods and services greatly improves supply chain performance (Chowdhury *et al.*, 2021).

The impact of timely delivery of goods and services on program or business performance needs no further emphasis than given by Chowdhury *et al.* (2021), who postulated its increasing criticality, with failure to deliver on time resulting in high penalties of lost sales, obsolete inventories, and expediting costs. It is then true to say that a well-designed supply chain strategy which includes a supply chain risk management plan can effectively coordinate performance, eliminate redundancies and uncertainties, and maximize efficiencies in terms of costs and speed (Chowdhury *et al.*, 2021). In addition, Tse *et al.* (2019) found that risk management in quality has a positive effect on firm performance. The element for risk management of quality is supplier development and proactive product recalls, which significantly amplify the effect on the firm's performance, which includes financial performance and quality performance. In the same way, Liu *et al.* (2018) found that supply chain risk has a positive direct effect on firm performance.

A study conducted by Parast (2020) also found that supply chain disruption has a significant effect on firm performance. Supply chain risk and disruption refer to demand disruption, supply disruption, and process disruption. The researcher

suggested that firms extend their supply chain to different regions. The most important factor that should be considered in selecting the region is the frequency of the disruption, to improving the firm performance due to the disruption. Wong *et al.* (2019) investigated the supply chain and external conditions under which supply chain resilience pays attention to the organisational information and processing theorisation and found that there is a positive association with supply chain performance. It is mentioned that supply chain resilience is important in contributing to risk management, market performance, and supply chain performance when firms experience a high level of infrastructure, supply-side disruption, and disruption from catastrophic events. Study by Ganesh and Kaplana (2022) stated the firm need to plan constantly to investigate the challenge due to the uncertain environment and the complexity in supply chain which is affect to the performance of firm. Thus, the supply chain risk management is significantly related with supply chain performance.

H2: There is a significant relationship between supply chain risk and supply chain performance among Malaysian SMEs.

2.9.3 Supply chain integration and information sharing

Many researchers have tested the relationship between supply chain integration and information sharing. For example, Kocoglu *et al.* (2011) found the role of supply chain integration plays a critical point in the information sharing process, which reinforces connectedness, collaborating, and coordinating among the supply chain members. In addition, Yu *et al.* (2020) also found that information is a strategy used in the collaboration mechanism. The study further found a positive relationship between the variables. The authors further stated that information sharing does not always benefit the environment and stakeholders, but it does demonstrate the advantages of collaboration between retailer and supplier. Moreover, Guan *et al.* (2020) mentioned that information sharing in the supply chain is one of the triggers for decision adjustments in other supply chains where information sharing is beneficial to the first

supply chain. The study has found that information sharing is more likely to occur when the manufacturer is more efficient in-service investment, consumer care is more important to service and the competition (Guan *et al.*, 2020).

The study by Ojha *et al.* (2019) in performance trade off in managing order fulfilment, the bullwhip effect in the supply chain, and the roles of information sharing, and information type has found that information sharing in the supply chain generally reduces the negative effect of the bullwhip effect. When a company is unwilling to reveal some sorts of information, it discovered that there is a considerable trade-off between performance in managing order fulfilment and the negative effects of the bullwhip effect. In addition, Kocoglu *et al.* (2011) revealed that supply chain integration plays a critical role in the information sharing process as it reinforces connectedness, collaboration, and coordination among members of the supply chain. From the previous studies, the researcher found that supply chain integration has a positive, significant impact on information sharing where the supply chain enhances the information sharing. Therefore, the supply chain integration significantly related to the information sharing.

H3: There is a significant relationship between supply chain integration and information sharing among Malaysian SMEs.

2.9.4 Information sharing and supply chain performance

To enhance and achieve the performance of the supply chain, this requires firms to exchange information and strategic supply chain data such as materials and product orders (Jia *et al.*, 2020). The benefits of information sharing bring a significant number of advantages to the manufacturing area, including reducing inventory and improving the efficiency of inventory management, reducing costs, and increasing productivity and quick response. The cycle time from the order to the delivery is reduced (Lotfi *et al.*, 2013). Furthermore, according to Maskey, Fei, and Nguyen (2015), information sharing has been identified as an important factor in supply chain management for

improving supply chain integration, lowering total cost, mitigating the bullwhip effect in the supply chain, and improving firm performance.

A study by Wang *et al.* (2020) found information disclosure has a positive effect on financial performance. Information sharing helps the firm gain many intangible benefits, such as increasing sales in the product market, better brands, and reducing costs in the stock market, which can improve the financial performance of the firm (Wang *et al.,* 2020). Similarly, to the study by Singh *et al.* (2021) found positive relationship between knowledge sharing and supply chain performance, especially on the financial performance, which contributes to the competitive advantages.

Yang *et al.* (2021) stated that the information sharing mitigates the bullwhip effect and reduce the costs and increasing the profits. According to Huang *et al.* (2022) the information sharing also mitigate the bullwhip effect and it help to smooth the production in firm and it increase the performance of supply chain. Guérineau and Leon (2019) said that information sharing reduces contract delinquencies and defaults when the firm is informationally opaque. Interestingly, Doblas-Madrid and Minetti (2013) state that information sharing does not reduce the cost of using guarantees and it may not loosen lending standards.

Information sharing is one of the crucial in supply chain management, since it help the firm to respond quickly to uncertainty and it reduces the cost and enhancing the customer service, reducing the lead time and increasing the quality and the profitability in firm (Huang *et al.,* 2022). However, there is a little research on the information sharing on supply chain performance. Therefore, information sharing positively influence the supply chain performance.

H4: There is a significant relationship between information sharing and supply chain performance among Malaysian SMEs.

2.9.5 Supply chain integration and supply chain performance

Several notable debates about the actual influence of supply chain integration on a company's success have erupted in recent years. There are several scholars who argue that only several dimensions of supply chain integration have a positive effect on the firm's performance. For instance, Som, Cobblah and Anyigba (2019) highlight that supply chain integration consists of several dimensions, including operational integration, relational integration, customer integration, and supplier integration. The authors argued that the operational integration could increase the firm's performance while the relational integration might have negative impacts on the performance as it could be influenced by many other variables. However, no more explanation of the variables was provided. Pakurár *et al.* (2019) have also suggested that customer integration has little effect on the firm's performance but did not further state the actual reasons.

Ho, Kumar, and Shiwakoti (2020) have also found that higher levels of integration generally lead to better performance. Ho *et al.* (2020) further concluded that supply chain integration directly relates to business performance. Also, internal collaboration directly affects firm performance as mentioned by Zhong *et al.* (2022). Besides Kamble *et al.* (2021) examine the impact of supply chain integration on performance using all three integration variables.

Flynn *et al.* (2010) assessed the impact of three dimensions of supply chain integration (supplier integration, customer integration, and internal integration) on operational and business performance. The authors found that internal integration directly relates to both business and operational performance and that customer integration relates to operational performance. Although supplier integration is not related directly to either type of performance, the integration of supplier and customer were related to operational performance. Internal and external integration influence each other along with performance. Research indicates that internal integration's impact on performance depends on the functional areas that are being integrated and the level of external integration (Ho *et al.*, 2020). In line with other papers from 2000 onwards discussing supply chain integration and performance, Stock *et al.* (2000) and Munir *et al.* (2020) found that the levels of integration correlate and influence each other positively.

However, a recent study conducted by Asnordin *et al.* (2021) revealed that the internal and process dimensions of supply chain integration have a significant positive impact on supply chain performance, similar to the findings obtained by Wong *et al.* (2021). Hendijani and Saei (2020), who studied the supply chain integration and performance of the automotive parts and steel industries, also reported that supply chain integration is a vital factor for improving firms' performance, especially in facing demand uncertainty. Supply chain integration consists of two fundamental elements, which are supplier and customer integration (Wiengarten *et al.,* 2016). It could help to reduce the purchase cost as well as provide a comprehensive understanding of the market needs and expectations through close collaboration with the supplier and customers (Zhao *et al.,* 2015). Furthermore, according to Sinnandavar *et al.* (2018), it facilitates the flow of funds, materials, and information among independent organizations, resulting in improved performance. The findings obtained from the studies of Chen *et al.* (2018) and Kumar *et al.* (2017) strongly supported that the supply chain integration has superior impact towards the firm's performance.

H5: There is a significant relationship between supply chain integration and supply chain performance among Malaysian SMEs.

2.9.6 Supply chain risk management mediating the relationship of supply chain integration and supply chain performance

Supply chain risk management is important role in firm, and it must be considered by every organisation in order to achieve the effectiveness and efficiencies of the integration and the performance of supply chain. Managing the supply chain risk has become critical for the survival and growth of firm (Alfalla-Luque & Medina-Lopez, 2015; Ganesh & Kaplana, 2022). The entire supply chain process needs to be designed, managed, and coordinated as a unit (Forslund, 2015). To improve the supply chain risk, the firm must prepare for all outcomes or side effects that may occur to handle the risks in supply chain activities. This is because the longer the supply chain, the greater the risk the firm will incur.

The main objective of the supply chain is to generate value for the end-consumer and the main purpose of supply chain risk management is to reduce the vulnerability and to mitigate the disruption impact to the performance of supply chain in firm to enhance the effectiveness of the firm (Baz & Ruel, 2021). Through the integration of activities, this objective can be achieved among connected organisations and, owing to the removal of resource waste and operational duplication, should result in reduced costs (Zhong *et al.*, 2022). Successful integration involves a smooth stream of timely and accurate information across these supply chain companions. It is generally acknowledged that supply chain integration is critical to improving performance and gaining competitive advantages (Flynn *et al.*, 2010; *Munir et al.*, 2020; Zhao *et al.*, 2013). The implementation of supply chain risk management in firm help to preventing the disruption and lowering the operational accident. Besides that, supply chain risk management also allow to react to the external environment and improve the operational performance of firm (Munir *et al.*, 2020). The supply chain risk management consist of the measuring, monitoring, and mitigating the risk and uncertainty event help to enhance the performance of supply chain (Ganesh & Kaplana, 2022).

In order to integrate the supply chain with a different organisation or firm, a few variables need to be taken into account. According to Bagheri *et al.* (2014), there are four variables such as trust, information technology, supply chain integration, and performance of the firm. The firm needs to be prepared with all these variables before they decide to integrate business with other companies in the supply chain. This is to prepare the solutions for any risks that might occur during the process. Even though information technology really helps in many ways, mostly in business, there are risks in adopting it (Smith, & Ulu 2017). Supply chain risk management is important role in firm to manage the risk and deal with complexity, uncertainty, and unexpected disruption and indirectly it improves the performance of firm (Munir *et al.* 2020; Ganesh & Kaplana, 2022). Besides that, with supply chain risk management can help to handle the risk such as a new global crisis which is pandemic covid-19 and rapidly adapt to the unexpected challenges (Rinaldi *et al.*, 2022).

Discussed above are a few mediating effects of the supply chain risks management in terms of supply chain integration that can have an impact on the

company's performance, whether it increases in quality or decreases in quantity (Bagheri *et al.,* 2014). A study by Mohamad *et al.* (2022) stated that the mediating effect of supply chain risk management on the relationship between supply chain integration and the performance of supply chain are indicated partially mediated. The findings show the importance of supply chain risk management in enhancing the relationship between supply chain integration and the supply chain performance for Malaysian SMEs. By effectively managing supply chain risks, SMEs can mitigate the negative impact of potentially disrupting the supply chain and improving the performance of firm. Therefore, this study is to focus on the supply chain risk management mediate the relationship in supply chain integration and supply chain performance.

H6: Supply chain risk management mediate the relationship between supply chain integration and supply chain performance.

2.9.7 Information sharing mediating the relationship of supply chain integration and supply chain performance

The information sharing one of the pivotal elements need to be focus in supply chain activities where, the information sharing help in improving the coordination of supply chain with mitigate the bullwhip effect and enables to smooth the production flows and the inventory management for the supply chain partners and it increase the performance (Huang, Ho & Kao, 2022). A study by Kocoglu *et al.* (2011) stated that information sharing is a major driver of competitive advantage in the business field. Effective information sharing in supply chain integration will improve supply chain coordination, quality of products and services, reduce supply chain costs, and achieve competitive advantage by sharing the risks as well as the benefits (Li & Lin, 2006). Further, Li and Lin (2006) mentioned that there are four types of information sharing, namely: information sharing with customers, information sharing with suppliers, inter-functional information sharing, and intra-organisational information sharing.

It is obvious that information sharing, mostly in the form of bids, is hard to

achieve, but it can be realised if we can handle the risks as discussed in the previous topic. Business goals that might be difficult to achieve by individual organisations alone can be achieved through value-based supply chain relationships. Therefore, information sharing in supply chain management are considered important as an essential pre-condition for staying competitive and enhancing performance, which in turn enhances efforts to build better value-based relationships through the supply chain network. Bodendorf & Franke (2022) stated the information sharing also consider as a key component of successful in supply chain management.

Since a decade, modern trends urged all inter-organisational supply chains to be agile, adaptable, and aligned to meet the needs of cooperative, and mutually beneficial supply chain partnerships in the value networks (Jayaram, 2010; Flynn *et al.*, 2010). This led firms to refocus on forming tighter and deeper relationships. By linking all supply chain members, we can meet the objectives of approaching a shared system of values across supply chain integration. The effectiveness and efficiency of the information sharing indirectly increase the profitability of the supply chain and performance of firm (Sarfazar, Chakrabortty & Essam, 2022).

Implementation of various supply chain activities ensures correct supply chain relationships and can facilitate the coordination of information flows from supplier to manufacturer and customer, as well as the backward flow from customer to manufacturer and supplier (Khanuja & Jain, 2019). Effective information sharing can give customers the ability to influence decisions of a manufacturer. Consequently, the manufacturer seeks a trust-based association with a customer because as the level of trust increases, the willingness of the parties to share physical, financial, and information-based resources is promoted (Khanuja & Jain, 2019). Therefore, a satisfied customer is the outcome of the effectiveness of sharing information in an organisation. We can make them satisfied with our product or services by integrating with external organisations, which benefits us in terms of sharing all the costs and risks in the supply chain. Achieving this objective will ensure good feedback from customers, which will increase performance value in a company (Kocoglu *et al.*, 2011).

The information flow is important in modern business processes nowadays and playing a crucial role in creating the superior of supply chain management (Wildan *et*

al., 2022). According to Khanuja and Jain (2019), information sharing inside business units across supply chain companions is to achieve the three key connections that are customer linkage, supplier linkage and internal linkage. Effective information flow in this integration will increase company performance (Bloom *et al.*, 2015). Wildan *et al.* (2022) also stated the effectiveness in managing the information flows with accurate and transparent information within the partners will enhance the performance of supply chain in firm. There is a few studies of mediating effect of information sharing on the relationship between supply chain integration and supply chain performance. Therefore, information sharing one of the important roles in firm to help the firm to interaction with the partners and improve the performance in firm.

H7: Information sharing mediate the relationship between supply chain integration and supply chain performance.

2.10 Summary

In conclusion, Chapter 2 explains previous studies related to supply chain integration, supply chain risk management, information sharing, and supply chain performance. Supply chain integration refers to the degree to which the firms can collaborate in managing the internal and external processes to realise the effective and efficient flows of the products and services, information, capital, and decisions to provide maximum value to customers at low cost and high speed (Alshurideh *et al.*, 2022; Peng *et al.*, 2016). In supply chain integration, there are three dimensions used in this study: internal integration, supplier integration, and customer integration. The supply chain risk management in this study was divided into two parts, which are internal risk and external risk. Information sharing in supply chains has become more efficient by the global introduction of long-term cooperation and coordination, which leads ultimately to the improvement of companies' competitive advantages (Lotfi *et al.*, 2013). In today's performance evaluation processes, companies tend to refer to several models that will differ in terms of corporate organisation, the distribution of responsibilities, and supply chain maturity (Estampe *et al.*, 2013). In supply chain performance,

operational performance is divided into four dimensions' plan, make, source, and deliver.

The understanding on the mediating effect of supply chain risk management and information sharing on the relationship between supply chain integration and supply chain performance is still lacking. There is a lack of research that examined supply chain integration, supply chain risk management, information sharing, and supply chain performance among Malaysian SMEs integrative study in one. Previous research mostly mentions this effect, but neither of them relates it to this context. Little information was known about those effects, and therefore, this is where this research needs to proceed to add to the existing knowledge on the supply chain management in SMEs. Therefore, this study investigates the mediating effect of supply chain risk management and information sharing on the relationship between supply chain integration and supply chain performance among Malaysian SMEs.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter on research methodology presents the research design, research preferred paradigm, measurement, developing research framework and hypothesis, population and sample, research instruments, research procedure, data analysis, descriptive statistics, and data analysis measures of this research work.

In this chapter, the major part of the discussion is focusing in the research design which is population and sample for the study, the instrument and procedures used to collect data and how the data collected is computed. It also highlighted the preferred research paradigm and research ethics. This chapter is important because it is intended to share about the method that can used to collect data, and the different types of statistical measurements used to analyse the raw data from the respondents. The organisation of this chapter is graphically presented in figure 3.1

The methodology is one aspect that needed attention. According to Hamid *et al.* (2021), study methodology guides the implementation and execution of research methods. Besides, the research methodology is also used to obtain certainty about the results thus the achievement of the research objectives of this study. The researcher explains the methods used in this study in this chapter. Study designs, population frames, sample selection, data collection procedures, measuring tools, and methods for analysing research data are all presented. This chapter further described variables and their measurement items, pilot study, data analysis, and type of data analysis used to test the research work.

3.2 Research design

Research design is a plan to choose the resources that can answer the research question. It is a framework connecting between the variables and to assume a form from the guidelines about the research agenda from the hypothesis to the data analysis. This study aims to examine supply chain risk management, information sharing, supply chain integration and supply chain performance of Malaysian SMEs listed in the Federation of Malaysian Manufacturers (FMM). Survey questionnaire was designed and distributed to get response from the selected sample. The questionnaire was distributed to the SMEs firm listed in FMM. Table 3.1 summarizes the research design of this study.

Table 3.1 Summary of the research design

Research objectives	The objectives of this study are to understand: To analyze the relationship between supply chain integration, supply chain risk management and information sharing To analyze the relationship between supply chain risk management, information sharing and supply chain performance. To analyze the relationship between supply chain integration and supply chain performance. To analyze the mediating effects of chain risk management and information sharing on the relationship between supply chain integration and supply chain performance.
Approach	The study approach was using quantitative approach by using questionnaire
Research sample	SMEs listed in FMM n=331
Research analysis	SPSS Reliability Exploratory Factor Analysis PLS-SEM Construct validity Composite reliability Average variance extracted (AVE) Structural Equation Modeling (SEM).
Finding	This study could contribute to the development and improvement of the theories and models of supply chain risk management by improving the performance of the supply chain in firms.

3.3 Research Procedure

This research study using quantitative approach which is the questionnaire distribute to achieve the research objectives. Figure 3.1 shown the research procedure of this study.

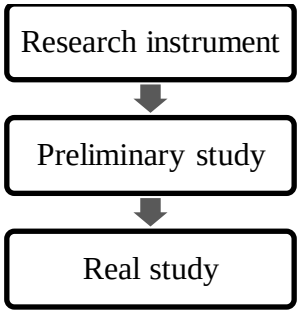

Figure 3.1: Research procedure of the study

3.3.1 Research instruments

This section discussed the specific measurement items used in this study for independent, dependent, and mediating variables. Most of the measurements for each variable are adopted from previous studies, while others are developed specifically for the research study. Supply chain integration, supply chain risk, and information sharing are taken as independent variables, and supply chain performance is considered a dependent variable. The scale of the measurement also depends on the type of data. There are four scales of the size; they are nominal, ordinal, interval, and ratio.

This study used questionnaires as an instrument for the implementation of getting data from the respondents. The research instrument is considered an essential tool in studying survey data, like the survey identified and described. A quality instrument should include the objectives. The researcher used questionnaires as the research instrument to gather the information needed to achieve the research objectives. According to Carpino, Mora, and Simone (2019), the use of the questionnaire could collect data in detail. It is simpler in structure, saves time, energy, and other costs involved. Questionnaires are used as they facilitate the process of obtaining data and provide tools to analyse the contents therein (Carpino *et al.*, 2019).

The questionnaire used in this study applied the Likert scale in sections B, C, D and E. Section B requires responders to answer the Likert Scale in rank 1, from very low to extremely high was used to measure the variable in the supply chain risk management questions. Whereas the five-point Likert scale for sections C, D and E ranging from 1 as a strongly disagree to 5 as strongly agree on items for supply chain integration, supply chain risk management, and information sharing on supply chain performance among Malaysian SMEs. The interval scale used in this study is more suitable for measuring the magnitude of preference among staff (Palinkas *et al.*, 2015). Table 3.1 shows the outlines of Likert Scale used in this study.

Table 3.1: Level of Likert Scale used

Part	Scale	Level of Agreement
B	1	Very Low
	2	Low
	3	Moderate
	4	High
	5	Extremely high
C D E	1	Strongly Disagree
	2	Disagree
	3	Neither Agree or Disagree
	4	Agree
	5	Strongly Agree

The items were developed through a process of validity and reliability certified by a set of questions identified by the researchers as an item that allows stimulation or feedback. The survey instrument consists of a questionnaire divided into five sections, as shown in Table 3.2.

Table 3.2: Section in Questionnaire

Section	Questions
A	Demography of study
B	Supply Chain Risk Management
C	Supply Chain Integration
D	Information Sharing
E	Supply Chain Performance

As shown in Table 3.2, questions for Section A is about the demography of the firms and in section B the questions asked about the supply chain risk management.

Questions Section C include supply chain integration. Internal integration, supplier integration, and customer integration are the three dimensions of supply chain integration. Questions asked in Section D, are about information sharing and are followed by Section E, which are the questions asked about supply chain performance. There are four elements in supply chain performance asked in this section: plan, source, make, and deliver.

3.3.1.1 Variable measurement

Table 3.3 represents the section B of the questionnaire and is about the supply chain risk management. The questions were adopted from the previous researchers as state in Table 3.3. The survey asked about the year the business has been operating, the principal activities of the company, the legal status and follow from the firm's business premises. In addition, it was asked about the total number of full-time employees working in the firm.

The importance of supply chain management's involvement in managing the supply chain risk, and the last question was the actual level of supply chain management's involvement in managing the supply chain risk management.

Table 3.3: Measurement items for supply chain risk management

Supply chain risk	
Items	Authors
Natural disaster	Ivanov and Wendler (2019), Kwok (2018)
Geopolitical risks	Baur and Smales (2018), Sekiyama (2022)
Infrastructure outage risks	Pala and Schrum (2018)
Manufacturing risks	Faehnlel and Livshits (2021)
Theft and shrinkage	Hamdaoui *et al.* (2022), Ye, Duan and Peng (2021)
Counterfeits	Ghadge *et al.* (2021)
Business continuity policies and practices	Margherita and Heikkila (2021), Kosieradzka *et al.* (2022)
Commodity price volatility	Pellegrino *et al.* (2019)
Economic cycle	Baur and Smales (2018), Sekiyama (2022)
Demand forecast	Nia *et al.* (2021)
Exchange rate	Ogunranti *et al.* (2021), Liu and Nagurney (2011)
Human resources risk	Shah *et al.* (2017), Jaouadi (2022)
Labour dispute/stoppage risk	Nagurney (2021)

Table 3.3 (continued)

Data / IT Security	Raka and Liangrokapart, (2015), Shahbaz *et al.* (2019)
Product design flow	Raka and Liangrokapart, (2015), Shahbaz *et al.* (2019)
Sustainability and corporate social responsibility compliance	Raka and Liangrokapart, (2015), Shahbaz *et al.* (2019)

The questions asked in Section C, as mentioned in Table 3.4, are about supply chain integration. Supply chain integration is divided into three dimensions of internal integration, supplier integration, and customer integration. It is worth mentioning that the questions for supply chain integration were adopted from the study of Flynn *et al.* (2010), De Vass *et al.* (2018); Feyissa *et al.* (2018). There were 24 questions used to measure internal integration.

Table 3.4: Measurement items for supply chain integration

	Internal Integration
1.	Encourage employees to work together
2.	Communication frequently
3.	Management works together
4	Generally speaking
	Supplier Integration
5.	We share our demand forecasts with our major supplier readily.
6.	Our major supplier shares their production schedule with us readily.
7.	Our major supplier shares their production capacity with us readily
8.	We share our inventory levels with our major supplier readily.
9.	The participation level of our major supplier in the design stage are high.
10.	Our customer are actively involved in our product design process.
11.	We maintain cooperative relationship with our supplier.
12.	We help our major supplier to improve its process to meet our needs better.
13.	We share our production plans with our major supplier readily
14.	Our major supplier shares available inventory with us readily.
15.	We maintain close communication with supplier about quality considerations and design changes.
16.	We strive to establish long term relationship with supplier.
	Customer Integration
17.	We share our available inventory with our major customer.
18.	We share our production plan with our major customer.
19.	Our customer give feedback on our quality and delivery performance.
20.	We strive to be highly responsive to our customer's needs.
21.	Our major customer shares demand forecast with us.
22.	Our major customer shares point of sales information with us.
23.	We are frequently in close contact with our customer.
24.	Our customer are actively involved in our product design process.

In Section D, as mentioned in Table 3.5, provides the questionnaire items about information sharing. The questions were adopted from the study of Rashed *et al.* (2010).

Table 3.5: Measurement items for information sharing

Information sharing	
1	We inform trading partners in advance of changing needs
2	Our trading partners share proprietary information with us
3	Keep us fully informed about issues that affect our business
4	Share business knowledge of core business processes with us
5	Exchange information that helps the establishment of business planning
6	Informed about events or changes that may affect the other partner

Section E as mentioned in Table 3.6 is about the questionnaire items for supply chain performance used in this research. "Supply chain performance" was referring to operational performance. Operational performance has four parts that are the plan, source, make, and delivery. The questions for the variable “supply chain performance” were adopted from the study of (Flynn *et al.*, 2010; Danese *et al.*, 2013 and Bruque-Cámara *et al.*, 2016).

Table 3.6: Measurement items for supply chain performance

Plan	
1.	The demand management and production planning processes in our company are integrated.
2.	The forecast develop for each product.
3.	The forecast develop for each customer.
4.	The forecast are credible or believable.
5.	The forecast accuracy are measured.
6.	The forecast are used to develop plans and make commitments.
7.	The performance evaluation process occur on a regular (scheduled) basis.
8.	In our company the sales, manufacturing and distribution organisations collaborate in developing the forecast.
Source	
9.	We do have procurement process in team designed.
10.	We measure and give feedback to the supplier performance.
11.	The information system in our company support the process.
12.	The procurement process are documented (written description, flow charts).
13.	In our company the supplier inter-relationships (variability, metrics) understood and are documented.
14.	The other functions (manufacturing, sales etc.) work closely with the procurement process team members.

Table 3.3 (continued)

15.	We collaborate with the supplier to develop a plan.
16.	The team meet on the regular basis.
17.	The process owner in our company are identified.
18.	We share planning and scheduling information with supplier.
Make	
19.	Our information system currently support the process.
20.	Our shop floor scheduling integrated with the overall scheduling process.
21.	Our current process adequately address the needs of the business.
22.	In our company the sales, manufacturing and distribution organisation collaborate in the planning and scheduling process.
23.	We have a documented (written description, flow charts, etc.) production planning and scheduling process.
24.	The supplier lead times are updated monthly.
Delivery	
25.	Our information system support the distribution management.
26.	We consolidate orders by customers, sources, carriers, etc.
27.	We have real time visibilities of order inquiries
28.	We measure customer requests versus the actual delivery.
29.	We have a single point of contact for all order inquiries.
30.	We use automatic identification during the delivery process to track order status.
31.	Our information system currently support the order commitment process.
32.	We have a Promise Delivery (order commitment) process, owner.
33.	Our order commitment process integrated with the supply chain decision process.

The respondent is required to answer all questions in this Section D. The questions were related to supply chain performance, which is plan, source, make, and delivery. There are 8 questions for a plan, 10 questions for source, 6 questions for making and 9 questions for delivery asked in these sections. These questions were adapted from the study of (Flynn *et al.,* 2010; Danese *et al.,* 2013; Bruque-Cámara *et al.,* 2016).

3.3.2 Preliminary study

Before going to the actual data collection, a preliminary study analyses determines whether the questionnaire is appropriate and valid. In the initial analysis, the survey questionnaire was examined critically by academicians and practitioners in terms of the opinions and views on the measurement instruments and concepts addressed in the

questionnaire. Preliminary data analysis recommends ensuring the data set is clean from biases. The research process begins with the selection, sampling, and collection of data. Data collection methods are more specific to the broad problem area of the research. After the process of data collection, editing of the raw data should be performed to ensure the data has no missing issues. The data collection must be checked for omissions, legibility, and consistency (Zikmund *et al.*, 2013).

To assess the reliability of the questionnaire used in the actual study, a pilot test should be conducted prior to the actual survey. According to Pratt (1980), a pilot study is the first stage of a trial (preliminary trial) before actual test items are conducted in the research sample. The pilot test was conducted with 30 respondents. Table 3.8 presents the results of the pilot test that are Cronbach alpha values. According to Cooper and Schindler (2014), a pilot test is conducted to detect the instrumentation and design weaknesses and provide a proxy of data for selecting the probability sample.

Pilot test has been run to measure the validation and reliability of the research instrument to ensure the research instrument can measure the variables accurately as suggested by (Cohen *et al.*, 2012). The aim of the pilot test is to measure the constructs' reliability and validity. In order to conduct this study, 30 questionnaires were collected from SMEs located in the area around Parit Raja, Batu Pahat. As recommended by Cooper, Schindler and Sun (2011) and Johanson and Brooks (2010), 30 respondents should suffice for the pilot test. The main purpose of pilot test is to measure the validity and reliability of the questionnaire items before proceeding with the real data collection.

Table 3.7: Pilot test

Variables	Number of items	Reliability analysis (Cronbach's alpha)
Supply chain integration	24	0.843
Supply chain risk	17	0.975
Information sharing	6	0.930
Supply chain performance	33	0.971

As can be seen from Table 3.7 for the reliability analysis, all the variables included in this study were able to satisfy the Cronbach alpha criteria' significance

value above 0.70 suggested by Hair *et al.* (2010). As a result, the study questionnaire was approved statistically and sent for further data collection. The following section describe in details the collection of data for this study.

3.3.2.1 Preliminary data analysis

Before going for actual data collection, a preliminary study was carried out to determine whether the questionnaire is valid and appropriate for the study. In the preliminary analysis survey questionnaire was examined critically by the academicians and practitioners for asking the views and opinions on the measurement instruments and concept addressed in the questionnaire. Issues and conflicts were discussed and then the modified questionnaire was used for further research process. Research process begins from the selection, sampling, and collection of the data. Data collection methods are more specific on the broad problem are of the research. After the process of the data collection, editing for the raw data was performed to ensure that the data has no missing issues. According to Palinkas *et al*. (2015) respondents who have answered 75 percent of the questionnaire are considered for sampling purpose of this research. Data screening is very important to ensure that the data is entered correctly without any outliers. Figure 3.2 displays the overview of the preliminary data analysis for this study.

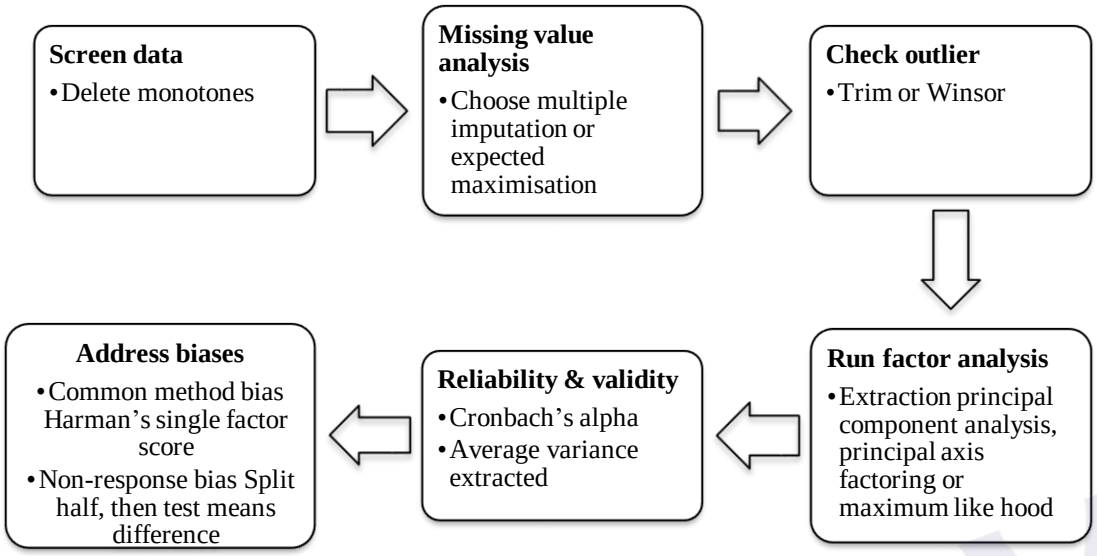

Figure 3.2: A common approach preliminary data analysis

i) Coding screening

It is necessary to clean and screen the data for any mistakes or errors before the commencement of any meaningful statistical analysis (Hair *et al.*, 2016 & Pallant, 2013). The primary aim of data screening is to establish the normality and reliability of the data for further analysis (Misra, 2012). Furthermore, the data was screened to remove missing data and massive errors or mistakes, revealing the frequency of all variable's questions with their specified Likert scales range of minimum and maximum (1 – 5 Likert Scale).

The objective of the study, the first and most important step in data preparation, is to assign codes to all the study data items. These codes allow the researcher to interpret the obtained data's results. The survey questionnaire is used in this investigation. To analyse the data, the questions were serially coded. The data was then entered into a data file using the SPSS software Version 23.

ii) Missing value analysis

The researcher intended to first detect missing information through descriptive statistical analysis before analysing the data. Missing data arises when a respondent does not answer some questions in the survey, either intentionally or unintentionally (Saunders, Lewis, & Thornhill, 2019). Any record of the survey questionnaire that

consists of more than 15% of missing data must be considered inappropriate (Hair *et al.*, 2016). However, many techniques are available to solve this problem, such as expectation maximisation, multiple imputation, maximum likelihood, estimation methods, hot-deck imputation, and multiple imputation, etc. (Vinzi *et al.*, 2010). Although it is easy to apply these techniques, but the sample size will be decreased because these techniques delete the complete answered response with the missing values (Vinzi *et al.*, 2010).

