RESILIENCE OF GLOBAL CHALLENGES: A STUDY OF MANUFACTURING RESILIENCE IN MALAYSIAN MANUFACTURING INDUSTRY

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FACULTY OF ACCOUNTANCY AND MANAGEMENT

DEPARTMENT OF INTERNATIONAL BUSINESS

DECEMBER 2024

RESILIENCE OF GLOBAL CHALLENGES: A STUDY OF MANUFACTURING RESILIENCE IN MALAYSIAN MANUFACTURING INDUSTRY

BY

WONG JING MUN

A final year project submitted in partial fulfilment of the requirement for the degree of

BACHELOR OF INTERNATIONAL BUSINESS (HONOURS)

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DECEMBER 2024

DECLARATION

I hereby declare that,

(1) This undergraduate FYP is the end result of our own work and that due acknowledgement has been given in the references to ALL sources of information be they printed, electronic, or personal.

(2) No portion of this FYP has been submitted in support of any application for any other degree or qualification of this or any other university, or other institutes of learning.

(3) Equal contribution has been made by each group member in completing the FYP.

(4) The word count of this research report is **10,983 words** .

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Date: 6 December 2024

ACKNOWLEDGEMENT

I would like to extend my heartfelt thanks to Dr. Law Kian Aun for his unwavering support throughout the research process. His generous dedication of time and effort with his patient guidance has been instrumental in the completion of this project. His understanding, encouragement, and personalized mentorship have laid a solid foundation for this thesis, and I am deeply appreciative of his assistance.

I am also grateful to University Tunku Abdul Rahman (UTAR) for providing me with the chance to undertake this research project. This experience has been invaluable in enhancing my research skills and will be beneficial for my future endeavours.

Besides, my sincere thanks go to all the respondents who participated in the survey. I would like to thank all the respondents who had spent their valuable time and effort to filling up the questionnaires. Their willingness to take the time to complete it have been immensely helpful. During the progress of distribution of questionnaires, the respondents have given their valuable feedback on the defective parts of questionnaires. The insights and responses provided were crucial in the successful completion of this part of the research.

As Alfred North Whitehead once said, "No one who achieves success does so without the help of others. The wise and confident acknowledge this help with gratitude." With this in mind, I wish to express my sincere gratitude to everyone who directly or indirectly assisted me in bringing this research study to completion.

DEDICATION

This study is dedicated to everyone who played a role in its success with no matter their contributions were direct or indirect. Every effort made, regardless of its nature is deeply valued and appreciated. Firstly, I extend my gratitude to Universiti Tunku Abdul Rahman (UTAR) for its unwavering support. The university provided vital resources, such as E-Databases, and facilities, including computer laboratories, which greatly facilitated the smooth and efficient progress of this study. Secondly, I would like to express my heartfelt appreciation to my Final Year Project (FYP) supervisor, Dr. Law Kian Aun. His commitment, time, and effort in guiding me through the research process were meaningful. His insightful advice and mentorship helped me navigate and get rid of challenges at every stage of the study. Finally, I am deeply thankful to all the respondents who took part in the survey. Their dedication and willingness to complete the questionnaires were instrumental in the success of this research. Without their valuable input, this project would not have been successful.

In summary, the successful completion of this study would not have been achievable without the steadfast support and contributions of these individuals and organizations.

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LIST OF ABBREVIATIONS

MR	Manufacturing Resilience
SCD	Supply Chain Disruptions
ISL	Information Sharing Levels
CA	Collaborative Actions
EU	Environmental Uncertainty
TRS	Trust Relationship with Supplier
DV	Dependent Variable
IVs	Independent Variables

PREFACE

This study is crucial for the completion of our undergraduate course, Bachelor of International Business, offered by Universiti Tunku Abdul Rahman. The topic of this study is "Resilience of Global Challenges: A Study of Manufacturing Resilience in the Malaysian Manufacturing Industry." This research aims to examine how components such as supply chain disruptions, levels of information sharing, collaborative actions, environmental uncertainty, and trust relationships with suppliers significantly influence manufacturing resilience in Malaysia. In the face of global challenges, manufacturing resilience has become increasingly important for businesses to sustain operations and competitiveness. Factors such as supply chain disruptions caused by external shocks including natural disasters, pandemics, and geopolitical issues have highlighted the need for robust strategies. The effective information sharing, collaborative actions between stakeholders, and trust-based relationships with suppliers are critical in mitigating the adverse effects of these challenges and enhancing resilience within the manufacturing sector. Policymakers, industry players, and researchers must work together to understand the factors that drive manufacturing resilience and implement strategies that foster stability and adaptability. In this respect, this study is beneficial for the understanding of barriers attributed to uncertainties and disruptions in the environment to realise a sustainable manufacturing stance in Malaysia.

ABSTRACT

This research seeks to investigate global challenges affecting the resilience of the Malaysian manufacturing industry. Some of the chief factors that influencing resilience include supply chain disruption, information sharing, collaborative actions, environmental uncertainty, and trust relationships with suppliers. All of these independent variables are examined as determinants of manufacturing resilience. The target population consists of employers and employees within the manufacturing sector, with 250 questionnaires distributed using purposive sampling. Cronbach's Alpha will be used to measure reliability while the Statistical Package for Social Science (SPSS)will be analysed to test the data. The Multiple Regression Analysis and other relevant data analysis methods will be employed to analyze the collected data. The findings indicate that supply chain disruption, information sharing, collaboration, environmental uncertainty, and trust with suppliers significantly impact manufacturing resilience. Trust and cooperation are needed to build robust partnerships when environmental dynamics are beyond the control of an organisation and should be studied in more detail about its persistent impact. The research helps to enhance the existing knowledge on resilience in Malaysian manufacturing industry and contains some recommendations for enhancing strategic management in the context of global fluctuations.

Keywords: Manufacturing, Global Challenges, Resilience, Trust, Disruptions

Chapter 1: Research Overview

1.0 Introduction

The paper concentrates on the main challenges such as supply chain disruptions, information sharing and collaborative actions, environmental uncertainty, and trust relationships with suppliers in its 'Resilience of Global Challenges: A Study of Manufacturing Resilience in Malaysian Manufacturing Industry.' The research includes this chapter, a problem statement, the study's objectives and their consequences, questions, and hypotheses posed. The analyses will reveal how each of these challenges shows either a positive or negative relationship with resiliency and respective manufacturing trajectories.

1.1 Research Background

Resilience is defined as an organization's ability to adapt to disruptions while maintaining business objectives and restoring performance (Pertheban et al., 2023). According to MIDA 2024, the manufacturing sector is critical to Malaysia's economy but showed signs of slowdown in late 2023, with marginal growth (0.1%) in the fourth quarter and declines in electrical and electronics products. Global supply chain disruptions and geopolitical tensions, such as the Russia-Ukraine war, negatively impacted exports, leading to an 8% decline and a sluggish Manufacturing Purchasing Managers' Index. Despite these challenges, the sector is expected to recover in 2024, with projected GDP growth of 4.9% and improvements in manufacturing output and employment. However, resilience is essential for overcoming these setbacks and ensuring long-term economic stability.

In manufacturing, resilience refers to systems designed to minimize production losses during disruptions and enable rapid recovery. It involves the capacity to withstand high-impact disruptions, absorb their effects, and restore normal operations. This growing focus on resilience arises from the increasing frequency

of disasters and hazards (Gu et al., 2015). Resilience encompasses technical, organizational, social, and economic dimensions and ensures recovery to the original or an enhanced state (Ponomarov & Holcomb, 2009). The complexity and interconnectedness of global systems mean that unforeseen events can escalate into major disruptions, challenging business survival (Sahu et al., 2016).

Disruptions in manufacturing can be internal, such as machinery failures, or external, like supply chain volatility and raw material shortages. Resilience strategies, including redundancy (e.g., safety stocks) and flexibility (e.g., smart rescheduling), can mitigate these challenges (Touriki et al., 2021). In Malaysia, where the sector plays a vital economic role, staying updated on industrial advancements is key for maintaining revenue (Tay et al., 2021). Despite this, Malaysia's manufacturing sector is still transitioning from traditional to advanced technologies (Chuan & Zaidi, 2024), highlighting the ongoing need for resilience amidst global volatility.

1.2 Problem Statement

This paper aims to explore manufacturing resilience within Malaysia's manufacturing industry, a concept that has gained traction in supply chain management but remains underexplored, particularly in the Malaysian context. While resilience is frequently discussed in literature, the specific factors contributing to its development are not well-defined. As noted by Md. Galib An-Noor Amio et al. (2024), many studies overlook the factors that specifically build resilience in Malaysia's manufacturing sector. Furthermore, while collaborative actions and trust with suppliers are discussed in relation to supply chains, their connection to manufacturing resilience has not been sufficiently addressed (Siagian et al., 2021; Kashem et al., 2024). These elements may play a crucial role in enhancing manufacturing resilience, especially during global disruptions like the COVID-19 pandemic.

Another gap in the literature is the impact of environmental uncertainty on manufacturing resilience in Malaysia, which remains insufficiently examined.

Kashem et al. (2024) argues for empirical research to understand how Malaysian manufacturers adapt to risks associated with environmental uncertainty which is unpredictable and dynamic. Moreover, while many SMEs in Malaysia recognize the importance of resilient supply chain management and effective practices are seldom implemented which highlighted by Ying Ying Tang et al. (2020). This lack of implementation underscores the need for more developed strategies and a deeper understanding of resilience practices.

Past disruptions, such as the 2011 Japan earthquake and the 2014 Ebola outbreak, have emphasized the importance of resilience for business continuity. FEMA (2016) reports that many businesses affected by disruptions fail within a year, its underlining the necessity of robust resilience strategies. Despite this, there is limited research on information-related risks and their future impact (Colicchia et al., 2019). This research seeks to fill these gaps by identifying the factors, mechanisms, and strategies that enhance manufacturing resilience in Malaysia, particularly in the face of global and environmental challenges.

1.3 Research Objectives

The research objective is divided into two sections which are general objectives and specific objectives.

1.3.1 General Objectives

This study will bridge this research gap by finding the level of resilience in the Malaysian manufacturing industry when faced with global challenges. The study shall focus on five important independent variables, which are supply chain disruptions, information-sharing levels, collaborative actions, environmental uncertainties, and trust relationship with supplier. By examining the interaction between and the influence of these variables on manufacturing resilience, this study will yield useful insight to inform

policy-making and strategic decision-making in the Malaysian manufacturing sector.

1.3.2 Specific Objectives

1. To assess the impact of supply chain disruptions on manufacturing resilience in Malaysia.
2. To evaluate the role of information sharing levels in enhancing manufacturing resilience.
3. To examine the influence of collaborative actions on manufacturing resilience.
4. To examine the effects of environmental uncertainty on the resilience of the Malaysian manufacturing sector.
5. To assess the impact of trust relationship with supplier on manufacturing resilience in Malaysia.

1.3.3 Research Questions

1. How do supply chain disruptions affect the resilience of the Malaysian manufacturing industry?
2. To what extent does role of information sharing levels contribute to manufacturing resilience in Malaysia?
3. How do collaborative actions among industry stakeholders influence manufacturing resilience in Malaysia?
4. Does environmental uncertainty impact the resilience of the Malaysian manufacturing sector?
5. How do trust relationship with supplier affect the resilience of the Malaysian manufacturing industry?

1.4 Hypothesis of Study

H_0: There is no significant relationship between ***supply chain disruption*** and ***manufacturing resilience*** in the Malaysian manufacturing industry.
H_1: There is a significant relationship between ***supply chain disruption*** and ***manufacturing resilience*** in the Malaysian manufacturing industry.

H_0: There is no significant relationship between ***information sharing levels*** and ***manufacturing resilience*** in the Malaysian manufacturing industry.
H_2: There is a significant relationship between ***information sharing levels*** and ***manufacturing resilience*** in the Malaysian manufacturing industry.

H_0: There is no significant relationship between ***collaborative actions*** and ***manufacturing resilience*** in the Malaysian manufacturing industry.
H_3: There is a significant relationship between ***collaborative actions*** and ***manufacturing resilience*** in the Malaysian manufacturing industry.

H_0: There is no significant relationship between ***environmental uncertainty*** and ***manufacturing resilience*** in the Malaysian manufacturing industry.
H_4: There is a significant relationship between ***environmental uncertainty*** and ***manufacturing resilience*** in the Malaysian manufacturing industry.

H_0: There is no significant relationship between ***trust relationship with supplier*** and ***manufacturing resilience*** in the Malaysian manufacturing industry.
H_5: There is a significant relationship between ***trust relationship with supplier*** and ***manufacturing resilience*** in the Malaysian manufacturing industry.

1.5 Significant of Study

These findings could help Malaysian policymakers identify critical areas that need support in building resilience within the manufacturing sector. This may result in specific policies and initiatives to improve supply chain management, enhance collaboration, and build information-sharing mechanisms within the industry. The research will adopt concepts of trust and collaboration in the theoretical framework in order to find the resilience of global challenges in the Malaysian manufacturing industry. Previous studies have suggested that relevant variables associated with trust and collaboration include supply chain disruptions, information sharing, collaborative actions, environmental uncertainty, and trust relationships with suppliers. By being aware of these variables, scholars will be able to infer numerous behavioral characteristics that describe how the international crises may influence resilience in the Malaysian manufacturing industry.

