RMTB

RESEARCH IN MANAGEMENT OF TECHNOLOGY AND BUSINESS
e-ISSN: 2773-5044

Vol. 7 No. 2 (2026) 205-215
https://publisher.uthm.edu.my/periodicals/index.php/rmtb

# The Relationship between Risk Management Strategies and Supply Chain Resilience in the Face of Disruptions

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DOI: https://doi.org/10.30880/rmtb.2026.07.02.018

**Article Info**

Received: 30 September 2026
Accepted: 01 November 2026
Available online: 31 December 2026

**Keywords**

Risk management, supply chain resilience, supply chain disruptions

**Abstract**

In recent years, global supply chains have faced intensifying disruptions from pandemics, geopolitical tensions, and rapid technological change. These challenges have brought attention to the urgent need for organizations to adopt effective risk management strategies that strengthen supply chain resilience. This study investigates the relationship between risk management strategies and supply chain resilience, focusing on the Electrical and Electronics (E&E) industry in Shah Alam, Malaysia. The respondents consisted of professionals involved in supply chain management, operations, logistics, or related fields. A total of 100 valid responses were collected for data analysis. Researcher applied primary data which focuses on using a quantitative research for this study. Primary data were collected through a questionnaire survey to support the study. By providing insights into effective risk management practices, this research offers valuable guidance for organizations aiming to enhance their supply chain resilience in the face of current and future disruptions. The findings indicate that proactive risk identification and collaboration with supply chain partners show higher levels of implementation and are positively associated with supply chain resilience. Overall, the study provides practical insights for organizations seeking to enhance supply chain resilience through effective risk management practices.

## 1. Introduction

The global supply chain is a critical backbone of modern economies, facilitating the movement of goods and services from production to consumption. Rooted in systems thinking, supply chains are complex networks involving suppliers, manufacturers, logistics providers, and customers. These interconnected entities ensure efficiency and responsiveness across sectors such as manufacturing, electronics, pharmaceuticals, and consumer goods (Stevenson, 2015). In recent years, supply chains have become more vulnerable to disruptions, triggered by events such as natural disasters, pandemics, cyberattacks, and geopolitical conflicts (Dolgui & Ivanov, 2021). The COVID-19 pandemic further exposed global supply chain fragility, causing widespread material shortages, delays, and escalating costs (El Korchi, 2022). To mitigate such risks, organizations have increasingly adopted risk management strategies to safeguard continuity and performance. Supply chain risk management (SCRM) involves identifying, assessing, and addressing potential threats that could hinder supply operations (Sahab & Oulfarsi, 2024). Simultaneously, resilience refers to a supply chain's ability to absorb disruptions, recover to its prior state, or emerge stronger through adaptive strategies. Tools such as supplier diversification, collaboration with partners, inventory buffers, and digital technologies have shown promise in enhancing resilience (Wufron

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& Judijanto, 2024).Given these dynamics, this study investigates the relationship between risk management strategies and supply chain resilience within the Malaysian semiconductor sector, aiming to contribute practical insights into building robust supply systems amid ongoing uncertainties. In recent years, the global supply chain landscape has undergone significant transformations, influenced by various factors such as globalization, technological advancements, and unforeseen disruptions. The COVID-19 pandemic, for instance, highlighted the vulnerabilities within supply chains, causing widespread disruptions across industries (Ivanov & Dolgui, 2021). These events have underscored the importance of developing resilient supply chain systems capable of withstanding and adapting to such challenges. The concept of supply chain resilience has thus gained prominence, emphasizing the need for strategies that ensure continuity and robustness in operations (El Korchi, 2022).