The appropriate software used for statistical analysis in the study was using SPSS. This software provides two choices for dealing with the problem of missing data. The first is mean value replacement, and the second is case-wise deletion (Hair *et al.*, 2016). The missing values were eliminated during the data recoding process. According to Hair *et al.* (2016), if an indicator has less than 5% missing values, the mean value replacement approach should be used. This method has still influenced the variance of variables under the same sample size (Rostami, Gabler & Agnihotri, 2019).

iii) Factor analysis

Factor analysis is used to determine the extent to which variables are related and grouped to treat one combined variable or factor rather than a series of separate variables (Shrestha, 2021). The factor is positively correlated and is assumed to represent a dimension within the data. Five Likert scales, ranging from strongly disagree to strongly agree measured the constructs of this study. There is a several ways to analyse the factor which is by using principal component analysis (PCA), principal axis factoring (PAF), image factoring, maximum likelihood, alpha factoring, unweighted least squares and canonical (Tabachnick & Fidell, 2013). According to Tabachnick and Fidell (2013), PCA is one of the commonly used to analysis the factor. The PCA with varimax rotation is used to conduct the exploratory factor analysis. The PCA is a factor model in which factors are based on the total variance. Simultaneously, varimax rotation is an orthogonal factor rotation method that simplifies the factor matrix (Dien, 2010).

The purpose of using PCA is to summarise the data to the minimum number of factors for prediction purposes. Orthogonal varimax rotation is used to test whether those factors remain uncorrelated or statistically independent. The only element of

Eigenvalue greater than one is considered significant and used for further analysis. In contrast, those with less than one value is deemed insignificant and discorded. The variables with cross-loading, where a variable has two or more factor loadings exceeding the threshold value considered necessary for inclusion in the factor interpretation process on any factor excluded.

Therefore, this study used PCA to analyse the factor. The value of factor loading suggested by Tabachnick and Fidell (2013) is more than or equal to 0.60. Hair *et al.* (2013) suggests the acceptable factor loading value is at 0.45. If the factor value is below than 0.45, the item needs to remove from questionnaire. Besides that, if there is cross loading factor value in the analysis, the component of the item needs to remove. As shown in Table 3.8 below show the factor loading.

Table 3.8: Significant of factor loading based on sample size

Sample size	Significant of factor loading
50	0.75
60	0.70
70	0.65
85	0.60
100	0.55
120	0.50
150	0.45
200	0.40
250	0.35
350	0.30

iv) Reliability analysis

Reliability is a necessary contributor to validity, but it is not sufficient for validity (Coorper & Schindler, 2014). The reliability of the analysis is concerned with the precision and consistency and the accuracy of the measurement. Still, it is not about validity, which focuses on measurement and is concerned with estimating the degree of measurement that is free of random or unstable error (Coorper & Schindler, 2014). According to Cronbach (1951), Cronbach Alpha measured the reliability coefficient to show how well the items positively correlated with each other. As a measure of perceived consistency between response sets obtained from a set of sub-questions

(scale items), Cronbach's Alpha is usually calculated (Saunders *et al.,* 2019). Hair *et al.* (2019) recommend a minimum reliability of 0.60 for exploratory research, while 0.70 or higher is recommended for research that relies on established measures.

Based on the Rasch measurement model, if the value of Cronbach Alpha in between 0.60 to 0.99, indicates the items build in the level of acceptance and can be used in the research with 60 to 90 percent of the items is reliable (Bond & Fox 2015). To analysis the reliability of the questionnaire, internal consistency analysis used to measure the reliability of the item by using Cronbach alpha (Cronbach, 2016). Cronbach alphas consider as an important index of reliability to determine the item in questionnaire and show the correlation between the variables (Saunders *et al.,* 2019). The acceptable value for Cronbach alpha is in between 0.60 to 0.95 (Saunders *et al.,* 2019). If the value of Cronbach Alpha below than 0.60, means the item used in questionnaire is weak. Therefore, this study used Cronbach Alpha value to measure the reliability of the item which is the value of Cronbach Alpha is 0.60 and above.

Table 3.9: The reliability value (Bond & Fox, 2015)

Cronbach Alpha	Reliability
0.9 – 1.0	Very high and effective
0.7 – 0.8	Good and acceptable
0.6 – 0.7	Acceptable
<0.6	The item need correction
<0.5	The item needs to remove

Table 3.9 shows the reliability analysis criteria that were utilised in this study to assure that the results were valid and that the research findings were consistent in describing measurement reliability.

v) Validity analysis

The purpose of a validity analysis is to ensure that the instrument used in the study is accurate. A valid device is capable of measuring what it is designed to measure and is free of errors and bias (Hair *et al.,* 2019). The content and face validity are checked at the time the research instrument was developed. Content validity is a non-statistical and systematic inspection process.

3.3.3 Real study

For the real study, the questionnaire was distributing to the SMEs listed in FMM. The data collection was analysed by using SPSS and SEM-PLS to develop the framework of supply chain integration in enhancing the performance of supply chain in Malaysian SMEs.

3.3.3.1 Population and sampling

The samples are small groups of a large population. Creswell (2012) stated a population is a group of individuals with similar characteristics appropriate to the study's purpose. The sample selected must be relevant to the study so that it can represent the population involved. Hamid *et al.* (2021) suggest that before conducting research, the population of interest should be identified in advance. The population determines the field of research and the problems that each reviewer needs to assess. Saunders *et al.* (2019) state that sampling helps the researchers to select a suitable sample from the target population that represents all the characteristics of the population. Sampling can also save time and cost at the time of data collection and ensure accuracy.

Random sampling was used in this study to select the representatives of the persons who are participating in the research because they were readily available during the data collection for the study (Creswell, 2012). In addition, Creswell (2012) stated the random sampling refer to the random selected of the population where the random sampling is a straightforward of all the probability of sampling methods which involves a single random selection, and it requires a little advance knowledge about the population. The purpose of using random sampling in this study because the respondent for this study is the SMEs listed in FMM directory, which is manager, manager logistic, supervisor and for those whose knowledgeable in area of supply chain management in their firm. The questionnaire distributed to all SMEs firms listed in FMM and one respondent represent for one SME for the data collection. Creswell (2012) argues that individuals can be representative of the population. The sample can

provide the information's usefulness for answering the questions and the hypotheses stated in the study. The study focused on the manufacturing SME sectors listed in the Federation of Malaysian Manufacturing (FMM) Directory. For this study, the population is composed of 2305 firms. According to Krejcie and Morgan (1970)'s estimation of population sampling, 331 respondents represent approximately 2400 respondents. As a result, 331 is the required sample size for this study and it is referred to the Krejcie and Morgan, (1970) sample size determination shown in Figure 3.3.

N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	346
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	354
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	191	1200	291	6000	361
45	40	170	118	400	196	1300	297	7000	364
50	44	180	123	420	201	1400	302	8000	367
55	48	190	127	440	205	1500	306	9000	368
60	52	200	132	460	210	1600	310	10000	370
65	56	210	136	480	214	1700	313	15000	375
70	59	220	140	500	217	1800	317	20000	377
75	63	230	144	550	226	1900	320	30000	379
80	66	240	148	600	234	2000	322	40000	380
85	70	250	152	650	242	2200	327	50000	381
90	73	260	155	700	248	2400	331	75000	382
95	76	270	159	750	254	2600	335	1000000	384

Figure 3.3: Krejcie and Morgan, (1970) sample size determination

Formula to determine the sample size by Krejcie and Morgan, (1970) as shown in figure below.

$S = X^2NP(1 – P) + d^2 (N – 1) + X^2 P(1 – P)$

S = required sample size

X^2 = the table value of chi-square for 1 degree of freedom at desired confidence level (3.841).

N = the population size P = the population proportion (assumed to be 0.50 since this would provide the maximum sample size. *d* = the degree of accuracy expressed as a proportion (0.05)

Source: Krejcie and Morgan, (1970)

3.3.3.2 Data collection

Data collection is a vital process in conducting a research study. The data for this was collected immediately to ensure the review made it authentic and justified. The survey strategy was used to collect data, which was collected online, and questionnaires were delivered to the companies. In this study, the respondents were the managers of the SME companies listed in FMM Directory 2015. The questionnaire was emailed to the intended responders. Aside from that, the researcher visited and followed up on the locations of the individual companies needed to get responses. Figure 3.4 shown the conducting the questionnaires in this study.

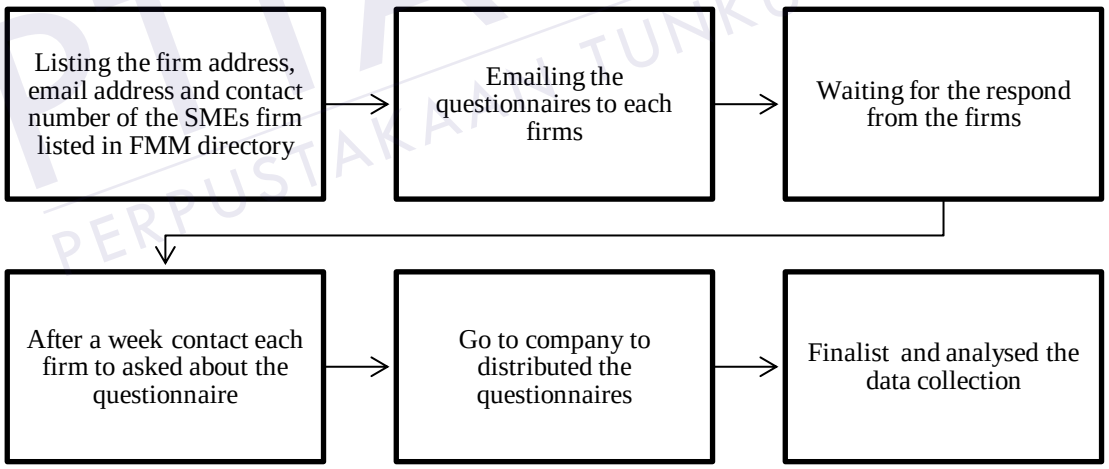

Figure 3.4: Conducting the research questionnaires

3.4 Data analysis

Data analysis typically include decreasing the data to control the quantity, creating summaries, looking for patterns, and employing statistical tools (Cooper & Schindler,

2014). According to Kim-Soon, Ahmed and Shy (2014), the relationship should be tested within the scope of study, prepared in accordance with theories, by creating appropriate models, estimating, and testing the relationship causes using Structural Equation Modelling (SEM). To analyse the data and evaluate the proposed hypotheses in this study, the SEM and statistical package science software (SPSS) were employed. The goal of SEM is to determine the link between unobserved and observable factors in a research project. As a result, structural equation modelling software of PLS-SEM was employed in this study to analyse the relationships among variables.

3.4.1 Structural equation modelling (SEM)

Structural equation modelling is an extension of the general linear model (GLM) that enables a researcher to test a set of regression equations simultaneously (Ramayah *et al.,* 2018). Structural equation modelling includes various models of the linear regression model of simultaneous equations for measurement, including the way symptoms of factor analysis, the unique models, latent growth models, several indicators, and multiple causes models, and theoretical models of item response (StataCorp LP, 2013). The structural equation model provides a robust framework for estimating the model user and the system processes the simultaneous equations with measurement errors (Jedidi *et al.,* 1997). Researchers often treat data as if it were retrieved from a single population (Muthen, 1989). SEM has been described as a combination of factor analysis and multiple regression exploration (Ramayah *et al.,* 2018). The primary purpose of SEM is to identify the relationship between the observed variables and unobserved variables. SEM software Partial Least Square (SMART-PLS) is used to determine the relationship between items and factors (Ramayah *et al.,* 2018).

SEM also provides a more appropriate inference framework for mediation analysis and other types of causal analysis (Hair *et al.*, 2019). With mediation analysis, the study can gain insight and acquire a deep understanding of the information mechanism. Such information provides dimensions to understanding the variables that can stimulate the identification of more appropriate alternative variables (Fairchild &

Mackinnon, 2009). When a model comprises latent variables, applying SEM in mediation analysis has a significant advantage. In addition, SEM facilitates interpretation and estimation. Besides, SEM simplifies the testing of mediation hypotheses, allowing for the testing of more complex mediation models in a single analysis (Ramayah *et al.,* 2018).

Structural analysis is a methodological principle that consists of obtaining the effects of actions reflecting the conditions of the cross-sections and interactions between the constructs (Ramayah *et al.,* 2018). The structural analysis was performed to incorporate the instruments' nonlinear responses to investigations, the effect of the measuring instruments on the constructs, and their interaction. The structural analysis was performed using maximum likelihood to decrease the discrepancy between the model and the sample. PLS-SEM has various rules of thumb that can be followed when utilizing it, as mentioned in Table 3.10.

Table 3.10: The Rules of Thumb for selecting the Partial Least Square SEM (Ramayah *et al.,* 2016)

Criteria	Partial Least Square SEM
Research goal	• The goal is to predict the key target of constructs or identify the key driver. • Exploratory or extension of an existing structural theory
Measurement model specification	• Formative measured constructs part of the structural model
Structural model	• Model is complex (many constructs and indicators)
Data characteristics and algorithm	• Covariance Based SEM cannot be met (Model specification, non-convergence, distributional data assumptions) • Sample size relatively small. • Data to some extent, non-normal. • Large data sets of CB SEM and PLS-SEM, results are similar. PLS-SEM results are a good approximation of CB-SEM results.
Model evaluation	• Latent variable scores are required in subsequent analysis.

Partial Least Analysis-Structural Equation Modeling (PLS-SEM) statistical data analysis is a sophisticated and cutting-edge technique. Based on the examination and identification of the complex interactions between the constructs or variables employed in this study, PLS offers the ability to examine such type of relationships. In addition, the proposed hypotheses for this study consisted of the first-order

reflective constructs and the second-order reflective constructs, thus PLS was appropriate to use. Table 3.11 shows the steps involved in PLS-SEM model evaluation.

Table 3.11: Step of PLS-SEM model evaluation

Step 1: Measuring the model
✓ Assessment of the internal consistency and reliability ✓ Assessment for the convergent validity ✓ Assessment for the discriminant validity
Step 2: Assessment of the structural model
✓ Evaluating the significance of the structural model path coefficient ✓ Evaluating the coefficient of determination R2 Value ✓ Assessing the f2 of effect sizes ✓ Assessing the predictive relevance Q2 of effect sizes
Step 3: Goodness of Fit (GoF)
✓ To test model reject or support ✓ Comparing competing models ✓ Assessing the consistent PLS Algorithm ✓ Assessing the Fit Summary results using PLS Algorithm ✓ The criteria of GoF is Standardized Root Mean Square Residual (SRMR), Exact Model Fit Tests, Normed Fit Index (NFI) and Root Mean Square Residual Covariance (RMS theta)

The purpose of the measurement model is to identify the validity and reliability of the constructs. Furthermore, it assessed the links among the constructs that factored loading and identified the linear relationship between different constructs concomitantly, which is the path coefficients (Ramayah *et al.,* 2016). Reflective and formative constructions are the two types of constructs. Reflective constructions emerge when causal arrows connect the latent factors to the indicator variables. Changes in the latent variables immediately produce changes in the assigned indicator. (Ramayah *et al.,* 2016). Therefore, validity and reliability are applicable to the reflective constructs and are evaluated by using PLS-SEM or conducting Confirmatory Factor Analysis (CFA). The study reflective constructs are shown in Table 3.12.

Table 3.12: Measurement constructs

First-order constructs	No. of items	Second-order constructs	Type
Internal integration	3	Supply chain integration	Reflective
Supplier integration			
Customer integration			
External risk	2	Supply chain risk	Reflective
Internal risk			
Information sharing	Reflective		
Plan	4	Supply chain performance	Reflective

Table 3.12 (continued)

Source			
Make			
Deliver			

The structural model constructs for this study are presented in Table 3.12. Different estimations are conducted, such as testing for signs of the structural model of path coefficients, evaluating the coefficient of determination R2 values, assessing the f2 of effect size, and assessing the predictive relevance Q2 of effect sizes. Finally, the proposed research model for this study was confirmed and presented based on the findings in Chapter 4.

3.4.1.1 SEM models without latent variables

The regression model and the path model are the two types of models available in SEM without latent variables. Variables were observed using the regression model. In regression, only the dependent variables have an error term; the independent variables are believed to be error-free (Ramayah *et al.*, 2016). The path model only observes the variables without latent variables. In addition, the path model is unlike the regression model, but like structural equation models, independent variables can be both causes and effects of other variables (Ramayah *et al.*, 2016). Only the dependent variables in path models have error terms. The independent variables in path models are assumed to be measured without error. The partial coefficients are calculated using only the independents in direct relation to the dependent variables (Ramayah *et al.*, 2016).

3.4.1.2 Process of a structural equation modelling

There are two steps in the structural equation modelling process. The first step is to validate the measurement model through confirmatory factor analysis (CFA), and the second step is to fit the structural model through path analysis (PA) (Ramayah *et al.*, 2016). After the validation of the measurement model, two or more models are

compared in terms of model-fit, which measures the extent to which the covariance predicted by the model corresponds to the covariance in the data. Modification index values and other coefficients are used to modify one or more models in order to improve fit (Ramayah *et al.*, 2016).

3.4.1.3 Exploratory factor analysis (EFA)

The exploratory factor analysis corresponds to the former task, which is available in general-purpose statistical software such as SPSS, SAS and Stata. The exploratory factor analysis assumes that each common factor affects every observed variable and the common elements are either correlated or uncorrelated, EFA explores the data and provides the researchers information about how many factors or constructs, component is needed to best represent the data (Ramayah *et al.*, 2016). According to Ramayah *et al.* (2016) EFA is conducted without knowing how many factors really exist or which indicator belong to which factor. The factors that emerge can only be named after the factor analysis is performed. Ramayah *et al.* (2016) stated the EFA is based on the results generated by correction statistics from the software, not from any theory.

3.4.1.4 Confirmatory Factor Analysis (CFA)

Confirmatory factor analysis is used to validate each item's suitability, and the value of goodness and its fit indices are compared to examine the goodness of model fit. Confirmatory factor analysis measures models with unmeasured covariance between each possible latent variable (Ramayah *et al.*, 2016). Unmeasured covariance indicates that one always draws two-headed covariance arrows connecting all the pairs of independent variables: associations and no causations. The purpose of the confirmatory factor analysis is to test the hypothesis about the factor structure. In confirmatory factor analysis, the theories come first; then, the model derived from the theory. The model is also tested for consistency with observed data (Ramayah *et al.*, 2016).

Table 3.13: Goodness of fit indices

Confirmatory factor analysis (CFA) (goodness of fit measure)	Acceptable Values	Sources
Chi-Square CMIN	NA	NA
Degree of freedom	NA	NA
CMIN/DF	CMIN/df ≤	Bentler and Bonnet (1989)
P-value	p≤0.05	Hair *et al.* (2006)
Root mean square residual (RMR)	No established thresholds (the smaller, the better)	Hair *et al.* (2006)
The goodness of fit (GFI)	>0.90 (the higher, the better)	Hair *et al.* (2006)
Comparative fit index (CFI)	>0.90	Hair *et al.* (2006)
Root mean square error of approximate (RMSEA)	<0.08	Hair *et al.* (2006)
Normal fit index (NFI)	≥0.90	Hair *et al.* (2006)
Incremental fit index (IFI)	≥0.90	Hair *et al.* (2006)
Relative fit index (RFI)	≥0.90	Hair *et al.* (2006)

3.4.1.5 Path analysis

The path analysis is in contrast with the measurement model. The path analysis is a set of independent and dependent variables in the model, as well as the direct effects connecting them via straight arrows and error terms. The path analysis model only focuses on the relationship of multiple observed variables, and to analyse the several regression equations simultaneously. Path analysis uses the same idea of model fitting and testing as any SEM.

3.4.1.6 Goodness of fit tests

The goodness of fit tests determines if the model can be provisionally accepted or rejected. Since the null hypothesis is under test that the models fit the data, the researcher needs to find a small non-significant chi-square model that fits the statistic, which does not allow rejecting the null hypothesis (Ramayah *et al.,* 2018). The fit indices outputs in Smar contain a plethora of model fit statistics designed to test or describe the overall model fit. The chi-square commonly reports the fit of statistics labelled as discrepancy in the PLS-SEM output. It is reported with the terms "df" and

"p" and the Tucker-Lewis Index (TLI), the Root Mean Square Error of Approximation (RMSEA), and lower and upper confidence interval boundaries.

Table 3.14: Model fit criterion, accepted level and interpretation (Ramayah *et al.*, 2018)

Model fit criterion	Acceptable level	Interpretation
Chi square (Discrepancy/ CMIN)	Tabled X^2-Value	Compares obtained X^2 value with tabled value for given df
Goodness of fit (GFI)	0 [no fit] to 1[perfect fit]	Values close to 0.95 reflects a good fit
Adjusted goodness of fit (AGFI)	0 [no fit] to 1[perfect fit]	Value adjusted for df, with 0.95 a good model fit
Root mean square residual (RMR)	Researcher dines level	Indicates the closeness of Σ to ^{s} matrix
Roof mean square error of approximation (RMSEA)	< 0.05	Values less than 0.05 represent a good model fit
Tuker-Lewis Index (TLI)	0 [no fit] to 1[perfect fit]	Values close to 0.95 reflect good fit
Normed fit index	0 [no fit] to 1[perfect fit]	Value close to 0.95 reflects a good model fit
Normed chi-square	1.0-5.0	
Parsimonious fit index (PFI)	0 [no fit] to 1[perfect fit]	Compares values in alternative models
Akaike information criterion	0 [perfect fit] to negative value [poor fit]	Compares values in alternative models

3.4.2 Measurement Model

Campbell and Fiske (1959) proposed two aspects to assess the validity of the test: convergent validity and discriminant validity. In structural equation modelling, confirmatory factor analysis is usually used to evaluate the construct validity.

3.4.2.1 Convergent Validity

According to Fornell and Larcker (1981), the criteria are often used to estimate the degree of shared variance between the model's latent variables. The level of correlation between the measurements of an identical idea is represented by convergent validity. Convergent validity indicates the construct provides the amount of the communal proportion of variance among the factors. The convergent validity construct loading, construct reliability (CR), and average variance extracted (AVE) are mandatory to

assume whether all items loaded on the construct are significant (Ramayah *et al.,* 2018). The AVE measures the level of variance captured by the construct versus the level due to measurement error. There are three standards for assessing convergent validity. Firstly, factor loadings indicators should be significant and higher than 0.50, and the CR values should be higher than 0.70. The last is the AVE for each construct should be higher than the variance error measurement (Fornell & Lacker, 1981). The value above 0.7 is considered very good, whereas the level value of 0.5 is acceptable. Construct reliabilities is a less biased estimate of reliability than Cronbach's' alpha, which is the value of CR is 0.7 and above are acceptable (Ramayah *et al.,* 2018).

3.9.2.2 Discriminant Validity

Discriminant validity is the degree to which measuring different traits is unrelated. According to the Fornell and Larcker (1981) testing system, the discriminant validity is assessed by comparing the variance captured by the construct and the share of variance with the other constructs. The average variance extracted from factor correlation parameters can be used to assess discriminant validity. The discriminant validity specifies the extent to which the construct given is different from all other constructs within the same measurement model (Hulland, 1999). In addition, Hair *et al.* (2019) describe the discriminant validity as the following condition, and it should be satisfied that the maximum shared variance should be lower than AVE. The square root of the AVE should be higher than the correlation of inter constructs. When the conditions are satisfied, the discriminant validity is ensured (Hair *et al.,* 2016).

Fornell and Larcker (1981) and Ramayah *et al.* (2016) stated that the indicators should load more strongly on their constructs than on other constructs in the model. Furthermore, the average variance shared between each construct should be more significant than the variance shared between the construct and other constructs (Fornell & Larcker, 1981: Ramayah *et al.,* 2016). According to Hair *et al.* (2013), discriminant validity means designing a unique or district construct from the other constructs by the empirical standard for the whole model. However, the discriminant validity can be measured using cross-loading, the Fornell and Lacker criterion, and the Heterotrait-

monotrait ratio of correlations (HTMT). The outer loadings evaluate the cross-loading among all the constructs. Chin (2010) proposed the cross-loading method for assessing discriminant validity. The discriminant validity is called a loading construct, and it should be more significant than all other cross-loading constructs. All the items or indicators loading the present research study are more significant than forming the cross-loading acceptable for discriminant validity.

3.4.3 Hypothesis testing (Direct Effect)

This study's initial aim is to check the direct relationships between supply chain integration (internal integration, customer integration, and supplier integration), information sharing, and supply chain performance using structural equation modelling to present a path of analysis including independent and dependent variables through software AMOS. The values of Chi-Square (CMIN), goodness of fit index (GFI), Adjusted Goodness of Fit Index (AGFI), comparative Fit Index (CFI), Tucker Lewis Index (TLI), Normed Fit Index (NFI), Roof Mean Square Error of Approximation (RMSEA), and Root Mean Square Residual (RMR) present the good model fit (Hair *et al.,* 2013).

3.4.4 Hypothesis testing (Mediating Effect)

A mediator is to explain how or why the independent variable is related to the dependent variables. The mediation is exemplified by the question, "how did it work?". The focus is on understanding the mechanisms underlying the causal chain of events or the underlying process. According to Kenny and Judd (2014), mediation is a process or an intervening the variable. Therefore, the mediation effect will occur when the impact of independent variables on the dependent variables is transmitted through the mediator, which is one or more other variables. It discusses the underlying hypothesis that causes some variations of one variable in another variable, which leads to some variations in the results of the affected variables (Little, 2013). Using a mediator and a third explanatory variable, the mediation analysis seeks to clarify and discover the

fundamental mechanism of an observed relationship between independent and dependent variables.

To investigate the mediating effect of supply chain risk management between the relationship of supply chain integration and supply chain performance, as well as the mediating effect of information sharing between the relationships of supply chain integration and supply chain performance, a structural model was developed to test those relationships. Hayes and Preacher (2014) and Hair *et al.* (2013) recommended three phases for analysing the mediating effect, as presented in the following Table 3.15.

Table 3.15: Steps for analysis of mediation effect

Steps	Outcome	Conclusion
Step 1: assess the significance of the direct effect without the mediator.	Not significant	No mediation effect
	Significant	Proceed to step two
Step 2: assess the significance of the indirect effect with including the mediator.	Not significant	No mediation effect
	Significant	Proceed to step three
Step 3: assess the strength of the mediation by calculating the variance account for (VAF)	VAF > 80%	Full mediation
	20% ≤ VAF ≤ 80%	Partial mediation
	VAF < 20%	No mediation

3.5 Summary

The third chapter described the study's location, the study population, sample size, the survey instrument, data collection methods, data analysis methods, initial expectations, study administration, and a flow chart study that was employed in this study. The location for the study is in Malaysia, focusing on SMEs. The study's respondents were SMEs registered with the Federation of Malaysian Manufacturers. Purposive sampling was utilized to acquire data for the study. The collected data was analysed using SPSS and PLS-SEM. The research methodology employed in order to respond to the research questions posed in Chapter 1 The results of the study are disclosed and described in Chapter 4.

CHAPTER 4

ANALYSIS AND FINDINGS

4.1 Introduction

The study's findings are presented in this chapter. It also addresses the administration of the questionnaire, the response rate of the data distribution, the general characteristics of the respondent firms, and the findings of the statistical analysis performed. The results of structural model assessment and the mediation effect using PLS are also presented in this chapter. This chapter concludes with a summary of the research findings.

4.2 Survey questionnaire administration

Table 4.1 summarises the survey questionnaire administration. A sample size of 331 respondents were needed for this study based on the Krejcie and Morgan (1970) population estimation. 242 surveys were collected from the 2305 set emailed and disseminated to the respondents' targeted. Due to missing data, similarity feedback, univariate and multivariate outliers, and other factors, 31 of the retrieved responses were excluded. The invalid data included 10 questionnaires with 0.43% of missing data, 3 questionnaires with 0.13% of similarity feedback issues and 18 questionnaires with 0.78% dependent on outliers. Thus, the final responses who participated in this research were 211, with 63.75% considered valid and adequate for further analysis.

Table 4.1: Survey questionnaire administration

Description	Number	Percentage
Sample size	331	100
Total questionnaires received	242	10.50
Response rate	242/331	73.1
Questionnaires with missing data	10	0.43
Similarity feedback in questionnaires	3	0.13
Outlier in data	18	0.78
Total valid questionnaires	**211**	**63.75%**

4.3 Demography of respondents'

This section discusses the respondent's demographics, which include the year the company has been in operation, the number of employees working, the type of industry, the status of the business, the business premise, the department responsible for supply chain management, and whether the logistics are run in-house or outsourced. The education, experience in supply chain management, and risk assessment of the respondent all play a role in the supplier selection process, as illustrated in Table 4.2.

Table 4.2: The summary of respondents' demography

Number of year company has been operating	Frequency	Percent (%)
Less than 1 year	2	0.9
1 to 3 years	7	3.3
4 to 10 years	62	29.4
Over 10 years	140	66.4
Total	211	100
Type of industry	Frequency	Percent (%)
Agricultural product and Machinery	36	17.1
Automotive parts and Components	7	3.3
Environment & Waste Management: Products and services	15	7.1
Furniture, Carpets and Wood Related Products	8	3.8
Household Products and Appliances	9	4.3
Iron, Steel and Metal Products	8	3.8
Pharmaceutical, Medical equipment, cosmetic and Toiletries	2	0.9
Rubber products	3	1.4
Automation technology	6	2.8

Table 4.2 (continued)

Building materials and related Product	17	8.1
Chemical and Adhesives Products	6	2.8
Food and Beverage	28	13.3
Gifts, Stationery and office Supplier	4	1.9
Industrial and Engineering Products and Services	28	13.3
Paper, packaging, labelling and printing	11	5.2
Plastic products and Resins	10	4.7
Services	9	4.3
Others	4	1.9
Total	211	100
Status of business	Frequency	Percent (%)
Sole proprietors	27	12.8
Partnership	58	27.5
Limited liability partnership	40	19.0
Limited liability company	84	39.8
Others	2	0.9
Total	211	100
Business premise	Frequency	Percent (%)
Home-based	6	2.8
Leased space	178	84.4
Other	27	12.8
Total	211	100
The firm has a separate department or division responsible for supply chain management	Frequency	Percent (%)
Yes	143	67.8
No	68	32.2
Total	211	100
In-house logistics/outsourced	Frequency	Percent (%)
Own logistics	122	57.8
Outsources or contact to an external party	89	42.2
Total	211	100
Education of the respondents	Frequency	Percent (%)
Secondary education	2	0.9
Diploma / Degree	208	98.6
Master Degree/ Doctorate	1	0.5
Total	211	100
Risk assessment in the supplier selection process.	Frequency	Percent (%)
Critical and mandatory	73	34.6
Optional, but often supplier risk is considered in the selection process	136	64.5
Optional, often supplier risk is not considered in the selection process	2	0.9
Total	211	100

Table 4.2 shows that the number of companies that have been in operation for more than ten years is 140 (66.4%); the second-highest number is 62 (29.4%) of companies that have been in operation for four to ten years, and the year that one to three companies have been in operation is seven (3.3%). The most recent is less than a year, with 2 (0.9%) firms.

For the section that is "type of industry", among the respondents, most of them were related to the agricultural products and machinery industry with the highest number of 36 (17.1%), followed by the food and beverage industries and the engineering products and service industries with 28 (13.3%). In addition, the industry of building materials and related products was 17 (8.1%), the environment and waste management: products and services were 15 (7.1%) and other types of industrial were below 10 respondents.

Among the respondents, 84 (39.8%) of the participants' status of business was limited liability companies, 58 (27.5%) business status was partnership, and 40 (19%) were limited liability partnerships. In addition, the sole proprietors were 27 (12.8%) and 2 (0.9%) business status was mentioned "others' status". Furthermore, for “business premise”, more than half of the respondents with number 178 (84.4%) were leased space, followed by another 27 (12.8%), and home-based were 6 (2.8%).

The firm's results have a separate department or division responsible for supply chain management shown in Table 4.2 indicates that most of the firm have different departments or divisions accountable for supply chain 143 (67.8%). While 68 (32.2%) of the firms do not have a separate or division responsible for supply chain management. The logistics run in the company or outsourced. Most of the study's participants run their own logistics, which is 122 (57.8%), and the rest of the participants were outsourcing or contracted to external parties 89 (42.2%). The result for the education of the respondents in this study indicates more than half of the participants were diploma/degree holder 208 (98.6%), and only 2 (0.9%) respondents were from secondary education, and 1 (0.5%) participant was a master's degree/doctorate.

The role that risk assessment plays in the supplier selection process in the firm, as shown in Table 4.2, indicates that the optional, but often supplier risk-considered in the selection process 136 (64.5%), followed by the critical and mandatory 73 (34.6%)

and 2 (0.9%) of the firm participants were optional, often supplier risk is not a consideration in the selection process.

4.4 Missing value analysis

SPSS software provides two choices for dealing with the problem of missing data. The first is mean value replacement, and the second is case-wise deletion. The missing value is eliminated from the recodes or data (Hair *et al.*, 2016; Ringle *et al.*, 2005). According to Hair *et al.* (2016), if any indicator contains less than 5 per cent of missing values, the mean value replacement method can be used. This method can still influence the variance of variables under the same sample size (Rostami *et al.*, 2109).

Descriptive statistics show there are 10 cases with more than 0.43% missing values. The lost value was identified by checking the original survey questionnaires where they show the typing mistake, and the values ware arranged by utilising the mean value replacement method in PLS software. Finally, there is no missing data in the whole data set.

4.5 Exploratory factor analysis

Statistical software Statistical Package for Social Sciences (SPSS) was used for exploratory factor analysis to analyse the data. Factor analysis was applied for each item on the scale to reduce the items to a smaller number of underlying factors. The principal component analysis was used to extract the element (Eigenvalue > 1). A rotation matrix is used to facilitate the interpretation of the factor matrix. The Kaiser-Meyer-Olkin and Bartlett's Test of Sphericity is used to validate factor analysis. According to Hulland (1999), loading values equal to and greater to 0.40 are acceptable, while Tabachnick and Fidell, (2013) suggest the acceptable threshold for factor analysis is 0.6 Hair (2016).

Table 4.3: Factor analysis of supply chain risk management

Supply chain risk management	Factor Loading	
Internal risk	Factor 1	Factor 2
Human resources risks (skills shortage, turnover)	.947	-.152
Sustainability and corporate social responsibility compliance.	.851	-.121
Labor dispute/stoppage risks (your own, supplier, 3rd parties-e.g. carries)	.828	-.026
Product design flows (quality, safety)	.686	.057
Counterfeits	.632	.086
Your company's business continuity policies and practice.	.580	.237
Data/IT security	.570	.237
Supplier's business continuity policies and practices	.535	.324
Manufacturing production reliability and flexibility	.501	.293
Infrastructure outage risks (power, telecoms, utilities)	.430	.317
External risk		
Geopolitical risks	-.124	.927
Natural disaster risks	-.106	.864
Economic cycle risks (expansion/contraction)	.101	.750
Exchange rate risks	.074	.680
Poor demand forecasts	.098	.674
Theft and shrinkage	.229	.548
Commodity price volatility risks	.215	.536
Eigen-Value Percentage variance explained	50.035	7.773
Reliability (alpha)	.909	.879
Total variance explained A measure of sampling adequacy (KMO) Barlett's test of sphericity significant	57.808 .918 .000	

As mentioned in Table 4.3, the factor analyses on 17 items of supply chain risk management, resulted in 2 factors where factor 1 and factor 2. The sampling adequacy value was found to be 0.918, with total variance explained by 50.035% and for factor 2 is 7.773%. The first factor consists of 10 items related to an internal risk. The factor loading for the first factor was above the cross loading and higher than the acceptable value of 0.50 provided by Hair *et al.* (2013). The item of "human resources risks (skills shortage, turnover)" was found to have high factor loadings of 0.947. None of the items were dropped as all of them were above the acceptable value. The second factor of supply chain risk management, named "external risk," consisted of seven items. All the items were above the sufficient loading value. None of the items were extracted due to their acceptable loadings.