This paper provides valuable lessons to the managers and the policy makers in regard to how they can foster leadership, culture, and social responsibly for sustainability. It focuses on manufacturing resilience in Malaysia, underscoring the sector's importance to the nation's economic growth. (Khaddage-Soboh et al., 2024) The Ministry of International Trade and Industry (MITI) aims to rejuvenate Malaysia's manufacturing industry by focusing on productivity, GDP contribution, innovation, and the creation of high-skilled jobs (Ministry of International Trade and Industry, 2017). Penang has been a major contributor to this growth which accounting for 43% of its GDP and experiencing significant year-on-year growth between 2015 and 2019 (Penang Institute, 2021). However, global challenges such as China's lockdown in January 2020 have tested the sector's resilience, particularly in raw material supply. This highlights vulnerabilities in global supply chains and the importance of effective management (Wooi Leng Ong & Siu Ming Lee, 2024). The study emphasizes how Malaysian manufacturers have enhanced their resilience through better supply chain management, information sharing, and collaboration in response to these challenges.

As the study targets crises at the firm level, it has relevant implications for policy formulation. They demanded more support by the government, especially in terms of financial support, towards the strengthening of local supply chains and the survival of SMEs. The study will also appeal to larger local and international companies to source raw materials from local suppliers, adapting their business model to new operational realities. It has also encouraged the governments to embrace the cloud and automation technology for increasing efficiency and minimizing contacts between employees. (Wooi Leng Ong & Siu Ming Lee, 2024). In brief, these are important discoveries for Malaysian policymakers who seek to enhance manufacturing sector safeguards.

1.6 Conclusion

In a nutshell, this chapter provides an overview of the research, including the background, problem statement, objectives, research questions, hypothesis development, and study significance. The study examines the resilience of Malaysia's manufacturing industry amid global challenges which concentrating on factors like supply chain disruptions, information sharing, and environmental uncertainties. Chapter 2 will discuss theories, variables, and hypotheses.

Chapter 2 Literature Review

2.0 Introduction

Chapter 2 reviews relevant literature, focusing on the resilience of Malaysia's manufacturing industry amid globalization challenges. It is divided into three sections which the first discusses manufacturing resilience and its independent variables includes supply chain disruption, information sharing, collaboration, environmental uncertainty, and supplier trust, the second covers theoretical models, and the third presents the conceptual framework and hypotheses.

2.1 Underlying Theories

The following will discuss the trust theory and synergy theory.

2.1.1 Trust Theory

This paper highlights the critical role that trust plays in building resilience in manufacturing companies in regard to supplier relationships. Trust is a composite of goodwill, capability, and computational trust; it represents an informal governance mechanism that functions to reduce opportunistic behavior and to align partner interests. Relationships based on trust improve preparedness through consonant acts and improved support from suppliers, which eventually reduces supply chain disruption. During contingencies, trust accelerates responsiveness by allowing for coordination and solidarity, thereby enabling the on-time completion of operations. Following contingencies, trust helps in a rapid recovery of production through the means of effective negotiation and contributes to long-term stability in relationships with supply chain partners. In a nutshell, trust is crucial for resilient supply

chain building that would withstand and recover from disruptions (Yang et al., 2022).

2.1.2 Synergy Theory

The concept of "synergy" originates from the theory of synergetic in the natural sciences, which was developed in the 1970s by the German physicist Hermann Haken. As systems science has evolved, the idea of synergy has increasingly been embraced by the business management community. In line with Scholten and Schilder's study, we apply synergy theory to describe collaborative action (Scholten & Schilder, 2015). This passage highlights the importance of trust and collaboration in fostering long-term partnerships between companies and their stakeholders, as suggested by synergy theory. Trust and collaboration facilitate resource development and integration, which are vital for supply chain resilience. Nonetheless, the impact of collaborative actions between manufacturers and suppliers on resilience, particularly during emergencies, is not well-explored. While synergies in supply chains aim to create mutually beneficial relationships and risk-averse strategies that can improve resilience, the effectiveness of joint actions in enhancing resilience is still debated. Some scholars argue that collaboration boosts visibility, agility, and flexibility, making it crucial for resilience. This ongoing debate underscores the need for further research into the role of collaborative action in the resilience of manufacturing companies (Yang et al., 2022).

2.2 Review of Literature

2.2.1 Manufacturing Resilience (Dependent Variable)

The level of resilience exhibited by manufacturers has been investigated through preparedness, responsiveness, and recovery capabilities (Hohenstein et al., 2015). Resilience is a multifaceted concept defined differently across various fields. In sociology, it often refers to recovery from disasters (Johnson et al., 2013), while in engineering, it emphasizes safety science and risk management (Wiig et al., 2020). Specifically, in the manufacturing industry, resilience refers to a company's ability to manage and recover from disruptions, including understanding risks, their impacts, and how to react to and restore operations. A company's internal preparedness systems are crucial in defining its resilience, particularly in how resources are managed before disruptions and how quickly it adapts to changing conditions. Other scholars point to four levels as being readiness, response, recovery, and renewal whereas others speak of simply agility, visibility, and flexibility. In a better multidisciplinary perspective resilience is more about the ability to change and cope with changes as well as crises and keep main functions and structures (Jovane et al. 2008).

Resilience became integrated in supply chain management and is now another factor to handle risks in supply chain (Adobor and McMullen, 2018; Ponomarov and Holcomb, 2009). While the existing literature covers a lot of information on supply chain resilience, the current research focusing on the manufacturing resilience is scarce (Datta, 2017). This study extends existing research by defining manufacturing resilience as a dependent variable and breaking it down into three core dimensions which resulting in improved supply chain management performance as measured by preparedness, responsiveness, and recovery capability (Brandon-Jones et al., 2014; Dubey et al., 2018). Resilient is now used universally to Supply chain,

the academia focusing on both pre-Disruptions, encompassing attributes such as flexibility and collaboration and post disruptions capability. Collaboratively built and shared supply chain resilience within the nets strengthens overall supply chains and allows the accomplishment of disruption management, reduction of disruption effects, and resurgence at a faster rate. (Chowdhury & Quaddus, 2016)

2.2.2 Supply Chain Disruption (Independent Variable)

This paper focuses on the impact of supply chain disruption on manufacturing organizations based on the interruption of their supply chain regarding supply, delivery, procurement, and distribution of materials/products. Many disruptions include natural calamities, manmade crises, economic and political volatility and were worst hit by the COVID-19 outbreak. Pandemic restrictions including lockdowns and border closures jeopardized the supply chain due to delays in acquisition of raw materials and change in customers' preference complicated the supply chains further (Kapparashetty, 2020). It uncovered gaps in production, travel, and hospitality industries within manufacturing, tourism and transportation sectors (Mao et al., 2021). A research by manufacturing industry at KPMG International revealed that controlling supply chain disruptions was the third most significant impediment to performance enhancement programmes. Aon Risk Solutions showed that the number of international businesses losing income as a result of supply chain disruption increased from 28% to 42 % in 2011 to 2013 (Revilla, 2014).

The frequency and possible consequences of natural disasters are presented in the Global Risks Report 2016, and it seems that they are rather a global issue. These challenges were exacerbated by disruption of material supplies and operational disruptions occasioned by the COVID-19 pandemic (Pertheban et al., 2023). They show that information flow integration and creation of linkages among manufacturing organisations have become

pertinent in reducing production vulnerability particularly in future global risks as pointed out by Belhadi, et al. (2021).

After a disruption in the supply chain, it becomes necessary for manufacturing firms to cultivate resilience. Resilience relates to the capacity which an organization must adapt and to rebuild after internal or external shocks with the goal of surviving, reacting, and growing in conditions of unpredictability. This shows that the level and way that a firm can respond is the key to resilience in manufacturing. These measures make it possible for firms to counter threat like the pandemics and deal with disruptions that affect functionality (Belhadi et al., 2022; Ali et al., 2021; Roberta Pereira et al., 2014, p. 429). It is crucial in business continuity management as it enables organizations to recover quickly from disruptions (Berger & Gideon, 2021). Some of the strategic agile strategies include backup suppliers, and substitutable design information that enhances the firm's performance in the face of disruptions (Ambulkar et al., 2015; Belhadi et al., 2022).

H_1: There is a significant relationship between supply chain disruption and manufacturing resilience in the Malaysian manufacturing industry.

2.2.3 Information-Sharing Level (Independent Variable)

Information sharing is critical in building the resilience of the supply chain through technology and communication known as the Information Sharing Level (ISL). Big data and predictive analytics incorporate highly efficient ways of disseminating information so that organizations can gain visibility and reliability especially during emergency (Yang et al., 2022). Information as an intangible asset provides firms with a competitive edge in forecasting their performance while in coordinating manufacturing and delivery systems, and in evaluating organizational performance within the supply chain. Manufacturers and suppliers continue to build trust to increase reliability and punctuality in providing information to one another (Fan et al., 2020). This study defines organizations that foster information sharing,

trust, and collaboration as likely to achieve better supply chain disruption and resilience than those that do not (Pertheban et al., 2023).

Nonetheless, the realization of incorrect market demand information forms erroneous estimations throughout the provision of the supply chain details (Prajogo & Olhager, 2012). Evaluation and anticipatory behaviour as facilitated by communication, commitment and dependency are necessary in moderating excesses, and stabilising transaction flows and associated risks (Kumar & van Dissel, 1996). It is obvious then that trust, commitment, and interdependence are critical in enhancing information sharing and cooperation (Sheu et al., 2006). The manufacturing flexibility depends on the quality of information technology, which provides effective real-time information exchange and promotes appropriate adjustments in interactions with the partners regarding the market requirements. Integrated communication through effective IT enablers improves integrated systems and supply chain adaptability and disruption management (Liu & Lee, 2018).

The integration of information enhances the commercial value, competitiveness, and productivity that are critical for supply chain sustainability (Trivellas et al., 2020; Reklitis et al., 2021). An information sharing reduces uncertainty and increases the firm's ability to respond thus improving on recovery activities which are critical for economic sustainability in case of crises (He et al., 2014; Aslam et al., 2020). The information flow volumes decrease uncertainty, increase response rates, and overall uplift recovery during disruption thereby increasing economic strength and operational utility (Parashar et al., 2020). However, mistrust actually slows down the sharing of information and weakens the anti-fragility of a firm (Dubey et al., 2019). In short, the authors stated that there is the need for manufacturers to appreciate the relevance of trust and information exchange as key to reconstructing a reliable supply chain.

H_2: There is a significant relationship between information sharing levels and manufacturing resilience in the Malaysian manufacturing industry.

2.2.4 Collaborative Action (Independent Variable)

Supply chain collaboration refers to the deliberate activities organized to improve collaboration among all stakeholders in the supply chain especially in a period of deception (Choon Tan et al., 2002). According to Qi and Hui, emergency management consists of four phases: for mitigation, planning, implementation, assessment (also known as the four Ps) and for incident management there is the acronym PPRR for prevention, preparation, response and recovery. In the prevention phase, potential crisis causes are looked at so as to isolate early warning signs, and the response phase deals with practical steps to sort out issues. Recovery means taking reverting back to the state and handling the impact of the crisis (Yang et al., 2022).

It is therefore critical that firms engage in cooperation in order to build resilience on issues that affect manufacturing performance. This is due to the fact that continued communication to promote learning and use of information which breeds no opportunism together with exchange of experience with other similar organizations accelerates technological development and capacity. Manufacturers and suppliers need to work together because risk sharing, resource access, and operation resilience are other reasons that keep companies connected. Supplier relationship development results in enhanced stability and higher rehabilitation rates in emergencies where integrated relationships show potential for better risk and resource allocation (Scholten & Schilder, 2015; Formentini & Romano, 2016).

Ponomarov & Holcomb also focuses on integration of cross functional teamwork from the mitigation to recovery process. It is advisable to have excellent supply chain relations, develop crisis contingency plans and plans. The response phase relies on flexibility, speed and communication, clarity. Recovery seeks to make changes in the warehousing functions and at the same time to increase delivery effectiveness (Yang et al., 2022). Apparently,

the collaboration is central to the improvement of pre- and post-severity preparedness, response, and recovery capacities and, more broadly, manufacturing risk and resilience. Such an approach makes it possible for firms to handle risks and to recover faster hence promoting a more secure supply chain.

H_3: There is a significant relationship between collaborative actions and manufacturing resilience in the Malaysian manufacturing industry.

2.2.5 Environmental Uncertainty (Independent Variable)

The research finds out that ENU is a relevant factor of manufacturing companies' resilience. Different studies point to ENU its impact on the sector's interactions and reveals that ENU may pose as a threat to the development of trust (Wagner et al., 2002) and may indeed present some difficulty in the building of stable relationships (Yen & Abosag, 2016). Since environmental factors have a significant impact on working relationships between the supplier and manufacturer, factors such as cost saving and market leverage must act as motivators to encourage cooperation between the two suppliers and manufacturers (Lambert et al.,).

The unpredictable nature of emergencies and how it is difficult to anticipate market requirements, the problem of predicting how competitors shall respond, the challenge of integrating technologies, and doubting survival beyond the coming period are key constituents of this uncertainty (Wuyts & Geyskens, 2005). These aspects generate more unpredictability and fluctuation of the operating environment for the firms and restrain their capacity to manage and predict their future.

During these conditions, it is challenging for the firms to be able to deploy defensive response mechanisms that will enable them to operate at their optimum best in terms of being resilient (Wuyts & Geyskens, 2005). Both reliance and dependence influence partnership in collaboration whereas

declining uncertainty may build stability of the transactions (Kumar, & van Dissel, 1996). However, during such uncertainty such as during a pandemic, both the public and organizations themselves are also more interested in organization's profit-making in isolation. In this regard, trust may encourage the ad hoc or self-interest behaviours that that reduce the communicational value of trust with regard to co-cooperation (Yang et al., 2022).