Malaysia, as a pivotal player in the Southeast Asian manufacturing sector, has not been immune to these challenges. The nation's manufacturing industry, particularly in electronics and semiconductors, faced significant setbacks due to supply chain disruptions, including delays in raw material procurement and logistical challenges (MIDA, 2023). These disruptions have prompted Malaysian manufacturers to reevaluate their supply chain strategies, focusing on enhancing resilience and mitigating risks associated with global uncertainties. The Malaysian Investment Development Authority (MIDA) has emphasized the need for adopting advanced technologies and diversifying supply sources to bolster the nation's manufacturing resilience. To address these challenges, organizations are increasingly turning to risk management strategies that encompass proactive planning, supplier diversification, and the integration of digital technologies. The adoption of Industry 4.0 technologies, such as the Internet of Things (IoT), Artificial Intelligence (AI), and blockchain, has been instrumental in providing real-time visibility and enhancing decision-making processes within supply chains (Maheshwari *et al.*, 2023). These technologies enable organizations to anticipate potential disruptions, respond swiftly, and maintain operational continuity. Furthermore, collaborative approaches involving stakeholders across the supply chain have proven effective in building resilience and ensuring a coordinated response to challenges. Despite the growing awareness and implementation of these strategies, many organizations, particularly in developing economies, still face hurdles in fully integrating risk management and resilience practices. A study by Deloitte (2021) revealed that a significant number of firms lack structured frameworks for supply chain risk management, often relying on reactive measures rather than proactive planning. This gap underscores the necessity for further research and development of comprehensive models that can guide organizations in building resilient supply chains. Understanding the interplay between risk management strategies and supply chain resilience is crucial for enhancing the robustness of supply chains, particularly in the face of increasing global uncertainties.

The Malaysian semiconductor industry has been significantly disrupted by recent global events, especially the COVID-19 pandemic. These disruptions exposed critical vulnerabilities such as raw material shortages, labor constraints, and logistical delays, exemplified by the partial shutdown of Bosch’s chip factory in Muar, which impacted major car manufacturers like Tesla and Nissan (Hassan *et al.*, 2023). Beyond the pandemic, ongoing geopolitical tensions, trade restrictions, and scarcity of essential materials like neon and palladium due to conflicts such as the Russia-Ukraine war have further strained supply chains. Trade barriers, such as tariffs and restrictions imposed by leading economies like the United States, have disrupted international supply chains and increased operational costs for local firms. These challenges have revealed that existing supply chain strategies may be insufficient to manage the increasing complexity and unpredictability of global disruptions (Ivanov & Dolgui, 2021; Katsaliaki *et al.*, 2022.). Despite growing awareness of risk management’s importance, there is limited empirical evidence on how specific strategies can enhance supply chain resilience within the Malaysia Electrical and Electronics (E&E) industry (Um & Han, 2021). Without a clear understanding of effective risk management practices, it is difficult to develop tailored policies that strengthen the industry’s ability to withstand and recover from shocks. This study therefore aims to explore the impact of risk management approaches such as supplier diversification, scenario planning, and collaboration on improving supply chain resilience, providing insights to better prepare the Malaysian Electrical and Electronics (E&E) industry for future disruptions (Wang *et al.*, 2024). The aim of this study is to propose the relationship between risk management strategies and supply chain resilience in the face of disruptions, to assess the level of supply chain resilience in the Electrical and Electronics (E&E) industry in Malaysia, and to examine the relationship between risk management strategies and supply chain resilience during disruptions.

## 2. Literature Review

### 2.1 Resilience Theory

Resilience Theory, originally rooted in ecological science, was first introduced by C. S. Holling in 1973 to explain how ecosystems withstand external shocks while maintaining core functions. Over time, the theory has been adapted to various fields, including organizational and supply chain management, where it is used to explore how systems respond to disruptions. In the supply chain context, resilience emphasizes a system's ability not only to recover from unexpected disturbances but also to adapt and evolve in ways that enhance future performance(Mishra *et al.*, 2024). This theoretical lens is particularly relevant for industries exposed to frequent global shocks, such as Malaysia's semiconductor sector. In supply chain management, resilience refers to a system's ability to anticipate risks, prepare for disruptions, and recover rapidly while maintaining operational continuity (Pettit *et al.*, 2010). This approach reframes risk management from being merely reactive to becoming proactive and adaptive. Rather than focusing solely on efficiency, supply chains are now increasingly expected to balance lean practices with resilient structures that can handle volatility. Resilience Theory highlights several core capabilities that firms must develop to thrive under uncertainty. These include robustness (withstanding shocks with minimal impact), agility (responding quickly to change), adaptability (adjusting structures and processes in response to new conditions), and transformability (evolving into a stronger state after a disruption) (Ivanov & Dolgui, 2021). Building these capabilities often involves the use of risk management strategies such as redundancy, supplier diversification, collaboration, and data-driven decision-making. The integration of Industry 4.0 technologies like digital twins, predictive analytics, and real-time monitoring further strengthens these resilience di mensions (Tang & Veelenturf, 2019). The COVID-19 pandemic illustrated how firms with resilience-oriented cultures and systems recovered more effectively than those focused solely on cost minimization. For example, (Chowdhury *et al.*, 2024), found that companies with proactive risk identification and collaboration frameworks in place responded faster and more flexibly to supply disruptions. In the Malaysia's manufacturing landscape, where semiconductor firms face global supply volatility, implementing resilience theory offers strategic value. It enables organizations to assess, plan, and respond in ways that reduce vulnerability and improve long-term competitiveness. This study therefore adopts Resilience Theory as a foundation for examining how risk management strategies impact supply chain resilience in the Malaysia Electrical and Electronics (E&E) industry.