4.6 Reliability analysis

The reliability test was conducted for the actual data. Bond and Fox (2015) define the reliability of an item, showing the stability of the item. Table 4.4 below shows the reliability of this study. As we can see, the Cronbach's alpha for each variable is acceptable. The reliability of Cronbach alpha values exceeding 0.60 is sufficient (Nunnaly, 1978).

Table 4.4: Reliability analysis

Item		Cronbach's Alpha	No. item	N	Decision
Supply chain risk	External risk	0.909	10	211	Very high and effective
	Internal risk	0.879	7	211	Good and acceptable
Supply Chain Integration	Internal integration	0.829	4	211	Very high and effective
	Supplier integration	0.918	12	211	Very high and effective
	Customer integration	0.889	8	211	Very high and effective
Information sharing	Information sharing	0.903	6	211	Very high and effective
Supply Chain Performance	Plan	0.883	9	211	Good and acceptable
	Source	0.920	10	211	Very high and effective
	Make	0.870	6	211	Good and acceptable
	Delivery	0.921	9	211	Very high and effective

4.7 Normality test

The normality, namely kurtosis and skewness, was performed and the results are shown in Table 4.5. The normality test of supply chain integration, supply chain risk management, information sharing, and supply chain performance was performed. The rule of thumb for the normality test suggested by Kline (2011) is characterised as having a skewness of less than 3 and a kurtosis of less than 10. The skewness values are between -1.38 and -0.55, and the values of kurtosis are between -0.748 and 1.227, showing normal distribution.

Table 4.5 shows the results of normality analysis of all variables of this study. The value of skewness and kurtosis for the supply chain integration element of internal integration is -1.267 and 3.394, supplier integration is 0.193 and 1.199, and customer

integration is -1.696 and 3.071 it shown the data is not normal. Value skewness and kurtosis for the element of external risk -0.980 and 3.644, and external risk is -1.003 and 2.438 shown the data for supply chain risk is not normal. The value for information sharing is -0.100 and 0.927 indicates the data is normal distribution. The supply chain performance value for the skewness and kurtosis is -0.794 and 1.470 for the plan, -0.660 and 2.451 for source, 0.116 and 2.399 for make, and -0.578 and 2.745 for delivery shown the data is not in normal distribution.

Table 4.5: Normality analysis of skewness and kurtosis

Supply chain integration	Skewness	Kurtosis
Internal	-1.267	3.394
Supplier	0.193	1.199
Customer	-1.696	3.071
Supply chain risk	Skewness	Kurtosis
External	-0.980	3.644
Internal	-1.003	2.438
Information sharing	Skewness	Kurtosis
Information sharing	-0.100	0.927
Supply chain performance	Skewness	Kurtosis
Plan	-0.794	1.470
Source	-0.660	2.451
Make	0.116	2.399
Delivery	-0.578	2.745

4.8 Descriptive analysis results

This section describes the survey's descriptive analysis. The results of the mean and standard deviation of each variable are reported in Table 4.6.

Table 4.6: Mean and standard deviation for each variable

Variables		Mean	Level of Importance	Standard Deviation
Supply Chain Integration	Customer	4.125	High	0.615
	Supplier	3.508	Medium	0.585
	Internal	4.251	High	0.489
Supply chain risk management	Internal	3.368	Medium	0.499
	External	3.186	Medium	0.493
	Information Sharing	3.926	Medium	0.453
Supply Chain Performance	Plan	4.122	High	0.407
	Source	3.854	Medium	0.416
	Make	3.991	Medium	0.334
	Delivery	3.791	Medium	0.416

Note: Scale *1 to 3= Low, ** 3 to 4=Medium, ***4 to 5= High

The mean values and standard deviation of the variables in this study are shown in Table 4.6. Findings for “supply chain integration” was above average and were nearly strongly agree. Customer integration has a mean value of 4.125, the supplier integration has a mean of 3.508, and internal integration has a mean of 4.251. The items for “supply chain risk management” were 3.368 for internal and external 3.926, which means the vital level of supply chain risk management is medium. Furthermore, the items for “information sharing” were closer to highly increased, which the value of the mean is 3.926 showing the level of importance was medium. The mean values for "supply chain performance" with its dimensions such as "plan" showed the necessary high level of 4.122. The other three dimensions have a medium level of importance for the "source" 3.854, "making" 3.991, and "delivery" 3.791. From the results, it is clear that all the variables have shown a positive response for each variable.

4.8.1 Supply chain integration

Table 4.7 describes the details of the mean values and standard deviation for each item included in supply chain integration. The mean values for the dimension of internal integration are of high level, whereas the item of "encourage employees to work together" shows a high level of mean that is 4.7062.

Table 4.7: Mean standard deviation of supply chain integration

No.	Supply chain integration		Mean		Standard deviation	
1	Internal Integration	Encourage employees to work together	4.7062	4.4182	.57645	.48195
2		Communicate frequently	4.2986		.55287	
3		Management works together	4.2938		.60072	
4		Generally speaking	4.3744		.63779	
5	Supplier Integration	Close communication with the supplier	4.1564	3.8002	.68951	.52480
6		Maintain a cooperative relationship	4.1659		.65172	
7		Establish long term relationship with the supplier	4.1611		.67796	
8		Customer is actively involved in our product design process	3.4171		.80858	

Table 4.7 (continued)

9		The participation level of our major supplier in the design stage are high	3.4739		.80654	
10		Major supplier shares their production schedule	3.5545		.79319	
11		Major supplier shares their production capacity	3.6303		.71436	
12		Major supplier shares available inventory	3.6919		.77144	
13		Share our production plans with our major supplier	3.6777		.72403	
14		Share our demand forecasts with our major supplier	3.8578		.66810	
15		Share our inventory levels with our major supplier	3.7536		.71443	
16		Help our major supplier to improve its process to meet our needs better.	4.0616		.62564	
17	Customer Integration	Frequently in close contact with our customer.	4.3886	3.7778	.73722	.56606
18		Give feedback on our quality and delivery performance.	4.0948		.63285	
19		Strive to be highly responsive to our customer's needs.	4.2891		.81464	
20		The customer actively involved in our product design process.	3.2275		.80794	
21		Customer shares Point of Sales (POS) information with us	3.0474		.72875	
22		Customer shares demand forecast with us	3.6114		.75002	
23		Share our available inventory with our major customer	3.8246		.76380	
24		Share our production plan with our major customer	3.2938		.78274	

Note: Scale *1 to 3= Low, ** 3 to 4=Medium, ***4 to 5= High

4.8.2 Supply chain risk management

Table 4.8 shows the mean values and standard deviation of "supply chain risk". The mean value of all the internal risk items is medium level, while the items relating to human resources had the highest value among internal risk items, with a mean value of 3.5924 and the lowest value of mean is 3.0758 for data/IT security. The mean value for external risk shown most of the items is medium level while the item relating to the theft and shrinkage had the highest value among the external risk with a mean value of 3.3555 and the geopolitical risks had a low mean value is 2.9336.

Table 4.8: Mean and standard deviation of supply chain risk

No.	Supply chain risk		Mean		Standard deviation	
1.	Internal risk	Human resources risks (skills shortage, turnover)	3.5924	3.3682	.63601	.49951
2.		Labour dispute/stoppage risks (your own, supplier, 3rd parties-e.g. carries)	3.3365		.70071	
3.		Sustainability and corporate social responsibility compliance.	3.3081		.69343	
4.		Product design flows (quality, safety)	3.4692		.70559	
5.		Your company's own business continuity policies and practice.	3.3175		.63142	
6.		Counterfeits	3.4550		.68425	
7.		Data/IT security	3.0758		.67184	
8.		Supplier's business continuity policies and practices	3.2180		.59350	
9.		Manufacturing production reliability and flexibility	3.5829		.62981	
10.		Infrastructure outage risks (power, telecoms, utilities)	3.3270		.76977	
11.	External risk	Geopolitical risks	2.9336	3.1869	.62895	.49379
12.		Natural disaster risks	3.1422		.70958	
13.		Economic cycle risks (expansion/contraction)	3.1754		.56278	
14.		Poor demand forecasts	3.2654		.59816	
15.		Exchange rate risks	3.0995		.70003	
16.		Theft and shrinkage	3.3555		.69124	
17.		Commodity price volatility risks	3.3365		.63662	

Note: Scale *1 to 3= Low, ** 3 to 4=Medium, ***4 to 5= High

4.8.2.1 The importance level versus actual level of supply chain risk management

This section deliberates the comparison between the level of importance of supply chain management and the actual level of management of supply chain risk in the company. To identify the difference in the importance and the actual level of supply chain management involved in handling the risk of the supply chain, a Paired-samples t-test was tested.

Table 4.9: Paired-samples t-test

	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
				Lower	Upper			
Pair 1 Important Actual	0.23148	0.41218	0.02838	0.17554	0.28742	8.158	210	0.000

The Paired-samples t-test revealed the statistically significant difference between the importance level of supply chain management and the actual level of supply chain management involvement in managing the company's supply chain risk. The significance value is 0.000, which means the p-value is less than 0.05 and is significant. The study found that there is a significant difference between the actual levels of supply chain risk management compared to the stated importance.

Table 4.10: Paired Samples Statistics

Supply chain risk	Mean	N	Std. Deviation	Std. Error Mean
Importance level	3.5466	211	0.48782	0.03358
Actual level	3.3152	211	0.38051	0.02620

Table 4.10 describes the mean value between the importance level and the actual level of supply chain risk management. The mean value of the "importance level" is 3.5466, which is higher than the mean value of the "actual level" of risk management (3.3152). Therefore, the firm have to pay attention on the supply chain risk management in their firm, in order to enhance the performance of the company.

4.8.3 Information sharing

Table 4.11 indicates the mean values and standard deviation for all items of information sharing. All the items showed medium levels except for "inform trading partner in advance of changing needs" which was 4.2559, followed by the item of "trading partners share proprietary information" was 3.9052 and the standard deviation is 0.55250. The lowest mean value of information sharing is a “supplier informed about events or changes that may affect the other partner" is 3.8009, and the standard

deviation is 0.55908. The overall mean for information sharing is 3.9265, and the standard deviation is 0.45397.

Table 4.11: Mean and standard deviation for information sharing

No.	Information sharing	Mean		Standard deviation	
1.	Inform trading partners in advance of changing needs	4.2559	3.9265	.64800	.45397
2.	Trading partners share proprietary information with us	3.9052		.55250	
3.	The supplier keeps us fully informed about issues that affect our business.	3.8341		.53092	
4.	Supplier share business knowledge of core business processes with us	3.8910		.49997	
5.	Supplier exchange information that helps the establishment of business planning.	3.8720		.51430	
6.	Supplier informed about events or changes that may affect the other partner.	3.8009		.55908	

Note: Scale *1 to 3= Low, ** 3 to 4=Medium, ***4 to 5= High

4.8.4 Supply chain performance

Table 4.12 shows the mean values and standard deviation of each item of "supply chain performance". The majority of the items have medium to high mean values. The highest mean value of "plan" and its item "forecast develops for each customer" is 4.0948. Overall, the mean value of "supply chain performance" is of medium level, which is the highest mean value among supply chain performance. In addition, the mean values for the variables that are "make" has a mean value of 3.9850, followed by "plan" 3.941, "source" 3.8777, and “delivery” mean value is 3.8399.

Table 4.12: Mean and standard deviation of supply chain performance

No.	Supply chain performance		Mean		Standard deviation	
1.	Plan	The performance evaluation process occurs on a regular (scheduled) basis.	3.7204	3.9414	.56274	.41333
2.		The forecast develops for each product.	3.9052		.60200	
3.		The forecast develops for each customer.	4.0948		.62528	
4.		The forecast is credible or believable.	3.8057		.65840	

Table 4.12 (continued)

5.		The forecast is used to develop plans and make commitments.	3.9052		.48846	
6.		The forecast accuracy is measured.	3.7346		.58202	
7.		The demand management and production planning processes in our company are integrated.	3.9716		.45685	
8.		In our company, the sales, manufacturing and distribution organisations collaborate in developing the forecast.	4.0711		.50678	
9.	Make	We have a documented (written description, flow charts, etc.) production planning and scheduling process.	3.9668	3.9850	.55535	.41774
10.		The supplier lead times are updated monthly.	4.0995		.73972	
11.		Our shop floor scheduling integrated with the overall scheduling process.	3.8720		.49543	
12.		Our information system currently supports the process.	3.9763		.50181	
13.		Our current process adequately addresses the needs of the business.	3.9763		.41908	
14.		In our company, the sales, manufacturing and distribution organisation collaborate in the planning and scheduling process.	4.0190		.44681	
15.	Source	The procurement process documented (written description, flow charts).	3.7820	3.8777	.60767	.44371
16.		The information system in our company supports the process.	3.8483		.55698	
17.		In our company, the supplier inter-relationships (variability, metrics) understood and documented.	3.7820		.56892	
18.		The process owner in our company identified.	4.1659		.58225	
19.		We share planning and scheduling information with the supplier.	3.8815		.54352	
20.		We collaborate with the supplier to develop a plan.	3.9100		.48447	
21.		We measure and give feedback to the supplier performance.	3.8531		.61119	
22.		We do have the procurement process in a team designed.	3.7583		.66430	
23.		The team meet regularly.	3.8104		.57079	

Table 4.12 (continued)

24.		The other functions (manufacturing, sales etc.) work closely with the procurement process team members.	3.8957		.60830	
25.		Overall, this decision process area performs very well.	3.8578		.47677	
26.	Delivery	We have a Promise Delivery (order commitment) process, owner.	3.8626	3.8399	.46298	.41333
27.		We measure customer requests versus the actual delivery.	3.8720		.50495	
28.		Our information system currently supports the order commitment process.	3.9052		.51688	
29.		Our order commitment process integrated with the supply chain decision process.	3.9810		.40192	
30.		Our information system supports distribution management.	3.9242		.48199	
31.		We have a single point of contact for all order inquiries.	3.7867		.54947	
32.		We consolidate orders by customers, sources, carriers, etc.	3.8531		.49012	
33.		We use automatic identification during the delivery process to track order status.	3.6019		.67103	
34.		We have real-time visibilities of order inquiries	3.7725		.62137	

Note: Scale *1 to 3= Low, ** 3 to 4=Medium, ***4 to 5= High

4.9 Measurement model using Smart-PLS

The measurement model was used to test the reliability and validity of the constructs (Henseler, Ringle & Sinkovics, 2009). The factor loading results were used to check each item's reliability. If the item loading is greater than 0.70, it should be considered adequate. Although, some researchers argue that the loading value of each item factor should be equal to or larger than 0.50, which is also acceptable (Hair *et al.*, 2013). In this study, all the items' factor loadings as shown in Table 4.3 were acceptable and fulfilled the requirement.

The types of validity assessed by the criteria of this study's model are: convergent validity and discriminant validity. The convergent validity of the average variance extracted (AVE) is 0.50 and above. Besides that, the construct validity for all the fitness index for the model met the required level. Hair (2010) and Kline (2011) stated the requirements that need to be followed and achieved by validating the latent variables. Figure 4.1 shows the measurement model of this study.

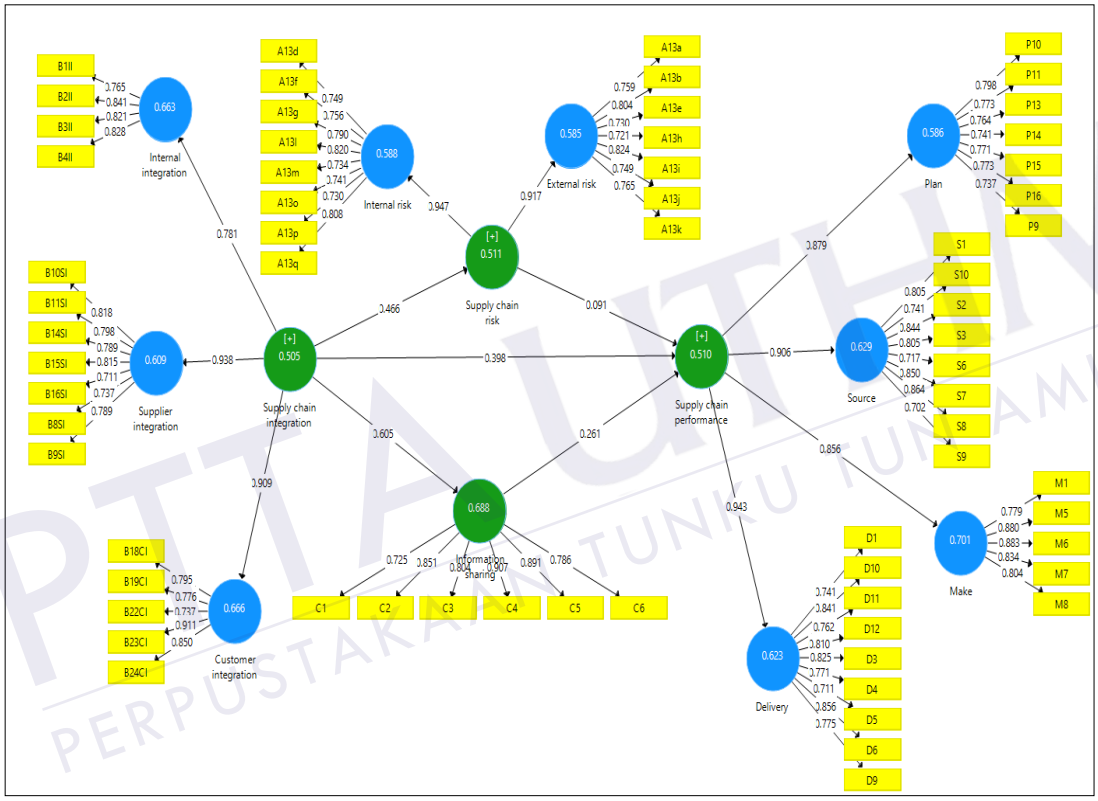

Figure 4.1: Measurement model

4.9.1 Reliability analysis (Internal consistencies)

According to Hair *et al.* (2017), most researchers used to follow two tests to ensure reliability. The first type of test is pre-tested the designed survey questionnaires by experts in a specific research field. The second type of reliability test is the pilot test by utilising a small sample size out of the whole sample size. While some scholars debate that the Cronbach's alpha can be used traditionally, it has faced challenges of deficiency or miscalculating the reliability of the construct (Sekaran & Bougie, 2016;

Hair *et al.*, 2013). On the other hand, Chin (2010) argued that the composite reliability is more rigorous than Cronbach's alpha for measurement reliability. Therefore, this research study applied both methods for testing and reliability.

Table 4.13: Reflective construct reliability

Constructs		Composite reliability		Cronbach's alpha	
Information sharing		0.930		0.908	
Supply chain integration	Internal integration	0.887	0.942	0.830	0.934
	Supplier integration	0.916		0.893	
	Customer integration	0.908		0.873	
Supply chain risk	Internal risk	0.919	0.940	0.899	0.931
	External risk	0.908		0.881	
Supply chain performance	Plan	0.908	0.968	0.882	0.965
	Sources	0.931		0.915	
	Make	0.921		0.893	
	Deliver	0.937		0.924	

Table 4.13 indicates the results of composite reliability and Cronbach alpha of this study. The value of composite reliability for all constructs ranges from 0.887 to 0.937, which exceeds the rule of thumb minimum value of 0.70; therefore, the value of composite reliability in this study is excellent. In the same way, the Cronbach alpha values are more than the minimum threshold value of 0.70, and the range is from 0.830 to 0.924, which is considered excellent. Thus, this confirms that all the constructs of this research model are highly reliable and highly acceptable. The next sections describe the constructs validity.

4.9.2 Validity test

There are two types of suitable measurements for evaluating the validity test: convergent validity and discriminant validity. This study conducted validity test and the results are discussed in the following sections.

4.9.2.1 Convergent validity

This part analyses the Average Variance Extracted (AVE), factor loading and the composite reliability for each variable in this study using Smart-PLS. Hair *et al.* (2017) suggested using factor loading and AVE to assess the convergent validity. The results are shown in Table 4.14.

Table 4.14: Item cross-loadings and AVE for constructs.

Construct		Items	Loading	AVE	
Supply chain integration	Internal integration	B1	0.765	0.663	0.505
		B2	0.841		
		B3	0.821		
		B4	0.828		
	Supplier integration	B10	0.818	0.609	
		B11	0.798		
		B14	0.789		
		B15	0.815		
		B16	0.711		
		B8	0.737		
		B9	0.789		
	Customer integration	B18	0.795	0.666	
		B19	0.776		
		B22	0.737		
		B23	0.911		
		B24	0.850		
Supply chain risk	Internal risk	d	0.749	0.588	0.511
		f	0.756		
		g	0.790		
		l	0.820		
		m	0.734		
		o	0.741		
		p	0.730		
		q	0.808		
	External risk	A	0.759	0.585	
		b	0.804		
		e	0.730		
		h	0.721		
		i	0.824		
		j	0.749		
		k	0.765		
Information sharing		C1	0.725	0.688	
		C2	0.851		
		C3	0.804		
		C4	0.907		
		C5	0.891		
		C6	0.786		

Table 4.14 (continued)

Supply chain performance	Plan	P10	0.798	0.586	0.510
		P11	0.773		
		P13	0.764		
		P14	0.741		
		P15	0.771		
		P16	0.773		
		P18	0.737		
	Source	S1	0.805	0.629	
		S10	0.741		
		S2	0.844		
		S3	0.805		
		S6	0.717		
		S7	0.850		
		S8	0.864		
		S9	0.702		
	Make	M1	0.779	0.701	
		M5	0.880		
		M6	0.883		
		M7	0.834		
		M8	0.804		
	Delivery	D1	0.741	0.623	
		D10	0.841		
		D11	0.762		
		D12	0.810		
		D3	0.825		
		D4	0.771		
		D5	0.711		
		D6	0.856		
		D9	0.775		

Table 4.14 shows the results of convergent validity of this study. As can be seen, all the extreme loading values are more significant than 0.6. Table 4.14 demonstrates that all constructs exceeded the benchmark point of 0.5, as suggested by Henseler *et al.* (2009) and Aimran *et al.* (2015), that the AVE value must be equal to or greater than 0.5, or 50% adequacy for convergent validity. As a result, the convergent validity has attained the fair value among all constructs of this study.

4.9.2.2 Discriminant validity

The Fornell-Lacker criterion approach is very conservative for evaluating discriminant validity. This approach compares the square root of the AVE values of each construct with the squared inter-construct correlation value (Ramayah *et al.*, 2016). Similarly,

Hair *et al.* (2013) mentioned that each construct's value of square root AVE should be greater than the highest value of inter-construct correlation with other constructs.

Table 4.15: Discriminant validity using Fornell and Lacker Criterion

Variables	Information sharing	Supply chain integration	Supply chain risk	Supply chain performance
Information sharing	**0.830**			
Supply chain integration	0.605	**0.711**		
Supply chain performance	0.544	0.598	**0.714**	
Supply chain risk	0.463	0.466	0.397	**0.715**

Table 4.15 shows the results of the discriminant validity testing using the Fornell and Lacker Criterion for the model of this study. It presents all the construct AVE square root values (bold) and the correlation values among the latent constructs are. All the square roots of the AVE value of the indicator and the construct are more significant than their correlation matrix of inter-constructs correlation value, indicating that this study's discriminant validity is accepted. Some researchers have found that the Fornell-Lacker criterion approach is not sufficient and has potential weaknesses in testing discriminant validity (Henseler *et al.*, 2015; Ronkko & Evermann, 2013).

For this reason, this study also measured the discriminant validity using the Heterotrait-Monotrait Ratio of correlations (HTMT). The approach of HTMT has two main features over the dis-attenuated score of correlation among the constructs. It does not require factor analysis to acquire the factor loading and does not demand the calculation of construct scores (Henseler *et al.*, 2015). The HTMT criterion results are compared to the predefined threshold value. The HTMT criterion results are compared to the predefined threshold value. The acceptable discriminant validity of the correlation value of HTMT should not exceed the threshold validity. Kline (2011) recommended that the threshold value be 0.85; meanwhile, Henseler *et al.* (2015) suggested a threshold value of 0.90. Therefore, if the correlation value is higher than the threshold level, which is 0.85 or 0.90, there is an issue with the discriminant validity. This study follows the level of threshold of 0.85 and 0.90 suggested by Henseler *et al.* (2015).

Table 4.16: HTMT Criterion

Variables	Information sharing	Supply chain integration	Supply chain risk	Supply chain performanc e
Information sharing				
Supply chain integration	0.651			
Supply chain performance	0.575	0.629		
Supply chain risk	0.511	0.491	0.421	

Table 4.16 shows that all HTMT criterion values are below both threshold values of 0.85 and 0.90. It confirmed that the constructs' discriminant validity is reliable and that the measurement model is satisfactory. Thus the measurement model for this study is valid and fit to be deployed to assess parameters for the structural model.

4.10 Analysis of the structural model

The structural model evaluation highlights the relationship between all of the independent variables, dependent variables, and mediators in all of the research model's hypotheses (Shrestha, 2021). The fundamental goal of the model is to discover all research questions and answer them by analysing the proposed hypotheses of the research. Based on the conceptual framework, seven hypotheses were created for this study. The assessment of structural model provides the empirical support of the fundamental theories employed in this study. Furthermore, the structural model analysis is used to analyse the model's predictability and the relationship between the constructs.

Some of the researchers advocated that the measurements such as of R^2, path coefficient, and significant values are the best for interpreting the results and assessing the structural model. Therefore, the majority of the results reported R-square, path coefficient size, and significant metrics. While f^2 and Q^2 findings are less typically reported than R2, path coefficient, and significance results (Hair *et al.,* 2017). Furthermore, this study also performed the mediation analysis. Finally, four criteria for evaluating the structural model PLS-SEM are presented: path coefficient

significance, level of determination (R^2) values, effect size (f^2), predictive relevance (Q^2), and goodness of model fit.

4.10.1 Significance of path coefficient

In the last section, the measurement model evaluation generates all of the research model's specified path coefficients (see Figure 4.1). The structural model's evaluation, on the other hand, is essential in determining the level of significance of the path coefficients. The bootstrapping is carried out in this step of the structural model. Scholars have differing views on the sample selection before bootstrapping is performed.

As illustrated in the Figure, the bootstrapping presents t-statistics values to measure the level of significance of the path coefficients. Hair *et al.* (2017) recommended the difference value of path coefficient and t-statistical value for assessing the research model's hypotheses. Path coefficients are evaluated by the standard magnitude values of +1 to -1. If the path coefficient value is near to +1, then it means a very strong positive relationship. If the value is near to -1, it means there is a very strong negative relationship. On the other hand, if the value is very close to zero (0), it shows a very weak relationship. Similarly, the significance level or p-value is less than 0.05 (5%) and the t-statistical value is more than 1.96, which means it is significant, as shown in Table 4.17.

Table 4.17: Level of path coefficient

Assessment	Level of acceptance	Results
Path coefficient	P value <0.01 t value > 2.58 (two-tailed) t value > 2.33 (one tailed)	Significant
	P value <0.05 t value > 1.96 (two-tailed) t value > 1.645 (one tailed)	
	P value <0.10 t value > 1.645 (two-tailed) t value > 1.28 (one tailed)	

Using bootstrapping, the findings of path coefficient, t-statistic value, and significance level values are provided in Table 4.17. The direct relationship between

supply chain integration and supply chain risk is statistically significant and positive (β=0.466, t-value=6.202, p-value=0.00). Similarly, the relationship between supply chain integration and information sharing has shown a positive and significant relationship (β=0.605, t-value=12.858, p-value=0.00). For the relationship between information sharing and supply chain performance it is found significant and positive (β=0.261, t-value=3.346, p-value=0.00). In the same way, the relationship between supply chain integration and supply chain performance is found positive and significant between the constructs (β=-0.398, t-value=5.195, p-value=0.000). However, the relationship between supply chain risk and supply chain performance is insignificant (β=0.091, t-value=1.085, p-value=0.139).

Table 4.18: Results of structural model path coefficient

Dependent construct	Independent constructs	Path coefficient	T-Statistics	P-Value
Supply chain risk	Supply chain integration	0.466	6.202	0.000
Information sharing	Supply chain integration	0.605	12.858	0.000
Supply chain performance	Information sharing	0.261	3.346	0.000
	Supply chain risk	0.091	1.085	0.139
	Supply chain integration	0.398	5.195	0.000

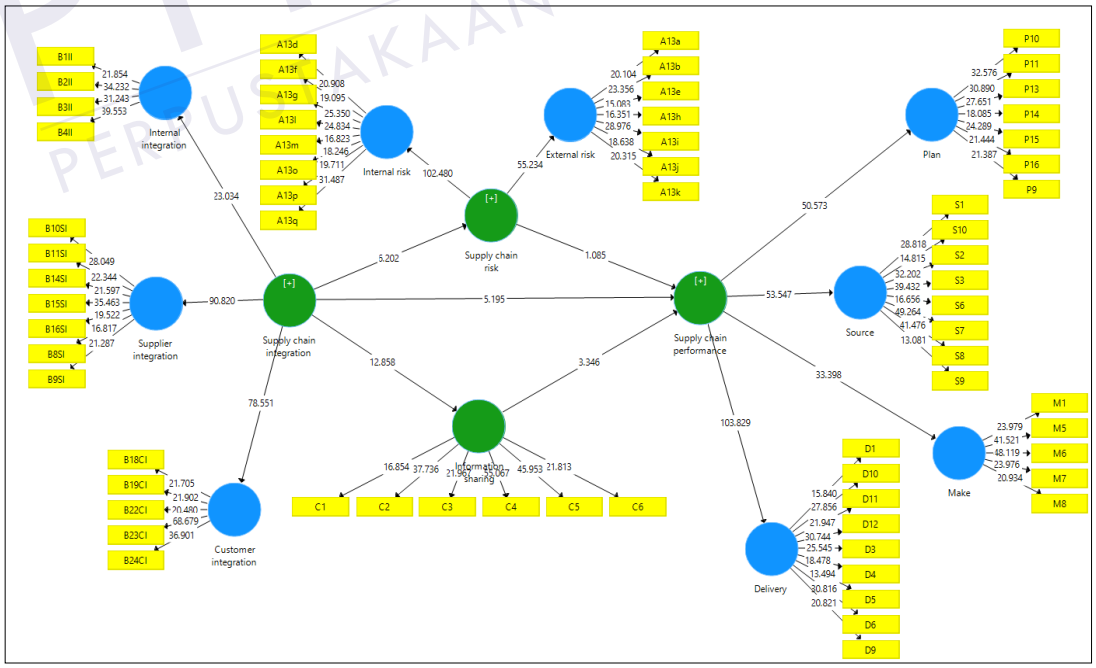

Figure 4.2: Structural Model T-Statistical

As shown in Figure 4.2, t-value can be compared with the standard normal distribution's critical values to decide whether the coefficient is significantly differenced from zero. The critical values for the significance level of 1% (a=0.01) and 5% (a=0.05) probability of error are 2.33 and 1.645, respectively.

4.10.2 Assessing the determination of R^2

The significant evaluation in PLS-SEM indicates the value of $R^{2,}$ which is also known as the coefficient of determination (Henseler *et al.,* 2013). The coefficient of R^2 is to assess the accuracy of the model and measure the amount of variance among the dependent variables that can be explained by predicted constructs. Furthermore, the independent variables have mutual effects on the dependent variables, and the variance of the dependent variables is presented by the independent variables that influenced them (Hair *et al.,* 2013). According to Chin (2010), R^2 values, which are 0.67, 0.33, and 0.19 for dependent variables, represent a substantial, moderate, and weak level of predictive accuracy. Besides, Hair *et al.* (2017) suggests that the R^2 values of 0.75, 0.50, and 0.25 for dependent variables be considered to have substantial, moderate, and weak predictive accuracy levels. This study followed the suggestions of Hair *et al.* (2017) for the determination of R^2.

Table 4.19: Results of R^2

Dependent construct	Independent constructs	R^2
Supply chain risk	Supply chain integration	0.217
Information sharing	Supply chain integration	0.841
Supply chain performance	Information sharing	0.416
	Supply chain risk	

As shown in Figure 4.1 and Table 4.19, the measurement model of this study displays the R^2 values. However, the R^2 value for supply chain risk is 0.217, which is considered low level of predictability. It demonstrates that the supply chain integration explains 21.7% of the total variance. The R^2 for information sharing is 0.841, which is considered a substantial level, and reveals that supply chain integration explains 84.1% of the overall variance in information sharing. Furthermore, the R^2 value for supply

chain performance is 0.416, which is moderate and means that 41.6% of the total variance is explained by supply chain integration, information sharing, and supply chain risk.

4.10.3 Assessing the effect size ($f^{2)}$

The f^2 is the effect size relative to the effect of independent variables or constructs on dependent constructs by the assessment of R^2 values (Chin, 1998). The estimated value of effect size reveals the contribution of each independent variable (supply chain integration). However, it is considered that the higher value of f^2 is better for controlling the independent variables on the dependent variables (Henseler *et al.*, 2013).

Cohen (2012) and Hair *et al.* (2013) suggested values of 0.35, 0.15, and 0.02 to evaluate the effect size results, denoting large, medium, and small effects, respectively. Table 4.20 shows the effect size of all four independent variables on the dependent variable. Supply chain integration has a large effect size (f2 = 0.579), whereas information sharing has a medium effect size (f2 = 0.069), and supply chain risk has a small effect size (f2 = 0.010).

Table 4.20: Results of f^2

Dependent construct	Independent constructs	f^2
Supply chain risk	Supply chain integration	0.227
Information sharing	Supply chain integration	0.579
Supply chain performance	Information sharing	0.069
	Supply chain risk	0.010
	Supply chain integration	0.160

4.10.4 The predictive relevance Q^2

After assessing the effect size, the next evaluation is to test the predictive relevance ($Q^{2)}$ capacity of the research model. Usually, only the goodness of fit is used to identify the quality of the research model in PLS-SEM. According to Geisser (1974), the Q^2 test is used to evaluate the predictive relevance, which looks at the quality of the

research model, calculated by the blindfolding methods. In addition, Hair *et al.* (2016) and Stone, (1974) added that Q^2 advocates the research model must effectively predict each indicator of the dependent variable. In SmartPLS, the blindfolding method is a re-sampling procedure which systematically deletes and predicts each indicator of the dependent constructs in a reflective measurement model (Hair *et al.*, 2013). The calculated value of Q^2 larger than zero (0) means that the independent constructs have predictive relevance for the dependent constructs (Hair *et al.*, 2013).