Some of the features highlighted by the mediating role of trust between action toward the environment include elements such as supply and logistics challenges where such variables make collaboration ineffective and cumbersome (Yang et al., 2022, p. 313). Hence, managing these uncertainties would be pertinent in enhancing the propensity of the manufacturing sector in Malaysia vis-à-vis vitiating the wholesome and robust development of realized and potential partnerships.

H_4: There is a significant relationship between environmental uncertainty and manufacturing resilience in the Malaysian manufacturing industry.

2.2.6 Trust relationship with supplier (Independent Variable)

While materializing in the supply chain systems flexibility and particularly during emergencies like natural disasters or similar health calamities like COVID 19, trust and solidarity between partners is the key pointers towards building up resilience and minimizing disruption risks (Rezazadeh et al., 2019). The synergy theory focuses on the ways that working sustainable long-term cooperation between the business and its stakeholders can be created from the basis of trust and commitment (Adesanya et al., 2020). Among the trust-based cooperative norms some of them allow the formation and integration into the resources (Vlachos & Dyra, 2020).

Previous research in the previous area regarding resilience has not provided a level of empirical work on the application of collaborative action to be shared by the manufacturer and suppliers collectively. However, trust is a critical factor in developing new partnerships between suppliers and manufacturers

during supply chain initiatives such as problem-solving cooperatives (Huang et al., 2020). Resilience of manufacturing is built on high levels of trust that stem from first, openness of communications, and second, higher tolerance for risk by partners (Kwon & Suh, 2005). Another work mentions that the reliable environment in the supply chain is one of the essential prerequisites to ensure the collaborative business relationship between partners (Camarinha-Matos, 2016).

Business which maintains good relations with their suppliers also enjoy a stable supply channel and can quickly return to production once disrupted through calamities. It also makes a manufacturer communicate with their suppliers and in the process create synergy. The situation calls for enhancing outstanding supply chain performance as it is among the best strategies of developing relationship capital with suppliers and increasing the organizations' long-run competitiveness (Yang et al., 2022). As pointed out earlier, trust enhances information exchange, willingness to take risks, and a willingness to enlist others which are all crucial foundations for supply chain cooperation.

Reciprocal relationship requires that there is some level of trust in which the partners are expected to protect the interest of the firm even when the firm cannot keep a very close eye on them. Trust also minimizes and encourages adherence to policies against self-serving actions protecting valuable and sustained business relationships. Thus, the continuous supplies help to maintain good relationship with the suppliers, especially when catastrophes disrupt the operations of the company and the supply chain network (Bhattacharya & Klinken, 2019; Naghshineh & Lotfi, 2019; Wieland & Alajaji, 2015).

H_5: There is a significant relationship between trust relationship with supplier and manufacturing resilience in the Malaysian manufacturing industry.

2.3 Review of Relevant Theoretical Models

There are various studies have been conducted to assess the manufacturing resilience.

2.3.1 The Moderating Role of Environmental Uncertainty

This study shows that trust-based supplier relationships (TRS) enhance collaboration, improving resilience through productivity and risk-sharing. Collaborative action (COL) partially mediates the trust-resilience link, with environmental uncertainty (ENU) influencing collective efforts during pandemics (Yang et al., 2022).

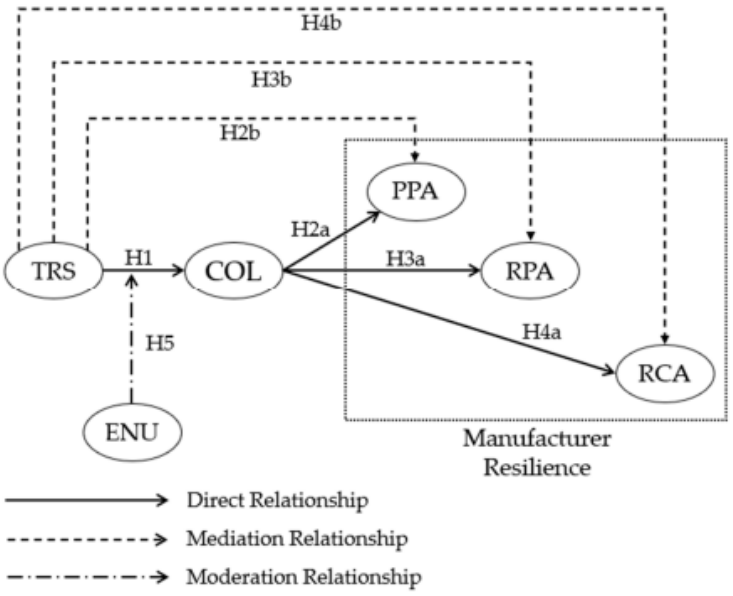


Figure 2.3.1 The Moderating Role of Environmental Uncertainty
Adapted from: Yang, J.; Liu, Y.; Kholaif, M.M.N.H.K. Trust Relationship with Suppliers, Collaborative Action, and Manufacturer Resilience in the COVID-19 Crisis. Behav. Sci. 2023, 13, 33.

2.3.2 The mediating role of Information Sharing Level

The model illustrates variable relationships with colored lines: red lines show direct effects of trust-based supplier relationships (TRS) on preparedness (PPA), risk preparedness (RPA), and risk/crisis adaptation (RCA); green line indicates TRS's effect on information sharing level (ISL); blue lines represent ISL's direct effects on PPA, RPA, and RCA; yellow lines highlight ISL's mediating role between TRS and these outcomes (Yang et al., 2022).

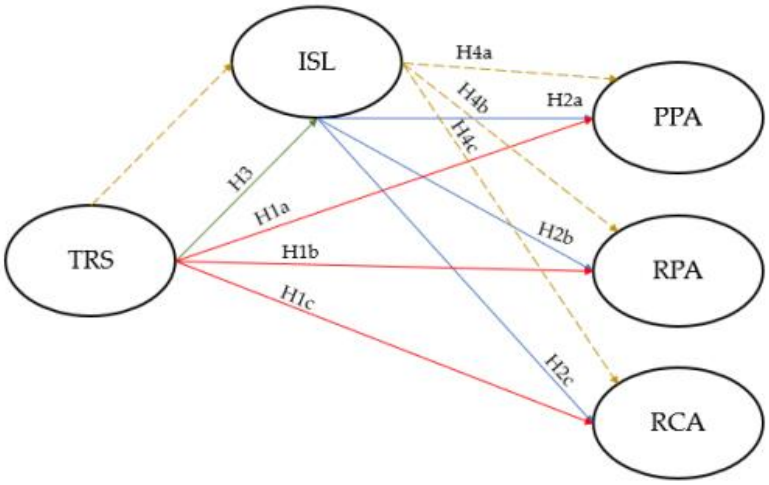


Figure 2.3.2 The mediating role of ISL between TRS and PPA, RPA and RCA
Adapted from: Yang, J.; Liu, Y.; Jia, Y. Influence of Trust Relationships with Suppliers on Manufacturer Resilience in COVID-19 Era. Sustainability 2022, 14, 9235.

2.4 Conceptual Framework

Below is the proposed theoretical framework. The framework comprised independent variables and dependent variable.

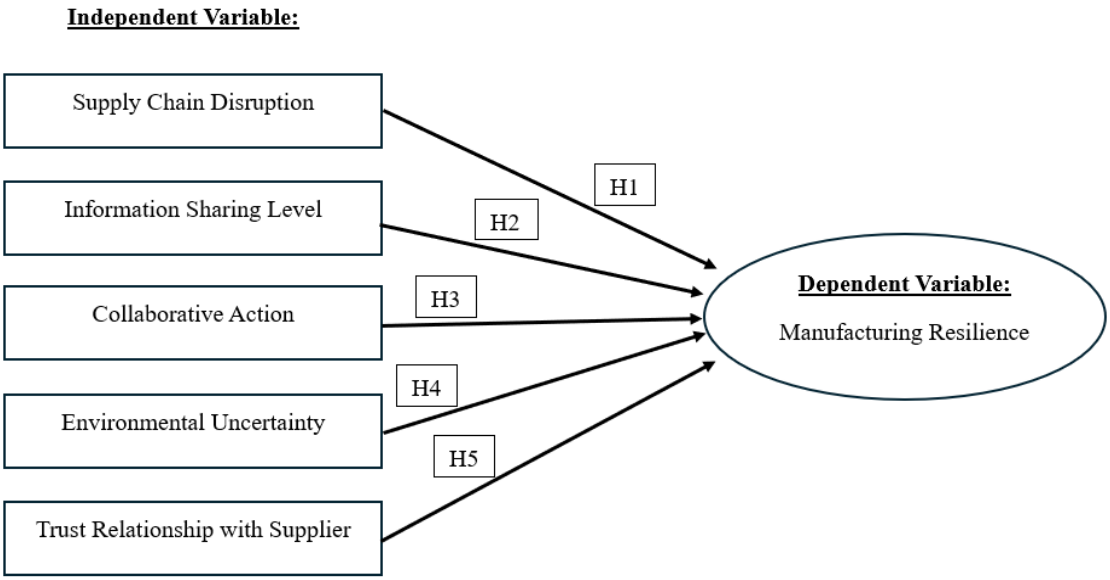


Figure 2.4: Conceptual Framework

Source: Developed for this research.

2.5 Conclusion

Simply put, this chapter offered an in-depth review of the literature concerning the study's dependent and independent variables. Drawing on key studies, both theoretical and conceptual models were developed. Chapter 3 will now outline the research methodology in detail.

Chapter 3: Methodology

3.0 Introduction

This chapter covers the research methodologies, detailing the systematic approach to data collection and analysis. It will examine the research design, data collection methods, sampling design, research instruments, construct measurement, data processing, and data analysis.

3.1 Research Design

The research design refers to the strategic plan and analytical method selected to logically integrate various study elements, ensuring the research problem is investigated comprehensively and systematically. This approach aligns the study's components to effectively address the core research question (D.A. De Vaus, 2014). Thus, this research adopts a quantitative, causal, and descriptive conceptual framework.

3.1.1 Quantitative Research

According to the attributes it can be divided into nonmetric data or qualitative data and metric data or quantitative data (Hair et al., 2016). Quantitative research focuses on measurable data, emphasizing patterns, connections, and values using quantifiable tools (Watson, 2015). This research examines the causal relationships between supply chain disruption, information sharing, collaborative action, environmental uncertainty, trust relationship with suppliers, and manufacturing resilience in the Malaysian manufacturing

industry. It aims to identify the nature of these relationships and determine the independent variable with the greatest impact on resilience.

3.1.2 Causal Research

Causal research aims to establish causality between independent variables and dependent variables by examining their relationships and effects. (Oppewal, 2010). In this study, causal research is employed to investigate how each independent variable such as supply chain disruption, information sharing level, collaborative action, environmental uncertainty, and trust relationship with suppliers which affects the dependent variable, manufacturing resilience.

3.1.3 Descriptive Research

Descriptive research provides a detailed depiction of individuals, events, or situations, offering a comprehensive profile from individual, organizational, and industry perspectives. It allows data collection from diverse respondents (Sileyew, 2019). In this study, the questionnaire included demographic profiles to characterize the population concerning key variables.

3.2 Data Collection Methods

Primary data consists of original information collected directly from the source, offering reliable insights through direct observation and interactions. In contrast, secondary data includes information obtained from existing sources, such as reports and literature, which provides contextual understanding and supports analysis (Sileyew, 2019). Hence, both primary and secondary data sources will be utilized in this study.

3.2.1 Primary Data

Primary data is considered more reliable, offering a higher level of confidence in decision-making due to its direct link to the events being studied (Sileyew, 2019). Primary data helps gather information relevant to the research objectives and is valuable for identifying global challenges that may affect Malaysian manufacturing resilience. In this study, survey questionnaires have been distributed to collect primary data as they are simple, convenient, and reliable.

3.2.2 Secondary Data

The study utilized a variety of sources for secondary data, including reputable journals, books, articles, periodicals, proceedings, magazines, newsletters, newspapers, websites, and other materials relevant to the manufacturing sector. Also, existing working documents, manuals, procedures, reports, statistical data, policies, regulations, and standards were reviewed (Sileyew, 2019). Secondary data offers a more accessible and cost-effective means of obtaining information. In this research, secondary data includes variables and questionnaires from previous studies conducted by other researchers.

3.3 Sampling Design

Sampling entails selecting a subset of a population to estimate its characteristics (Sajjad Kabir, 2016). A high-quality sample is essential for making accurate decisions. Before data collection, it is important to establish the sampling design to effectively conduct the study. The sampling design process involves four key steps which to defining the target population, selecting the sampling frame and location, choosing the suitable sampling technique, and determining the appropriate sample size.

3.3.1 Target Population

There are over 4,000 manufacturing and industrial service companies of various sizes were identified and selected from business directories published by the Federation of Malaysian Manufacturers (FMM) in 2023 (Federation of Malaysian Manufacturers, 2023). Accordingly, the study's population includes manufacturing companies in Malaysia, ranging from SMEs to large enterprises, as well as employees from various other industries.

3.3.2 Sampling Frame

A sampling frame is defined as the set of source materials from which a sample is drawn, serving the purpose of identifying specific members of the target population to be interviewed in the survey (Turner, 2003). In this study, the sampling frame includes Malaysian manufacturing firms across various sectors, ranging from SMEs to large enterprises. Companies are selected based on their involvement in manufacturing and their experience with global challenges. The sample comprises firms of different operational scales to ensure a thorough understanding of resilience strategies.