#### 2.1.1 Supply Chain Resilience

Supply chain resilience is becoming one of the essential components in today's business operations due to the rising uncertainties and unpredictable disruptions across global markets. It is commonly defined as the capability of a supply chain to recover from adverse events and continue operating effectively despite external or internal shocks (Wieland & Durach, 2021). The concept is crucial for companies, especially in high-risk industries such as the semiconductor sector, where even a minor disruption may result in substantial delays or financial losses. According to (Jüttner & Maklan, 2011) resilience within a supply chain is typically characterized by four key capabilities which include flexibility, velocity, visibility, and collaboration. These elements allow organizations to anticipate risks, react promptly, and adapt strategies to uphold supply chain continuity. Moreover, resilience not only supports a company's short-term recovery but also enhances its long-term sustainability and competitiveness. From a business perspective, the implementation of resilience strategies helps to minimize customer dissatisfaction, reduce operational downtime, and maintain stable production flows (Aslam *et al.*, 2020). As pointed out by (Hallikas *et al.*, 2021), resilient supply chains tend to be more efficient in risk response planning, leading to improved agility and performance. In view of this, it is essential for organizations to embed resilience as part of their supply chain strategy. For instance, companies that invested in resilient practices during the COVID-19 pandemic were able to respond faster and maintain service levels compared to those who did not. Thus, resilience in the supply chain has become a fundamental factor in ensuring business continuity and achieving long-term growth in today's competitive and volatile environment.

#### 2.1.2 Supply Chain Disruptions

Disruptions refer to unexpected events that interrupt the regular flow of goods, services, or information in a supply chain. These events can come from natural disasters, pandemics, political issues, or sudden policy changes, all of which may cause delays, higher costs, and loss of control in operations (Ivanov, 2020). As noted by (Lv *et al.*, 2024), disruptions often occur without warning, spread quickly across networks, and reduce a company's ability to respond effectively. The outbreak of COVID-19 exposed serious weaknesses in many global supply chains. However, even in the post-pandemic period, new types of disruptions have continued to emerge. For example, the Russia-Ukraine war has affected the global supply of key raw materials such as palladium and neon, which are essential in Electrical and Electronics (E&E) industry (Xiong *et al.*, 2025). In addition, trade barriers and tariff changes, particularly those driven by the United States, have disrupted supplier networks and

increased operational costs (Freund *et al.*, 2024). Political instability and poor infrastructure in some developing regions have also made supply chains more vulnerable. These disruptions do not only affect production lines but also influence planning and decision-making. Companies may struggle with forecasting demand, maintaining stable inventory, or securing key supplies. According to (Wieland & Durach, 2021), even a short-term disruption can lead to long-lasting financial and reputational damage, especially if the company is not well-prepared. In high-tech industries like E&E, even minor issues can have serious ripple effects on downstream sectors such as automotive and electronics (Raposo García, 2022). Therefore, companies must better understand the sources and impacts of disruptions in order to build a stronger and more flexible supply chain. As stated by (Akhavan & Philsoophian, 2023), investing in adaptive and responsive strategies is essential for managing uncertainty and preparing for future challenges.