Table 4.21: Results of Q^2

Independent constructs	Dependent construct	Q^2
Supply chain integration	Supply chain risk	0.104
Supply chain integration	Information sharing	0.246
Supply chain risk	Supply chain performance	0.206
Supply chain integration		
Information sharing		

For this study, the Q^2 results are presented in Table 4.21. As shown in Table 4.21, all the values of the predictive relevance capacity for research model of the dependent variables are larger than zero (0). Thus, it signifies the predictive relevance of the quality of the research model. All three Q2 values for supply chain risk (Q^2 = 0.104), information sharing (Q^2 = 0.246) and supply chain performance (Q^2 = 0.206) are more than 0, indicating that the model has sufficient predictive relevance.

4.10.5 Analysis of mediation effect

The most important purpose of this section is to analyse the last objective (RO4) which is concerned with evaluating the mediation effect of supply chain risk management and information sharing on the relationship between supply chain integration and supply chain performance. The bootstrapping procedure in SmartPLS is more appropriate for assessing the mediation hypotheses (Edwards & Bagozzi, 2000; Picon, Castro & Roldan, 2014). This study used 5000 re-samples to generate a 97.5% confidence interval (percentiles) for the mediators.

Based on the analysis of the results shown in Table 4.22 and Figure 4.2, the study has established that the direct relationships of supply chain integration, supply chain risk, and information sharing of Malaysian SMEs are positively and statistically significant. Whereas, the indirect relationships were tested, analysed and presented in Table 4.22.

Table 4.22: Summary of the results of mediation analysis

Path	Beta Estimate	SE	t-values	p-values	Decision
SCI-SCR-SCP	0.043	0.040	1.068	0.143	Not Supported
SCI-IS-SCP	0.158	0.052	3.025	0.001	Supported

According to Hair *et al.* (2013); Hayes and Preacher (2014), if the indirect relationship between the independent and dependent variable is found to be insignificant, that means the relationship will be considered to have no mediation. Based on the finding shown in Table 4.22, the mediating analysis of supply chain risk with the relationship between supply chain integration and supply chain performance was found insignificant. This means that supply chain risk has not mediated the relationship between supply chain integration and supply chain performance. The mediation analysis of information sharing on the relationship between supply chain integration and supply chain performance was found significant. Therefore, information sharing has mediated the relationship between supply chain integration and supply chain performance.

4.10.6 Variance accounted for (VAF)

After confirming the indirect effects (mediation) significance of the relationships between independent and dependent variables, it is essential to identify the strength of the mediating construct. For the purpose, Hair *et al.* (2017) recommended that the strength of mediation assessment can be calculated by employing the formula that is Variance Accounted For (VAF).

$$VAF = \frac{\text{Indirect effect}}{\text{Total effect}}$$

Where, total effect = Direct effect + indirect effect.

However, if the VAF calculated value is less than 20%, it will be considered that no mediation effect exists. Whereas, if the value of VAF lies between 20% to 80%, that is considered a partial mediation effect or relationship. If the VAF value is greater than 80%, it will be considered a full mediation effect or relationship (Hair *et al.*, 2017; Ramayah *et al.*, 2016). To find the strength of the mediating among the variables, the following calculation was conducted.

Mediation 1: VAF = 0.043 / (0.043 + 0.567)
= 0.141
= 14.1%

Mediation 2: VAF = 0.158/ (0.158 + 0.567)
= 0.265
= 26.5%

Table 4.23: Variance Accounted For (VAF)

Path	Beta Estimate	SE	t-values	VAF	Decision
SCI - SCR – SCP	0.141	0.040	1.068	14.1%	No Mediation
SCI - IS - SCP	0.158	0.052	3.025	26.5%	Partial Mediation

Table 4.23 reveals that the calculated value of variance accounted for (VAF). Test results of 14.1% show that supply chain risk has no mediation influence on the relationship between supply chain integration and supply chain performance. Furthermore, Hypothesis 7 has a VAF of 26.5 percent, indicating that information sharing partially mediated the relationship between supply chain integration and supply chain performance, which ranges from 20% to 80%.

4.10.7 Goodness of fit (GoF)

Henseler, Hubona and Ray (2016) indicated the overall goodness of fit (GoF) of the model should be a starting point of a model assessment. Ramayah *et al.* (2016) further added that if a model does not fit the data, it contains more information than the model conveys. This study used the Standardised Root Mean Square Residual (SRMR) to assess the GoF for the research model. Henseler *et al.* (2015) stated SRMR was one of the first fit model proposed by the SEM literature.

A value of less than 0.10 or 0.08 is considered a good fit (Hu & Bentler, 1999). According to Povlov, Maydeu-Olivares, and Shi (2020), values ranging from 0.993 to 0.999 across the condition indicate a normal distribution and an excellent fit to the SRMR value's sampling distribution. Table 4.24 shows the saturated model of this research is at the value of SRMR 0, and the estimated model shows 0.110, which means the GoF of the research model is a good fit. The squared discrepancy between the co-relations and the model implied correlations, the value should be closed to zero, and the threshold value is ≤ 0.08 (Henseler *et al.*, 2015).

Table 4.24: Model fit

	Saturated model	Estimated model
SRMR	0.110	0.116

4.11 Testing of the research hypothesis

In chapter 2, the literature review provided comprehensive and detailed information about the study hypotheses, which were earlier presented in structural models (Figure 4.1). The results of all hypotheses testing are presented in Table 4.25.

Table 4.25: Results of research hypothesis testing

Hypothesis	Beta Estimate	S.E	t-value	p-value	Decision
H1	0.466	0.075	6.202	0.000	Significant
H2	0.091	0.084	1.0851	0.139	Not Significant
H3	0.605	0.047	12.858	0.000	Significant
H4	0.261	0.078	3.346	0.000	Significant
H5	0.398	0.077	5.195	0.000	Significant
H6	0.043	0.040	1.068	0.143	Not Significant
H7	0.139	0.047	2.935	0.002	Significant

4.11.1 Hypothesis 1

The first hypothesis (H1) represent that "there is a significant relationship between supply chain integration and supply chain risk management among Malaysian SMEs". The hypothesis (H1) was tested and the results from Table 4.25 and Figure 4.3 revealed that there is a positive and significant relationship between supply chain integration and supply chain risk management among Malaysian SMEs (β=0.466, t=6.202 and p=0.000). Thus, the findings have confirmed that supply chain integration has a significant effect on improving supply chain risk management among Malaysian SMEs. Thereby, the results lead to the acceptance of the hypothesis.

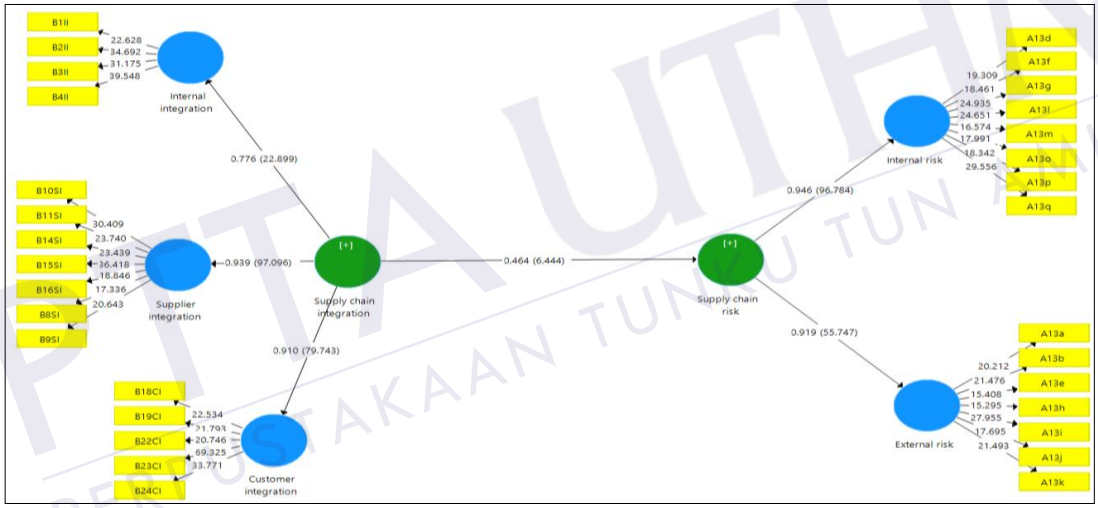

Figure 4.3: Relationship between supply chain integration and supply chain risk management

4.11.2 Hypothesis 2

H2 hypothesis that "there is a significant relationship between supply chain risk management and supply chain performance among Malaysian SMEs". This hypothesis was tested statistically and the results are as mentioned in Table 4.25 and Figure 4.4. It is found that there is a positive but insignificant relationship between supply chain risk management and supply chain performance among Malaysian SMEs (β=0.091,

t=1.0851 and p=0.139). Therefore, the findings lead to the rejection of the hypothesis (H2).

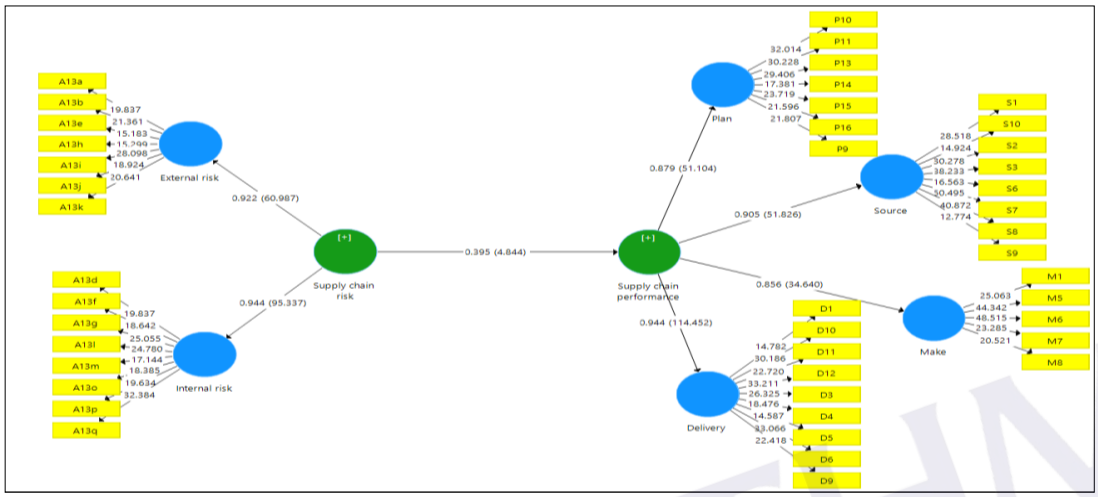

Figure 4.4: Relationship between supply chain risk management and supply chain performance

4.11.3 Hypothesis 3

The proposed Hypothesis H3 suggests that "there is a significant relationship between supply chain integration and information sharing among Malaysian SMEs". This hypothesis was tested and the findings, as mentioned in Table 4.25 and Figure 4.5, indicate a positive and significant relationship between supply chain integration and information sharing among Malaysian SMEs (β=0.605, t=12.858 and p=0.000). The study indicates the supply chain integration in Malaysian SMEs has a direct influence on information sharing. Therefore, the results of this study lead to the acceptance of the hypothesis.

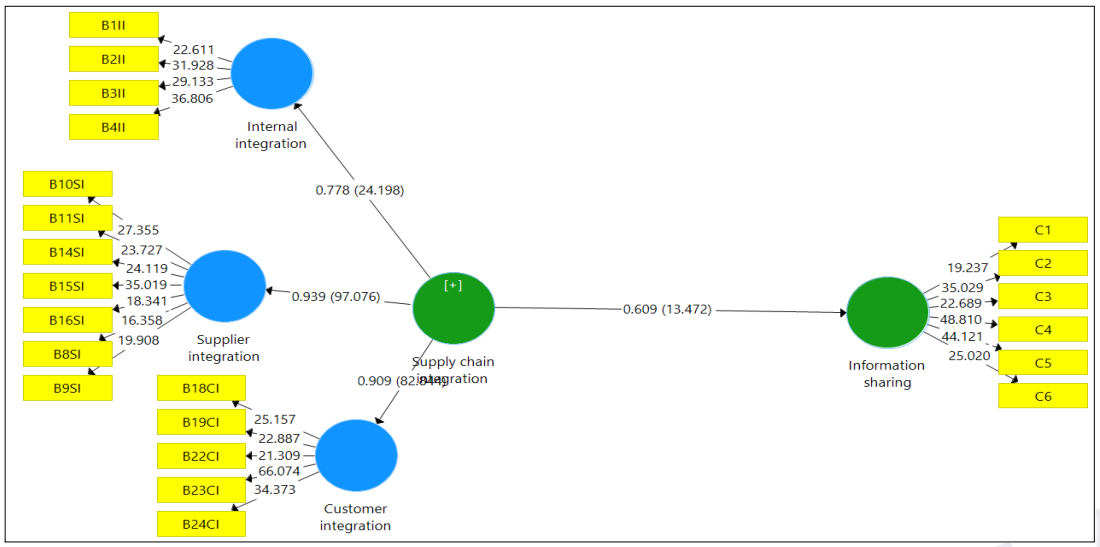

Figure 4.5: Relationship between supply chain integration and information sharing

4.11.4 Hypothesis 4

Hypothesis H4 represent that "there is a significant relationship between information sharing and supply chain performance among Malaysian SMEs". The results for hypothesis H4 as mentioned in Table 4.25 and Figure 4.6 confirm a positive and significant relationship between information sharing and supply chain performance among Malaysian SMEs (β=0.261, t=3.346 and p=0.000). As per the proposed hypothesis, the finding proved that information sharing in Malaysian SMEs effectively enhances firm performance. Therefore, the results of this study lead to the acceptance of the hypothesis.

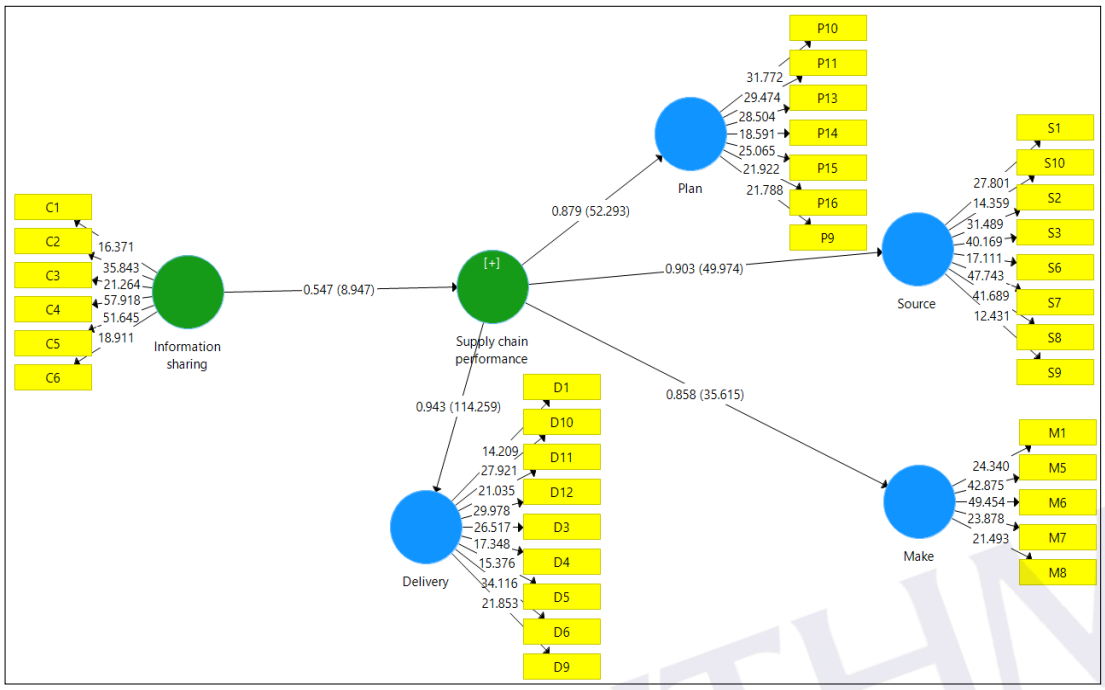

Figure 4.6: Relationship between information sharing and supply chain performance

4.11.5 Hypothesis 5

The fifth hypothesis (H5), represents that "there is a significant relationship between supply chain integration and supply chain performance among Malaysian SMEs". This hypothesis was tested and the results in Table 4.25 and Figure 4.7 confirmed a positive and significant relationship between supply chain integration and supply chain performance among Malaysian SMEs (β=0.398, t=5.195 and p=0.000). As a result, it is evident that supply chain integration assists Malaysian SMEs improve their supply chain performance. Hence, the findings of this study lead to the hypothesis' acceptance.

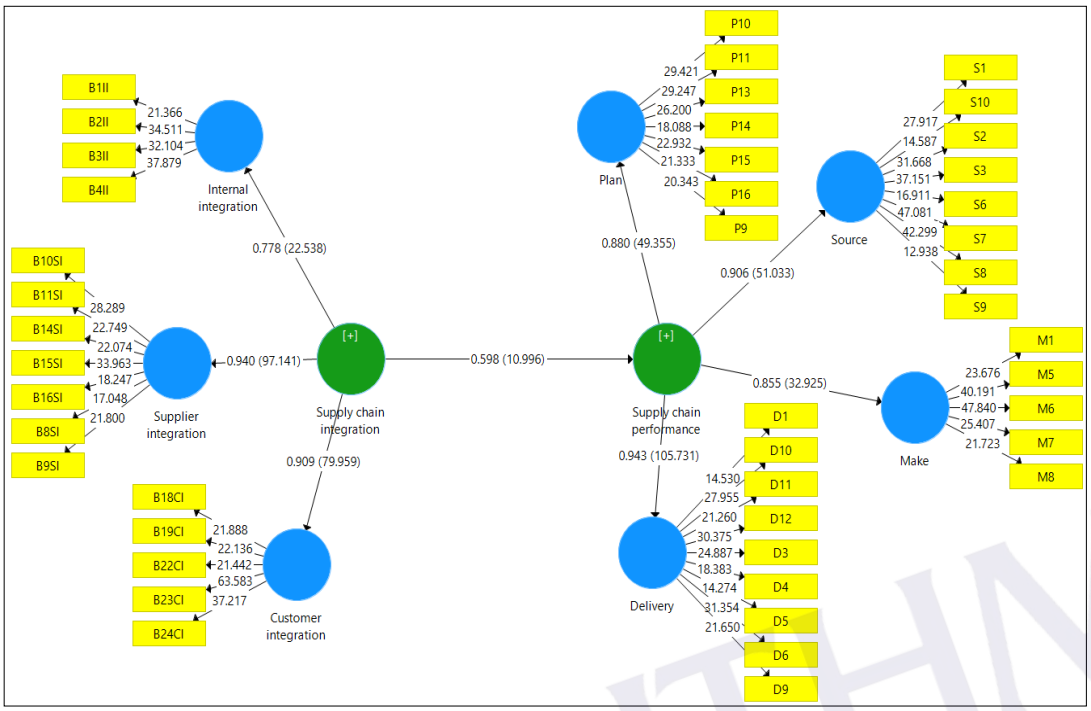

Figure 4.7: Relationship between supply chain integration and supply chain performance.

4.11.6 Hypothesis 6

Hypothesis H6 signifies that "supply chain risk management mediates the relationship between supply chain integration and supply chain performance among Malaysian SMEs". This hypothesis was tested and the results in Table 4.25 and Figure 4.8 reveal an indirect effect of supply chain risk management in the relationship between supply chain integration and supply chain performance was insignificant (β=0.043, t=1.068 and p=0.143). Thus, the findings provide evidence that the supply chain risk management does not mediate the relationship between supply chain integration and supply chain performance among Malaysian SMEs. Consequently, the results lead to the rejection of the hypothesis (H6).

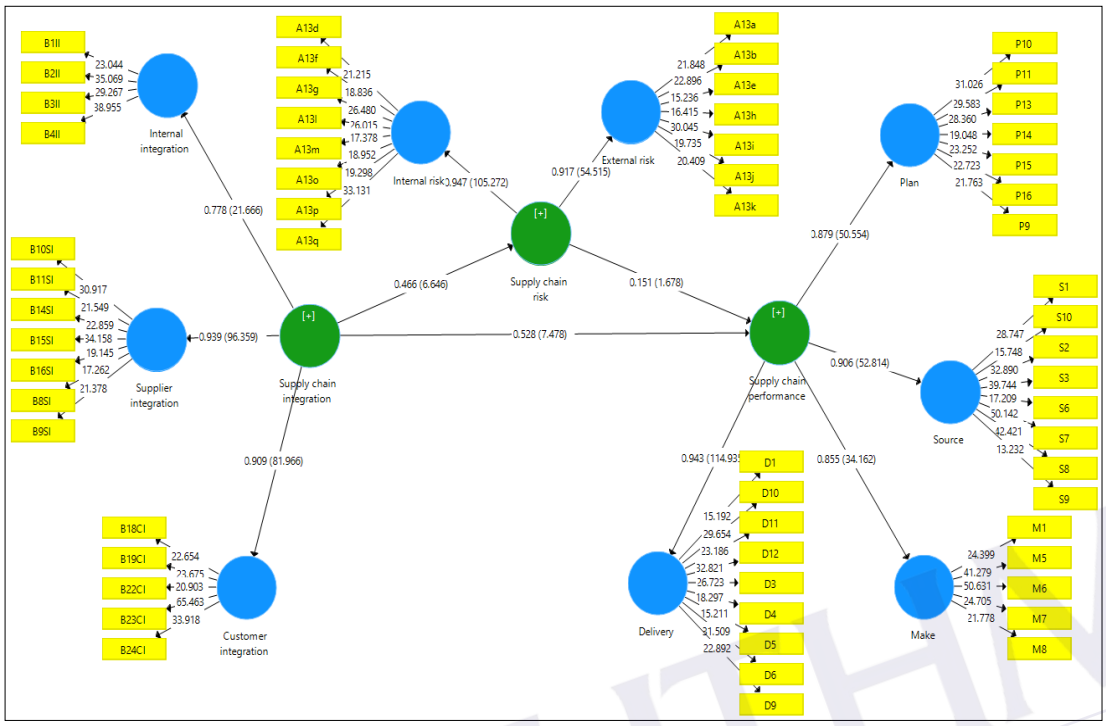

Figure 4.8: Mediating role of the supply chain risk management between the relationship supply chain integration and supply chain performance

4.11.7 Hypothesis 7

According to Hypothesis H7, "information sharing mediates the relationship between supply chain integration and supply chain performance among Malaysian SMEs". This hypothesis was tested to see if information sharing had a mediating effect on supply chain integration and supply chain performance in Malaysian SMEs. The results are shown in Table 4.25 and Figure 4.9, which confirm that the indirect effect of information sharing in the relationship between supply chain integration and supply chain performance was found positive and statistically significant (β=0.139, t=2.935 and p=0.002). Thus, the findings provide evidence that information sharing partially mediates the relationship between supply chain integration and supply chain performance. Thereby, the results lead to the acceptance of the hypothesis.

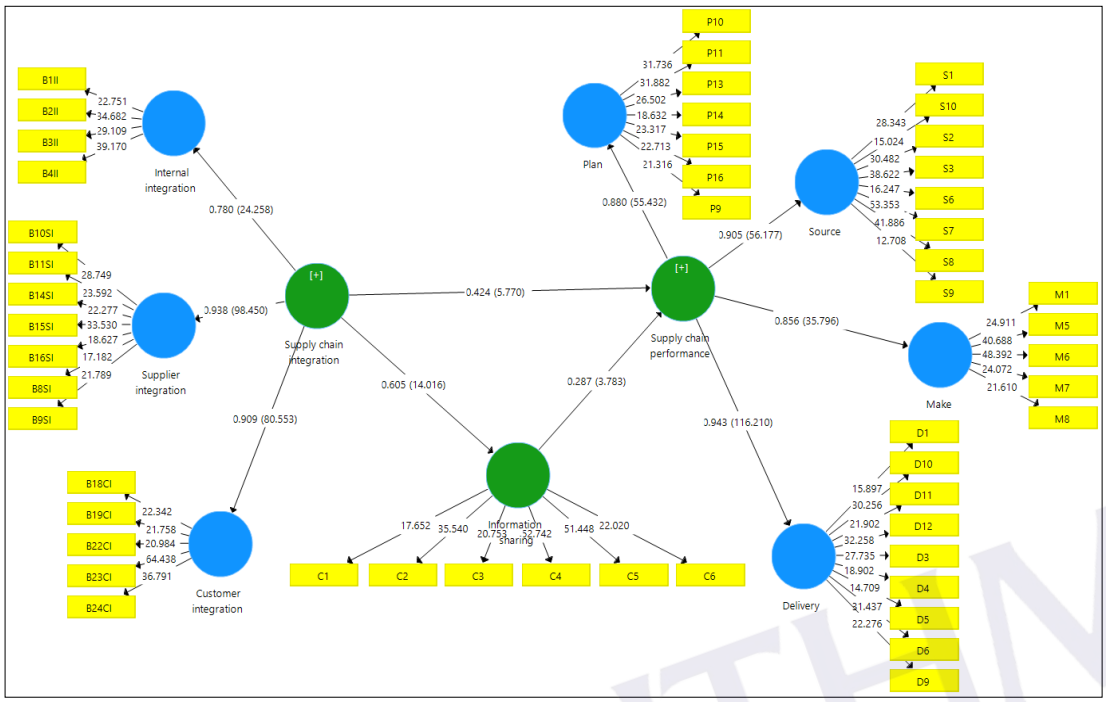

Figure 4.9: Mediating role of the information sharing between the supply chain integration and supply chain performance

4.12 Conclusion on the hypothesis testing

Based on the findings from the structural model shown in Figure 4.2, it was found that supply chain integration has a positive and statistically significant relationship with supply chain risk management. The relationship between supply chain risk management and supply chain performance is not significant relationship between the variables. While the results prove that supply chain integration has a positively significant relationship between information sharing and the information sharing has a significant effect on the supply chain performance. Furthermore, it was found that supply chain integration and supply chain performance has a positive and significant relationship. Further corroborated by the results of mediation analysis, supply chain risk management failed to mediate the relationship between supply chain integration and supply chain performance, but the result of information sharing has partially mediated the relationship between supply chain integration and supply chain performance. Therefore, the study supports the hypotheses H1, H3, H4, H5 and H7 while reject hypotheses H2 and H6.

Table 4.26: Summary of research hypothesis

No.	Research Hypothesis	Research Finding
1.	H_1: There is a significant relationship between supply chain integration and supply chain risk among Malaysian SMEs.	Supported
2.	H_2: There is a significant relationship between supply chain risk and supply chain performance among Malaysian SMEs.	Not Supported
3.	H_3: There is a significant relationship between supply chain integration and information sharing among Malaysian SMEs.	Supported
4.	H_4: There is a significant relationship between information sharing and supply chain performance among Malaysian SMEs.	Supported
5.	H_5: There is a significant relationship between supply chain integration and supply chain performance among Malaysian SMEs.	Supported
6.	H_6: Supply chain risk mediate the relationship between supply chain integration and supply chain performance among Malaysian SMEs	Not Supported
7.	H_7: Information sharing mediate the relationship between supply chain integration and supply chain performance among Malaysian SMEs	Supported

4.13 Summary

This chapter discussed quantitative data analysis by presenting the data preparation and the assessment of multivariate assumptions. Moreover, this chapter provided detailed data analysis by employing the partial least squares (PLS-SEM) and 7 hypotheses were tested by employing measurement and structural model evaluation. In addition, the chapter also presented both mediating of supply chain risk, and information sharing on the relationship between supply chain integration and supply chain performance among Malaysian SMEs listed in FMM. Five out of seven research hypotheses are supported and accepted with empirical proofs.

CHAPTER 5

DISCUSSION AND CONCLUSION

5.1 Introduction

The purpose of this chapter is to discuss the findings from the data analysis of this study. This chapter discusses and concludes the findings based on the research questions developed in this study. Besides that, based on the research findings, this chapter came out with the discussion about the contribution of the study to the knowledge, industry and theoretical. Finally, a conclusion is presented after the study's limitations as well as suggestions for future research are discussed.

5.2 Summary of the findings

The purpose of this study is to understand the mediating effect of supply chain risk management and information sharing on the relationship between supply chain integration and supply chain performance among Malaysian SMEs. The research objectives were develop based on the previous literature review. The objectives of the study are to examine the effects of supply chain integration, supply chain risk management and information sharing on the supply chain performance in Malaysian SMEs. A descriptive analysis of supply chain integration is carried out. This is followed by the factor analysis of supply chain integration, supply chain risk management, information sharing, and supply chain performance. After doing the factor analysis, further analysis using Smart-PLS was carried out to look at the direct relationship and mediating effect of the relationships between variables.

Factor analysis carried out on the items of the supply chain integration yielded three factors, which consist of internal integration, supplier integration, customer integration, and external integration. Components of supply chain risk are internal risk and external risk, while information sharing is the factor itself. There are four factors in supply chain performance, which are plan, source, make, and delivery. The relationships between each variable were tested in this study. It was found that the relationships were significant and supported, apart from the relationship between supply chain risk and supply chain performance, which was found insignificant and not supported.

This study has found that there is no mediating effect of supply chain risk management on the relationship between supply chain integration and supply chain performance. It is contrary to the finding of the mediating effect of information sharing on the relationship between supply chain integration and supply chain performance.

5.3 Research discussions

The key research findings of this study are based on the outcomes of quantitative data analysis with the aim of investigating the effect of supply chain integration, supply chain risk, and information sharing on supply chain performance among Malaysian SMEs listed in Federation Malaysian Manufacturing. This section discusses the findings based on the objectives of this research:

i) To analyze the relationship between supply chain integration, supply chain risk management and information sharing

ii) To analyze the relationship between supply chain risk management, information sharing and supply chain performance.

iii) To analyze the relationship between supply chain integration and supply chain performance.

iv) To analyze the mediating effects of chain risk management and information sharing on the relationship between supply chain integration and supply chain performance.

5.3.1 Supply chain integration and supply chain risk management

The findings from the first research question proved that supply chain integration, which represented by three dimensions, which are internal integration, supplier integration, and customer integration, can enhance the implementation of supply chain risk management in Malaysian SMEs. In other words, supply chain integration motivates managing the risk of the supply chain. There are a few empirical studies on the integration of the supply chain and supply chain risk management.

This study has found supply chain integration has a significant effect on supply chain risk management among Malaysian SMEs. Similar to the study by Munir *et al.* (2020), which found the dimensions of supply chain integration, namely internal integration, supplier integration, and customer integration, have a positive direct effect on the supply chain risk. Supply chain integration helps in mitigating risks and improving supply chain risk management. Supplier integration and customer integration help in reducing information distortion and leading to more accurate information in supply chain activities such as forecasting demand, improving the efficiency of the allocation of resources, and lowering the bullwhip effect (Schoenherr & Swink, 2012).

A study by Wiengarten *et al*. (2016) showed different results showing that the relationship between supply chain integration and supply chain risk was insignificant. The authors further mentioned that companies cannot complement supplier integration through supply chain risk management practices when situated in high-risk environments (weak rule of law), thus strengthening the impact of customer integration on cost performance.

5.3.2 Supply chain risk management and supply chain performance

Risk is one of the inherent in supply chain and threating the effectiveness and efficiencies of the performance of the supply chain. The supply chain risk management is one of the important elements to manage the disruptions that effect of on the supply chain performance. The findings of the study revealed that supply chain risk

management has insignificant relationship with supply chain integration and supply chain performance among Malaysian SMEs. However this is different from the finding of Liu *et al.* (2018), who found that risk management positively influences the performance of the supply chain. Which is supported by the study by Tse *et al.* (2019) on managing quality risk in the supply chain to drive supply chain performance, which has found the risk management practices positively influences supply chain performance. The various roles and control mechanisms work together with the appropriate risk management to improve the performance of the supply chain.

The significant risk of management and supply chain integrative practices is dealing with the complexity and uncertainty faced. The firm is striving to manage risk, handle unexpected disruptions, and improve performance in every changing area of uncertainty in the business environment (Munir *et al.*, 2020). The study of Parast (2020) has found that R&D innovation mitigates the significant effects of supply chain disruption, process disruption, and demand disruption on firm performance. Previous researchers have found that supply chain risk management is very crucial for supply chain performance in order to improve the capabilities of the firm and increase customer value (Parast 2020; Tse *et al.*, 2019; Liu *et al.*, 2018).

However, the findings of this study illustrated that there is insignificant relationship between supply chain risk management and supply chain performance at Malaysian SMEs. Therefore, the SMEs sector in Malaysia need to give an extra attention on the supply chain risk management in their company, in order for the firm to enhance the performance in their firm.

5.3.3 Supply chain integration and information sharing

Supply chain integration emphasises the value of creating linkages among members of the chain. Supply chain integration also improves information sharing through engendering trust based on the relationship (Kocoglu *et al.*, 2011). The findings confirmed that supply chain integration is an appropriate mechanism for improving information sharing among Malaysian SMEs. Similarly, previous studies reveal that supply chain integration and information sharing have a positive influence on each

other. Mitchell and Kovach (2016) said that information sharing can improve supply chain activities and it has a positive impact on supply chain visibility.

Maskey *et al.* (2015) mentioned that information sharing is one of important factors in the supply chain that could help to improve and enhance the supply chain integration to reduce costs and mitigate the bullwhip effect. The study by Kocoglu *et al.* (2011) has found that information sharing is positively influenced by supply chain integration especially, supply chain integration enhances the involvement of customers in supply chain activities and increases the effort of supply chain partners in information flow.

5.3.4 Information sharing and supply chain performance

The study revealed a significant relationship between information sharing and supply chain performance. Information sharing is leading to enhanced performance, especially in reducing costs and reducing inventory. If information sharing is used effectively and efficiently, the manufacturers are able to reduce the costs of inventory. Besides that, Lotfi *et al.* (2013) mentioned that information sharing improves visibility into the plan of altering the existing one, and sharing information about the demand enables the members of the supply chain to make an accurate prediction based on the real demand of the firm. Information sharing has become more efficient in the supply chain, which can ultimately lead to improved performance and competitive advantages (Lotfi *et al.,* 2013).

This study has found the positive influence of information sharing on supply chain performance, which is in line with the findings of Kumar and Pugazhendhi (2012). As mentioned by Kumar and Pugazhendhi (2012) information sharing is one of the important components in the supply chain, which refers to the extent of crucial information availability to members in the supply chain, which can be in term of tactical information related to purchasing, logistical and operational scheduling of strategic customers in long term corporate planning and also in marketing. Similarly, Marinagi *et al.* (2015) found a positive effect of information sharing on supply chain

performance. Besides that, other researchers also supported the outcome of this study, which Sabry (2015) showed.