3.3.3 Sampling Location

The study targets key Malaysian manufacturing hubs such as Kuala Lumpur, Penang, Johor, Selangor, Perak. The research surveying 250 respondents from diverse sectors, including textiles, metal, chemicals, and food manufacturing, via online questionnaires.

3.3.4 Sampling Element

The sampling element for this study comprises individual manufacturing firms operating within Malaysia. This includes small and medium-sized enterprises (SMEs) engaged in manufacturing activities. The focal point is on identifying firms that have either experienced or are actively managing their manufacturing resilience strategies. These elements are essential for understanding their overall resilience to global challenges.

3.3.5 Sampling Technique

The research employs purposive sampling that matches the sample to the research objectives to improve the rigorously collected data (Campbell et al., 2020). This technique involves identifying experienced firms in handling global issues and the management of resilience strategies hence offer a macroscopic perception of manufacturing resilience from a strategic sample selection.

3.3.6 Sampling Size

Sample size recommendations in reliability studies vary from 30 to over 400, depending on the authors' experiences and statistical theories (Donner & Eliasziw, 1987). In this research study, G*Power yields 138 samples per analysis, but 250 manufacturing firms are to be selected for broad sample coverage and elaborate analysis. This results in sound information on resilience approaches in diverse sectors and levels in Malaysia.

F tests – Linear multiple regression: Fixed model, R^2 deviation from zero			
Analysis:	A priori: Compute required sample size		
Input:	Effect size f^2	=	0.15
	A err prob	=	0.05
	Power (1- β err prob)	=	0.95
	Number of predictors	=	5
Output:	Non-centrality parameter λ	=	20.700
	Critical F	=	2.2828562
	Numerator df	=	5
	Denominator df	=	132
	Total sample size	=	138
	Actual power	=	0.9507643

Table 3.3.6: G*Power Calculation of Sample Size

Source: G*Power software

3.4 Research Instrument

A self-administered questionnaire using Google Forms is employed for collecting data from respondents. Advanced technology like Google Forms can enhance education by developing effective questionnaire instruments to support research and learning. (Ruliyanti et al., n.d.). Respondents will complete the questionnaire electronically, or it may be delivered face-to-face and collected afterward.

3.4.1 Questionnaire Design

The study employs a structured questionnaire with a concise cover page introducing the research and its focus on Malaysian manufacturing resilience. The questionnaire is categorized into two sections. Section A gathers general information about the Malaysian manufacturing industry, including respondents' demographics such as gender, income level, and company size. Section B delves into core questions analyzing the relationships between independent variables and manufacturing resilience as the dependent variable. Construct measurements use a 5-point Likert scale which ranging from 1 (Strongly Disagree) to 5 (Strongly Agree) which allowing respondents to present their level of agreement with each statement.

Variables	Number of Items	Measurement Scale
Manufacturing Resilience	3	5-Point Likert Scale
Supply Chain Disruptions	5	5-Point Likert Scale
Information Sharing Levels	5	5-Point Likert Scale
Collaborative Actions	5	5-Point Likert Scale
Environmental Uncertainty	5	5-Point Likert Scale
Trust Relationship with Supplier	5	5-Point Likert Scale

Table 3.4.1: Summary of Measures

Source: Developed for the research

3.4.2 Pilot Test

A pilot test is instrumental in refining interviews and enhancing data collection. This process helps validate qualitative data for the study (Gani et al., 2020). Several authors emphasize the significance of conducting a pilot test, as it allows for the early detection of potential flaws by identifying issues and areas that may require adjustments in the research instrument, thereby adding value and credibility to the research (Dikko, 2016).

3.5 Construct Measurement

Construct measurement involves understanding the origin of the construct and the measurement scale employed.

3.5.1 Origin of Construct

Construct	Sources
Manufacturing Resilience	• Acquaah (2007) • Flatten et al. (2011)
Supply Chain Disruption	• Gölgeci & Kuivalainen (2019) • Gölgeci & Ponomarov (2014)
Information Sharing Levels	• Prajogo & Olhager (2012) • Yang et al. (2022)
Collaborative Actions	• Yang et al. (2022) • Wu et al. (2014)
Environmental Uncertainty	• Yang et al. (2022) • Wuyts & Geyskens. (2005) • Kwok et al. (2018)
Trust Relationship with Supplier	• Yang et al. (2022) • Kwok et al. (2018)

Table 3.5.1: Origin of Construct

Source: Developed for the research

3.5.2 Data Scale of Measurement

The questionnaire in this research paper comprises two sections allow respondents to answer questions that best reflect their receptions. In addition, three different types of measurement scales are utilized in this questionnaire which are nominal scale, ordinal scale, and interval scale.

3.5.2.1 Nominal Scale

A nominal scale assigns numbers to label or identify subjects or objects without implying any quantitative value (Hair et al., 2016). In Section A, the use of the nominal scale is demonstrated by categorizing respondents' gender into two groups such as male or female.

3.5.2.2 Ordinal Scale

Ordinal scales enable the ordering or ranking of variables based on the extent of the attribute they possess (Hair et al.,2016). In Section A, the ordinal scale is applied to measure information in a sequence or ranking but without numeric measurements. For example, the age groups listed in the questionnaire with the option of '18 – 24', '25 – 34', '35 – 44', '45 – 54', '55 – 64', and '65 and over'.

3.5.2.3 Interval Scale

The interval scale represents the exact differences between measurement points, requiring a well-defined unit of measurement and allowing for mathematical operations such as illustrated by the question about monthly allowance, with options including 'Below RM1000', 'RM1000-RM3000', 'RM3000-RM5000', and 'Above RM5000'.

3.5.2.4 Likert Scale

Likert scale questionnaires are basically easier to be applied to measure affective variables such as motivation and self-efficacy for carrying out the surveys (Nemoto & Belgar, 2014). Section B of the questionnaire uses an ordinal scale, 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree) to assess respondents' opinions on the constructs and their level of agreement with the survey items.

3.6 Data Processing

Data processing involves steps like response checking, editing, coding, transcribing, and cleaning to ensure reliability and accuracy. Researchers must verify that all survey questionnaires are fully completed before processing for validation.

3.6.1 Data Checking

The questionnaire checking process involves reviewing for errors, including issues with question flow, content, and grammar. This step ensures data quality by confirming that questions are clear, comprehensible, and easily understood by respondents.

3.6.2 Data Editing

Data editing is performed to correct any mistakes before the data is considered valid information. Incomplete responses from respondents will be removed during this stage. Other than that, data editing helps maintain the research's standards by minimizing errors and ensuring the accuracy of the collected data.

3.6.3 Data Coding

In data coding, data is standardized and converted into numerical values. Each category in the questionnaire is assigned a specific code. To cite an example, in Section A of the study, 'male' can be coded as 1 and 'female' as 2. In Section B, responses ranging from 'Strongly Disagree' to 'Strongly Agree' can be coded from 1 to 5 to reflect the degree of agreement with the statements.

3.6.4 Data Transcription

Data transcription involves transferring data into SPSS software for analysis. Once the data is input into SPSS, the software processes it to generate reliable results.

3.6.5 Data Cleaning

The purpose of verifying data is to ensure the accuracy of information input from the questionnaire into SPSS software. Inconsistencies can compromise data accuracy, making data cleaning essential in this study to maintain the quality of the collected data.

3.7 Data Analysis

Data analysis involves describing, illustrating, condensing, and summarizing data, followed by evaluation using systematic statistical or logical techniques. Improper analysis can lead to misunderstandings. Therefore, SPSS is used to assess the reliability, significance, and accuracy of the collected data through descriptive analysis and measurement validation.

3.7.1 Descriptive Analysis

Descriptive analysis involves converting raw data into a more understandable format for researchers to evaluate. It provides detailed information about the studied population, including frequency distribution, measures of central tendency (mean, mode, median), and measures of dispersion (range, variance, and standard deviation).

3.7.2 Scale Measurement

Scale measurement is employed to evaluate the reliability and validity of the questionnaire. In this research, the reliability test has been performed using SPSS.

3.7.2.1 Reliability Test

The reliability test measures the stability and consistency of the research construct. Researchers use Cronbach's Alpha for this purpose; a higher coefficient value indicates greater consistency and reliability of the variable.

Coefficient Range	Strength of Association
< 0.6	Unsatisfactory
0.6 to < 0.7	Fair
0.7 to < 0.8	Satisfactory
0.8 to < 0.9	Highly Satisfactory
> 0.9	Outstanding

Table 3.7.2.1: Range of Cronbach's Alpha Value

Source: Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. *International Journal of Medical Education*, *2*(2), 53–55.

3.7.3 Inferential Analysis

Inferential analysis is used to determine whether the hypothesis is supported by measuring the relationships between variables in the research.

3.7.3.1 Multiple Regression Analysis

Multiple regression analysis is a method used to examine the linear relationship between a dependent variable and multiple independent variables. It helps researchers determine whether there is a significant relationship between the dependent variable and the five independent variables.

Furthermore, multiple regression analysis is suitable because both the dependent and independent variables can be measured using the same scale. Besides, the results of the ANOVA test and coefficient values will be presented at the conclusion of the analysis.

The formula of multiple regression analysis:

$$\mathbf{Y = a + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots\ldots + \beta_n X_n}$$

Whereby,

Y = Dependent Variable

a = Constant

β_1 = Coefficient associated with the independent variables

X_1 = Independent Variables

Equation:

$$\mathbf{YMR = \beta_1 SCD + \beta_2 ISL + \beta_3 CA + \beta_4 EU + \beta_5 TRS}$$

Whereby:

MR = Manufacturing Resilience

SCD = Supply Chain Disruptions

ISL = Information Sharing Levels

CA = Collaborative Actions

EU = Environmental Uncertainty

TRS = Trust Relationship with Supplier

3.8 Conclusion

In essence, this chapter outlines the research methodology. A total of 250 questionnaires will be distributed to the target respondents, and the collected data will be entered into SPSS software for analysis and interpretation. Chapter 4 will present and discuss the statistical results derived from the data.

Chapter 4: Data Analysis

4.0 Introduction

A total of 250 survey questionnaires were distributed, with 7 excluded due to unemployment and leaving 243 responses for analysis using SPSS 29.0. The analysis includes a pilot test, outlier detection, descriptive statistics, Cronbach's Alpha, Pearson correlation, and multiple regression to assess relationships affecting manufacturing resilience. Results are presented through tables and graphs, with both descriptive and inferential statistics used to verify reliability and assess relationships within the data.

4.1 Descriptive Analysis

4.1.1 Demographic Profile

The questionnaire included demographic questions such as gender, age, employment status, industry, location, company size, position, and monthly income. This information provides context for analyzing data trends and patterns. It helps to interpret how demographic factors may influence the study's results and enhance understanding of respondent backgrounds.

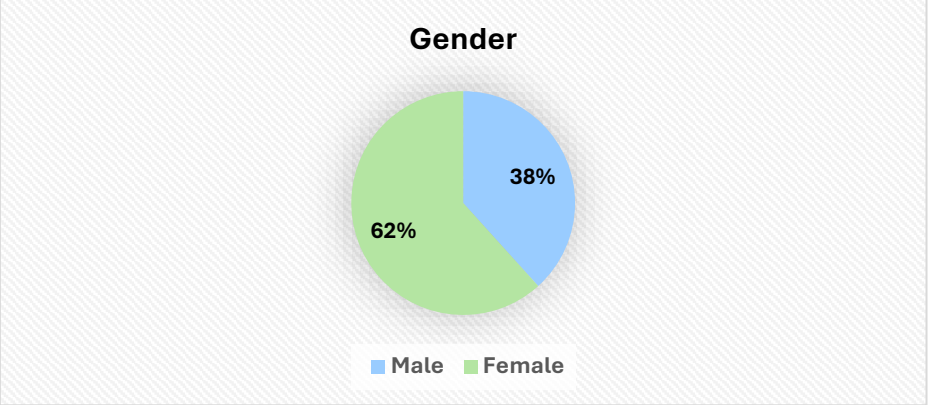
4.1.1.1 Gender

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	150	61.7	61.7	61.7
	Male	93	38.3	38.3	100.0
	Total	243	100.0	100.0	

Source: Developed for this research.

Table 4.1: Gender



Source: Developed for this research.

Figure 4.1: Gender

First and foremost, there are 243 respondents were grouped by gender. According to the Figure 4.1 and Table 4.1 show that, 61.7% (150 respondents) are female and 37.3% (93 respondents) are male. It indicates slightly more female participants than male in the survey.