## 2.2 Risk Management Strategies

### 2.2.1 Diversification

Diversification in supply chain management refers to the deliberate expansion of sourcing, production, and distribution channels across multiple suppliers, regions, or products. Supply chain diversification can improve the ability of firms to cope with supply chain disruptions and risks (Yin & Ran, 2022). For example, supply base diversification can help firms to avoid production shutdowns due to supply interruptions. Previous research has demonstrated the ability of supply chain diversification to address the risk of supply chain disruption. A diversified supply chain base can improve the operational flexibility of firms and help firms promptly meet the needs of the market and customers. This approach reduces dependency on a single node and mitigates systemic risks such as geopolitical disruption or localized failures. Lin *et al.* (2021) stated that supply chain diversification enhances firms' ability to withstand and recover from shocks, improving overall resilience and flexibility. Diversification is widely recognized as a strategic pillar for enhancing supply chain resilience, as it reduces dependency on any single supplier, market, or logistics path. By diversifying sources of supply, production locations, and distribution networks, firms create multiple fallback options that reduce the risk of total system failure during disruptions (Huo *et al.*, 2024). Research has shown that diversification significantly enhances a supply chain's ability to respond and recover quickly from unexpected shocks such as natural disasters, geopolitical instability, or pandemics. A study by Brandon-Jones *et al.* (2014) found that organizations with diversified supply sources exhibited stronger operational continuity and faster post-disruption recovery (Brandon-Jones *et al.*, 2014) . This relationship highlights that diversification acts as a structural safeguard, particularly in globalized and complex supply networks. As discussed earlier, diversification enhances supply chain flexibility and reduces the risk of complete failure during disruptions by providing alternative sources of supply, manufacturing, and logistics. Firms that adopt diversification strategies are more likely to recover quickly and maintain operations during uncertainty. Therefore, the following hypothesis is proposed:

H1: Diversification has a positive and significant relationship with supply chain resilience.

### 2.2.2 Redundancy

Redundancy in the context of supply chain management refers to the deliberate incorporation of excess capacity or backup resources to safeguard operations against unexpected disruptions. This includes maintaining safety stock, multiple or backup suppliers, excess production capacity, and alternative transportation routes or facilities. These redundancies serve as structural buffers that absorb the shock when a disruption occurs, preventing the entire supply chain from stalling (Kamalahmadi *et al.*, 2022). Unlike flexibility, which emphasizes rapid adaptation, redundancy focuses on stability through preparedness. It may come with additional costs, such as storage or supplier management expenses, but it can significantly reduce recovery time and minimize operational downtime. In high-risk sectors like semiconductor manufacturing, where time-sensitive production is critical, redundancy ensures continuity and performance even under stress. Redundancy is a key contributor to supply chain resilience as it provides buffer capacity in the form of safety stocks, excess inventory, spare production capacity, or alternate suppliers and routes. These redundant resources enable firms to maintain critical operations during disruptions and allow faster recovery without sacrificing service levels. Empirical findings suggest that firms adopting redundancy strategies are better equipped to withstand shocks, particularly in sectors where lead times and continuity are crucial. According to (Kamalahmadi & Parast, 2016), redundancy directly improves both the robustness and resilience of supply chains, especially in manufacturing environments. However, they also note that redundancy must be optimally managed to avoid excessive cost burdens. Redundancy contributes to resilience by providing buffer capacity in the form of excess inventory, backup suppliers, or contingency plans. This allows organizations to absorb shocks and continue operations even when primary systems are affected. In view of this, the second hypothesis is developed:

H2: Redundancy has a positive and significant relationship with supply chain resilience.