5.3.5 Supply chain integration and supply chain performance

This study proves that the implication of supply chain integration leads to an increase in supply chain performance. The previous study by Alfalla-Luque *et al.* (2015) found supply chain integration has a significant influence on supply chain performance. In addition, Elkady, Moizer and Liu, (2014) found that the contribution of supply chain integration improves the performance of the supply chain. Besides that, it can help to reduce the cost of inventory, increase sales, improve customer service, and refine the forecast of each product (Elkady, Moizer & Liu, 2014). Thus, from the evidence of previous studies and the findings of this study, it is confirmed that supply chain integration has a positive influence on the supply chain performance of Malaysian SMEs.

Integration is one of the prominent research streams in the operations and supply chain management literature. In the previous study, the scholars found a positive effect of supply chain integration on operational performance. A study by Gimenez *et al.* (2012) indicates that supply chain integration has improved performance. Similar to the study of Shou *et al.* (2018), external integration influences the relationship of operational performance, that is, quality, delivery, flexibility, and cost performance.

5.3.6 Mediating effect of supply chain risk management between supply chain integration and supply chain performance.

This study has found that there is no significant mediating effect of supply chain risk management on the relationship between supply chain integration and supply chain performance. This differs from the other study by Bagheri *et al.* (2014), which revealed the mediating effect of supply chain risk management on the supply chain integration has an impact on the company's performance, either increasing or decreasing the

performance of the supply chain. Not only that, but Jajja *et al.* (2018) found the mediating influence of the dimensions supply chain integration, which are supplier integration and customer integration, has a positive effect on the relationship between supply chain risk and agility performance. Jajja *et al.* (2018) propose that firms deal with supply chain risk by implementing integrative practices with suppliers and customers in order to improve their performance. In the same way, Munir *et al.* (2020) found that supply chain risk partially mediates between supply chain integration and supply chain performance.

5.3.7 Mediating effect of information sharing between supply chain integration and supply chain performance.

The last research hypothesis of this study is related to determining the mediating effect of supply chain integration on the relationship between information sharing and supply chain performance in Malaysian SMEs. The study has found that supply chain integration mediates the relationship between information sharing and supply chain performance and is partially supported. In addition, the study has also provided the direct and indirect effects between supply chain integration, information sharing, and supply chain performance, which showed significant support and effect on each other. This result concurred with the previous studies such as Kocoglu *et al.* (2014), providing that information sharing has a moderate and positive relationship between supply chain integration and supply chain performance. The study by Marinagi *et al.* (2015) stated that there is a significant mediating effect of information sharing through the relationship of information quality and performance.

Information sharing is a partial mediator important in supply chain integration and the supply chain performance. The firms need to emphasised the information sharing in their firms for them to communicated effectively and efficiency with their internal and external partnership in order to achieve and enhance the performance of their firm. Besides that, to understand the important of information sharing in their firm is a crucial for them to used information sharing effectively in firms. The mediating effect of the information sharing is important part in influencing the

performance of supply chain in firm. Therefore, this study has found the mediator of information sharing is important factor should be focus on this framework study.

5.3.8 Summary of the research finding

The finding of this study can be conclude that, the supply chain integration was helping to enhancing the performance of supply chain in SMEs firms. While the supply chain risk management and information sharing as a mediator to the relationship of supply chain integration and supply chain performance. Performance of the supply chain can be achieving when firms used supply chain integration in their firms and understand the important of supply chain integration in their firm. Based on the research finding, it found the information sharing is a partial mediator which is important to the relationship of supply chain integration and supply chain performance. It is the evident that information sharing is considered as a key resource for business competitive advantages. Sharing of information is important in business nowadays in order to improve supply chain coordination, quality of products and services, reduce supply chain costs, and share the risk as well as the benefits. Table 5.1 presents the overall findings of the study.

Table 5.1: Summary of research finding

No.	Research Hypothesis	Research Finding
1.	H_1: There is a significant relationship between supply chain integration and supply chain risk among Malaysian SMEs.	Accepted
2.	H_2: There is a significant relationship between supply chain risk and supply chain performance among Malaysian SMEs.	Rejected
3.	H_3: There is a significant relationship between supply chain integration and information sharing among Malaysian SMEs.	Accepted
4.	H_4: There is a significant relationship between information sharing and supply chain performance among Malaysian SMEs.	Accepted
5.	H_5: There is a significant relationship between supply chain integration and supply chain performance among Malaysian SMEs.	Accepted
6.	H_6: Supply chain risk mediate the relationship between supply chain integration and supply chain performance among Malaysian SMEs	Rejected
7.	H7: Information sharing mediate the relationship between supply chain integration and supply chain performance among Malaysian SMEs	Accepted

Table 5.1 summarizes the findings of this study, which shows that hypothesis H1, H3, H4, H5, and H7 are accepted. However, hypothesis H2 and H6 were rejected due to insignificant relationship between the variables. Therefore, the Malaysian SMEs should pay more attention to supply chain integration, risk management and information as these factors can influence supply chain performance.

5.4 Research contribution

Every piece of research adds to the body of knowledge, industry, theory, academia, or literature, among other things. In the same way, this research has several contributions and the following sections, the findings of this study are presented as major contributions, such as contributing to knowledge and contributing to research and development performance.

5.4.1 Contribution to the knowledge

This study contributes the new knowledge in literature on the mediating effect of supply chain risk and information sharing on the relationship of supply chain integration and supply chain performance among Malaysian SMEs. Based on the research finding of this study, found the there is a contribution on the knowledge especially in supply chain to enhancing the supply chain performance among Malaysian SMEs as listed below;

i) Empirically analyses showed there is a statistically significant relationship between supply chain integration, information sharing and supply chain performance among Malaysian SMEs.

ii) The research proves that information sharing is a partial mediator to the relationship between supply chain integration and supply chain performance among Malaysian SMEs. This contributes to the existing literature on supply chain management by increasing our understanding of the factor that impact supply chain performance.

iii) This study found that information sharing is a key factor in enhancing the supply chain performance. This underscores the importance of the establishing effective communication channels and data sharing mechanisms between supply chain partners, which can help to mitigate risks and improve the overall performance.

iv) Better understanding of the impact of supply chain integration on supply chain performance among Malaysian SMEs.

v) Establishment of a baseline for future research in this area, which can help to identify gaps in the understanding and guide future studies that can further enhance our understanding on how supply chain performance can be affected by supply chain integration, information sharing and supply chain risk management .

5.4.2 Contributions to the industry

i) The models proposed in this study can be used by managers to predict the strength of relationships and mediate the effects of supply chain integration, supply chain risk, and information sharing on supply chain performance in Malaysian SMEs, with a view to making them core decision issues where necessary.

ii) The understanding gained can help Malaysian SMEs in the area of supply chain activities to enhance their performance in the supply chain.

iii) This implies that the outcome of this study could be used as a competitive tool to overcome stiff competition by prioritising the appropriate area with the tendency to yield a fruitful outcome.

iv) The study provides insights into the unique challenges faced by the Malaysian SMEs in the context of supply chain integration and performance, which can be valuable for policymakers and industry associations seeking to support SMEs development.

v) The study highlights the importance of information sharing as a key enabler of supply chain integration and performance, providing a roadmap for SMEs seeking to improve their information management practices.

Overall, this study provides valuable contribution to both the academic literature on supply chain management and the practical application of the supply chain principles in the context of Malaysian SMEs. By improving the understanding of the factors that influence supply chain performance, the study can help SMEs to compete more effectively in the global marketplace.

5.5 Limitation of research

The limitation of this study is the possibility of the method used in this study. Taking into consideration how the research instrument is conducted, the likelihood of the bias cannot be cancelled out. Despite the researcher's efforts to ensure the random distribution of the questionnaire across the various companies, complete success was not achieved. The research design of this study used a fully quantitative method, and the instruments used in this study were questionnaires to collect the data.

This study was conducted on Malaysian SMEs that were listed in FMM. Besides that, companies with more than 200 employees or large companies were excluded from this research. Furthermore, the limitation of this study is that one respondent represents one company whose employees are knowledgeable in the area of supply chain in their company. Instead of using Google Docs and email to collect data, it is suggested that specific sectors with a sufficient population be identified and arrangements made with respondents to collect the necessary information. However, it would be a very expensive way of collecting data and methods.

Lastly, the limitation of this study is relating to the variables that were used. Whereas the variables of supply chain performance for this study were measured using operational performance. This study only focuses on the SME sector. The other models, such as SCOR, were not useful for this study because of the size of the company, but the SCOR model is a systematic model for measuring supply chain

performance, especially for large companies. Aside from that, only general knowledge about information sharing was used in this study as a variable for information sharing. There are a lot of dimensions to information sharing that can be used for future research.

5.6 Suggestion for future research

This research has gained knowledge about the mediating effect of supply chain risk management and information sharing on the supply chain integration and performance among Malaysian SMEs. Regarding the future research suggestions, it has been previously acknowledged that this study has limitations relating to the method used in this study. The findings of this research has found there is a several suggestions should be implement for the future research which is;

i) Based on the research findings the researcher suggests the future researcher to do an experimental study to test the supply chain framework developed in this study to further enhance our understanding on the relationship.

ii) Future research can test the framework on the large companies and compare with the findings from studies on SMEs.

iii) In the era of technology, it was suggested and introduce of using the digitalisation of the supply chain in the activities of the supply chain in the company. Therefore, this study suggests future research should also investigate the digitalisation of the supply chain's operations and performance.

5.7 Conclusion

According to the findings of this study, it is found that supply chain integration has a positive influence on supply chain risk management, information sharing, and supply chain performance. In addition, information sharing was also found to increase supply chain performance in Malaysian SMEs. Information sharing was found to have played an important mediating effect between supply chain integration and supply chain performance. This study also found supply chain risk management has not influenced

supply chain performance. Finally, supply chain risk management has not mediated the relationship between supply chain integration and supply chain performance.

This study has demonstrated that Malaysian SMEs should increase their awareness relating to supply chain integration, supply chain risk management, and information sharing in order to enhance supply chain performance. In summary, this study provides empirical evidence regarding the influence of supply chain integration on supply chain risk management, information sharing, and supply chain performance to enhance the effectiveness and efficiency of supply chain activities. The overall findings of this study may also contribute to improving the supply chain performance of Malaysian SMEs.

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Appendix A

A COPY OF COVER LETTER AND RESEARCH QUESTIONNAIRE FOR RESPONDENTS

UNIVERSITI TUN HUSSEIN ONN MALAYSIA
Faculty Technology Management and Business
Parit Raja 86400 Batu Pahat, Johor.

To:
The CEO/ Chief Executive/ General Manager/
Manager Logistics/ Manager Operation and Production,

Dear Sir/Madam,
Re: Study of "The effect of supply chain integration, supply chain risk and information sharing on supply chain performance of Malaysian SMEs"
I write to appeal to you to be my respondent to this academic research enabling the study of "The effect of supply chain integration, supply chain risk and information sharing on supply chain performance of Malaysian SMEs".

There is no right or wrong answer, only your honest opinion matters. Your cooperation is valuable and certainly contribute to the successful completion of this academic research.

All information provided by you will be treated with utmost confidentiality. No names of individual and organization will be revealed. Information will only use for research purposes and reported in on an aggregate basic.

The questionnaire will take 10 to 15 minutes to complete. Upon completion, please return to me through the email avlynjay@gmail.com.

I must thank you in advance for your precious time. Should you have any queries, please do not hesitate to contact my research supervisor, Professor Dr. Ng Kim Soon at contact number 019-9409547 or me Avlyin Jay at 014-8793642.

Thank You.

Yours sincerely,

Avlyin Jay Binti Sumayong
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Title of Research: The effect of supply chain integration, information sharing, firms' characteristics on supply chain performance of Malaysian SMEs

SECTION A: Background Information of Company

1. Please indicate how many years your company has been operating? (Please tick (/) on the box).

a	Less than 1 year	
b	1 to 3 years	
c	4 to 10 years	
d	Over 10 years	

2. What is the nature of industrial activity of the company? (Please tick (/) on the box).

No	Industry		No	Industry	
a.	Agricultural product & Machinery		j.	Automation technology	
b.	Automotive parts & Components		k.	Building materials & related Product	
c.	Ceramic & Tiles		l.	Chemical & Adhesives Products	
d.	Environment & Waste Management: Products and services		m.	Food & Beverage	
e.	Furniture, Carpets & Wood Related Products		n.	Gifts, Stationery & office Supplier	
f.	Household Products & Appliances		o.	Industrial & Engineering Products & Services	
g.	Iron, steel & Metal Products		p.	Paper, packaging, labelling & printing	
h.	Pharmaceutical, Medical equipment, cosmetic & Toiletries		q.	Plastic products & Resins	
i.	Rubber products		r.	Services	

Others (Please state); _____

3. What is the legal status of this business? Please tick (/) on the box).

a	Sole proprietors	
b	Partnership	
c	Limited liability partnership	
d	Limited liability company	

4. What is your firm's business premise? (Please tick (/) on the box.)

A	Home Based	
B	Leased Space	
C	Other	

5. Do your company have a separate department or division responsible for supply chain management? Please tick (/) on the box.

a.	Yes	
b.	No	

6. Do you run your own logistics operations? Please tick (/) on the box.

a.	Own Logistics	
b.	Outsource or contract to external party	

7. General data
   a. Number of employees in your company: _____people.

   b. The percentage of company's capital held by foreign company: _____%

8. Profile of respondent
   a. Job Position: _____
   b. Education: Please tick (/) on the box.

a	Primary education	
b	Secondary education	
c	Diploma / Degree	
d	Master Degree / Doctorate	

   c. Experience in supply chain management: _____ years

9. How often do you conduct assessment or audit of your critical suppliers' risk factor and resilience? Please tick (/) basing on the scale for Question 11a, b and c.

Scale	Frequency
1	Twice a year or more often
2	Annually
3	Not at all

No	Questions	1	2	3
a.	Critical suppliers	1	2	3
b.	Important suppliers	1	2	3
c.	All other suppliers	1	2	3

10. In your opinion, what should be the level of importance of a supply chain management (SCM) team involvement in managing (measuring, monitoring, mitigating) the SCM risk in your company? Please rate Q12a to Q12q for the type of supply chain risk basing on the following scale.

Scale	Level of Importance of involvement in Managing SCM Risk
5	Very high
4	High
3	Moderate
2	Low
1	Very low

No	Questions	1 Very low	2	3	4	5 Very high
a.	Natural disaster risks	1	2	3	4	5
b.	Geopolitical risks	1	2	3	4	5
c.	Infrastructure outage risks (power, telecoms, utilities)	1	2	3	4	5
d.	Manufacturing production reliability and flexibility	1	2	3	4	5
e.	Theft and shrinkage	1	2	3	4	5
f.	Counterfeits	1	2	3	4	5

g.	Supplier's business continuity policies and practices	1	2	3	4	5
h.	Commodity price volatility risks	1	2	3	4	5
i.	Economic cycle risks (expansion/contraction)	1	2	3	4	5
j.	Poor demand forecasts	1	2	3	4	5
k.	Exchange rate risks	1	2	3	4	5
l.	Human resources risks (skills shortage, turnover)	1	2	3	4	5
m.	Labor dispute/stoppage risks (your own, supplier, 3rd parties-e.g. carries)	1	2	3	4	5
n.	Your company's own business continuity policies and practice.	1	2	3	4	5
o.	Data/IT security	1	2	3	4	5
p.	Product design flows (quality, safety)	1	2	3	4	5
q.	Sustainability and corporate social responsibility compliance.	1	2	3	4	5

11. In your opinion, what is the level of actual level of a supply chain management (SCM) team involvement in managing (measuring, monitoring, mitigating) the SCM risk for your company? Please rate Q13a to Q13q for the type of supply chain risk basing on the following scale by placing a tick on the number scale.

Scale	Level of Importance of involvement in Managing SCM Risk
5	Very high
4	High
3	Moderate
2	Low
1	Very low

No	Questions	1 Very Low	2	3	4	5 Very High
a.	Natural disaster risks	1	2	3	4	5
b.	Geopolitical risks	1	2	3	4	5
c.	Infrastructure outage risks (power, telecoms, utilities)	1	2	3	4	5
d.	Manufacturing production reliability and flexibility	1	2	3	4	5
e.	Theft and shrinkage	1	2	3	4	5
f.	Counterfeits	1	2	3	4	5
g.	Supplier's business continuity policies and practices	1	2	3	4	5
h.	Commodity price volatility risks	1	2	3	4	5
i.	Economic cycle risks (expansion/contraction)	1	2	3	4	5
j.	Poor demand forecasts	1	2	3	4	5
k.	Exchange rate risks	1	2	3	4	5
l.	Human resources risks (skills shortage, turnover)	1	2	3	4	5
m.	Labor dispute/stoppage risks (your own, supplier, 3rd parties-e.g. carries)	1	2	3	4	5
n.	Your company's own business continuity policies and practice.	1	2	3	4	5
o.	Data/IT security	1	2	3	4	5
p.	Product design flows (quality, safety)	1	2	3	4	5
q.	Sustainability and corporate social responsibility compliance.	1	2	3	4	5

IMPORTANT: For Section B, Section C and Section D, please rate your level of agreement for each of the statements basing on the following scale by placing a tick (/) on the number:

Scale	Level of Agreement
1	Strongly Disagree

2	Disagree
3	Neither Agree or Disagree
4	Agree
5	Strongly Agree

SECTION B: Supply Chain Integration

The following statements are about supply chain integration, please rate your company basing on your degree of agreement.

No	Questions on Internal Integration	1 Strongly disagree	2	3	4	5 Strongly agree
B1	We encourage employees to work together to achieve common goals, rather than encourage competition among individual.	1	2	3	4	5
B2	Departments in the plant communicate frequently with each other.	1	2	3	4	5
B3	Management works together very well on all important decisions.	1	2	3	4	5
B4	Generally speaking, everyone in plan works very well together.	1	2	3	4	5

No	Questions on Supplier Integration	1 Strongly disagree	2	3	4	5 Strongly agree
B5	We maintain close communication with supplier about quality considerations and design changes.	1	2	3	4	5
B6	We maintain cooperative relationship with our supplier.	1	2	3	4	5
B7	We strive to establish long term relationship with supplier.	1	2	3	4	5
B8	Our customer are actively involved in our product design process.	1	2	3	4	5
B9	The participation level of our major supplier in the design stage are high.	1	2	3	4	5
B10	Our major supplier shares their production schedule with us readily.	1	2	3	4	5
B11	Our major supplier shares their production capacity with us readily.	1	2	3	4	5
B12	Our major supplier shares available inventory with us readily.	1	2	3	4	5
B13	We share our production plans with our major supplier readily.	1	2	3	4	5
B14	We share our demand forecasts with our major supplier readily.	1	2	3	4	5
B15	We share our inventory levels with our major supplier readily.	1	2	3	4	5
B16	We help our major supplier to improve its process to better meet our needs.	1	2	3	4	5

No	Questions on Customer Integration	1 Strongly disagree	2	3	4	5 Strongly agree
B17	We are frequently in close contact with our customer.	1	2	3	4	5

B18	Our customer give feedback on our quality and delivery performance.	1	2	3	4	5
B19	We strive to be highly responsive to our customer's needs.	1	2	3	4	5
B20	Our customer are actively involved in our product design process.	1	2	3	4	5
B21	Our major customer shares Point of Sales (POS) information with us.	1	2	3	4	5
B22	Our major customer shares demand forecast with us.	1	2	3	4	5
B23	We share our available inventory with our major customer.	1	2	3	4	5
B24	We share our production plan with our major customer.	1	2	3	4	5

Section C: Information Sharing

The following statements are about supply chain information sharing, please rate your company basing on your degree of agreement.

No	**Questions on Information Sharing**	**1** Strongly disagree	**2**	**3**	**4**	**5** Strongly agree
C1	We inform trading partners in advance of changing needs	1	2	3	4	5
C2	Our trading partners share proprietary information with us	1	2	3	4	5
C3	Supplier keep us fully informed about issues that affect our business.	1	2	3	4	5
C4	Supplier share business knowledge of core business processes with us.	1	2	3	4	5
C5	Supplier exchange information that helps establishment of business planning.	1	2	3	4	5
C6	Supplier informed about events or changes that may affect the other partner.	1	2	3	4	5

Section D: Supply Chain Performance

No	**Questions on Plan**	**1** Strongly disagree	**2**	**3**	**4**	**5** Strongly agree
P1	We do have an operations strategy planning in our team designed.	1	2	3	4	5
P2	When we meet, we do make adjustments in the strategy and document them.	1	2	3	4	5
P3	We look at customer profitability.	1	2	3	4	5
P4	Our team look at product profitability.	1	2	3	4	5
P5	We analyze the variability of demand for products.	1	2	3	4	5
P6	We have a documented demand forecasting process.	1	2	3	4	5
P7	In process planning we use the historical data in developing the forecast.	1	2	3	4	5
P8	We use mathematical methods (statistics) for demand forecasting.	1	2	3	4	5

P9	The performance evaluation process occur on a regular (scheduled) basis.	1	2	3	4	5
P10	The forecast develop is for each product.	1	2	3	4	5
P11	The forecast develop is for each customer.	1	2	3	4	5
P12	The forecast is updated weekly.	1	2	3	4	5
P13	The forecast are credible or believable.	1	2	3	4	5
P14	The forecast are used to develop plans and make commitments.	1	2	3	4	5
P15	The forecast accuracy are measured.	1	2	3	4	5
P16	The demand management and production planning processes in our company are integrated.	1	2	3	4	5
P17	In our company the sales, manufacturing and distribution organizations collaborate in developing the forecast.	1	2	3	4	5
P18	Overall the decision process area are perform very well.	1	2	3	4	5

No	**Questions On Source**	**1** Strongly disagree	**2**	**3**	**4**	**5** Strongly agree
S1	The procurement process are documented (written description, flow charts).	1	2	3	4	5
S2	The information system in our company support the process.	1	2	3	4	5
S3	In our company the supplier inter-relationships (variability, metrics) understood and are documented.	1	2	3	4	5
S4	The process owner in our company are identified.	1	2	3	4	5
S5	We share planning and scheduling information with supplier.	1	2	3	4	5
S6	We collaborate with the supplier to develop a plan.	1	2	3	4	5
S7	We measure and give feedback to the supplier performance.	1	2	3	4	5
S8	We do have procurement process in team designed.	1	2	3	4	5
S9	The team meet on the regular basis.	1	2	3	4	5
S10	The other functions (manufacturing, sales etc.) work closely with the procurement process team members.	1	2	3	4	5
S11	Overall, this decision process area perform very well.	1	2	3	4	5

No	**Questions on Make**	**1** Strongly disagree	**2**	**3**	**4**	**5** Strongly agree
M1	We have a documented (written description, flow charts, etc.) production planning and scheduling process.	1	2	3	4	5
M2	We have someone who owns the process.	1	2	3	4	5
M3	We have weekly planning cycles.	1	2	3	4	5
M4	The supplier lead times are updated monthly.	1	2	3	4	5
M5	Our shop floor scheduling integrated with the overall scheduling process.	1	2	3	4	5
M6	Our information system currently support the process.	1	2	3	4	5
M7	Our current process adequately address the needs of the business.	1	2	3	4	5

M8	In our company the sales, manufacturing and distribution organization collaborate in the planning and scheduling process.	1	2	3	4	5
M9	Overall the decision process performs very well.	1	2	3	4	5

No	**Questions on Delivery**	**1** Strongly disagree	**2**	**3**	**4**	**5** Strongly agree
D1	We have a Promise Delivery (order commitment) process owner.	1	2	3	4	5
D2	We meet short-term customer demands from the finished good inventory.	1	2	3	4	5
D3	We measure customer requests versus the actual delivery.	1	2	3	4	5
D4	Our information system currently support the order commitment process.	1	2	3	4	5
D5	Our order commitment process integrated with the supply chain decision process.	1	2	3	4	5
D6	Our information system support the distribution management.	1	2	3	4	5
D7	We used mathematical tool to assist in distribution planning.	1	2	3	4	5
D8	Our distribution management process are integrated with the supply chain decision process (production planning and scheduling, demand management, etc.)	1	2	3	4	5
D9	We have a single point of contact for all order inquiries.	1	2	3	4	5
D10	We consolidate orders by customers, sources, carriers, etc.	1	2	3	4	5
D11	We use automatic identification during the delivery process to track order status.	1	2	3	4	5
D12	We have real time visibilities of order inquiries	1	2	3	4	5
D13	Overall the decision process performs very well.	1	2	3	4	5

Thank you very much for your kind support.

Do you want to me to email to you a summary of the findings of this research? If yes, please provide your email address here: _____

APPENDIX B

SPSS OUTPUT FOR FACTOR ANALYSIS FOR SUPPLY CHAIN INTGERATION, SUPPLY CHAIN RISK, INFORMATION SHARING AND SUPPLY CHAIN PERFORMANCE

FACTOR ANALYSIS SUPPLY CHAIN INTEGRATION FOR INTERNAL INTEGRATION

Correlation Matrix					
		B1II	B2II	B3II	B4II
Correlation	B1II	1.000	.516	.429	.534
	B2II	.516	1.000	.652	.573
	B3II	.429	.652	1.000	.594
	B4II	.534	.573	.594	1.000

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.781
Bartlett's Test of Sphericity	Approx. Chi-Square	315.552
	df	6
	Sig.	.000

Communalities		
	Initial	Extraction
B1II	1.000	.559
B2II	1.000	.718
B3II	1.000	.684
B4II	1.000	.692
Extraction Method: Principal Component Analysis.		

Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.654	66.341	66.341	2.654	66.341	66.341
2	.594	14.843	81.184			
3	.427	10.673	91.857			
4	.326	8.143	100.000			
Extraction Method: Principal Component Analysis.						

Component Matrix[a]	
	Component
	1
B2II	.848
B4II	.832
B3II	.827

B1II	.748
Extraction Method: Principal Component Analysis.	
a. 1 components extracted.	

FACTOR ANALYSIS SUPPLY CHAIN INTEGRATION FOR SUPPLIER INTEGRATION

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.849
Bartlett's Test of Sphericity	Approx. Chi-Square	1778.182
	df	66
	Sig.	.000

Communalities		
	Initial	Extraction
B5SI	1.000	.446
B6SI	1.000	.497
B7SI	1.000	.427
B8SI	1.000	.519
B9SI	1.000	.610
B10SI	1.000	.627
B11SI	1.000	.621
B12SI	1.000	.451
B13SI	1.000	.457
B14SI	1.000	.628
B15SI	1.000	.620
B16SI	1.000	.469
Extraction Method: Principal Component Analysis.		

Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.374	53.113	53.113	6.374	53.113	53.113
2	1.581	13.176	66.289			
3	.940	7.831	74.121			
4	.787	6.562	80.682			
5	.499	4.157	84.839			
6	.438	3.647	88.486			
7	.359	2.990	91.476			
8	.287	2.393	93.869			
9	.238	1.985	95.853			
10	.204	1.697	97.551			
11	.168	1.398	98.949			
12	.126	1.051	100.000			
Extraction Method: Principal Component Analysis.						

Component Matrix[a]	
	Component
	1
B14SI	.793
B10SI	.792
B11SI	.788
B15SI	.788
B9SI	.781
B8SI	.720
B6SI	.705
B16SI	.685
B13SI	.676
B12SI	.672
B5SI	.668
B7SI	.654
Extraction Method: Principal Component Analysis.	
a. 1 components extracted.	

Correlation	B5SI	B6SI	B7SI	B8SI	B9SI	B10SI	B11SI	B12SI	B13SI	B14SI	B15SI	B16SI
B5SI	1.00	.747	.618	.352	.380	.389	.437	.279	.245	.586	.436	.430
B6SI	.747	1.00	.661	.401	.484	.328	.419	.358	.255	.590	.487	.489
B7SI	.618	.661	1.000	.311	.443	.462	.330	.205	.281	.619	.367	.482
B8SI	.352	.401	.311	1.00	.783	.618	.606	.482	.548	.384	.443	.325
B9SI	.380	.484	.443	.783	1.00	.652	.644	.534	.516	.461	.551	.319
B10SI	.389	.328	.462	.618	.652	1.00	.708	.483	.694	.554	.536	.430

B11SI	.437	.419	.330	.606	.644	.708	1.00	.691	.551	.498	.530	.413
B12SI	.279	.358	.205	.482	.534	.483	.691	1.00	.341	.432	.613	.424
B13SI	.245	.255	.281	.548	.516	.694	.551	.341	1.00	.466	.573	.401
B14SI	.586	.590	.619	.384	.461	.554	.498	.432	.466	1.000	.665	.659
B15SI	.436	.487	.367	.443	.551	.536	.530	.613	.573	.665	1.000	.641
B16SI	.430	.489	.482	.325	.319	.430	.413	.424	.401	.659	.641	1.00

FACTOR ANALYSIS SUPPLY CHAIN INTEGRATION FOR SUPPLIER INTEGRATION

Correlation Matrix								
Correlation	B17CI	B18CI	B19CI	B20CI	B21CI	B22CI	B23CI	B24CI
B17CI	1.000	.656	.724	.283	.258	.283	.485	.457
B18CI	.656	1.000	.639	.479	.434	.459	.606	.531
B19CI	.724	.639	1.000	.377	.290	.372	.595	.552
B20CI	.283	.479	.377	1.000	.677	.453	.389	.493
B21CI	.258	.434	.290	.677	1.000	.679	.477	.473
B22CI	.283	.459	.372	.453	.679	1.000	.670	.540
B23CI	.485	.606	.595	.389	.477	.670	1.000	.815
B24CI	.457	.531	.552	.493	.473	.540	.815	1.000

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.801
Bartlett's Test of Sphericity	Approx. Chi-Square	1083.140
	df	28
	Sig.	.000

Communalities		
	Initial	Extraction
B17CI	1.000	.469
B18CI	1.000	.639
B19CI	1.000	.572
B20CI	1.000	.456
B21CI	1.000	.490
B22CI	1.000	.547
B23CI	1.000	.721
B24CI	1.000	.668
Extraction Method: Principal Component Analysis.		

Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.562	57.021	57.021	4.562	57.021	57.021
2	1.251	15.641	72.663			
3	.741	9.266	81.929			
4	.490	6.121	88.050			
5	.344	4.305	92.355			
6	.280	3.495	95.850			
7	.200	2.495	98.345			
8	.132	1.655	100.000			
Extraction Method: Principal Component Analysis.						

Component Matrix[a]	
	Component

	1
B23CI	.849
B24CI	.817
B18CI	.800
B19CI	.757
B22CI	.739
B21CI	.700
B17CI	.685
B20CI	.675
Extraction Method: Principal Component Analysis.	
a. 1 components extracted.	

FACTOR ANALYSIS SUPPLY CHAIN RISK

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.918
Bartlett's Test of Sphericity	Approx. Chi-Square	2137.452
	df	136
	Sig.	.000

Communalities		
	Initial	Extraction
A13a	1.000	.642
A13b	1.000	.729
A13c	1.000	.458
A13d	1.000	.524
A13e	1.000	.512
A13f	1.000	.568
A13g	1.000	.611
A13h	1.000	.480
A13i	1.000	.670
A13j	1.000	.532
A13k	1.000	.548
A13l	1.000	.737
A13m	1.000	.607
A13n	1.000	.476
A13o	1.000	.552
A13p	1.000	.524
A13q	1.000	.659
Extraction Method: Principal Component Analysis.		

Total Variance Explained							
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadingsa
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	8.506	50.035	50.035	8.506	50.035	50.035	7.363
2	1.321	7.773	57.808	1.321	7.773	57.808	7.016
3	.879	5.171	62.980				
4	.845	4.971	67.951				
5	.825	4.851	72.802				
6	.693	4.078	76.879				
7	.592	3.480	80.359				
8	.519	3.053	83.412				
9	.485	2.850	86.262				
10	.451	2.652	88.914				
11	.371	2.184	91.098				
12	.327	1.926	93.024				
13	.288	1.695	94.719				

14	.250	1.468	96.188				
15	.241	1.420	97.607				
16	.231	1.358	98.965				
17	.176	1.035	100.000				
Extraction Method: Principal Component Analysis.							
a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.							

Component Matrix[a]		
	Component	
	1	2
A13g	.779	-.065
A13i	.761	.301
A13f	.744	-.123
A13q	.736	-.342
A13l	.733	-.447
A13o	.733	-.119
A13d	.721	-.066
A13b	.712	.472
A13e	.698	.159
A13k	.690	.268
A13p	.680	-.248
A13c	.676	-.027
A13h	.674	.159
A13j	.673	.280
A13a	.672	.436
A13m	.672	-.395
A13n	.656	-.213
Extraction Method: Principal Component Analysis.		
a. 2 components extracted.		

Pattern Matrix[a]		
	Component	
	1	2
A13l	.947	-.152
A13m	.851	-.121
A13q	.828	-.026
A13p	.686	.057
A13n	.632	.086
A13f	.580	.237
A13o	.570	.237
A13g	.535	.324
A13d	.501	.293
A13c	.430	.317
A13b	-.124	.927
A13a	-.106	.864
A13i	.101	.750
A13j	.074	.680
A13k	.098	.674
A13e	.229	.548
A13h	.215	.536
Extraction Method: Principal Component Analysis. Rotation Method: Oblimin with Kaiser Normalization.a		

a. Rotation converged in 9 iterations.

Structure Matrix		
	Component	
	1	2
A13l	.850	.449
A13q	.811	.500
A13m	.774	.419
A13g	.740	.664
A13f	.731	.606
A13p	.722	.492
A13o	.720	.598
A13d	.687	.611
A13n	.687	.487
A13c	.631	.590
A13b	.464	.848
A13i	.578	.815
A13a	.442	.797
A13k	.526	.736
A13j	.506	.727
A13e	.577	.694
A13h	.555	.673
Extraction Method: Principal Component Analysis. Rotation Method: Oblimin with Kaiser Normalization.		

FACTOR ANALYSIS INFORMATION SHARING

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.845
Bartlett's Test of Sphericity	Approx. Chi-Square	947.141
	df	15
	Sig.	.000

Communalities		
	Initial	Extraction
C1	1.000	.534
C2	1.000	.720
C3	1.000	.662
C4	1.000	.823
C5	1.000	.792
C6	1.000	.603
Extraction Method: Principal Component Analysis.		

Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.133	68.884	68.884	4.133	68.884	68.884
2	.587	9.777	78.661			
3	.515	8.587	87.248			
4	.400	6.669	93.917			
5	.295	4.913	98.831			
6	.070	1.169	100.000			
Extraction Method: Principal Component Analysis.						

Component Matrix[a]	
	Component
	1
C4	.907
C5	.890
C2	.848
C3	.814
C6	.776
C1	.730
Extraction Method: Principal Component Analysis.	
a. 1 components extracted.	