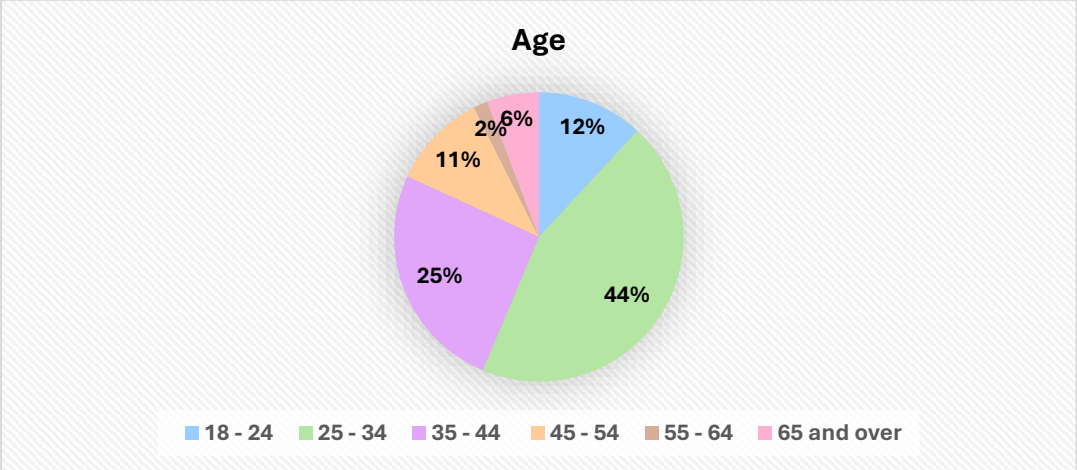
4.1.1.2 Age

Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18 - 24	29	11.9	11.9	11.9
	25 - 34	108	44.4	44.4	56.4
	35 - 44	62	25.5	25.5	81.9
	45 - 54	26	10.7	10.7	92.6
	55 - 64	4	1.6	1.6	94.2
	65 and over	14	5.8	5.8	100.0
	Total	243	100.0	100.0	

Source: Developed for this research.

Table 4.2: Age



Source: Developed for this research.

Figure 4.2: Age

Subsequently, the respondents were categorized into six age groups. As the Table 4.2 and Figure 4.2 shown above, the largest group, 44.4% (108 respondents), was aged 25 to 34. Other groups included 25.5% (62 respondents) which aged 35 to 44, 11.9% (29 respondents) aged 18 to 24, 10.7% (26 respondents) aged 45 to 54, and 5.8% (14 respondent) aged 65 and above, 1.6% (4 respondents) aged 55 to 64.

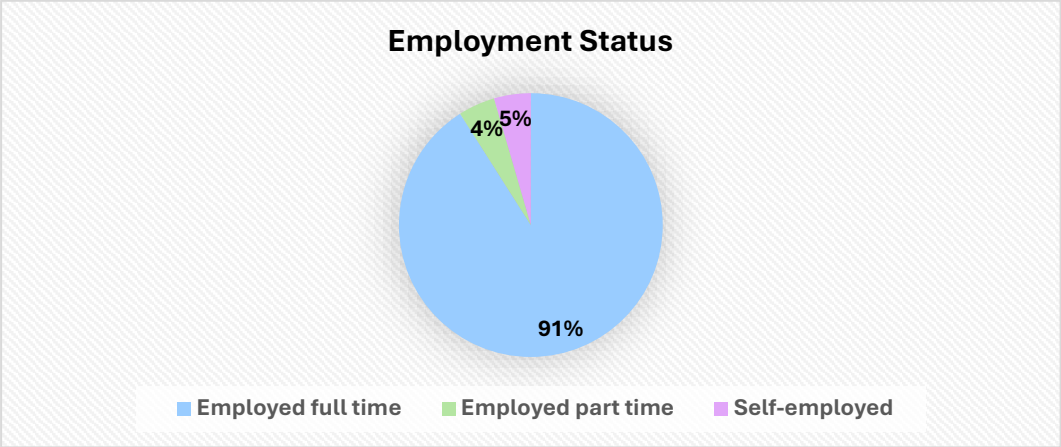
4.1.1.3 Employment Status

Employment status

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Employed full time	221	90.9	90.9	90.9
	Employed part time	11	4.5	4.5	95.5
	Self-employed	11	4.5	4.5	100.0
	Total	243	100.0	100.0	

Source: Developed for this research.

Table 4.3: Employment Status



Source: Developed for this research.

Figure 4.3: Employment Status

Figure 4.3 and Table 4.3 show respondents' occupation statuses. Among 243 respondents, 90.9% (221 respondents) were full-time employees, 4.5% (11 respondents) were part-time, and 4.5% (11 respondents) were self-employed.

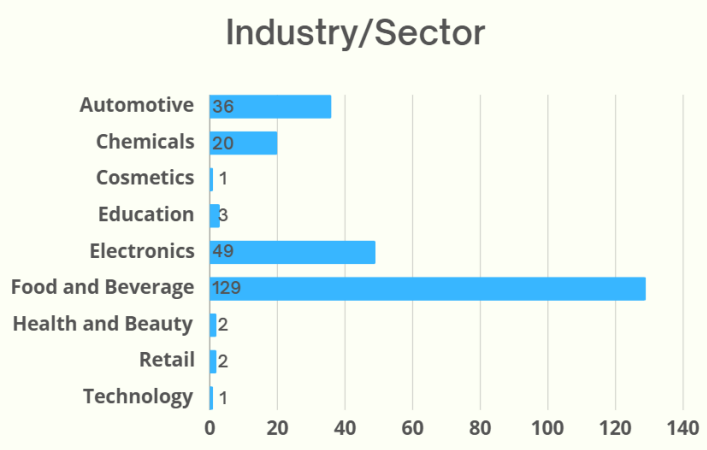
4.1.1.4 Industry / Sector

Industry/Sector

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Automotive	36	14.8	14.8	14.8
	Chemicals	20	8.2	8.2	23.0
	Cosmetics	1	.4	.4	23.5
	Education	3	1.2	1.2	24.7
	Electronics	49	20.2	20.2	44.9
	Food and Beverage	129	53.1	53.1	97.9
	Health and Beauty	2	.8	.8	98.8
	Retail	2	.8	.8	99.6
	Technology	1	.4	.4	100.0
	Total	243	100.0	100.0	

Source: Developed for this research.

Table 4.4: Industry / Sector



Source: Developed for this research.

Figure 4.4: Industry / Sector

Table 4.3 and Figure 4.3 show the distribution of respondents by industry. The Food and Beverage industry accounts for the largest share which at 53.1% (129 respondents). The Electronics industry follows with 20.2% (49 respondents), and the Automotive industry represents 14.8% (36 respondents). The Chemicals industry includes 8.2% (20 respondents), while the Education sector makes up 1.2% (3 respondents). Both the Health and Beauty and Retail industries each account for 0.8% (2 respondents). Lastly, the Cosmetics and Technology sectors have the lowest representation which at 0.4% (1 respondent) each.

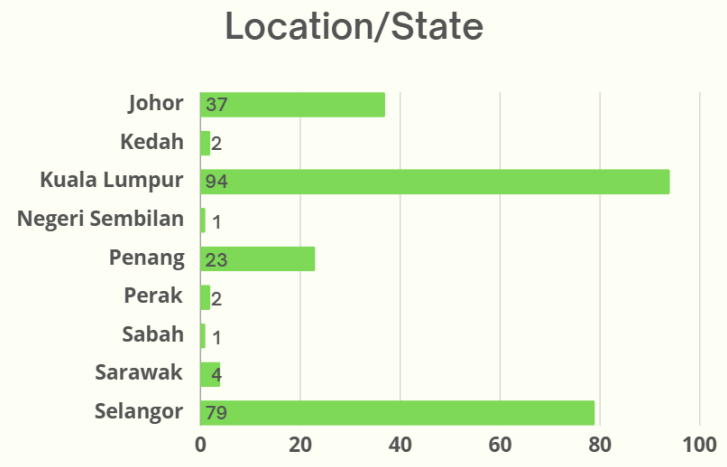
4.1.1.5 Location / State

Location/State

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Johor	37	15.2	15.2	15.2
	Kedah	2	.8	.8	16.0
	Kuala Lumpur	94	38.7	38.7	54.7
	Negeri Sembilan	1	.4	.4	55.1
	Penang	23	9.5	9.5	64.6
	Perak	2	.8	.8	65.4
	Sabah	1	.4	.4	65.8
	Sarawak	4	1.6	1.6	67.5
	Selangor	79	32.5	32.5	100.0
	Total	243	100.0	100.0	

Source: Developed for this research.

Table 4.5: Location / State



Source: Developed for this research.

Figure 4.5: Location / State

Table 4.5 and Figure 4.5 illustrate respondents' distribution by state. Most of the respondents are from Kuala Lumpur which at 38.7% (94 respondents), followed by 32.5% (79 respondents) from Selangor and 15.2% (37 respondents) from Johor. Then, Penang accounts for 9.5% (23 respondents), while smaller proportions are from Sarawak with 1.6% (4 respondents), Kedah and Perak with 0.8% (2 respondents) each, and Sabah and Negeri Sembilan, each contributing 0.4% (1 respondent). This distribution indicates that the majority of respondents are concentrated in urban or industrialized areas, particularly in Kuala Lumpur and Selangor.

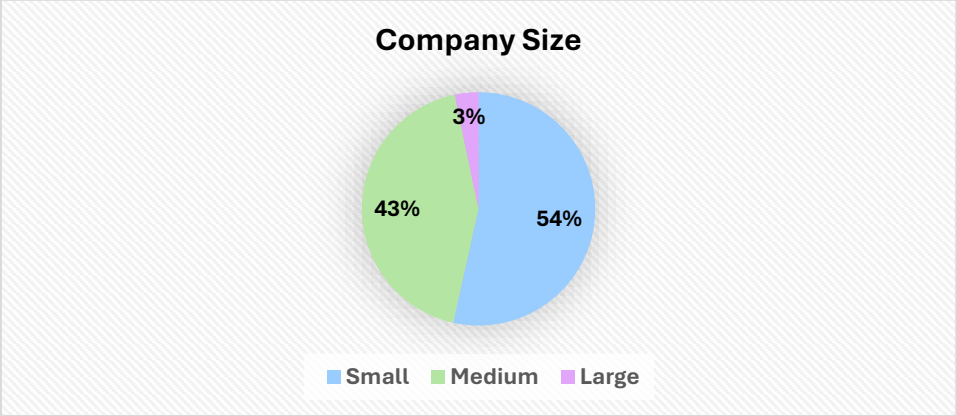
4.1.1.6 Company Size

Company Size

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Large (251+ employees)	8	3.3	3.3	3.3
	Medium (51-250 employees)	105	43.2	43.2	46.5
	Small (1-50 employees)	130	53.5	53.5	100.0
	Total	243	100.0	100.0	

Source: Developed for this research.

Table 4.6: Company Size



Source: Developed for this research.

Figure 4.6: Company Size

Table 4.6 and Figure 4.6 illustrate the distribution of respondents based on company size. Most respondents work in small companies at 53.5% (130 respondents), followed by medium-sized companies at 43.2% (105 respondents). There is only 3.3% (8 respondents) work in large companies. This data shows a predominance of respondents from smaller to medium-sized companies, with minimal representation from large companies.

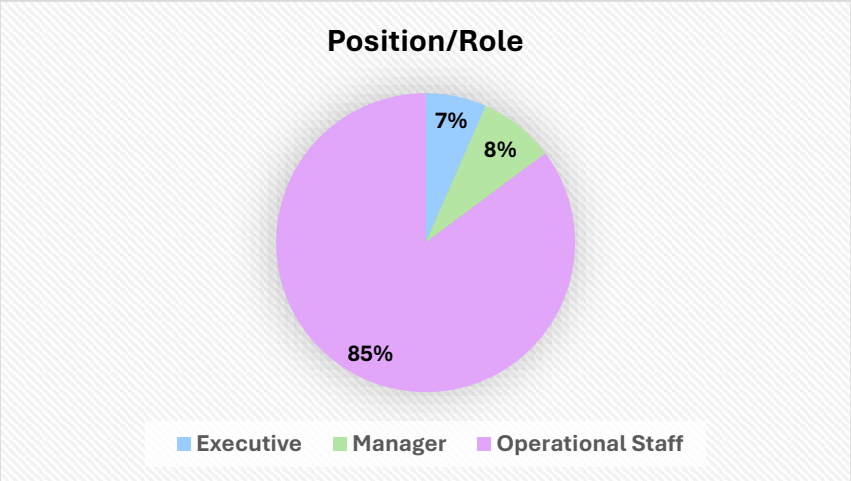
4.1.1.7 Position / Role

Your position/role

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Executive	16	6.6	6.6	6.6
	Manager	20	8.2	8.2	14.8
	Operational Staff	207	85.2	85.2	100.0
	Total	243	100.0	100.0	

Source: Developed for this research.

Table 4.7: Position / Role



Source: Developed for this research.

Figure 4.7: Position / Role

Table 4.6 and Figure 4.6 show the distribution of respondents by position. Most respondents are operational staff (85.2%, 207 respondents). Next, the manager levels have (8.2%, 20 respondents) as well as the fewest respondents in executive roles (6.6%, 8 respondents).

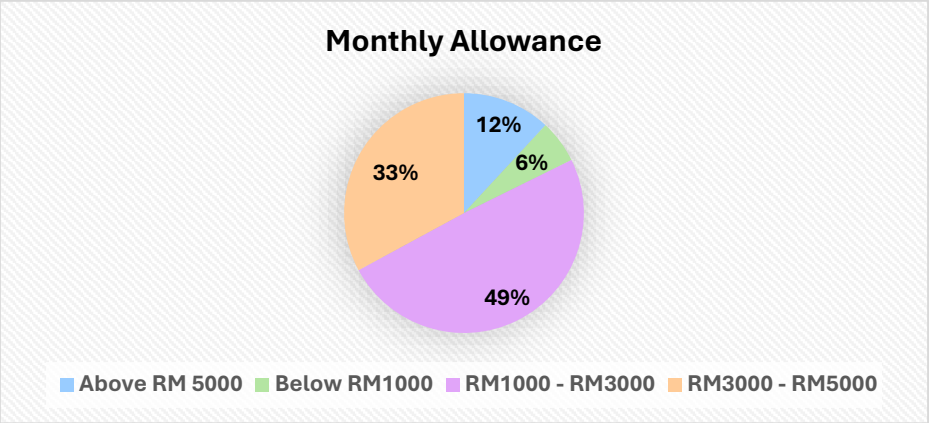
4.1.1.8 Monthly Income

How much is your monthly allowance?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Above RM5000	29	11.9	11.9	11.9
	Below RM1000	14	5.8	5.8	17.7
	RM1000-RM3000	120	49.4	49.4	67.1
	RM3000-RM5000	80	32.9	32.9	100.0
	Total	243	100.0	100.0	

Source: Developed for this research.