### 2.2.3 Collaboration With Supply Chain Partners

Collaboration in a supply chain relates to the capability of two or more autonomous firms to work effectively together, planning and executing supply chain operations toward common goal (Cao *et al.*, 2010). Collaboration entails strategic partnerships among supply chain stakeholders—including suppliers, logistics providers, and customers to share information, coordinate actions, and jointly manage risks. For example, supply chain collaboration enables the development of synergies among partners, facilitates joint planning and encourages real-time information exchange required to prepare for, respond to and recover from supply chain disruptions while reducing their impact (Scholten & Schilder, 2015). Effective collaboration strengthens resilience by improving visibility, trust, and coordinated response during disruptions. The literature recognizes collaboration as a key enabler of supply chain resilience and rapid recovery. Collaboration with supply chain partners is a foundational component of building a resilient supply chain. Strong inter-organizational relationships promote transparency, real-time information sharing, joint risk assessments, and coordinated responses to disruptions. Collaborative strategies enable firms to pool resources, align contingency plans, and jointly manage uncertainties. Scholten and Schilder (2015) demonstrated that collaborative practices significantly enhance a supply chain's adaptive capacity and flexibility, leading to higher resilience levels (Scholten & Schilder, 2015). Their study emphasized that trust and communication between partners are essential to the effectiveness of these collaborations, especially during turbulent periods such as economic downturns or natural disasters. Collaboration enhances resilience through shared information, aligned responses, and mutual support among partners. Firms that invest in strong supply chain relationships are more agile and adaptable when facing disruptions. Accordingly, the third hypothesis is proposed:

H3: Collaboration with supply chain partners has a positive and significant relationship with supply chain resilience.

### 2.2.4 Proactive Risk Identification

Proactive risk identification is the process of detecting emerging threats before they materialize into disruptive events. By leveraging tools such as early-warning systems, scenario simulations, and continuous risk monitoring, firms can anticipate and address vulnerable points in the supply chain. This forward-looking practice is foundational to effective supply chain risk management and resilience building. By identifying these causative events and their causal relationship, businesses can adopt a more proactive approach to risk management. This proactive stance is central to the proposed framework, which utilizes the concept of cause and effect to systematically identify contributing events to a risk. Through this approach, it becomes possible to not only identify but also quantify or assess the likelihood of the main risk event occurring, enabling more effective mitigation strategies (Shahsavari *et al.*, n.d.). Proactive risk identification enhances supply chain resilience by enabling organizations to detect potential threats early and implement mitigation measures before they escalate into major disruptions. This involves continuous monitoring of internal and external environments, conducting risk assessments, and developing contingency strategies. Research indicates that firms that engage in proactive risk identification are better prepared to respond swiftly and effectively when disruptions occur. According to Ho *et al.* (2015), proactive risk management practices contribute to organizational resilience by improving agility, foresight, and responsiveness. The study underscores that early risk detection is a critical precursor to building resilient and disruption-ready supply chains. Proactive risk identification equips firms with early warning capabilities and facilitates better preparedness against disruptions. Organizations that detect and respond to potential risks early are more resilient in dynamic environments. Hence, the final hypothesis is formulated as follows:

H4: Proactive risk identification has a positive and significant relationship with supply chain resilience.

## 2.3 Research Framework

This study is grounded in Resilience Theory, which focuses on an organization's ability to anticipate, absorb, adapt to, and recover from disruptions. In the context of supply chain management, resilience theory provides a framework to understand how firms can build capabilities such as diversification, redundancy, collaboration, and proactive risk identification to respond effectively to unexpected events. Applying this theory allows the research to explore how semiconductor firms in Malaysia strengthen their supply chain resilience through strategic risk management practices.