FACTOR ANALYSIS SUPPLY CHAIN PERFORMANCE FOR PLAN

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.823
Bartlett's Test of Sphericity	Approx. Chi-Square	872.172
	df	28
	Sig.	.000

Communalities		
	Initial	Extraction
P9	1.000	.521
P10	1.000	.620
P11	1.000	.609
P13	1.000	.549
P14	1.000	.540
P15	1.000	.544
P16	1.000	.658
P17	1.000	.452
Extraction Method: Principal Component Analysis.		

Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.493	56.164	56.164	4.493	56.164	56.164
2	.888	11.094	67.259			
3	.731	9.135	76.394			
4	.603	7.544	83.937			
5	.508	6.354	90.291			
6	.326	4.070	94.361			
7	.249	3.115	97.476			
8	.202	2.524	100.000			
Extraction Method: Principal Component Analysis.						

Component Matrix[a]	
	Component
	1
P16	.811
P10	.787
P11	.780
P13	.741
P15	.738
P14	.735
P9	.722
P17	.673
Extraction Method: Principal Component Analysis.	
a. 1 components extracted.	

FACTOR ANALYSIS SUPPLY CHAIN PERFORMANCE FOR SOURCE

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.889
Bartlett's Test of Sphericity	Approx. Chi-Square	1340.914
	df	45
	Sig.	.000

Communalities		
	Initial	Extraction
S1	1.000	.610
S2	1.000	.687
S3	1.000	.576
S4	1.000	.489
S5	1.000	.433
S6	1.000	.547
S7	1.000	.693
S8	1.000	.709
S9	1.000	.536
S10	1.000	.570
Extraction Method: Principal Component Analysis.		

Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.849	58.493	58.493	5.849	58.493	58.493
2	1.027	10.267	68.760			
3	.659	6.593	75.353			
4	.519	5.188	80.542			
5	.490	4.900	85.442			
6	.449	4.494	89.936			
7	.352	3.516	93.452			
8	.277	2.774	96.226			
9	.234	2.338	98.564			
10	.144	1.436	100.000			
Extraction Method: Principal Component Analysis.						

Component Matrix[a]	
	Component
	1
S8	.842
S7	.832
S2	.829
S1	.781
S3	.759
S10	.755
S6	.739
S9	.732
S4	.699
S5	.658

Extraction Method: Principal Component Analysis.
a. 1 components extracted.

FACTOR ANALYSIS SUPPLY CHAIN PERFORMANCE FOR MAKE

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.861
Bartlett's Test of Sphericity	Approx. Chi-Square	716.992
	df	15
	Sig.	.000

Communalities		
	Initial	Extraction
M1	1.000	.577
M4	1.000	.439
M5	1.000	.783
M6	1.000	.787
M7	1.000	.666
M8	1.000	.622
Extraction Method: Principal Component Analysis.		

Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.874	64.575	64.575	3.874	64.575	64.575
2	.758	12.635	77.210			
3	.517	8.620	85.830			
4	.345	5.752	91.582			
5	.315	5.248	96.830			
6	.190	3.170	100.000			
Extraction Method: Principal Component Analysis.						

Component Matrix[a]	
	Component
	1
M6	.887
M5	.885
M7	.816
M8	.789
M1	.760
M4	.663
Extraction Method: Principal Component Analysis.	
a. 1 components extracted.	

FACTOR ANALYSIS SUPPLY CHAIN PERFORMANCE FOR DELIVERY

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.898
Bartlett's Test of Sphericity	Approx. Chi-Square	1352.204
	df	36
	Sig.	.000

Communalities		
	Initial	Extraction
D1	1.000	.529
D3	1.000	.674
D4	1.000	.576
D5	1.000	.488
D6	1.000	.728
D9	1.000	.611
D10	1.000	.720
D11	1.000	.606
D12	1.000	.680
Extraction Method: Principal Component Analysis.		

Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.613	62.371	62.371	5.613	62.371	62.371
2	.999	11.095	73.467			
3	.652	7.245	80.712			
4	.472	5.245	85.957			
5	.391	4.342	90.299			
6	.279	3.098	93.397			
7	.233	2.592	95.989			
8	.197	2.184	98.172			
9	.164	1.828	100.000			
Extraction Method: Principal Component Analysis.						

Component Matrix[a]	
	Component
	1
D6	.853
D10	.849
D12	.825
D3	.821
D9	.782
D11	.779
D4	.759
D1	.727
D5	.698
Extraction Method: Principal Component Analysis.	
a. 1 components extracted.	

APPENDIX C

SPSS OUTPUT FOR RELIABILITY FOR SUPPLY CHAIN INTGERATION, SUPPLY CHAIN RISK, INFORMATION SHARING AND SUPPLY CHAIN PERFORMANCE

RELIABILITY FOR SUPPLY CHAIN INTEGRATION (INTERNAL INTEGRATION)

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.829	.830	4

Item Statistics			
	Mean	Std. Deviation	N
B1II	4.7062	.57645	211
B2II	4.2986	.55287	211
B3II	4.2938	.60072	211
B4II	4.3744	.63779	211

Inter-Item Correlation Matrix				
	B1II	B2II	B3II	B4II
B1II	1.000	.516	.429	.534
B2II	.516	1.000	.652	.573
B3II	.429	.652	1.000	.594
B4II	.534	.573	.594	1.000

Summary Item Statistics							
	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Inter-Item Correlations	.550	.429	.652	.223	1.519	.005	4

Item-Total Statistics					
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
B1II	12.9668	2.366	.574	.351	.819
B2II	13.3744	2.245	.704	.513	.765
B3II	13.3791	2.170	.670	.498	.778
B4II	13.2986	2.058	.684	.470	.772

Scale Statistics			
Mean	Variance	Std. Deviation	N of Items
17.6730	3.716	1.92779	4

RELIABILITY FOR SUPPLY CHAIN INTEGRATION (SUPPLIER INTEGRATION)

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.918	.919	12

Item Statistics			
	Mean	Std. Deviation	N
B5SI	4.1564	.68951	211
B6SI	4.1659	.65172	211
B7SI	4.1611	.67796	211
B8SI	3.4171	.80858	211
B9SI	3.4739	.80654	211
B10SI	3.5545	.79319	211
B11SI	3.6303	.71436	211
B12SI	3.6919	.77144	211
B13SI	3.6777	.72403	211
B14SI	3.8578	.66810	211
B15SI	3.7536	.71443	211
B16SI	4.0616	.62564	211

Inter-Item Correlation Matrix												
	B5SI	B6SI	B7SI	B8SI	B9SI	B10SI	B11SI	B12SI	B13SI	B14SI	B15SI	B16SI
B5SI	1.000	.747	.618	.352	.380	.389	.437	.279	.245	.586	.436	.430
B6SI	.747	1.000	.661	.401	.484	.328	.419	.358	.255	.590	.487	.489
B7SI	.618	.661	1.000	.311	.443	.462	.330	.205	.281	.619	.367	.482
B8SI	.352	.401	.311	1.000	.783	.618	.606	.482	.548	.384	.443	.325
B9SI	.380	.484	.443	.783	1.000	.652	.644	.534	.516	.461	.551	.319
B10SI	.389	.328	.462	.618	.652	1.000	.708	.483	.694	.554	.536	.430
B11SI	.437	.419	.330	.606	.644	.708	1.000	.691	.551	.498	.530	.413
B12SI	.279	.358	.205	.482	.534	.483	.691	1.000	.341	.432	.613	.424
B13SI	.245	.255	.281	.548	.516	.694	.551	.341	1.000	.466	.573	.401
B14SI	.586	.590	.619	.384	.461	.554	.498	.432	.466	1.000	.665	.659
B15SI	.436	.487	.367	.443	.551	.536	.530	.613	.573	.665	1.000	.641
B16SI	.430	.489	.482	.325	.319	.430	.413	.424	.401	.659	.641	1.000

Summary Item Statistics							
	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Inter-Item Correlations	.485	.205	.783	.579	3.829	.018	12

Item-Total Statistics					
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
B5SI	41.4455	34.382	.594	.642	.915

B6SI	41.4360	34.352	.639	.696	.913
B7SI	41.4408	34.581	.579	.628	.915
B8SI	42.1848	32.837	.666	.678	.912
B9SI	42.1280	32.274	.735	.745	.908
B10SI	42.0474	32.331	.743	.719	.908
B11SI	41.9716	33.047	.743	.711	.908
B12SI	41.9100	33.663	.603	.624	.915
B13SI	41.9242	33.975	.611	.607	.914
B14SI	41.7441	33.544	.733	.663	.909
B15SI	41.8483	33.139	.731	.707	.909
B16SI	41.5403	34.745	.613	.561	.914

Scale Statistics			
Mean	Variance	Std. Deviation	N of Items
45.6019	39.660	6.29760	12

RELIABILITY FOR SUPPLY CHAIN INTEGRATION (CUSTOMER INTEGRATION)

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.889	.891	8

Item Statistics			
	Mean	Std. Deviation	N
B17CI	4.3886	.73722	211
B18CI	4.0948	.63285	211
B19CI	4.2891	.81464	211
B20CI	3.2275	.80794	211
B21CI	3.0474	.72875	211
B22CI	3.6114	.75002	211
B23CI	3.8246	.76380	211
B24CI	3.7393	.78274	211

Inter-Item Correlation Matrix								
	B17CI	B18CI	B19CI	B20CI	B21CI	B22CI	B23CI	B24CI
B17CI	1.000	.656	.724	.283	.258	.283	.485	.457
B18CI	.656	1.000	.639	.479	.434	.459	.606	.531
B19CI	.724	.639	1.000	.377	.290	.372	.595	.552
B20CI	.283	.479	.377	1.000	.677	.453	.389	.493
B21CI	.258	.434	.290	.677	1.000	.679	.477	.473
B22CI	.283	.459	.372	.453	.679	1.000	.670	.540
B23CI	.485	.606	.595	.389	.477	.670	1.000	.815
B24CI	.457	.531	.552	.493	.473	.540	.815	1.000

Summary Item Statistics							
	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Inter-Item Correlations	.505	.258	.815	.557	3.159	.020	8

Item-Total Statistics					
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
B17CI	25.8341	16.482	.582	.599	.883
B18CI	26.1280	16.398	.724	.598	.871
B19CI	25.9336	15.577	.664	.628	.876
B20CI	26.9953	16.081	.582	.558	.884
B21CI	27.1754	16.345	.616	.640	.880
B22CI	26.6114	16.048	.648	.626	.877
B23CI	26.3981	15.298	.774	.784	.864
B24CI	26.4834	15.365	.738	.710	.868

Scale Statistics			
Mean	Variance	Std. Deviation	N of Items
30.2227	20.507	4.52850	8

RELIABILITY FOR SUPPLY CHAIN RISK (INTERNAL RISK)

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.909	.911	10

Item Statistics			
	Mean	Std. Deviation	N
A13c	3.3270	.76977	211
A13d	3.5829	.62981	211
A13f	3.4550	.68425	211
A13g	3.2180	.59350	211
A13l	3.5924	.63601	211
A13m	3.3365	.70071	211
A13n	3.3175	.63142	211
A13o	3.0758	.67184	211
A13p	3.4692	.70559	211
A13q	3.3081	.69343	211

Item-Total Statistics					
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
A13c	30.3555	20.202	.601	.451	.906
A13d	30.0995	20.757	.662	.502	.901
A13f	30.2275	20.329	.673	.558	.900
A13g	30.4645	20.707	.721	.599	.898
A13l	30.0900	20.216	.757	.630	.895
A13m	30.3460	20.199	.677	.542	.900
A13n	30.3649	21.052	.604	.451	.904
A13o	30.6066	20.411	.673	.529	.900
A13p	30.2133	20.321	.650	.467	.902
A13q	30.3744	19.950	.730	.587	.896

Inter-Item Correlation Matrix										
	A13c	A13d	A13f	A13g	A13l	A13m	A13n	A13o	A13p	A13q
A13c	1.000	.459	.503	.489	.507	.563	.265	.458	.400	.435
A13d	.459	1.000	.564	.588	.584	.384	.442	.458	.485	.514
A13f	.503	.564	1.000	.493	.658	.474	.402	.370	.562	.506
A13g	.489	.588	.493	1.000	.527	.475	.539	.591	.460	.669
A13l	.507	.584	.658	.527	1.000	.619	.502	.530	.502	.610
A13m	.563	.384	.474	.475	.619	1.000	.425	.573	.469	.550
A13n	.265	.442	.402	.539	.502	.425	1.000	.549	.487	.526
A13o	.458	.458	.370	.591	.530	.573	.549	1.000	.477	.542
A13p	.400	.485	.562	.460	.502	.469	.487	.477	1.000	.550
A13q	.435	.514	.506	.669	.610	.550	.526	.542	.550	1.000

Summary Item Statistics

	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Inter-Item Correlations	.505	.265	.669	.404	2.521	.006	10

Scale Statistics			
Mean	Variance	Std. Deviation	N of Items
33.6825	24.951	4.99510	10

RELIABILITY FOR INFORMATION SHARING

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.903	.908	6

Item Statistics			
	Mean	Std. Deviation	N
C1	4.2559	.64800	211
C2	3.9052	.55250	211
C3	3.8341	.53092	211
C4	3.8910	.49997	211
C5	3.8720	.51430	211
C6	3.8009	.55908	211

Inter-Item Correlation Matrix						
	C1	C2	C3	C4	C5	C6
C1	1.000	.600	.567	.542	.542	.444
C2	.600	1.000	.595	.704	.694	.617
C3	.567	.595	1.000	.667	.619	.610
C4	.542	.704	.667	1.000	.927	.620
C5	.542	.694	.619	.927	1.000	.590
C6	.444	.617	.610	.620	.590	1.000

Summary Item Statistics							
	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Inter-Item Correlations	.623	.444	.927	.483	2.090	.011	6

Item-Total Statistics					
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
C1	19.3033	5.146	.630	.436	.906
C2	19.6540	5.170	.774	.606	.880
C3	19.7251	5.343	.731	.553	.887
C4	19.6682	5.251	.837	.877	.873
C5	19.6872	5.245	.811	.864	.876
C6	19.7583	5.356	.677	.494	.895

Scale Statistics			
Mean	Variance	Std. Deviation	N of Items
23.5592	7.419	2.72380	6

RELIABILITY FOR SUPPLY CHAIN PERFORMANCE (PLAN)

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.883	.885	9

Item Statistics			
	Mean	Std. Deviation	N
P6	4.0427	.49095	211
P9	3.7204	.56274	211
P10	3.9052	.60200	211
P11	4.0948	.62528	211
P13	3.8057	.65840	211
P14	3.9052	.48846	211
P15	3.7346	.58202	211
P16	3.9716	.45685	211
P17	4.0711	.50678	211

Inter-Item Correlation Matrix									
	P6	P9	P10	P11	P13	P14	P15	P16	P17
P6	1.000	.233	.336	.297	.379	.434	.173	.451	.390
P9	.233	1.000	.554	.428	.495	.319	.557	.562	.421
P10	.336	.554	1.000	.657	.566	.423	.512	.544	.428
P11	.297	.428	.657	1.000	.427	.575	.554	.560	.444
P13	.379	.495	.566	.427	1.000	.579	.523	.472	.384
P14	.434	.319	.423	.575	.579	1.000	.548	.564	.393
P15	.173	.557	.512	.554	.523	.548	1.000	.437	.290
P16	.451	.562	.544	.560	.472	.564	.437	1.000	.708
P17	.390	.421	.428	.444	.384	.393	.290	.708	1.000

Summary Item Statistics							
	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Inter-Item Correlations	.462	.173	.708	.535	4.090	.013	9

Item-Total Statistics					
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
P6	31.2085	11.280	.442	.302	.885
P9	31.5308	10.422	.617	.514	.872
P10	31.3460	9.932	.708	.588	.864
P11	31.1564	9.904	.682	.585	.866
P13	31.4455	9.820	.661	.522	.869
P14	31.3460	10.627	.664	.591	.869
P15	31.5166	10.299	.627	.529	.871
P16	31.2796	10.564	.743	.674	.864
P17	31.1801	10.796	.579	.518	.875

Scale Statistics			
Mean	Variance	Std. Deviation	N of Items
35.2512	12.979	3.60270	9

RELIABILITY FOR SUPPLY CHAIN PERFORMANCE (SOURCE)

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.920	.920	10

Item Statistics			
	Mean	Std. Deviation	N
S1	3.8720	.60767	211
S2	3.8483	.55698	211
S3	3.7820	.56892	211
S4	4.1659	.58225	211
S5	3.8815	.54352	211
S6	3.9100	.48447	211
S7	3.8531	.61119	211
S8	3.7583	.66430	211
S9	3.8104	.57079	211
S10	3.8957	.60830	211

Inter-Item Correlation Matrix										
	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
S1	1.000	.674	.704	.424	.430	.462	.590	.607	.506	.531
S2	.674	1.000	.662	.562	.397	.532	.704	.647	.523	.572
S3	.704	.662	1.000	.368	.347	.499	.661	.666	.371	.457
S4	.424	.562	.368	1.000	.484	.475	.551	.486	.568	.479
S5	.430	.397	.347	.484	1.000	.610	.406	.421	.526	.524
S6	.462	.532	.499	.475	.610	1.000	.550	.509	.489	.566
S7	.590	.704	.661	.551	.406	.550	1.000	.803	.507	.509
S8	.607	.647	.666	.486	.421	.509	.803	1.000	.607	.609
S9	.506	.523	.371	.568	.526	.489	.507	.607	1.000	.533
S10	.531	.572	.457	.479	.524	.566	.509	.609	.533	1.000

Summary Item Statistics							
	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Inter-Item Correlations	.536	.347	.803	.456	2.314	.010	10

Item-Total Statistics					
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
S1	34.9052	15.848	.717	.614	.911
S2	34.9289	15.933	.775	.659	.908
S3	34.9953	16.205	.690	.648	.913
S4	34.6114	16.382	.630	.480	.916

S5	34.8957	16.780	.587	.483	.918
S6	34.8673	16.773	.676	.536	.914
S7	34.9242	15.566	.777	.736	.907
S8	35.0190	15.162	.790	.753	.907
S9	34.9668	16.280	.669	.544	.914
S10	34.8815	15.962	.690	.532	.913

Scale Statistics			
Mean	Variance	Std. Deviation	N of Items
38.7773	19.688	4.43714	10

RELIABILITY FOR SUPPLY CHAIN PERFORMANCE (MAKE)

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.870	.888	6

Item Statistics			
	Mean	Std. Deviation	N
M1	3.9668	.55535	211
M4	4.0995	.73972	211
M5	3.8720	.49543	211
M6	3.9763	.50181	211
M7	3.9763	.41908	211
M8	4.0190	.44681	211

Inter-Item Correlation Matrix						
	M1	M4	M5	M6	M7	M8
M1	1.000	.437	.642	.544	.549	.502
M4	.437	1.000	.594	.545	.376	.326
M5	.642	.594	1.000	.773	.605	.613
M6	.544	.545	.773	1.000	.699	.660
M7	.549	.376	.605	.699	1.000	.664
M8	.502	.326	.613	.660	.664	1.000

Summary Item Statistics							
	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Inter-Item Correlations	.569	.326	.773	.447	2.374	.014	6

Item-Total Statistics					
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
M1	19.9431	4.454	.648	.462	.852
M4	19.8104	4.088	.551	.389	.889
M5	20.0379	4.341	.821	.701	.823
M6	19.9336	4.348	.804	.708	.826
M7	19.9336	4.824	.697	.583	.848
M8	19.8910	4.802	.654	.541	.852

Scale Statistics			
Mean	Variance	Std. Deviation	N of Items
23.9100	6.282	2.50646	6

RELIABILITY FOR SUPPLY CHAIN PERFORMANCE (DELIVERY)

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.921	.924	9

Item Statistics			
	Mean	Std. Deviation	N
D3	3.8720	.50495	211
D6	3.9242	.48199	211
D9	3.7867	.54947	211
D10	3.8531	.49012	211
D11	3.6019	.67103	211
D12	3.7725	.62137	211
D1	3.8626	.46298	211
D4	3.9052	.51688	211
D5	3.9810	.40192	211

Inter-Item Correlation Matrix									
	D3	D6	D9	D10	D11	D12	D1	D4	D5
D3	1.000	.664	.639	.559	.509	.590	.597	.720	.551
D6	.664	1.000	.586	.678	.613	.642	.572	.583	.705
D9	.639	.586	1.000	.626	.582	.666	.502	.499	.434
D10	.559	.678	.626	1.000	.733	.750	.561	.565	.518
D11	.509	.613	.582	.733	1.000	.821	.405	.412	.413
D12	.590	.642	.666	.750	.821	1.000	.437	.481	.421
D1	.597	.572	.502	.561	.405	.437	1.000	.662	.472
D4	.720	.583	.499	.565	.412	.481	.662	1.000	.496
D5	.551	.705	.434	.518	.413	.421	.472	.496	1.000

Summary Item Statistics							
	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Inter-Item Correlations	.574	.405	.821	.416	2.025	.011	9

Item-Total Statistics					
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
D3	30.6872	11.035	.760	.672	.909
D6	30.6351	11.052	.797	.697	.907
D9	30.7725	10.919	.721	.560	.912
D10	30.7062	10.980	.806	.700	.907
D11	30.9573	10.289	.720	.712	.914
D12	30.7867	10.330	.782	.760	.908
D1	30.6967	11.584	.647	.524	.916

D4	30.6540	11.218	.680	.620	.914
D5	30.5782	11.969	.614	.524	.919

Scale Statistics			
Mean	Variance	Std. Deviation	N of Items
34.5592	13.838	3.71997	9

APPENDIX D

SPSS OUTPUT FOR MEAN FOR SUPPLY CHAIN INTGERATION, SUPPLY CHAIN RISK, INFORMATION SHARING AND SUPPLY CHAIN PERFORMANCE

MEAN FOR SUPPLY CHAIN INTEGRATION

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
B1II	211	1.00	5.00	4.7062	.57645
B2II	211	3.00	5.00	4.2986	.55287
B3II	211	3.00	5.00	4.2938	.60072
B4II	211	3.00	5.00	4.3744	.63779
B5SI	211	1.00	5.00	4.1564	.68951
B6SI	211	1.00	5.00	4.1659	.65172
B7SI	211	1.00	5.00	4.1611	.67796
B8SI	211	2.00	5.00	3.4171	.80858
B9SI	211	1.00	5.00	3.4739	.80654
B10SI	211	1.00	5.00	3.5545	.79319
B11SI	211	1.00	5.00	3.6303	.71436
B12SI	211	1.00	5.00	3.6919	.77144
B13SI	211	2.00	5.00	3.6777	.72403
B14SI	211	1.00	5.00	3.8578	.66810
B15SI	211	1.00	5.00	3.7536	.71443
B16SI	211	2.00	5.00	4.0616	.62564
B17CI	211	2.00	5.00	4.3886	.73722
B18CI	211	2.00	5.00	4.0948	.63285
B19CI	211	1.00	5.00	4.2891	.81464
B20CI	211	1.00	5.00	3.2275	.80794
B21CI	211	1.00	5.00	3.0474	.72875
B22CI	211	1.00	5.00	3.6114	.75002
B23CI	211	2.00	5.00	3.8246	.76380
B24CI	211	2.00	5.00	3.7393	.78274
Valid N (listwise)	211				

MEAN FOR SUPPLY CHAIN INTEGRATION

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
A13a	211	1.00	5.00	3.1422	.70958
A13b	211	1.00	5.00	2.9336	.62895
A13c	211	1.00	5.00	3.3270	.76977
A13d	211	1.00	5.00	3.5829	.62981
A13e	211	1.00	5.00	3.3555	.69124
A13f	211	1.00	5.00	3.4550	.68425
A13g	211	1.00	5.00	3.2180	.59350
A13h	211	1.00	5.00	3.3365	.63662

A13i	211	1.00	5.00	3.1754	.56278
A13j	211	1.00	5.00	3.2654	.59816
A13k	211	1.00	5.00	3.0995	.70003
A13l	211	1.00	5.00	3.5924	.63601
A13m	211	1.00	5.00	3.3365	.70071
A13n	211	1.00	5.00	3.3175	.63142
A13o	211	1.00	5.00	3.0758	.67184
A13p	211	1.00	5.00	3.4692	.70559
A13q	211	1.00	5.00	3.3081	.69343
Valid N (listwise)	211				

MEAN FOR SUPPLY CHAIN INTEGRATION

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
C1	211	3.00	5.00	4.2559	.64800
C2	211	3.00	5.00	3.9052	.55250
C3	211	3.00	5.00	3.8341	.53092
C4	211	3.00	5.00	3.8910	.49997
C5	211	3.00	5.00	3.8720	.51430
C6	211	2.00	5.00	3.8009	.55908
Valid N (listwise)	211				

MEAN FOR SUPPLY CHAIN INTEGRATION

Descriptive Statistics									
	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
P9	211	2.00	5.00	3.7204	.56274	-.448	.167	.276	.333
P10	211	3.00	5.00	3.9052	.60200	.040	.167	-.261	.333
P11	211	3.00	5.00	4.0948	.62528	-.069	.167	-.450	.333
P13	211	2.00	5.00	3.8057	.65840	-.478	.167	.608	.333
P14	211	3.00	5.00	3.9052	.48846	-.230	.167	1.017	.333
P15	211	2.00	5.00	3.7346	.58202	-.473	.167	.470	.333
P16	211	2.00	5.00	3.9716	.45685	-.719	.167	4.399	.333
P17	211	2.00	5.00	4.0711	.50678	-.317	.167	2.885	.333
M1	211	2.00	5.00	3.9668	.55535	-.352	.167	1.433	.333
M4	211	2.00	5.00	4.0995	.73972	-.446	.167	-.211	.333
M5	211	3.00	5.00	3.8720	.49543	-.268	.167	.732	.333
M6	211	3.00	5.00	3.9763	.50181	-.047	.167	1.029	.333
M7	211	3.00	5.00	3.9763	.41908	-.155	.167	2.779	.333
M8	211	3.00	5.00	4.0190	.44681	.087	.167	2.094	.333
D1	211	3.00	5.00	3.8626	.46298	-.479	.167	1.050	.333
D3	211	3.00	5.00	3.8720	.50495	-.224	.167	.620	.333
D4	211	3.00	5.00	3.9052	.51688	-.135	.167	.629	.333
D5	211	3.00	5.00	3.9810	.40192	-.153	.167	3.297	.333
D6	211	2.00	5.00	3.9242	.48199	-.722	.167	3.059	.333

D9	211	2.00	5.00	3.7867	.54947	-.765	.167	1.297	.333
D10	211	2.00	5.00	3.8531	.49012	-1.066	.167	2.818	.333
D11	211	1.00	5.00	3.6019	.67103	-.951	.167	1.539	.333
D12	211	1.00	5.00	3.7725	.62137	-1.607	.167	4.231	.333
Valid N (listwise)	211								

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
S1	211	2.00	5.00	3.8720	.60767
S2	211	2.00	5.00	3.8483	.55698
S3	211	2.00	5.00	3.7820	.56892
S4	211	3.00	5.00	4.1659	.58225
S5	211	2.00	5.00	3.8815	.54352
S6	211	3.00	5.00	3.9100	.48447
S7	211	1.00	5.00	3.8531	.61119
S8	211	1.00	5.00	3.7583	.66430
S9	211	2.00	5.00	3.8104	.57079
S10	211	1.00	5.00	3.8957	.60830
S11	211	2.00	5.00	3.8578	.47677
Valid N (listwise)	211				

COMBINE ANALYSIS MEAN FOR ALL VARIABLES

Descriptive Statistics									
	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
II	211	2.50	5.00	4.4182	.48195	-.872	.167	1.381	.333
SI	211	1.83	5.00	3.8002	.52480	-.158	.167	1.915	.333
CI	211	2.00	5.00	3.7778	.56606	-.928	.167	2.404	.333
IS	211	2.83	5.00	3.9265	.45397	-.100	.167	.927	.333
Plan	211	3.00	5.00	3.9219	.33782	.316	.167	2.935	.333
Sources	211	2.40	5.00	3.8777	.44371	-.776	.167	2.436	.333
Make	211	3.00	5.00	3.9905	.39985	-.380	.167	1.487	.333
Delivery	211	2.75	5.00	3.8258	.37898	-.191	.167	1.995	.333
IR	211	1.20	5.00	3.3682	.49951	-1.003	.167	2.438	.333
ER	211	1.29	5.00	3.1869	.49379	-.980	.167	3.644	.333
Valid N (listwise)	211								

APPENDIX E

SPSS OUTPUT FOR PAIRED SAMPLES FOR THE ACTUAL LEVEL AND IMPORTANT LEVEL OF SUPPLY CHAIN RISK

PAIRED SAMPLES FOR SUPPLY CHAIN RISK (ACTUAL AND IMPORTANT)

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	SCRMImportant	3.5466	211	.48782	.03358
	SCRMActual	3.3152	211	.38051	.02620

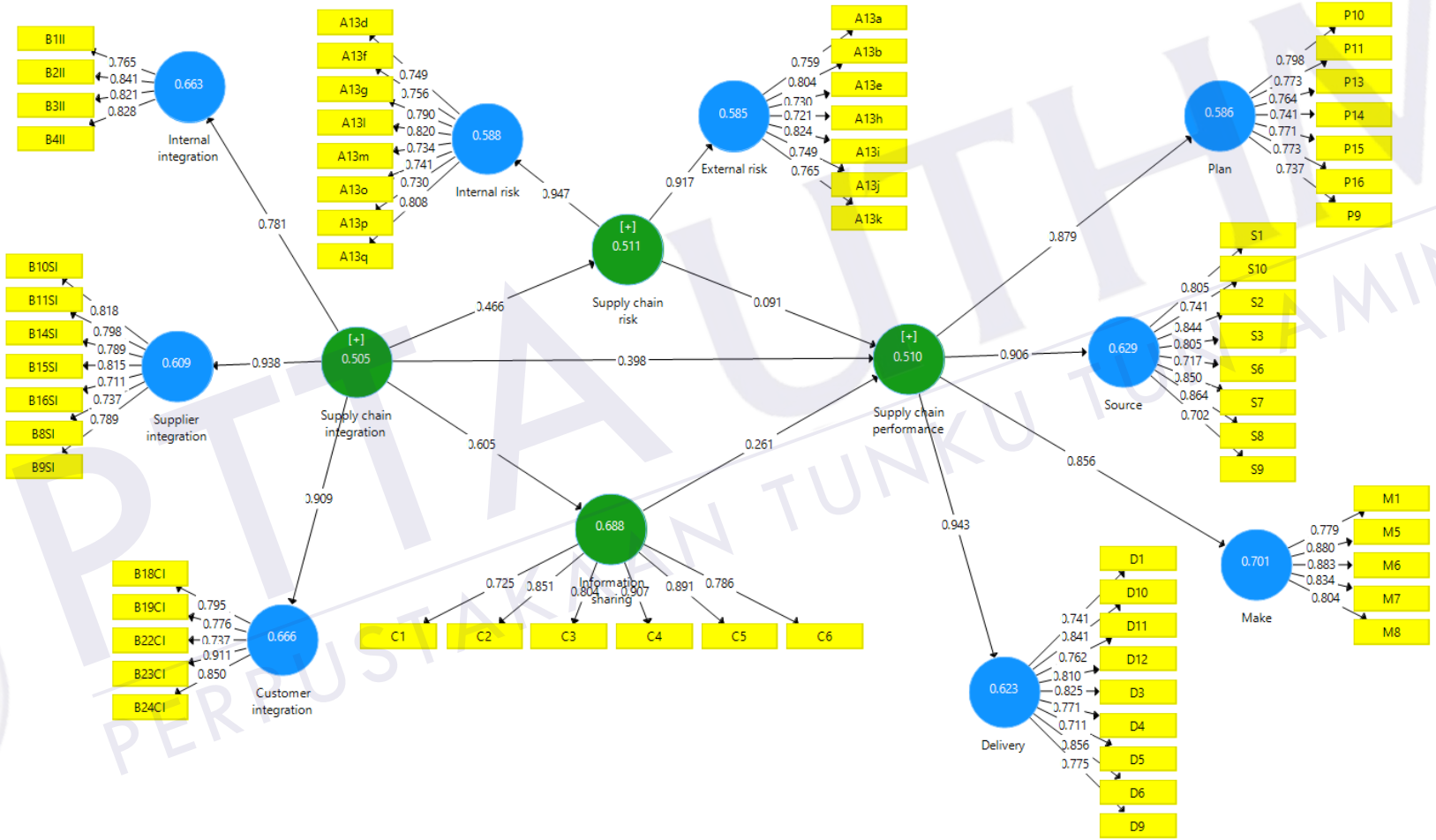
Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	SCRMImportant & SCRMActual	211	.573	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	SCRMImportant - SCRMActual	.23148	.41218	.02838	.17554	.28742	8.158	210	.000