Table 4.8: Monthly Income



Source: Developed for this research.

Figure 4.8: Monthly Income

Table 4.3 and Figure 4.3 show the monthly income distribution of respondents. The largest group earns between RM1000 and RM3000 (49.4%, 120 respondents), followed by RM3000 to RM5000 (32.9%, 80 respondents). 11.9% (29 respondents) earn RM50,000 and above, while the smallest group earns below RM1000 (5.8%, 14 respondents).

4.2 Central Tendencies Measurement of Constructs

4.2.1 Manufacturing Resilience

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
1. Our firm accesses valuable resources through relationships.	243	1	5	4.15	.869
2. Our firm leverages knowledge from business relationships.	243	1	5	4.21	.765
3. Our firm ensures quick information flow internally.	243	1	5	4.18	.846
Valid N (listwise)	243				

Source: Developed for this research.

Table 4.9: Manufacturing Resilience

First of all, the questions that are associated with manufacturing resilience are discussed. As illustrated on Table 4.9 above, the largest mean is 4.21 and the smallest standard deviation is 0.765 belong to MR2 and the lowest mean is 4.15 and the largest standard deviation is 0.869 is given by MR1.

4.2.2 Supply Chain Disruptions

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
1. Our company's supply chain effectively handles unforeseen disruptions by promptly resuming the flow of products.	243	1	5	4.07	.752
2. Our company's supply chain is capable of rapidly returning to its normal operations after experiencing a disruption.	243	1	5	4.16	.720
3. Our firm's supply chain can effectively control its structure and function during disruptions.	243	1	5	4.07	.840
4. Our firm's supply chain can transition to a better state after experiencing disruption.	243	1	5	4.15	.789
5. Our firm's supply chain is equipped to handle the financial impacts of potential disruptions.	243	1	5	4.13	.821
Valid N (listwise)	243				

Source: Developed for this research.

Table 4.10: Supply Chain Disruptions

Secondly, the questions related to supply chain disruptions are analysed. In Table 4.10, the highest mean is 4.16 given by SCD2 together with the lowest standard deviation of 0.720. In contrast, the lowest mean was recorded by SCD1 and SCD3 which is 4.07. The highest standard deviation of supply chain disruption is for SCD3 with 0.840.

4.2.3 Information-Sharing Level

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
1. I think trust can greatly influences the quality of information sharing.	243	1	5	4.19	.907
2. I believe information technology can boost companies' operational efficiency and flexibility.	243	1	5	4.26	.803
3. I believe that trust and information-sharing can affect both collaboration and resilience.	243	1	5	4.22	.866
4. I feel a high level of trust will encourage sharing confidential information between manufacturers and suppliers.	243	1	5	4.19	.856
5. I often engage in direct planning and communication with our suppliers.	243	1	5	4.12	.914
Valid N (listwise)	243				

Source: Developed for this research.

Table 4.11: Information-Sharing Level

According to findings highlighted in Table 4.11, ISL2 has the highest mean which stands at 4.26 and the lowest standard deviation which is 0.803 while the highest standard deviation which is the 0.915 and the lowest mean of 4.12 is for ISL5.

4.2.4 Collaboration Action

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
1. I believe a manufacturing company should have a support team for addressing urgent issues.	243	1	5	4.28	.773
2. I believe a manufacturing company should address business issues and conflicts with suppliers.	243	1	5	4.29	.838
3. I think a manufacturing company should regularly review contingency plans for product development and production with suppliers.	243	1	5	4.26	.825
4. I think a manufacturing company should collaborate with suppliers to anticipate operational risks and issues.	243	1	5	4.33	.770
5. I think a manufacturing company should regularly discuss upcoming production volumes and product types with suppliers.	243	1	5	4.34	.784
Valid N (listwise)	243				

Source: Developed for this research.

Table 4.12: Collaboration Action

As seen in Table 4.12, it shows the results of collaboration action from the research. CA5 has the highest mean score of 4.34, while CA3 has the lowest mean score of 4.26. Nevertheless, CA2 has the highest standard deviation at 0.838, while CA1 has the lowest standard deviation at 0.773.

4.2.5 Environmental Uncertainty

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
1. I can never anticipate when emergencies will occur in my manufacturing operations.	243	1	5	3.81	1.087
2. I find it challenging to implement technological innovations that affect production in my manufacturing processes.	243	1	5	3.96	.995
3. I discover that it is difficult to anticipate how my competitors will respond.	243	1	5	4.00	.966
4. I can't predict whether my company will thrive in the marketplace long-term.	243	1	5	3.87	1.028
5. I realise that it is hard to forecast market demand.	243	1	5	4.02	1.000
Valid N (listwise)	243				

Source: Developed for this research.

Table 4.13: Environmental Uncertainty

Table 4.13 shows that EU5 has the highest environmental uncertainty mean at 4.02, while EU1 has the lowest mean at 3.81. EU3 has the smallest standard deviation of 0.966, whereas EU1 has the highest standard deviation at 1.087. It is indicating greater variability in its rankings.

4.2.6 Trust Relationship with Supplier

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
1. I believe a manufacturing company must trust the suppliers to be honest and fulfil their commitments.	243	1	5	4.15	.869
2. I believe a manufacturing company must trust the suppliers to have the necessary personnel and equipment.	243	1	5	4.21	.765
3. I think a manufacturing company must believe that our suppliers are always prepared to assist and support us.	243	1	5	4.18	.846
4. I think the suppliers ought to consider our interests when making decisions	243	1	5	4.19	.815
5. I trust our suppliers to comprehend our concerns when we discuss issues with them.	243	1	5	4.32	.795
Valid N (listwise)	243				

Source: Developed for this research.

Table 4.14: Trust Relationship with Supplier

Last but not least, the trust relationship with suppliers was analysed using the mean and standard deviation. As shown in Table 4.14, TRS5 has the highest mean rank at 4.32, while TRS1 has the lowest mean rank at 4.15. TRS2 has the lowest standard deviation at 0.765, while TRS1 has the highest standard deviation at 0.869 which suggesting greater variability in its rankings compared to the other trust relationship variables.

4.3 Scale Measurement

4.3.1 Reliability Test for Pilot Study

No.	Construct	Cronbach's Alpha	Number of Items	Strengths
1	Manufacturing Resilience	0.731	3	Satisfactory
2	Supply Chain Disruption	0.770	5	Satisfactory
3	Information-Sharing Level	0.740	5	Satisfactory
4	Collaborative Action	0.724	5	Satisfactory
5	Environmental Uncertainty	0.803	5	Highly Satisfactory
6	Trust Relationship with Supplier	0.785	5	Satisfactory

Source: Developed for this research.

Table 4.15: Cronbach's Alpha Reliability Analysis

In this research, Cronbach's Alpha has been adopted by the researchers to measure the validity and reliability of the variables mentioned above. A small group of participants took part in the pilot test. A total of 28 questions in Section B of the questionnaire were examined which comprised 3 items for the dependent variable (MR) and 5 items each for the independent variables (SCD, ISL, CA, EU, TRS).

According to Table 4.15 and consistent with the recommendations in Table 3.4 of Chapter 3, the Cronbach's Alpha for all IVs and the DV is greater than 0.70. It is suggesting that all variables are considered satisfactory. Nonetheless, when comparing Cronbach's Alpha values across measures, the results indicate that environmental uncertainty has the highest reliability with a Cronbach's Alpha value of 0.803. Therefore, the entire content of the study was preserved.

4.4 Inferential Statistics

4.4.1 Pearson Correlation Analysis

Correlations

		MR	SCD	ISL	CA	EU	TRS
Pearson Correlation	MR	1.000	.103	.171	.246	.094	.922
	SCD	.103	1.000	.220	.232	.112	.072
	ISL	.171	.220	1.000	.469	.013	.206
	CA	.246	.232	.469	1.000	.035	.258
	EU	.094	.112	.013	.035	1.000	.129
	TRS	.922	.072	.206	.258	.129	1.000
Sig. (1-tailed)	MR	.	.054	.004	<.001	.071	<.001
	SCD	.054	.	.000	.000	.040	.131
	ISL	.004	.000	.	.000	.421	.001
	CA	.000	.000	.000	.	.296	.000
	EU	.071	.040	.421	.296	.	.023
	TRS	.000	.131	.001	.000	.023	.
N	MR	243	243	243	243	243	243
	SCD	243	243	243	243	243	243
	ISL	243	243	243	243	243	243
	CA	243	243	243	243	243	243
	EU	243	243	243	243	243	243
	TRS	243	243	243	243	243	243

Source: Developed for this research.

Table 4.16: Pearson Correlation Analysis

The correlation analysis reveals that TRS strongly influence MR with a very significant positive correlation ($r = 0.922$, $p < 0.001$), highlighting the importance of trust in ensuring operational adaptability and reliability. CA ($r = 0.246$, $p < 0.001$) and ISL ($r = 0.171$, $p = 0.004$) also positively contribute to resilience, supporting the hypothesis that cooperation and partnership strengthen resilience.

In contrast, SCD ($r = 0.103$, $p = 0.054$) and EU ($r = 0.094$, $p = 0.071$) show weak positive correlations, indicating minimal direct impact on resilience. The weak EU-

MR relationship suggests that uncertainty does not necessarily hinder manufacturers' ability to adapt and recover.

In short, the study brings out the conclusion that trust at the relationship level, cooperation actions and information flow are effective approaches when it comes to manufacturing resilience whereas managing disruption supply chain and uncertainty may need an indirect approach.

4.4.2 Multiple Linear Regression

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics			
					R Square Change	F Change	df1	df2
1	.924[a]	.854	.850	.25811008068	.854	276.334	5	237

a. Predictors: (Constant), TRS, SCD, EU, ISL, CA

Source: Developed for this research.

Table 4.17: Model Summary

The regression analysis demonstrates that trust relationship, supply chain disruption, environmental uncertainty, information sharing and cooperation as important influential determinants of manufacturing resilience. The model exhibits a strong positive correlation ($R = 0.924$) and explains 85.4% of the variance in resilience ($R^2 = 0.854$), with an adjusted R^2 of 0.850 confirming its stability. The F-statistic of 276.334 ensures the model's statistical significance. It is in this light that, trust and cooperation has been presented here as critical elements for creating resilience with supply chain disruptions and environmental uncertainty being the other relevant factors. According to Ozili (2023), R-square low value is tolerable if predictor variables are significant while a R-square high value is desirable if there is no problem of spurious causation or multiplier collinearity amongst variables in social science research.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	92.048	5	18.410	276.334	<.001[b]
	Residual	15.789	237	.067		
	Total	107.837	242			

a. Dependent Variable: MR

b. Predictors: (Constant), TRS, SCD, EU, ISL, CA

Source: Developed for this research.

Table 4.18: ANOVA

The ANOVA results indicate that the regression model, with predictors such as TRS, SCD, EU, ISL, and CA. It significantly explains the variation in MR, with a p-value less than 0.001. The high F-statistic (276.334) suggests that all predictors are significantly related to MR. The large sum of squares for the regression (92.048) compared to the residuals (15.789) highlights the model's effectiveness. Overall, the model is valid and efficient, offering a reliable basis for future analysis and decision-making.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	-.180	.196		-.916	.361	-.566	.207
	SCD	.052	.031	.044	1.712	.088	-.008	.112
	ISL	-.039	.031	-.036	-1.247	.214	-.101	.023
	CA	.018	.035	.014	.500	.618	-.052	.087
	EU	-.026	.022	-.030	-1.175	.241	-.070	.018
	TRS	1.030	.029	.926	35.548	<.001	.973	1.087

a. Dependent Variable: MR

Source: Developed for this research.

Table 4.19: Coefficients

The results of the regression analysis indicate that a significant positive relationship exists between TRS and MR of the organization as the standardized coefficient (Beta) is 0.926, and the unstandardized coefficient is 1.030. This suggests that

strong trust between manufacturers and suppliers significantly enhances resilience. Conversely, a low level of trust is associated with low resilience. On the other hand, other variables including SCD, ISL, CA and EU are weaker or non-significant determinations of resilience. As shown, SCD with the coefficient of 0.052 (p = 0.088) is not significant to prove the hypothesis. However, it only underlines the supremacy of trust in developing the robustness of manufacturing.

Therefore, the equation for multiple linear regressions as below:

Manufacturing Resilience (MR) =
(- 0.180) + 0.052 (SCD) + (- 0.039) (ISL) + 0.018 (CA) + (- 0.026) (EU) + 1.030 (TRS)

4.5 Hypothesis Results

4.5.1 Hypothesis 1

H_0: There is no significant relationship between ***supply chain disruption*** and ***manufacturing resilience*** in the Malaysian manufacturing industry.

H_1: There is a significant relationship between ***supply chain disruption*** and ***manufacturing resilience*** in the Malaysian manufacturing industry.

Based on the table 4.19. the p-value for supply chain disruption is 0.088 > 0.05. Therefore, H_1 is not supported and H_0 is supported which shows that there is no significant between supply chain disruption and manufacturing resilience in the Malaysian manufacturing industry.

4.5.2 Hypothesis 2

H_0: There is no significant relationship between ***information sharing levels*** and ***manufacturing resilience*** in the Malaysian manufacturing industry.

H_2: There is a significant relationship between ***information sharing levels*** and ***manufacturing resilience*** in the Malaysian manufacturing industry.

Based on the table 4.19. the p-value for information sharing levels is 0.214 > 0.05. Therefore, H_2 is not supported and H_0 is supported which shows that there is no significant between information sharing levels and manufacturing resilience in the Malaysian manufacturing industry.

4.5.3 Hypothesis 3

H_0: There is no significant relationship between ***collaborative actions*** and ***manufacturing resilience*** in the Malaysian manufacturing industry.

H_3: There is a significant relationship between ***collaborative actions*** and ***manufacturing resilience*** in the Malaysian manufacturing industry.

Based on the table 4.19. the p-value for collaborative actions is 0.618 > 0.05. Therefore, H_3 is not supported and H_0 is supported which shows that there is no significant between collaborative actions and manufacturing resilience in the Malaysian manufacturing industry.

4.5.4 Hypothesis 4

H_0: There is no significant relationship between ***environmental uncertainty*** and ***manufacturing resilience*** in the Malaysian manufacturing industry.

H_4: There is a significant relationship between ***environmental uncertainty*** and ***manufacturing resilience*** in the Malaysian manufacturing industry.

Based on the table 4.19. the p-value for environmental uncertainty is 0.241 > 0.05. Therefore, H_4 is not supported and H_0 is supported which shows that there is no significant between environmental uncertainty and manufacturing resilience in the Malaysian manufacturing industry.

4.5.5 Hypothesis 5

H_0: There is no significant relationship between ***trust relationship with supplier*** and ***manufacturing resilience*** in the Malaysian manufacturing industry.

H_5: There is a significant relationship between ***trust relationship with supplier*** and ***manufacturing resilience*** in the Malaysian manufacturing industry.

Based on the table 4.19. the p-value for trust relationship with supplier is 0.001 < 0.05. Therefore, H_5 is supported and H_0 is not supported which shows that there is no significant between trust relationship with supplier and manufacturing resilience in the Malaysian manufacturing industry.

4.6 Conclusion

Once again, this chapter summarizes data analysis, confirming respondent reliability and retaining usable data for descriptive and inferential analysis. Using SPSS 29.0, descriptive statistics, Pearson correlation, multiple linear regression, and reliability testing were conducted. Key independent variables showed significant impacts, with further discussion and implications reserved for the next chapter.

Chapter 5: Discussions, Conclusion, And Implications

5.0 Introduction

This chapter highlights the findings from previous analyses, addressing research questions and objectives. It includes discussions on statistical results, implications, limitations, and recommendations for future research. The chapter concludes by summarizing the study's contributions and identifying constraints and suggestions for future investigations.

5.1 Discussions

	Hypothesis	Significant Value	Outcome
H_1	Supply chain disruption has a significant impact on ***manufacturing resilience.***	P = 0.088 P-value > 0.5	Not Supported
H_2	Information-sharing level has a significant impact on ***manufacturing resilience.***	P = 0.214 P-value > 0.5	Not Supported
H_3	Collaborative action has a significant impact on ***manufacturing resilience.***	P = 0.618 P-value > 0.5	Not Supported
H_4	Environmental uncertainty has a significant impact on ***manufacturing resilience.***	P = 0.241 P-value > 0.5	Not Supported
H_5	Trust relationship with supplier has a significant impact on ***manufacturing resilience.***	P = 0.001 P-value < 0.5	Supported

Source: Developed for this research.

Table 5.1: Summary of Hypothesis Results Testing

5.1.1 Supply Chain Disruption

Table 5.1 shows that the supply chain disruption has a significant impact on manufacturing resilience, with a p-value of 0.088 (> 0.05). This study could not find evidence to support H_1.

Previous studies, such as Belhadi et al. (2022) and Ali et al. (2021), have demonstrated that supply chain disruptions negatively impact manufacturing resilience by challenging firms' flexibility and response mechanisms. However, the findings of this study (p=0.088) suggest that this relationship may be weaker or more context-dependent than previously reported. This could be attributed to differences in sample characteristics or the lack of detailed data on mediating factors like collaboration and resilience strategies. Consistent with Ambulkar et al. (2015), this result underscores the importance of tailored strategies for mitigating the effects of disruptions. Future research should explore these mediating factors and contextual influences to better understand the complex dynamics between disruptions and resilience.

5.1.2 Information-Sharing Level

Table 5.1 shows that the information-sharing level has a significant impact on manufacturing resilience, with a p-value of 0.214 (> 0.05). This study could not find evidence to support H_2.

While prior studies as Yang et al., 2022; Fan et al., 2020) emphasize the importance of Information Sharing Level (ISL) in enhancing supply chain resilience, this study found no significant correlation between ISL and manufacturing resilience in the Malaysian context (p=0.214). The discrepancy may stem from contextual differences, such as technology use, trust levels, and collaboration readiness. Also, mediating factors like trust or moderating factors like supply chain integration, often highlighted in past research, may not have been fully captured. Post-pandemic dynamics and variations in ISL measurement could also influence the results.

Despite this, descriptive data shows ISL practices remain prevalent, suggesting ISL could act as an enabler alongside other factors like joint problem-solving or technological innovation. Future research should examine ISL interactions with trust, technology, and supplier relationships through longitudinal and cross-industry approaches to better understand resilience-building.

5.1.3 Collaborative Action

Table 5.1 shows that the collaborative action has a significant impact on manufacturing resilience, with a p-value of 0.618 (> 0.05). This study could not find evidence to support H_3.

This study finds no direct impact of collaborative actions on manufacturing resilience, aligning with the view that collaboration is vital but not an independent factor. The lack of significant findings may stem from sector-specific characteristics, narrow operationalization of collaboration, or a focus on different resilience dimensions. Previous research (e.g., Yang et al., 2022) highlights trust, communication, and technological integration as mediators between collaboration and resilience, which may have been underexplored here. Collaboration's effectiveness may also depend on supply chain relationship maturity and crisis preparedness (Qi & Hui). A structured approach integrating contingency planning and strategic alignment could enhance collaboration's impact on resilience. Future research could examine these mediators, explore evolving collaboration effects across disruptions, and conduct cross-industry comparisons to understand collaborative practices in resilience-building (Scholten & Schilder, 2015; Ponomarov & Holcomb, 2009). This study emphasizes that collaboration, combined with enablers, remains crucial for manufacturing resilience.

5.1.4 Environmental Uncertainty

Table 5.1 shows that the environmental uncertainty has a significant impact on manufacturing resilience, with a p-value of 0.241 (> 0.05). This study could not find evidence to support H_4.

The hypothesis test found no strong evidence of a direct relationship between environmental uncertainty (ENU) and manufacturing resilience, as the p-value (0.241) exceeded 0.05. This result may reflect unique factors affecting Malaysian manufacturing firms, including the local economic environment, industry characteristics, and government support, which differ from those in other countries. The link between ENU and resilience may also be moderated by trust and collaboration, as Yang et al. (2022) suggested, where high collaboration or trust can offset uncertainty's effects on resilience. Additionally, the study may have captured only short-term impacts, while ENU might exert more influence on resilience over the long term. External variables such as government policies and regulatory frameworks, particularly in flexible supply chain strategies, may mediate this relationship. Future research should explore resilience across multiple timeframes, examine other uncertainties like geopolitical or technological ones, and focus on factors such as trust, collaboration, and operational flexibility.

5.1.5 Trust Relationship with Supplier

Table 5.1 shows that the trust relationship with supplier has a significant impact on manufacturing resilience, with a p-value of 0.001 (< 0.05). This study could find evidence to support H_5.

Trust plays a pivotal role in fostering collaborative relationships that help manufacturers withstand and recover from disruptions. Consistent with previous research, trust is crucial during crises like natural disasters and pandemics (Dubey et al., 2019), enabling open communication, resource sharing, and risk-taking to enhance supply chain agility and adaptability (Kwon & Suh, 2005). Long-term, trust-based partnerships facilitate resource integration and joint problem-solving, strengthening operational resilience (Adesanya et al., 2020; Vlachos & Dyra, 2020). The synergy theory further emphasizes that trust reduces risks and fosters collaboration, contributing to stable and resilient supply chains. Manufacturers with strong trust relationships are better equipped for quick recovery during crises (Scholten & Schilder, 2015). Trust not only aids disruption management but also ensures long-term competitive advantage and supply chain continuity (Hohenstein et al., 2015). Building trust through transparent communication, mutual problem-solving, and shared risk management is essential for resilience and preparedness.

5.2 Implication of the Study

5.2.1 Theoretical Implications

This study offers valuable theoretical insights by expanding the understanding of resilience in supply chain management. Traditionally, resilience models have primarily focused on operational flexibility, risk management, and the capacity to adapt to disruptions. However, this study introduces trust as a significant mediator in the relationship between supply chain collaboration and resilience. By positioning trust as a central element, the study challenges existing resilience frameworks that did not fully consider relational dynamics. This emphasizes that a resilient supply chain is not solely dependent on independent actions but thrives on interdependent relationships characterized by trust and cooperation. Furthermore, the study extends the synergy theory, which argues that long-term partnerships, based on mutual collaboration, foster organizational growth and resilience. Trust facilitates the integration of resources, such as information and capabilities, which strengthens the collective resilience of supply chain partners. Another important contribution is the emphasis on the behavioral aspects of trust. By demonstrating that trust reduces uncertainty, encourages open communication, and enables shared risk-taking, the study underscores how trust influences decision-making and strategies. Overall, this research enhances our understanding of how relational factors, specifically trust, play a vital role in shaping supply chain resilience during disruptions.

5.2.2 Practical Implications

This study's findings offer critical practical recommendations for manufacturing companies to enhance their resilience during disruptions. Building strong, trust-based relationships with suppliers emerges as a key factor in maintaining a resilient supply chain. Manufacturers should invest in long-term partnerships, focusing on transparent communication, collaboration, and mutual problem-solving to foster trust. This can be achieved through regular interactions, joint planning, and risk-sharing initiatives. In times of crisis, trust allows partners to respond quickly and efficiently, ensuring business continuity. Another practical implication is the need for strategic collaboration across the entire supply chain. Manufacturers should prioritize collaboration not just during normal operations but also in crisis preparedness, ensuring that clear contingency plans and protocols are in place. Trust will enable smoother coordination and faster decision-making when disruptions occur. The study also highlights the importance of integrating trust-building into risk management practices. Manufacturers should work on creating frameworks for joint risk assessments and emergency response strategies to prepare for potential disruptions. Lastly, fostering trust enhances competitiveness. Manufacturers with strong relationships with suppliers can better meet customer demands and remain operational during crises, giving them a competitive edge. Policymakers and industry bodies should also promote industry-wide collaboration to strengthen overall supply chain resilience.

5.3 Limitations

While this study offers valuable insights into the relationship between trust, collaboration, and manufacturing resilience, several limitations must be considered. First, the scope of the study was limited to manufacturing companies in a specific geographic region, which may affect the generalizability of the findings. Different regions may have varying levels of supply chain maturity, cultural factors, or business environments that influence how trust and collaboration impact resilience. Second, the study relies on cross-sectional data, which captures only a snapshot of the relationships between variables at a single point in time. This limits the ability to assess how these relationships evolve over time, particularly during long-term disruptions or crises. Future research could adopt a longitudinal approach to examine the dynamic nature of trust and collaboration in supply chains over extended periods. Third, the study primarily focuses on manufacturers and suppliers, which may overlook the role of other key supply chain partners such as logistics providers or retailers. Including these stakeholders could offer a more comprehensive understanding of how collaboration impacts resilience across the entire supply chain. Finally, the study relies on self-reported data, which may be subject to bias or inaccuracies. Researchers should consider using mixed methods, including interviews or case studies, to gain deeper insights into the practical dynamics of trust and collaboration.

5.4 Recommendations

Based on the study's findings, several recommendations can be made for both researchers and practitioners to further explore and enhance manufacturing resilience.

For researchers, a main recommendation is to broaden the scope of future studies by incorporating multiple industries and geographic regions. This would allow for a more diverse understanding of how trust and collaboration affect resilience in different contexts. By the same token, future research should explore the long-term impact of trust and collaboration on resilience by using longitudinal research designs. This would provide a clearer picture of how these factors evolve during prolonged disruptions. Another recommendation is to explore the role of technology and digital tools in facilitating trust and collaboration, as advancements in information systems and data sharing can significantly impact the effectiveness of these relationships.

For practitioners, it is crucial to prioritize trust-building in supplier relationships. Companies should invest in creating transparent, long-term partnerships that encourage mutual benefit, risk-sharing, and joint problem-solving. Practitioners should also establish formal frameworks for crisis preparedness, ensuring that suppliers are aligned on emergency response plans. Yet, it is recommended that companies invest in developing supply chain agility by enhancing their ability to respond quickly to changes and disruptions. Finally, policymakers and industry bodies should foster industry-wide collaboration and encourage best practices to build resilience across the entire supply chain network.