AVE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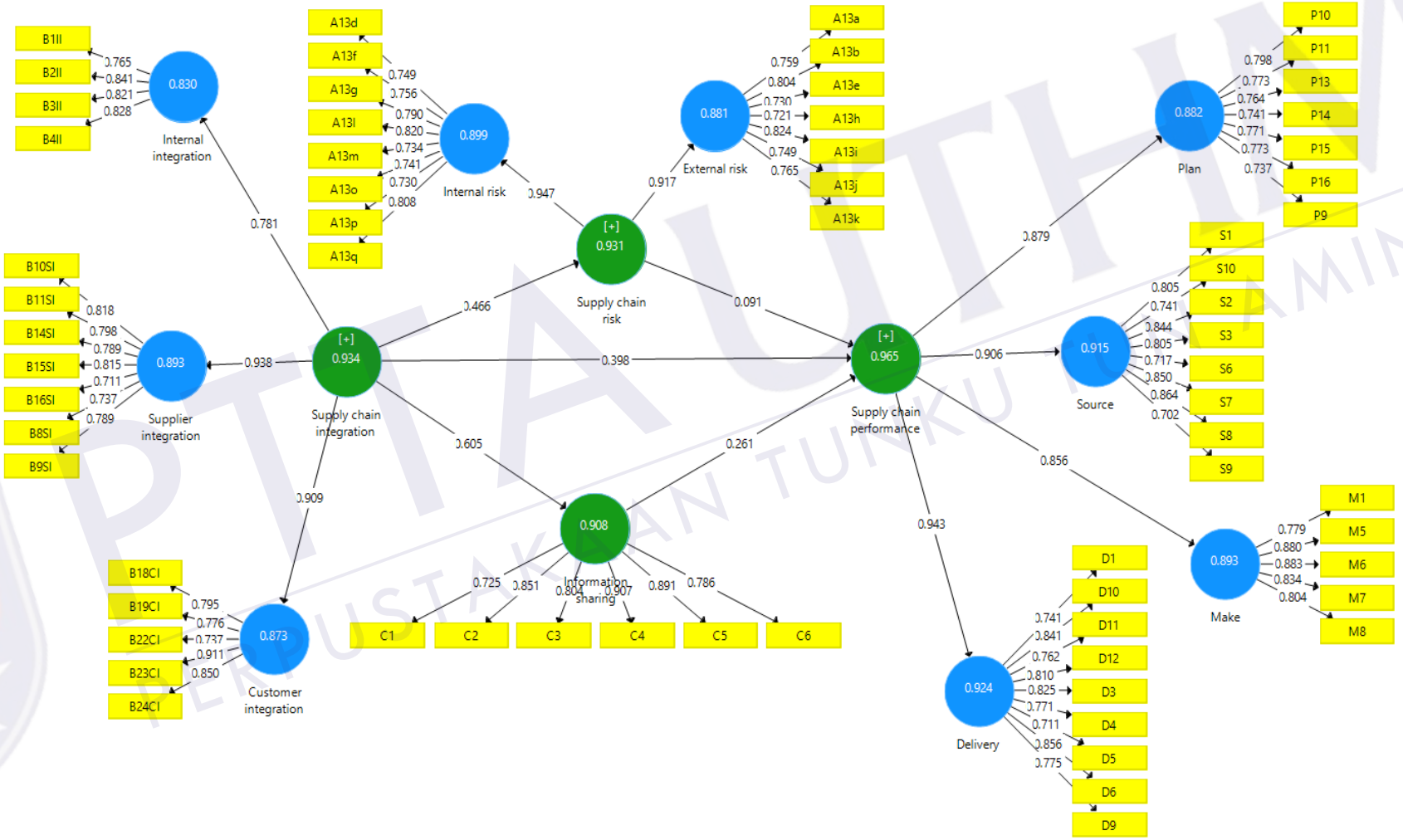
B2II
B3II
B4II
0.765
0.841
0.821
0.828
0.663
Internal integration
0.781
A13d
A13f
A13g
A13l
A13m
A13o
A13p
A13q
0.749
0.756
0.790
0.820
0.734
0.741
0.730
0.808
0.588
Internal risk
0.947
[+]
0.511
Supply chain risk
0.917
0.585
External risk
A13a
A13b
A13e
A13h
A13i
A13j
A13k
0.759
0.804
0.730
0.721
0.824
0.749
0.765
0.879
0.586
Plan
P10
P11
P13
P14
P15
P16
P9
0.798
0.773
0.764
0.741
0.771
0.773
0.737
B10SI
B11SI
B14SI
B15SI
B16SI
B8SI
B9SI
0.818
0.798
0.789
0.815
0.711
0.737
0.789
0.609
Supplier integration
0.938
[+]
0.505
Supply chain integration
0.466
0.091
0.398
[+]
0.510
Supply chain performance
0.906
0.629
Source
S1
S10
S2
S3
S6
S7
S8
S9
0.805
0.741
0.844
0.805
0.717
0.850
0.864
0.702
0.856
0.701
Make
M1
M5
M6
M7
M8
0.779
0.880
0.883
0.834
0.804
0.943
0.623
Delivery
D1
D10
D11
D12
D3
D4
D5
D6
D9
0.741
0.841
0.762
0.810
0.825
0.771
0.711
0.856
0.775
0.605
0.261
0.909
0.688
Information sharing
0.725
0.851
0.804
0.907
0.891
0.786
C1
C2
C3
C4
C5
C6
B18CI
B19CI
B22CI
B23CI
B24CI
0.795
0.776
0.737
0.911
0.850
0.666
Customer integration

CA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B2II
B3II
B4II
0.765
0.841
0.821
0.828
0.830
Internal integration
0.781
A13d
A13f
A13g
A13l
A13m
A13o
A13p
A13q
0.749
0.756
0.790
0.820
0.734
0.741
0.730
0.808
0.899
Internal risk
0.947
[+]
0.931
Supply chain risk
0.917
A13a
A13b
A13e
A13h
A13i
A13j
A13k
0.759
0.804
0.730
0.721
0.824
0.749
0.765
0.881
External risk
0.879
P10
P11
P13
P14
P15
P16
P9
0.798
0.773
0.764
0.741
0.771
0.773
0.737
0.882
Plan
B10SI
B11SI
B14SI
B15SI
B16SI
B8SI
B9SI
0.818
0.798
0.789
0.815
0.711
0.737
0.789
0.893
Supplier integration
0.938
[+]
0.934
Supply chain integration
0.466
0.398
0.091
[+]
0.965
Supply chain performance
0.906
S1
S10
S2
S3
S6
S7
S8
S9
0.805
0.741
0.844
0.805
0.717
0.850
0.864
0.702
0.915
Source
0.605
0.909
0.261
0.908
Information sharing
0.725
0.851
0.804
0.907
0.891
0.786
C1
C2
C3
C4
C5
C6
0.856
0.943
M1
M5
M6
M7
M8
0.779
0.880
0.883
0.834
0.804
0.893
Make
B18CI
B19CI
B22CI
B23CI
B24CI
0.795
0.776
0.737
0.911
0.850
0.873
Customer integration
D1
D10
D11
D12
D3
D4
D5
D6
D9
0.741
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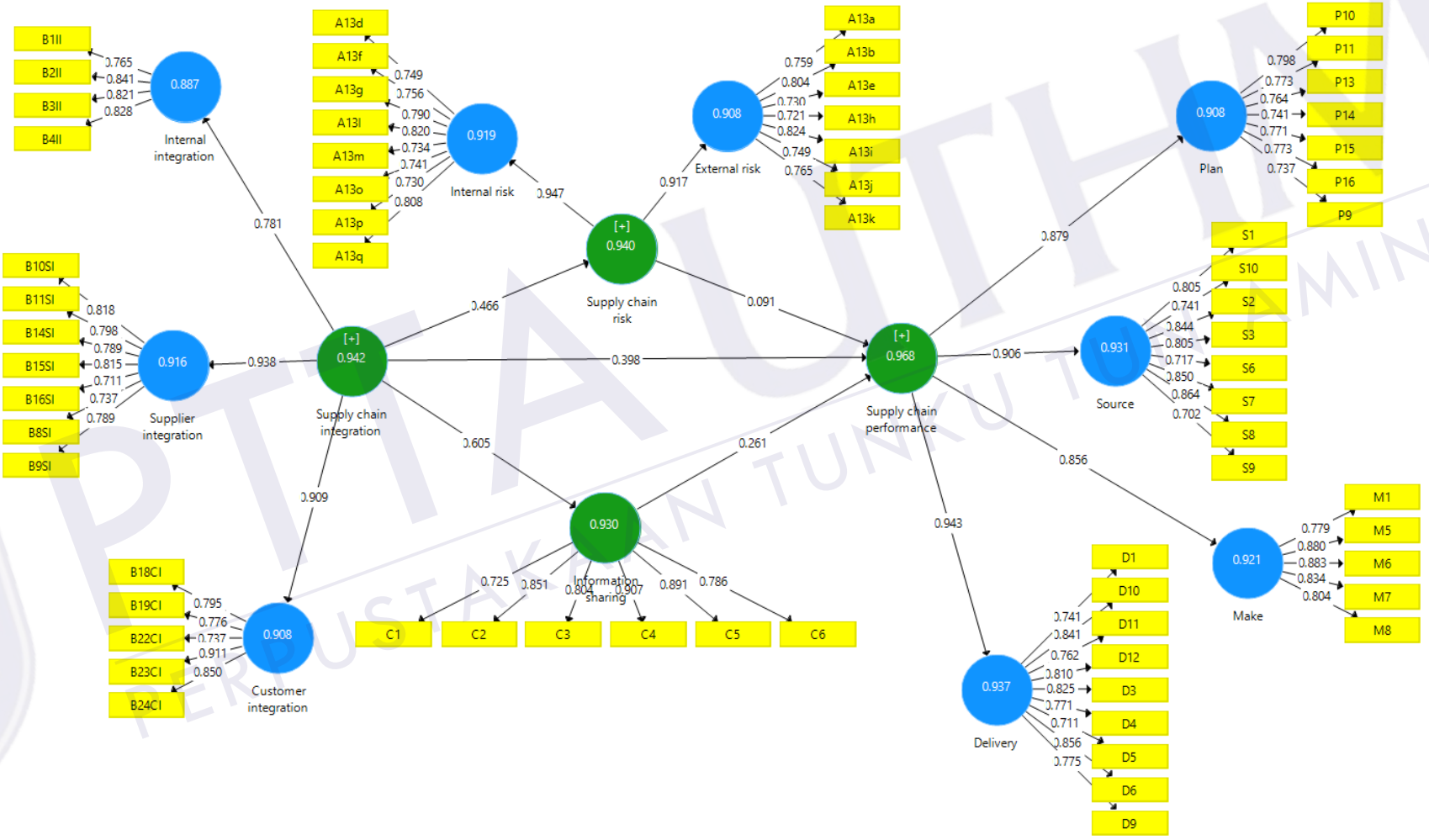
0.825
0.771
0.711
0.856
0.775
0.924
Delivery

CR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B2II
B3II
B4II
0.765
0.841
0.821
0.828
0.887
Internal integration
0.781
A13d
A13f
A13g
A13l
A13m
A13o
A13p
A13q
0.749
0.756
0.790
0.820
0.734
0.741
0.730
0.808
0.919
Internal risk
0.947
[+]
0.940
Supply chain risk
0.917
0.908
External risk
A13a
A13b
A13e
A13h
A13i
A13j
A13k
0.759
0.804
0.730
0.721
0.824
0.749
0.765
0.879
0.908
Plan
P10
P11
P13
P14
P15
P16
P9
0.798
0.773
0.764
0.741
0.771
0.773
0.737
B10SI
B11SI
B14SI
B15SI
B16SI
B8SI
B9SI
0.818
0.798
0.789
0.815
0.711
0.737
0.789
0.916
Supplier integration
0.938
[+]
0.942
Supply chain integration
0.466
0.398
0.091
[+]
0.968
Supply chain performance
0.906
0.931
Source
S1
S10
S2
S3
S6
S7
S8
S9
0.805
0.741
0.844
0.805
0.717
0.850
0.864
0.702
0.605
0.909
0.261
0.930
Information sharing
0.725
0.851
0.804
0.907
0.891
0.786
C1
C2
C3
C4
C5
C6
0.856
0.921
Make
M1
M5
M6
M7
M8
0.779
0.880
0.883
0.834
0.804
0.943
B18CI
B19CI
B22CI
B23CI
B24CI
0.795
0.776
0.737
0.911
0.850
0.908
Customer integration
0.937
Delivery
D1
D10
D11
D12
D3
D4
D5
D6
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0.711
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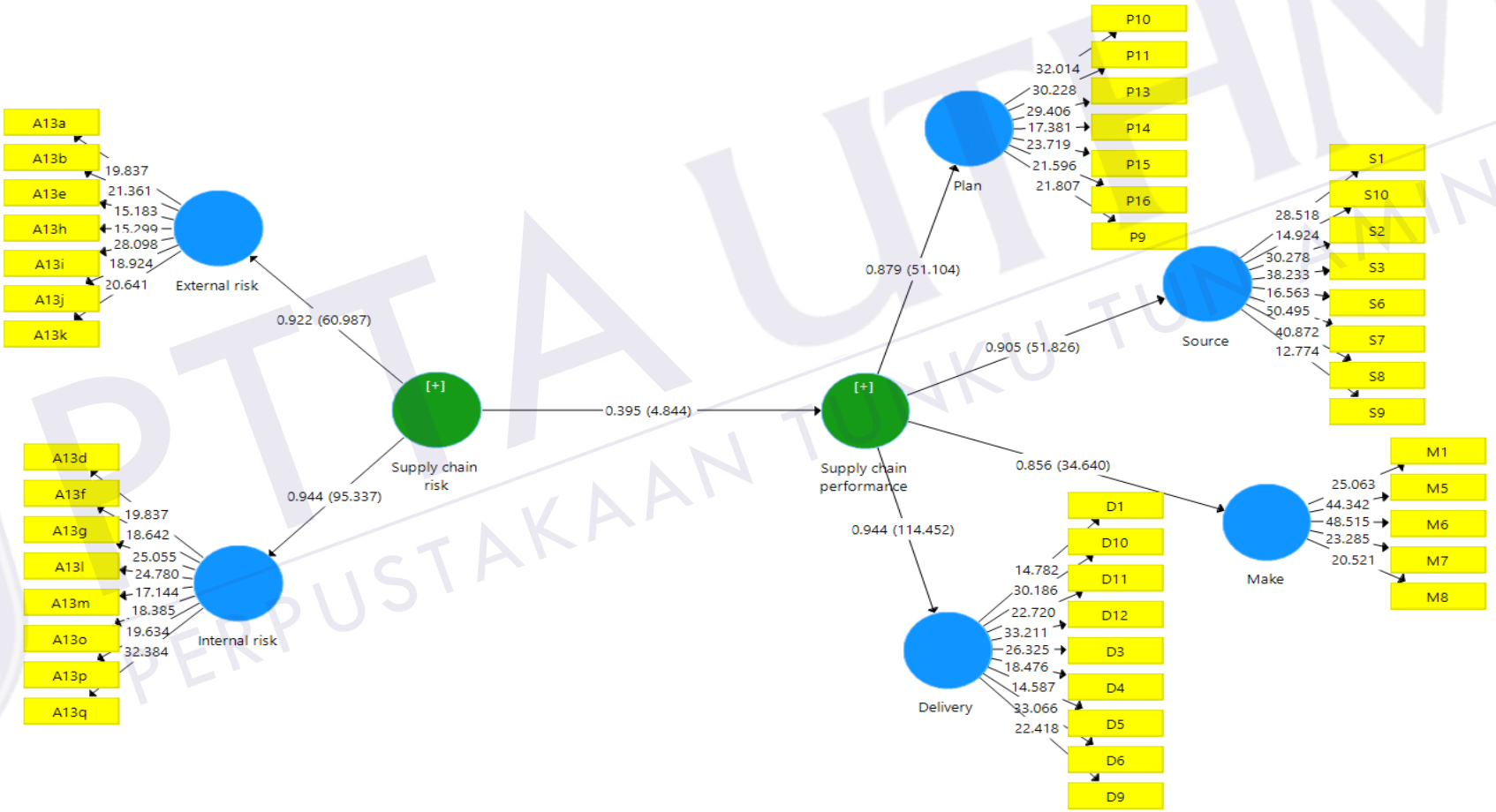
0.775

H1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A13b
A13e
A13h
A13i
A13j
A13k
19.837
21.361
15.183
15.299
28.098
18.924
20.641
External risk
0.922 (60.987)
A13d
A13f
A13g
A13l
A13m
A13o
A13p
A13q
19.837
18.642
25.055
24.780
17.144
18.385
19.634
32.384
Internal risk
0.944 (95.337)
[+]
Supply chain risk
0.395 (4.844)
[+]
Supply chain performance
0.879 (51.104)
Plan
P10
P11
P13
P14
P15
P16
P9
32.014
30.228
29.406
17.381
23.719
21.596
21.807
0.905 (51.826)
Source
S1
S10
S2
S3
S6
S7
S8
S9
28.518
14.924
30.278
38.233
16.563
50.495
40.872
12.774
0.856 (34.640)
Make
M1
M5
M6
M7
M8
25.063
44.342
48.515
23.285
20.521
0.944 (114.452)
Delivery
D1
D10
D11
D12
D3
D4
D5
D6
D9
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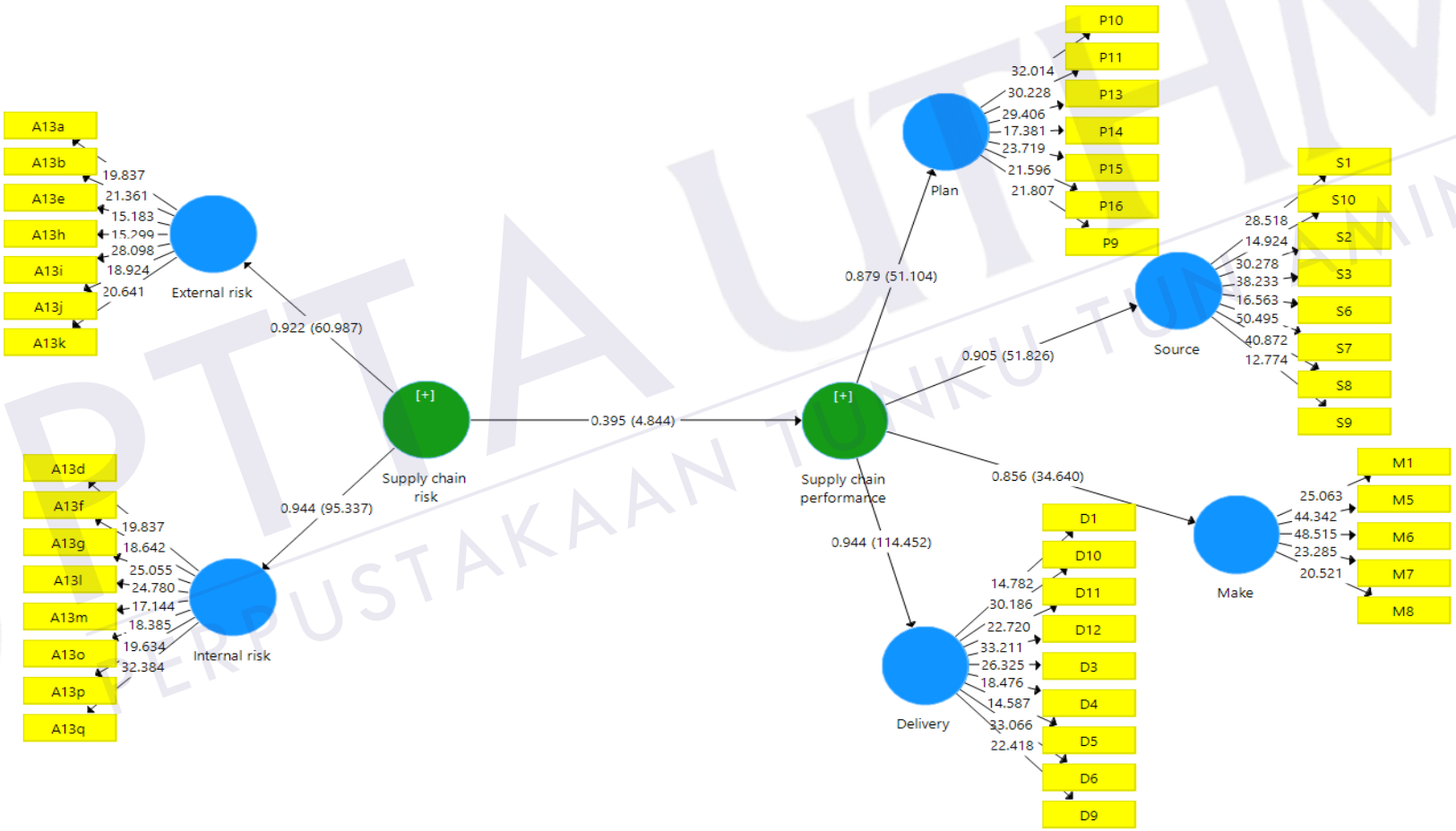
30.186
22.720
33.211
26.325
18.476
14.587
33.066
22.418

H2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A13b
A13e
A13h
A13i
A13j
A13k
19.837
21.361
15.183
15.299
28.098
18.924
20.641
External risk
0.922 (60.987)
A13d
A13f
A13g
A13l
A13m
A13o
A13p
A13q
19.837
18.642
25.055
24.780
17.144
18.385
19.634
32.384
Internal risk
0.944 (95.337)
[+]
Supply chain risk
0.395 (4.844)
[+]
Supply chain performance
0.879 (51.104)
P10
P11
P13
P14
P15
P16
P9
32.014
30.228
29.406
17.381
23.719
21.596
21.807
Plan
0.905 (51.826)
S1
S10
S2
S3
S6
S7
S8
S9
28.518
14.924
30.278
38.233
16.563
50.495
40.872
12.774
Source
0.856 (34.640)
M1
M5
M6
M7
M8
25.063
44.342
48.515
23.285
20.521
Make
0.944 (114.452)
D1
D10
D11
D12
D3
D4
D5
D6
D9
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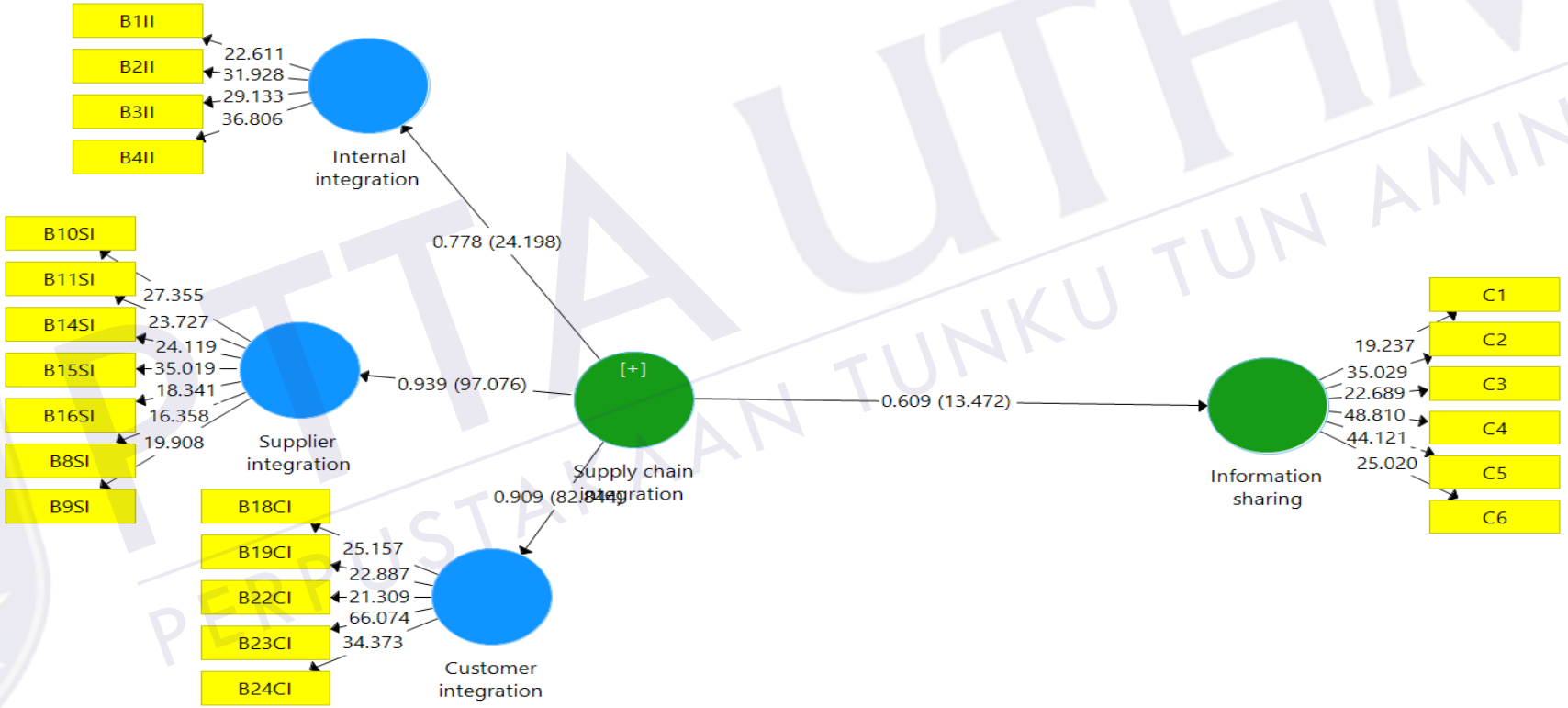
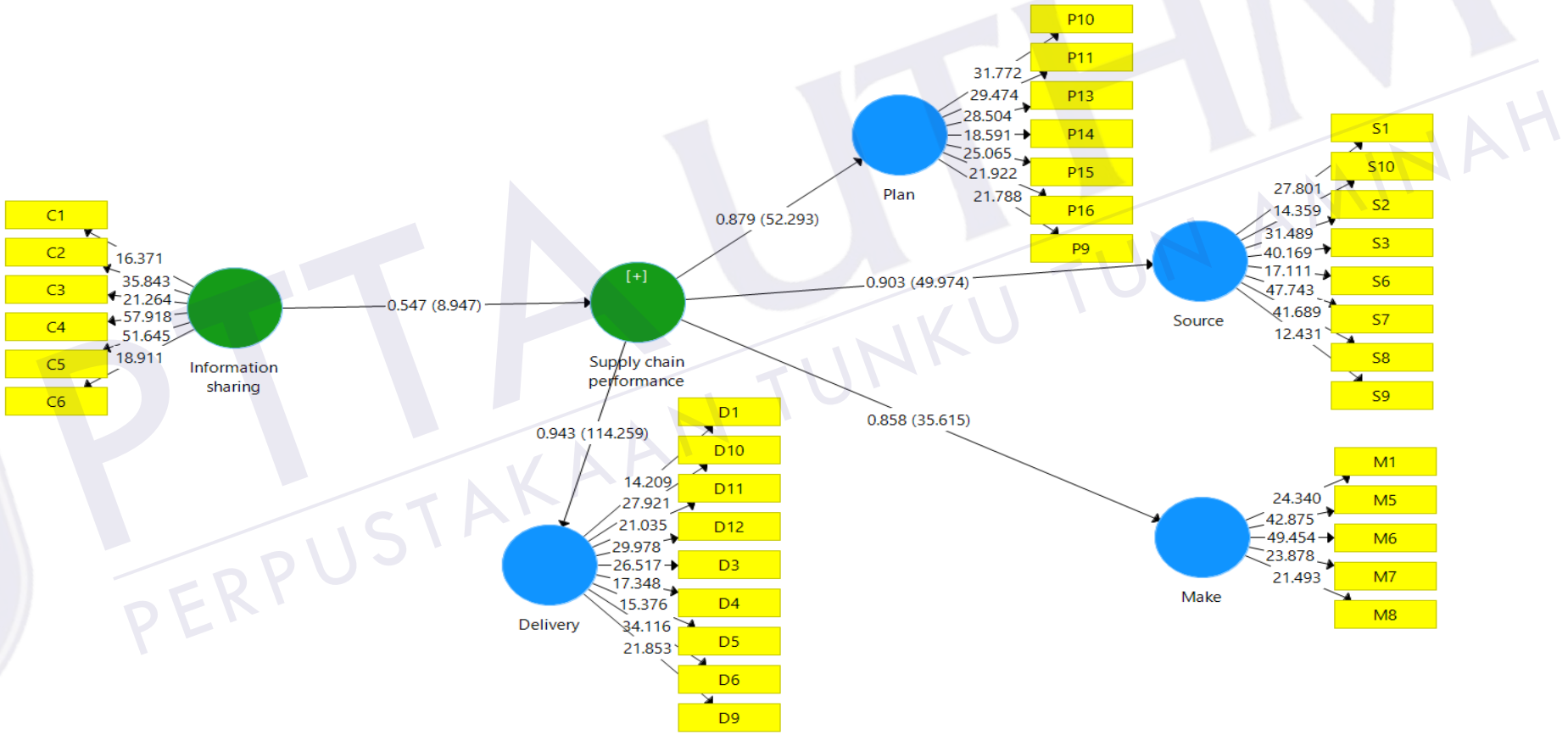
30.186
22.720
33.211
26.325
18.476
14.587
33.066
22.418
Delivery

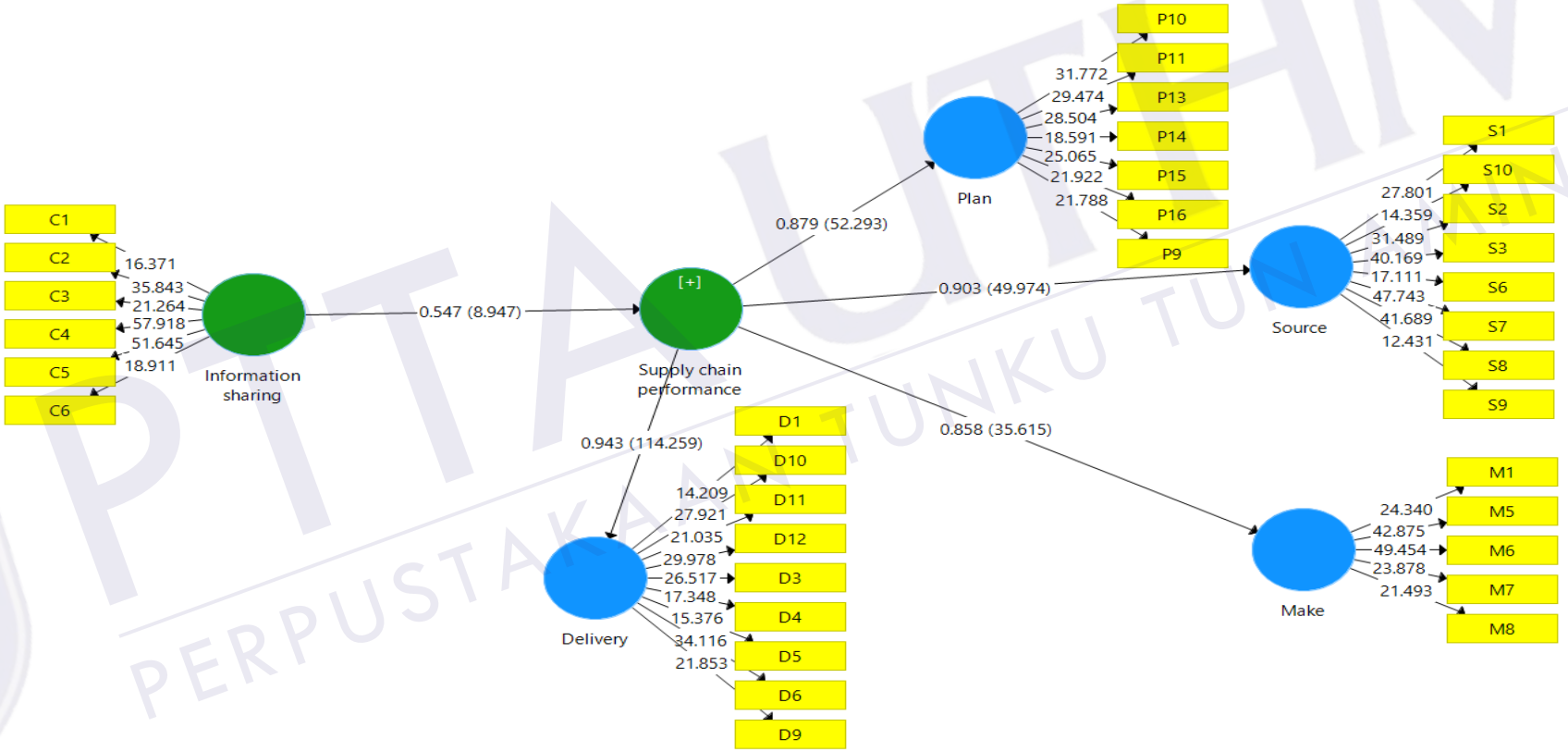
H3


B1II
B2II
B3II
B4II
22.611
31.928
29.133
36.806
Internal integration
0.778 (24.198)
B10SI
B11SI
B14SI
B15SI
B16SI
B8SI
B9SI
27.355
23.727
24.119
35.019
18.341
16.358
19.908
Supplier integration
0.939 (97.076)
[+]
0.609 (13.472)
Supply chain integration
0.909 (82.844)
B18CI
B19CI
B22CI
B23CI
B24CI
25.157
22.887
21.309
66.074
34.373
Customer integration
Information sharing
19.237
35.029
22.689
48.810
44.121
25.020
C1
C2
C3
C4
C5
C6

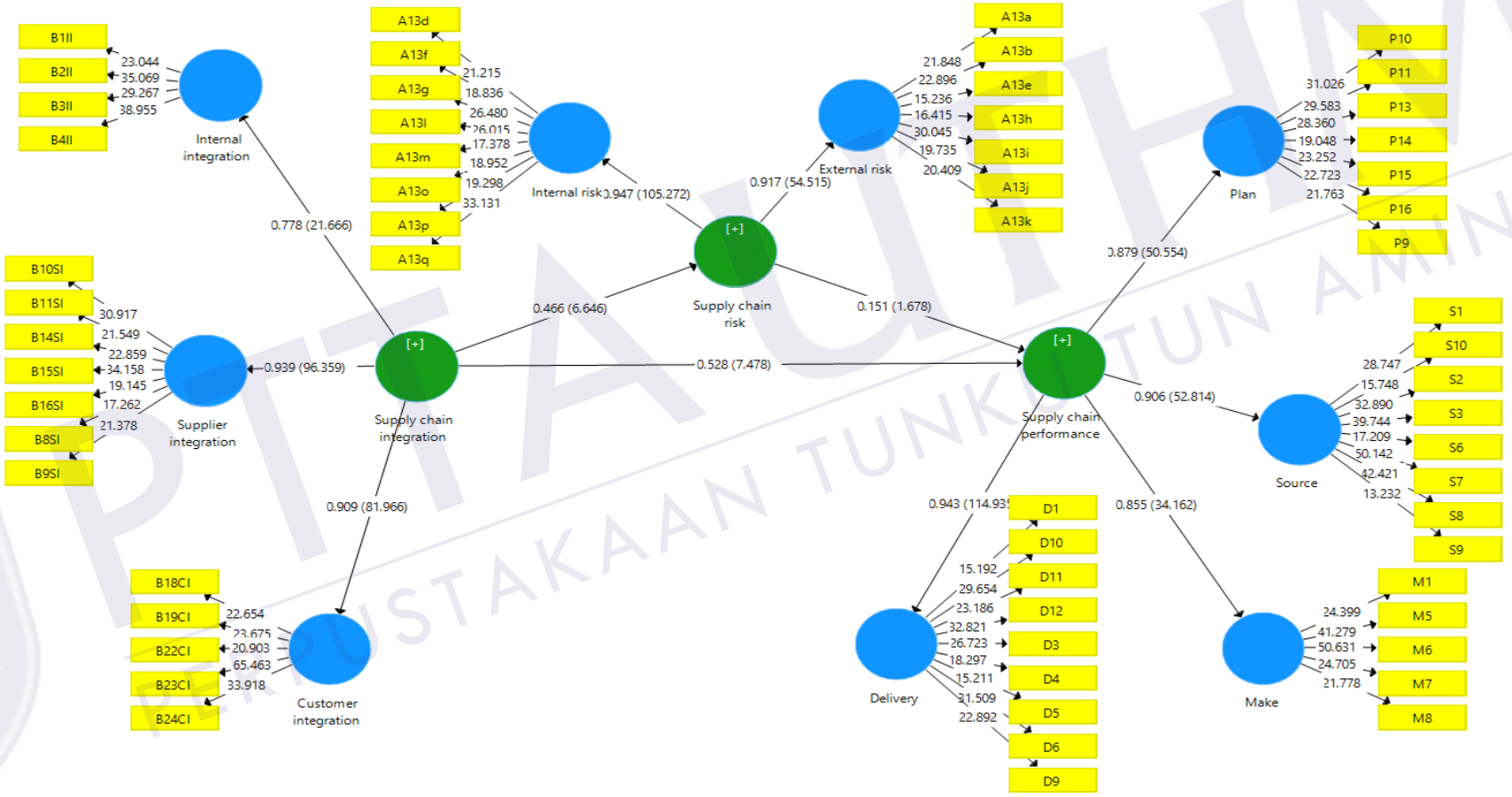
H4


C1
C2
C3
C4
C5
C6
16.371
35.843
21.264
57.918
51.645
18.911
Information sharing
0.547 (8.947)
[+]
Supply chain performance
0.879 (52.293)
Plan
P10
P11
P13
P14
P15
P16
P9
31.772
29.474
28.504
18.591
25.065
21.922
21.788
0.903 (49.974)
Source
S1
S10
S2
S3
S6
S7
S8
S9
27.801
14.359
31.489
40.169
17.111
47.743
41.689
12.431
0.858 (35.615)
Make
M1
M5
M6
M7
M8
24.340
42.875
49.454
23.878
21.493
0.943 (114.259)
Delivery
D1
D10
D11
D12
D3
D4
D5
D6
D9
14.209
27.921
21.035
29.978
26.517
17.348
15.376
34.116
21.853