5.5 Conclusion

All in all, this study examined the factors influencing manufacturing resilience, focusing on independent variables such as supply chain disruption, information sharing, collaborative actions, environmental uncertainty, and trust relationships with suppliers. Data collected via questionnaires and analyzed using SPSS 29.0 showed that while trust relationships had a significant positive impact on resilience, other factors did not. Specifically, supply chain disruption, information sharing, collaborative actions, and environmental uncertainty were not supported as significant influences on resilience. The study highlights that trust between manufacturers and suppliers fosters open communication, risk-sharing, and effective problem-solving, which is vital during crises. The lack of support for the expected effects of collaborative actions and environmental uncertainty could be due to complex supply chain dynamics or unaccounted contextual factors. Despite limitations like geographic focus and data type, the findings emphasize the importance of trust in enhancing resilience and offer a basis for further research and practical application in the field.

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SURVEY QUESTIONNAIRE

RESEARCH QUESTIONNAIRE

UNIVERSITI TUNKU ABDUL RAHMAN
FACULTY OF ACCOUNTANCY AND MANAGEMENT (FAM)
BACHELOR OF INTERNATIONAL BUSINESS (HONS)

RESILIENCE OF GLOBAL CHALLENGES: A STUDY OF MANUFACTURING RESILIENCE IN MALAYSIAN MANUFACTURING INDUSTRY

Dear respondent:

I am a student from Universiti Tunku Abdul Rahman (UTAR) and currently conducting research as part of my Final Year Project. The purpose of conducting this research is to examine the manufacturing resilience in the Malaysian manufacturing industry.

This questionnaire should take about 10 minutes to finish. Participation is entirely voluntary. You will be asked to answer all the statements, and your responses will be kept private and confidential for academic use only. Your valuable time and kind cooperation in completing the attached questionnaire is highly appreciated.

Thank you for participating in this survey. If you have any inquiries regarding this survey, please feel free to contact me via email at joannejm02@1utar.my.

Yours sincerely,
WONG JING MUN 2206943
Undergraduate Student
Faculty of Accountancy and Management (FAM)
Universiti Tunku Abdul Rahman (UTAR)

Introduction:

In a globally interconnected world, industries face significant challenges, including supply chain disruptions, role of information sharing levels, the influence of collaborative actions, the effects of environmental uncertainty, and the impact of trust relationships with suppliers. The Malaysian manufacturing sector, a key component of the national economy, confronts these issues directly. This study explores how resilient the Malaysian manufacturing industry is in adapting to and recovering from these global challenges. It aims to identify factors affecting resilience, evaluate the effectiveness of current strategies, and highlight areas needing further support. The insights will provide a comprehensive understanding of how Malaysian manufacturers are managing and adapting to ensure long-term sustainability and growth.

Section A: Demographic Profile

INSTRUCTION: Please select or fill in the blank for each of the questions below. Each question can only choose ONE answer.

1. Gender:
    - Male
    - Female
2. Age:
    - 18 – 24
    - 25 – 34
    - 35 – 44
    - 45 – 54
    - 55 – 64
    - 65 and over

3. Employment status:
    - Self-employed
    - Employed full time
    - Employed part time
    - Unemployed/ Looking for work/ Freelance

- Retired

4. Industry/Sector
    - Electronics
    - Automotive
    - Chemicals
    - Food and Beverage
    - Other (please specify)

5. Location/State
    - Kuala Lumpur
    - Penang
    - Johor
    - Selangor
    - Other (please specify)

6. Company Size
    - Small (1-50 employees)
    - Medium (51-250 employees)
    - Large (251+ employees)

7. Your position/role
    - Executive
    - Manager
    - Operational Staff
    - Other (please specify)

8. How much is your monthly allowance?
    - Below RM1000
    - RM1000-RM3000
    - RM3000-RM5000
    - Above RM5000

Section B: Construct Measurement

INSTRUCTION: For each of the statements given below, kindly select the ONE number that represents your opinion the most.

[1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly agree]

A) Manufacturing Resilience					
Statement	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1. Our firm accesses valuable resources through relationships.	1	2	3	4	5
2. Our firm leverages knowledge from business relationships.	1	2	3	4	5
3. Our firm ensures quick information flow internally.	1	2	3	4	5

B) Supply Chain Disruptions					
Statement	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
4. Our company's supply chain effectively handles unforeseen disruptions by promptly resuming the flow of products.	1	2	3	4	5
5. Our company's supply chain is capable of rapidly returning to its normal operations after experiencing a disruption.	1	2	3	4	5

6. Our firm's supply chain can effectively control its structure and function during disruptions.	1	2	3	4	5
7. Our firm's supply chain can transition to a better state after experiencing disruption.	1	2	3	4	5
8. Our firm's supply chain is equipped to handle the financial impacts of potential disruptions.	1	2	3	4	5

C) <u>Information Sharing Levels</u>					
Statement	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1. I think trust can greatly influences the quality of information sharing.	1	2	3	4	5
2. I believe information technology can boost companies' operational efficiency and flexibility.	1	2	3	4	5
3. I believe that trust and information-sharing can affect both collaboration and resilience.	1	2	3	4	5
4. I feel a high level of trust will encourage sharing confidential information between manufacturers and suppliers.	1	2	3	4	5
5. I often engage in direct planning and communication with our suppliers.	1	2	3	4	5

D) Collaborative Actions					
Statement	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1. I believe a manufacturing company should have a support team for addressing urgent issues.	1	2	3	4	5
2. I believe a manufacturing company should address business issues and conflicts with suppliers.	1	2	3	4	5
3. I think a manufacturing company should regularly review contingency plans for product development and production with suppliers.	1	2	3	4	5
4. I think a manufacturing company should collaborate with suppliers to anticipate operational risks and issues.	1	2	3	4	5
5. I think a manufacturing company should regularly discuss upcoming production volumes and product types with suppliers.	1	2	3	4	5

E) Environmental Uncertainty					
Statement	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1. I can never anticipate when emergencies will occur in my manufacturing operations.	1	2	3	4	5
2. I find it challenging to implement technological innovations that affect production in my manufacturing processes.	1	2	3	4	5
3. I discover that it is difficult to anticipate how my competitors will respond.	1	2	3	4	5
4. I can't predict whether my company will thrive in the marketplace long-term.	1	2	3	4	5
5. I realise that it is hard to forecast market demand.	1	2	3	4	5

F) Trust Relationship with Supplier					
Statement	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1. I believe a manufacturing company must trust the suppliers to be honest and fulfil their commitments.	1	2	3	4	5

2. I believe a manufacturing company must trust the suppliers to have the necessary personnel and equipment.	1	2	3	4	5
3. I think a manufacturing company must believe that our suppliers are always prepared to assist and support us.	1	2	3	4	5
4. I think the suppliers ought to consider our interests when making decisions	1	2	3	4	5
5. We trust our suppliers to comprehend our concerns when we discuss issues with them.	1	2	3	4	5

Thank you very much for your participation!

Your time and responses are deeply appreciated.

APPENDIX C

UNIVERSITI TUNKU ABDUL RAHMAN

FACULTY OF ACCOUNTANCY AND MANAGEMENT

UNDERGRADUATE FINAL YEAR PROJECT

Research Proposal Mark Sheet

Final Year Project Title:

Resilience of global challenges: A study of manufacturing resilience in Malaysian manufacturing industry

Name:	Wong Jing Mun	**Student ID:**	2206943

No	Criteria	Excellent (8 - 10 marks)	Good (5 - 7 marks)	Fair (3 - 4 marks)	Poor (0 - 2 marks)	Awarded
1	**Title and Abstract**	Clear, concise, and informative; abstract summarizes all key elements effectively.	Clear and informative; abstract summarizes most key elements.	Title and abstract are clear but may miss some key elements.	Title and abstract are somewhat unclear or incomplete.	
2	**Introduction/ Research Overview**	Clearly articulated, comprehensive understanding of the research topic, including background information and context.	Adequate overview of the research topic, with some gaps in understanding or context.	Limited overview of the research topic, lacking depth or context.	Minimal or unclear overview of the research topic.	
3	**Problem Statement**	A clear, specific, and well-defined research problem was identified, including its significance and relevance.	Clearly stated problem, but may lack specificity or clarity in its significance.	Problem statement is present but lacks clarity, specificity, or relevance.	The problem statement is unclear or missing.	
4	**Objectives**	Concise and measurable objectives that align with the research problem and address key aspects of the study.	Objectives are stated but may lack specificity or alignment with the research problem.	Objectives are vague or do not align with the research problem.	Objectives are missing or not relevant to the research problem.	
5	**Literature Review**	Comprehensive review of relevant literature, demonstrating a thorough understanding of existing research and its relevance to the proposed study.	Adequate literature review, covering key sources but may lack depth or critical analysis.	Limited literature review, missing key sources or failing to demonstrate relevance to the proposed study.	Minimal or no literature review provided.	
6	**Proposed Research Methodology**	Clearly articulated and appropriate research methodology, including data collection, analysis techniques, and ethical considerations.	The research methodology is stated but may lack detail or justification for its selection.	The research methodology is unclear or inappropriate for the research problem.	The research methodology is missing or severely inadequate.	
7	**Significance of Study**	Clearly articulated the significance of the proposed study, including potential contributions to the field and practical implications.	The significance of the study is mentioned, but its explanation may lack depth or clarity.	The significance of the study is not clearly explained or lacks relevance.	The significance of the study is not addressed.	
8	**Organisation of the Proposal**	Well-structured proposal with logical flow and clear headings/subheadings.	The proposal is organised but may lack coherence or consistency in structure.	Organization of the proposal is unclear or lacks logical flow.	The proposal is poorly organised and difficult to follow.	
9	**Quality of the Report**	Clear, concise writing with minimal grammar, spelling, and punctuation errors. A professional presentation with appropriate formatting.	The writing is generally clear but may contain some grammar, spelling, or punctuation errors. The presentation is acceptable but could be improved.	Writing is unclear or contains numerous grammar, spelling, or punctuation errors. The presentation is unprofessional.	Writing is illegible or incomprehensible with frequent grammar, spelling, or punctuation errors. Presentation is severely lacking.	
10	**References**	Extensive and relevant references, properly formatted.	Relevant references, mostly properly formatted.	References are relevant but formatting is inconsistent.	Few references, some may be irrelevant or improperly formatted.	
					Total	

APPENDIX D

UNIVERSITI TUNKU ABDUL RAHMAN

FACULTY OF ACCOUNTANCY AND MANAGEMENT

UNDERGRADUATE FINAL YEAR PROJECT

Final Year Project Assessment Form - Report

Final Year Project Title:

Resilience of global challenges: A study of manufacturing resilience in Malaysian manufacturing industry

Name:	Wong Jing Mun	**Student ID:**	2206943

No	Criteria	Excellent (8 - 10 marks)	Good (5 - 7 marks)	Fair (3 - 4 marks)	Poor (0 - 2 marks)	Awarded
1	**Title and Abstract**	Clear, concise, and informative; abstract summarizes all key elements effectively.	Title and abstract are clear but may miss some key elements.	Title and abstract are somewhat unclear or incomplete.	Title and abstract are unclear and do not summarize key elements.	
2	**Introduction**	Comprehensive background and context; clearly stated research question/hypothesis.	Adequate background; some context missing; research question/hypothesis is stated.	Background and context are vague; research question/hypothesis is unclear.	Background and context are missing or inadequate; research question/hypothesis is absent.	
3	**Literature Review**	Extensive review, critical analysis, and synthesis of relevant literature.	Adequate review with some analysis of relevant literature.	Limited review with minimal analysis of relevant literature.	Inadequate or no review of relevant literature.	
4	**Problem Statement & Objectives**	A clear, specific, and well-defined research problem was identified, including its significance and relevance. Clearly defined, specific, and measurable objectives.	Clearly stated problem, but may lack specificity or clarity in its significance. Objectives are stated but may lack specificity or measurability.	Problem statement is present but lacks clarity, specificity, or relevance. Objectives are vague or not well-defined.	The problem statement is unclear or missing. Objectives are absent or unclear.	
5	**Methodology**	Detailed, appropriate methods with clear rationale and feasibility.	Methods are outlined but some details or rationale may be lacking.	Methods are mentioned but lack clarity or rationale.	Methods are unclear, inappropriate, or not stated.	
6	**Results**	Results are clearly presented, well-organized, and thoroughly analyzed.	Results are presented but may lack organization or depth of analysis.	Results are unclear or poorly organized, with limited analysis.	Results are absent, unclear, or inadequately analyzed.	
7	**Discussion**	Insightful interpretation of results, connects to literature, discusses reasons for the findings.	Interpretation of results is present but may lack depth, some connection to literature.	Limited interpretation of results, minimal connection to literature.	Interpretation of results is absent or unclear, no connection to literature	
8	**Conclusion**	Comprehensive conclusion with discussions on implications supported by findings. Suggests future research.	Conclusion is present with key points somewhat summarized. Discussions on implications somewhat supported by findings. Suggests future research.	Weak conclusion, does not effectively summarize findings or suggest future research. Implications irrelevant to findings.	Conclusion is absent or very weak.	
9	**Writing Quality**	Excellent writing, free from errors, clear and professional.	Writing is clear but contains some errors or lacks professionalism.	Writing is unclear in parts, contains errors, and lacks professionalism.	Writing is unclear, contains numerous errors, and is unprofessional.	
10	**References**	Extensive and relevant references, properly formatted.	References are relevant but formatting is inconsistent.	Few references, some may be irrelevant or improperly formatted.	References are absent, irrelevant, or improperly formatted.	
					Total	