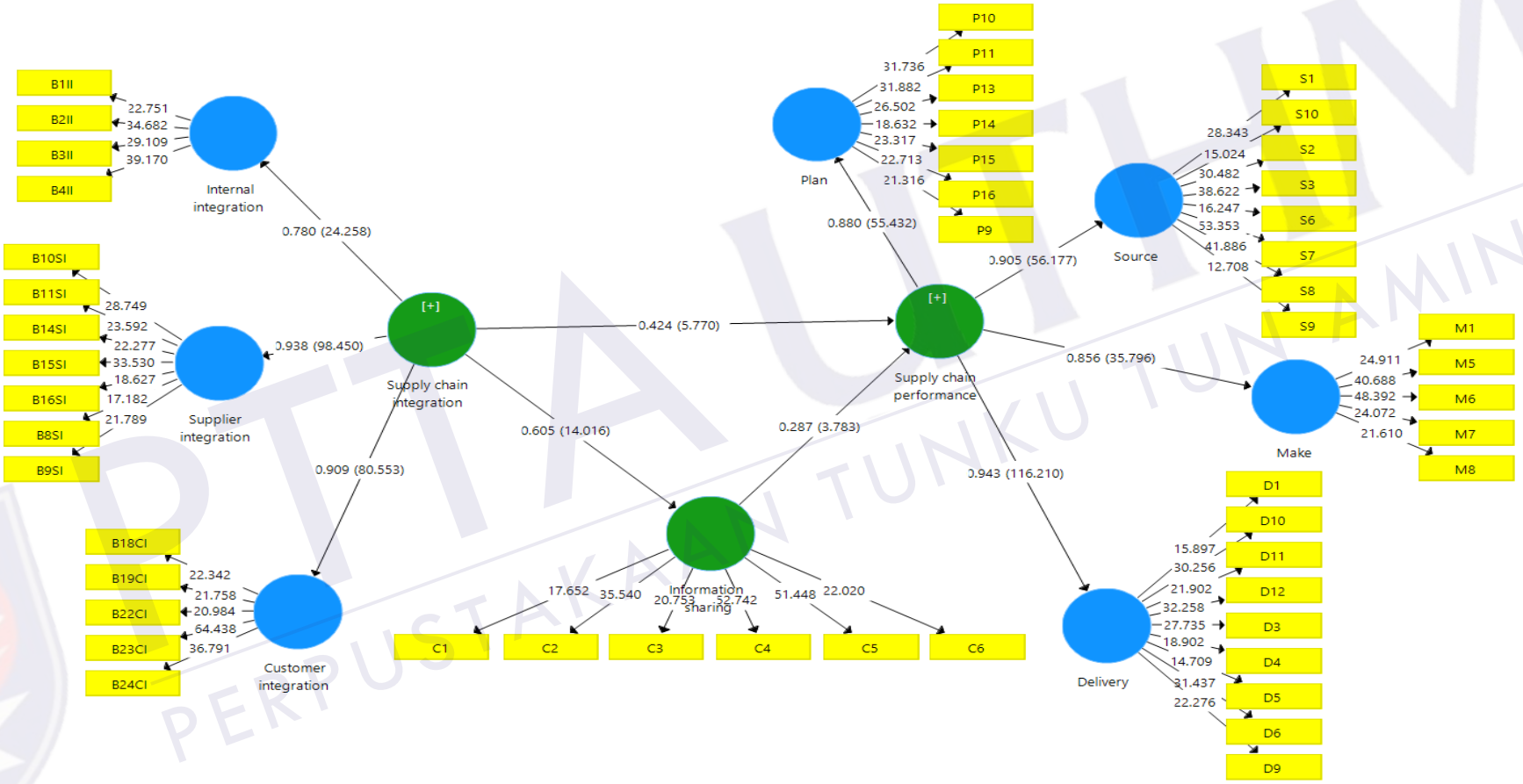
H5


C1
C2
C3
C4
C5
C6
16.371
35.843
21.264
57.918
51.645
18.911
Information sharing
0.547 (8.947)
[+]
Supply chain performance
0.879 (52.293)
Plan
P10
P11
P13
P14
P15
P16
P9
31.772
29.474
28.504
18.591
25.065
21.922
21.788
0.903 (49.974)
Source
S1
S10
S2
S3
S6
S7
S8
S9
27.801
14.359
31.489
40.169
17.111
47.743
41.689
12.431
0.858 (35.615)
Make
M1
M5
M6
M7
M8
24.340
42.875
49.454
23.878
21.493
0.943 (114.259)
Delivery
D1
D10
D11
D12
D3
D4
D5
D6
D9
14.209
27.921
21.035
29.978
26.517
17.348
15.376
34.116
21.853

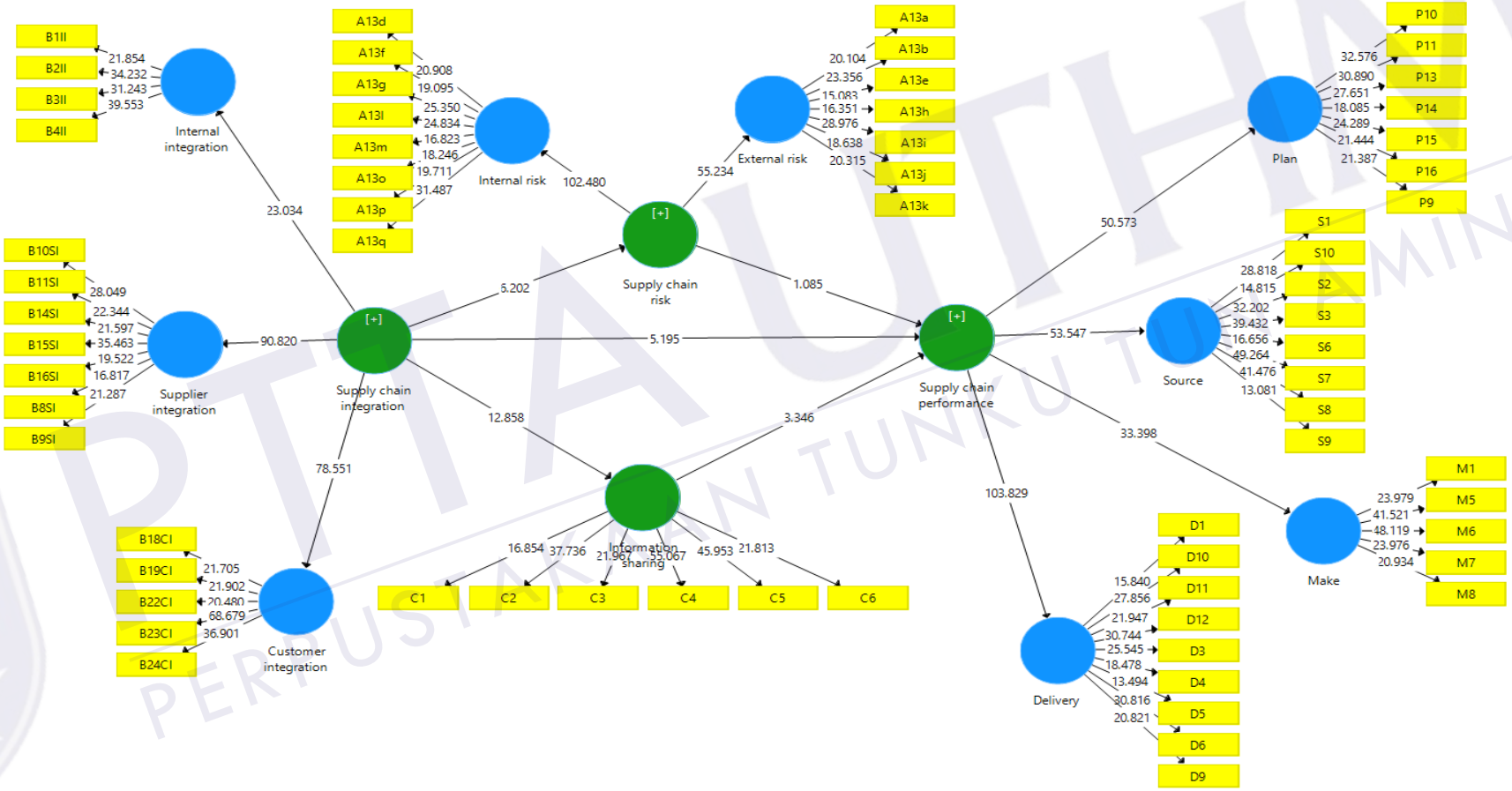
H6


B1II
B2II
B3II
B4II
23.044
35.069
29.267
38.955
Internal integration
A13d
A13f
A13g
A13l
A13m
A13o
A13p
A13q
21.215
18.836
26.480
26.015
17.378
18.952
19.298
33.131
Internal risk
0.778 (21.666)
0.947 (105.272)
[+]
0.917 (54.515)
External risk
A13a
A13b
A13e
A13h
A13i
A13j
A13k
21.848
22.896
15.236
16.415
30.045
19.735
20.409
P10
P11
P13
P14
P15
P16
P9
31.026
29.583
28.360
19.048
23.252
22.723
21.763
Plan
0.879 (50.554)
B10SI
B11SI
B14SI
B15SI
B16SI
B8SI
B9SI
30.917
21.549
22.859
34.158
19.145
17.262
21.378
Supplier integration
0.939 (96.359)
[+]
Supply chain integration
0.466 (6.646)
Supply chain risk
0.151 (1.678)
0.528 (7.478)
[+]
Supply chain performance
0.906 (52.814)
S1
S10
S2
S3
S6
S7
S8
S9
28.747
15.748
32.890
39.744
17.209
50.142
42.421
13.232
Source
0.909 (81.966)
0.943 (114.93
0.855 (34.162)
B18CI
B19CI
B22CI
B23CI
B24CI
22.654
23.675
20.903
65.463
33.918
Customer integration
D1
D10
D11
D12
D3
D4
D5
D6
D9
15.192
29.654
23.186
32.821
26.723
18.297
15.211
31.509
22.892
Delivery
M1
M5
M6
M7
M8
24.399
41.279
50.631
24.705
21.778
Make

H7

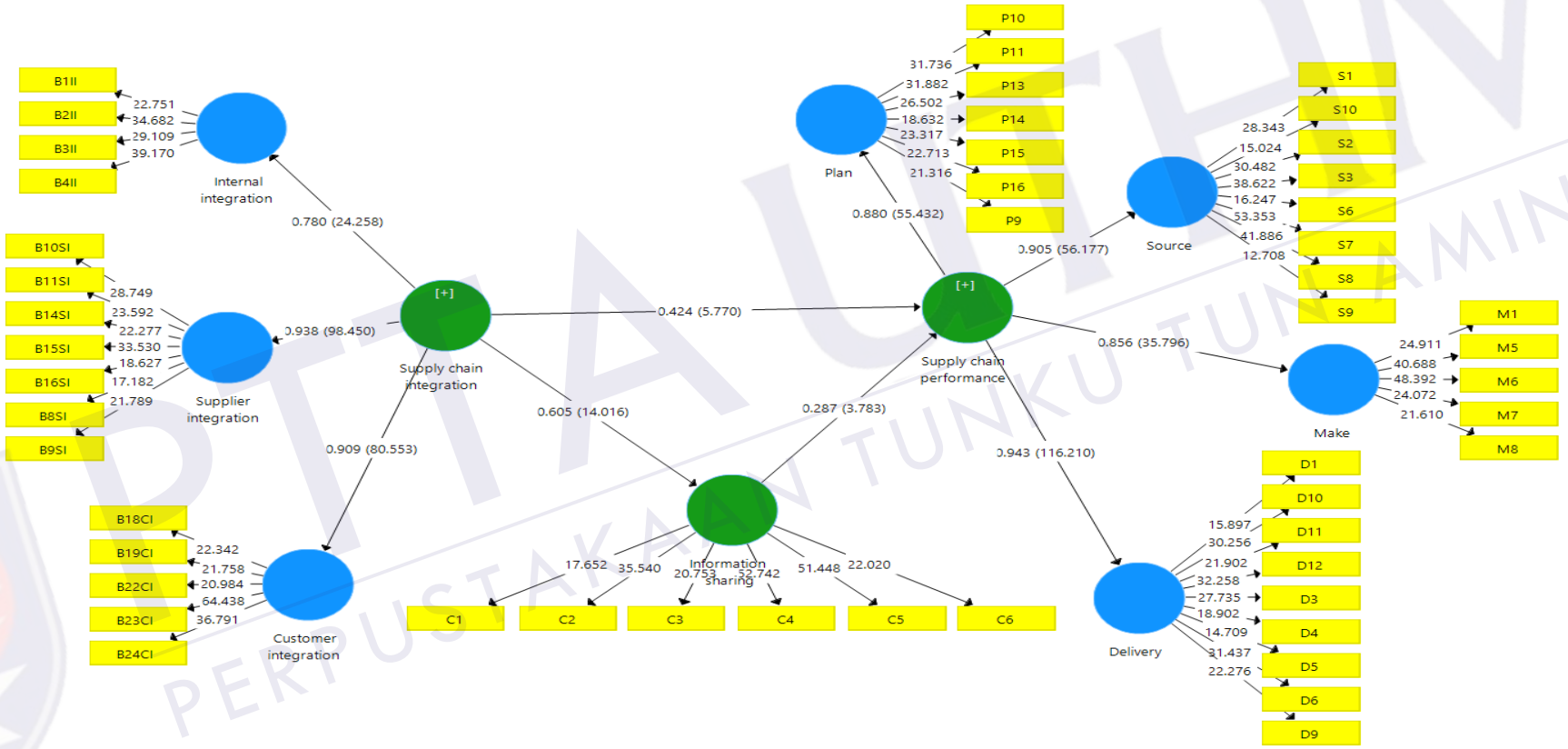


T-VALUE

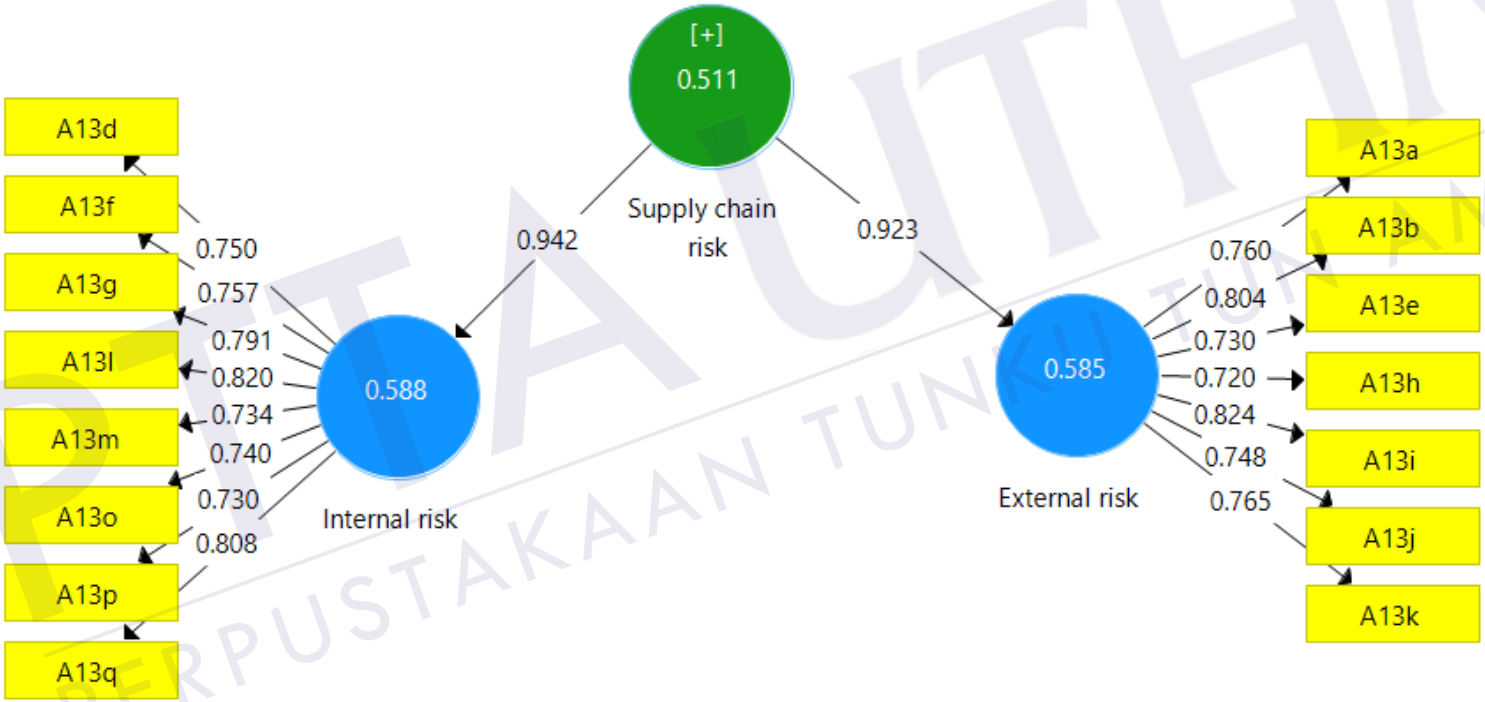

B1II
B2II
B3II
B4II
21.854
34.232
31.243
39.553
Internal integration
23.034
A13d
A13f
A13g
A13l
A13m
A13o
A13p
A13q
20.908
19.095
25.350
24.834
16.823
18.246
19.711
31.487
Internal risk
102.480
[+]
Supply chain risk
55.234
A13a
A13b
A13e
A13h
A13i
A13j
A13k
20.104
23.356
15.083
16.351
28.976
18.638
20.315
External risk
50.573
P10
P11
P13
P14
P15
P16
P9
32.576
30.890
27.651
18.085
24.289
21.444
21.387
Plan
B10SI
B11SI
B14SI
B15SI
B16SI
B8SI
B9SI
28.049
22.344
21.597
35.463
19.522
16.817
21.287
Supplier integration
90.820
5.202
[+]
Supply chain integration
5.195
1.085
[+]
Supply chain performance
53.547
S1
S10
S2
S3
S6
S7
S8
S9
28.818
14.815
32.202
39.432
16.656
49.264
41.476
13.081
Source
12.858
78.551
3.346
33.398
103.829
B18CI
B19CI
B22CI
B23CI
B24CI
21.705
21.902
20.480
68.679
36.901
Customer integration
Information sharing
16.854
37.736
21.967
55.067
45.953
21.813
C1
C2
C3
C4
C5
C6
M1
M5
M6
M7
M8
23.979
41.521
48.119
23.976
20.934
Make
D1
D10
D11
D12
D3
D4
D5
D6
D9
15.840
27.856
21.947
30.744
25.545
18.478
13.494
30.816
20.821
Delivery

APPENDIX F

PLS OUTPUT FOR THE SECOND ORDER
SECOND ORDER FOR SUPPLY CHAIN INTEGRATION



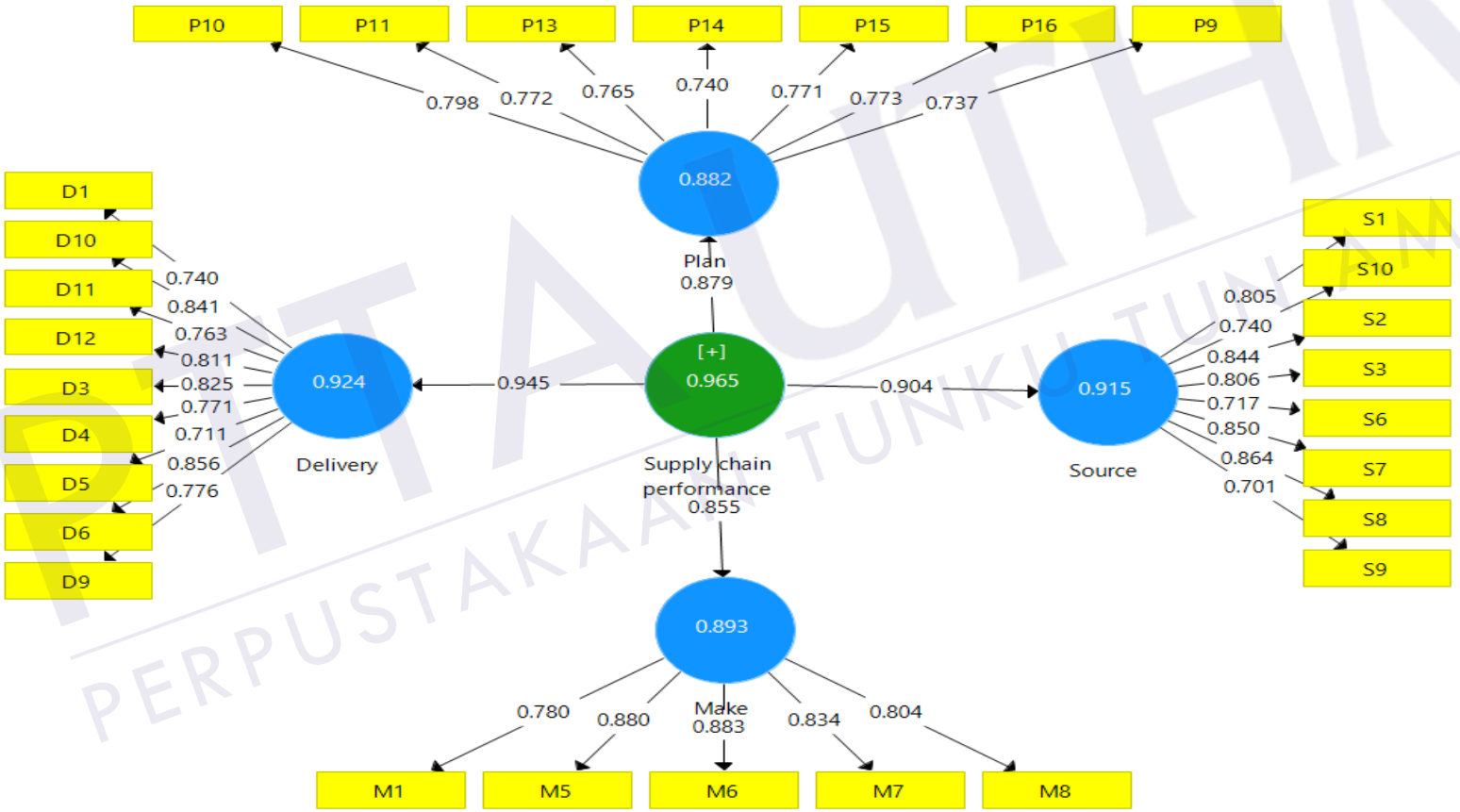
SECOND ORDER FOR SUPPLY CHAIN RISK



Cross Loadings

	Customer integration	Internal integration	Supplier integration	Supply chain integration
B10SI	0.605	0.447	0.819	0.739
B10SI	0.605	0.447	0.819	0.739
B11SI	0.583	0.424	0.799	0.715
B11SI	0.583	0.424	0.799	0.715
B14SI	0.628	0.631	0.788	0.784
B14SI	0.628	0.631	0.788	0.784
B15SI	0.755	0.559	0.814	0.824
B15SI	0.755	0.559	0.814	0.824
B16SI	0.720	0.531	0.710	0.754
B16SI	0.720	0.531	0.710	0.754
B18CI	0.794	0.539	0.616	0.738
B18CI	0.794	0.539	0.616	0.738
B19CI	0.775	0.575	0.576	0.722
B19CI	0.775	0.575	0.576	0.722
B1II	0.528	0.764	0.498	0.642
B1II	0.528	0.764	0.498	0.642
B22CI	0.738	0.329	0.637	0.670
B22CI	0.738	0.329	0.637	0.670
B23CI	0.911	0.469	0.715	0.810
B23CI	0.911	0.469	0.715	0.810
B24CI	0.851	0.422	0.686	0.761
B24CI	0.851	0.422	0.686	0.761
B2II	0.437	0.841	0.496	0.626
B2II	0.437	0.841	0.496	0.626
B3II	0.450	0.821	0.506	0.631
B3II	0.450	0.821	0.506	0.631
B4II	0.449	0.828	0.482	0.621
B4II	0.449	0.828	0.482	0.621
B8SI	0.483	0.329	0.739	0.623
B8SI	0.483	0.329	0.739	0.623
B9SI	0.507	0.351	0.791	0.663
B9SI	0.507	0.351	0.791	0.663

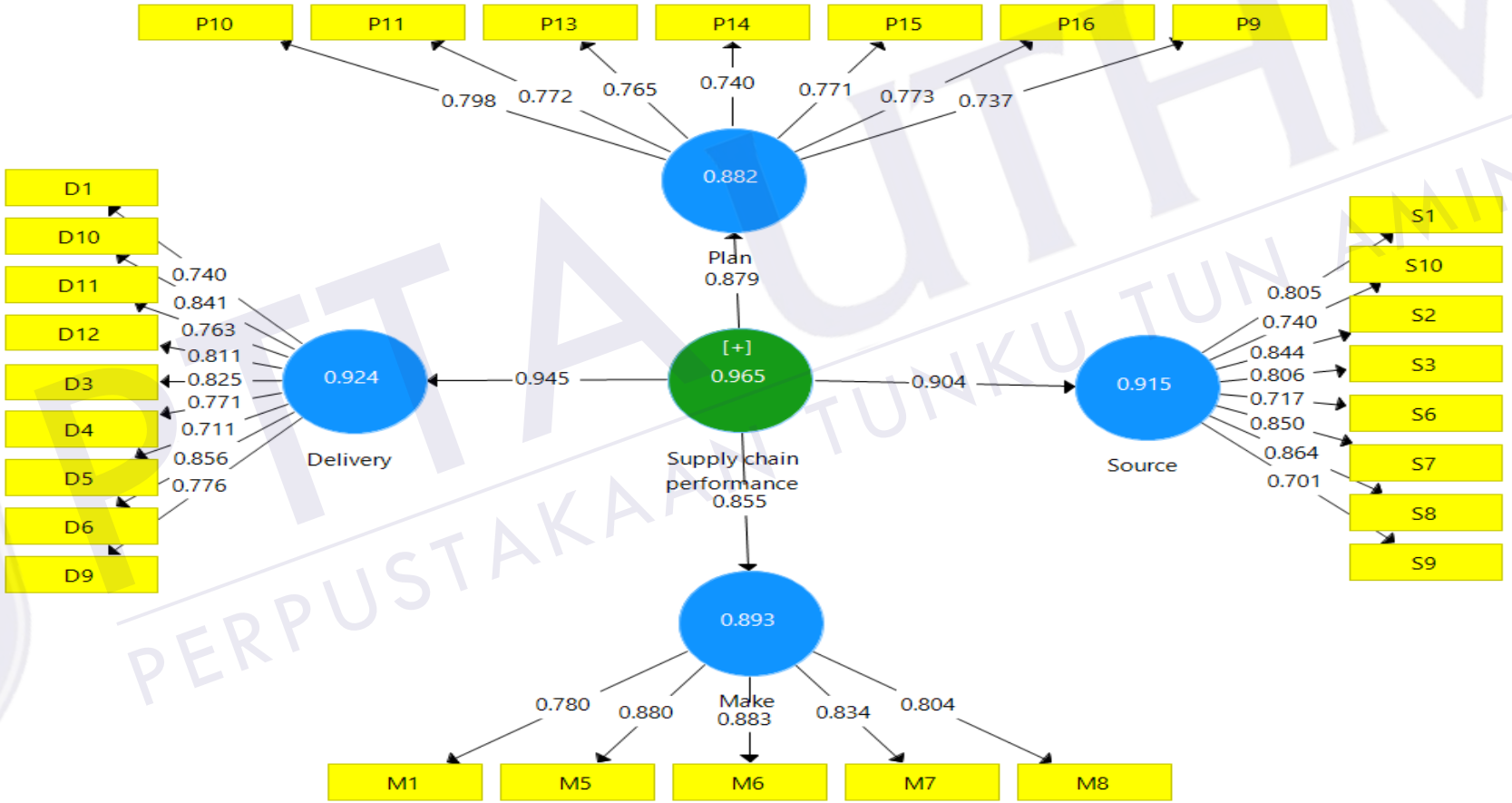
SECOND ORDER FOR SUPPLY CHAIN RISK



Cross Loadings

	External risk	Internal risk	Supply chain risk
A13a	0.760	0.520	0.677
A13a	0.760	0.520	0.677
A13b	0.804	0.564	0.724
A13b	0.804	0.564	0.724
A13d	0.589	0.750	0.723
A13d	0.589	0.750	0.723
A13e	0.730	0.601	0.708
A13e	0.730	0.601	0.708
A13f	0.632	0.757	0.748
A13f	0.632	0.757	0.748
A13g	0.650	0.791	0.777
A13g	0.650	0.791	0.777
A13h	0.720	0.568	0.684
A13h	0.720	0.568	0.684
A13i	0.824	0.612	0.761
A13i	0.824	0.612	0.761
A13j	0.748	0.553	0.690
A13j	0.748	0.553	0.690
A13k	0.765	0.552	0.697
A13k	0.765	0.552	0.697
A13l	0.513	0.820	0.725
A13l	0.513	0.820	0.725
A13m	0.478	0.734	0.658
A13m	0.478	0.734	0.658
A13o	0.608	0.740	0.727
A13o	0.608	0.740	0.727
A13p	0.522	0.730	0.678
A13p	0.522	0.730	0.678
A13q	0.543	0.808	0.733
A13q	0.543	0.808	0.733

SECOND ORDER FOR SUPPLY CHAIN PERFORMANCE



Cross Loadings

	Delivery	Make	Plan_	Source	Supply chain performance
D1	0.740	0.605	0.616	0.761	0.768
D1	0.740	0.605	0.616	0.761	0.768
D10	0.841	0.589	0.623	0.587	0.749
D10	0.841	0.589	0.623	0.587	0.749
D11	0.763	0.463	0.545	0.494	0.648
D11	0.763	0.463	0.545	0.494	0.648
D12	0.811	0.512	0.629	0.575	0.720
D12	0.811	0.512	0.629	0.575	0.720
D3	0.825	0.586	0.543	0.702	0.758
D3	0.825	0.586	0.543	0.702	0.758
D4	0.771	0.671	0.640	0.699	0.780
D4	0.771	0.671	0.640	0.699	0.780
D5	0.711	0.789	0.589	0.620	0.747
D5	0.711	0.789	0.589	0.620	0.747
D6	0.856	0.724	0.638	0.652	0.806
D6	0.856	0.724	0.638	0.652	0.806
D9	0.776	0.512	0.595	0.606	0.709
D9	0.776	0.512	0.595	0.606	0.709
M1	0.737	0.780	0.547	0.582	0.731
M1	0.737	0.780	0.547	0.582	0.731
M5	0.720	0.880	0.670	0.646	0.796
M5	0.720	0.880	0.670	0.646	0.796
M6	0.650	0.883	0.624	0.603	0.748
M6	0.650	0.883	0.624	0.603	0.748
M7	0.600	0.834	0.588	0.522	0.687
M7	0.600	0.834	0.588	0.522	0.687
M8	0.497	0.804	0.477	0.428	0.589
M8	0.497	0.804	0.477	0.428	0.589
P10	0.634	0.579	0.798	0.577	0.714
P10	0.634	0.579	0.798	0.577	0.714
P11	0.425	0.473	0.772	0.494	0.588
P11	0.425	0.473	0.772	0.494	0.588
P13	0.676	0.579	0.765	0.530	0.706
P13	0.676	0.579	0.765	0.530	0.706
P14	0.487	0.501	0.740	0.583	0.634
P14	0.487	0.501	0.740	0.583	0.634
P15	0.581	0.453	0.771	0.630	0.679
P15	0.581	0.453	0.771	0.630	0.679
P16	0.609	0.601	0.773	0.518	0.686
P16	0.609	0.601	0.773	0.518	0.686
P9	0.650	0.550	0.737	0.541	0.687
P9	0.650	0.550	0.737	0.541	0.687
S1	0.692	0.502	0.533	0.805	0.722
S1	0.692	0.502	0.533	0.805	0.722
S10	0.508	0.487	0.505	0.740	0.629
S10	0.508	0.487	0.505	0.740	0.629
S2	0.690	0.573	0.566	0.844	0.757
S2	0.690	0.573	0.566	0.844	0.757
S3	0.729	0.626	0.660	0.806	0.793
S3	0.729	0.626	0.660	0.806	0.793
S6	0.545	0.570	0.506	0.717	0.653
S6	0.545	0.570	0.506	0.717	0.653
S7	0.713	0.584	0.649	0.850	0.789
S7	0.713	0.584	0.649	0.850	0.789
S8	0.657	0.492	0.593	0.864	0.741
S8	0.657	0.492	0.593	0.864	0.741
S9	0.546	0.410	0.561	0.701	0.628
S9	0.546	0.410	0.561	0.701	0.628

VITA

Avlyin Jay Sumayong is an accomplished academician with a diverse educational background in Business Management, Technology Management, and Technical and Vocational Education. Her journey began in 2010 when she received a Diploma in Business Management from Politeknik Kuching Sarawak, Malaysia. This was followed by a Bachelor of Technology Management major in Production and Operation with Honours from Universiti Tun Hussein Onn Malaysia in 2012. After completing her undergraduate studies, Avlyin pursued a Master's degree in Technical and Vocational Education from the same university and graduated in 2015. Her focus on technical and vocational education reflects her interest in equipping students with practical skills and knowledge that are in demand in the workplace.

Avlyin completed her PhD at Universiti Tun Hussein Onn Malaysia, Faculty of Technology Management and Business. Her research focuses on the mediating effect of supply chain risk management, information sharing on the relationship between supply chain integration and supply chain performance among Malaysian SMEs. This research has significant practical impliciations for business, especially small and medium-sized enterprises, that are looking to improve their supply chain performance. In addition to her academic pursuits, Avlyin is also working as a lecturer at University Technology Sarawak.