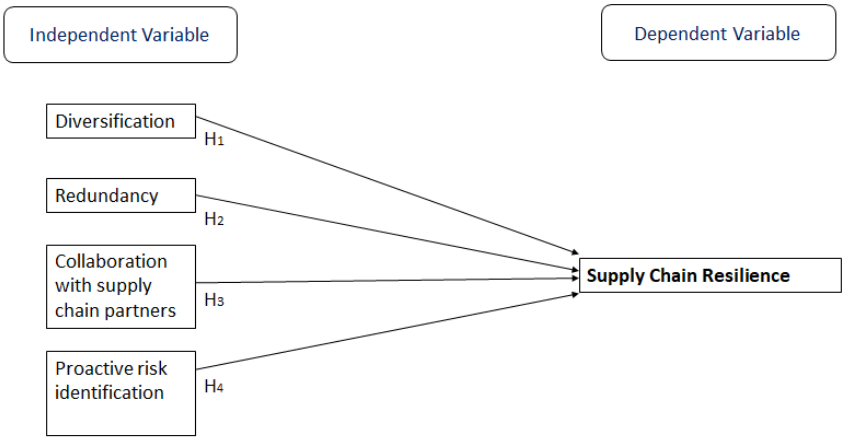



**Fig. 1** *Research framework*

## 3. Research Methodology

### 3.1 Research Design

The purpose of this study is to explore the relationship between risk management strategies and supply chain resilience within the Electrical and Electronics (E&E) industry in Shah Alam, Malaysia. This research intends to understand how various risk management approaches contribute to enhancing the resilience of supply chains in this specific industrial context. The type of investigation used is in this research correlational study delineates the important variables associated with the problem which determines the relationship between independent variables and dependent variable. Besides, there will be only a minimal researcher interference in this study as the researcher is simply focus on collecting and analyzing existing data rather than directly altering the risk management strategies or the supply chain resilience. Researcher is gathering the data and information by using quantitative method through online surveying which distribute questionnaires via Google Form. The questionnaire consists of parts which are Section A, B, C, D and F that mentioned part of demographic, questions related risk management strategies and supply chain resilience.

### 3.2 Population and Sampling Design

The target population of this study comprises employees involved in supply chain management, operations, or risk-related roles within Electrical and Electronics (E&E) industry located in Shah Alam, Malaysia. The target population of this study comprises employees involved in supply chain management, operations, or risk-related roles within Electrical and Electronics (E&E) industry located in Shah Alam, Malaysia. Shah Alam hosts approximately 40 to 60 electronics and electrical (E&E) companies, making it a suitable location for this study. A total of 100 respondents were selected to participate in the questionnaire survey. Purposive sampling was applied to ensure that respondents possess relevant experience in risk management strategies within the supply chain context. This study adopts a non-probability sampling design, specifically purposive sampling, as the respondents were deliberately selected from the Electrical and Electronics (E&E) industry in Shah Alam, Malaysia based on their relevance to the research objectives. This approach is appropriate due to time constraints and the need to obtain data from respondents with relevant industry experience.

### 3.3 Research Instrument

There are three main sections in the questionnaire which includes Section A, B, C, D and F that basically focus on the relationship between risk management strategies and supply chain resilience in the face of disruptions among Electrical and Electronics (E&E) industry in Johor. Section A consists of the demographic profile of respondents which enquired the questions of industry type, company size, position and years of experience in supply/risk management. While Section B, C, D and E is related to the independent variables which risk management strategies apply in Electrical and Electronics (E&E) industry. Meanwhile, Section C is concentrated on the dependent variable which is supply chain resilience in the industry. Table 1 shows the details of instruments used in this study.

**Table 1** *Research Instrument Questionnaire*

| Section | Category | Number of Key Questions |
|---|---|---|
| A | Respondent Background | 4 |
| B | Diversification | 5 |
| C | Redundancy | 5 |
| D | Collaboration with supply chain partners | 5 |
| E | Proactive Risk Identification | 5 |
| F | Supply Chain Resilience | 5 |

Although secondary data can be used to support the research, it is insufficient to generate valid and reliable conclusions without the inclusion of primary data. In general, primary data may be obtained through various methods such as surveys, observations, questionnaires, interviews, focus group discussions, case studies, experiments, diaries and other related techniques. Therefore, this study adopts questionnaires as the main primary data collection method to gather relevant information directly from the respondents. Primary data was considered essential to ensure the accuracy and relevance of findings tailored to the research objectives. The adoption of secondary data has saved researcher time and reduced costs when acquiring the information during the process of research. More specifically, the data can be obtained from various types of sources such as Science Direct, Google Scholar, Springer, Scopus, government websites, books, articles, journals, and so forth. The researcher uses the data and information obtained to have a better understanding and conduct further research. Additional information was obtained from the Department of Statistics Malaysia (DOSM) to understand the national context of manufacturing and supply chain operations. These sources contributed to a deeper understanding of risk management practices and the adoption of Industry 4.0 technologies in Malaysia's Electrical and Electronics (E&E) industry (Yeap *et al.*, 2024). All data collected was recorded with the purpose to investigate the relationship between risk management strategies and supply chain resilience in the face of disruptions.

## 3.4 Data Analysis

This study applies quantitative data analysis as the findings obtained from statistical analysis are expected to support the relationships between the independent and dependent variables. To ensure the accuracy and reliability of the research results, descriptive statistics and correlation analysis are employed in this study using the Statistical Package for Social Sciences (SPSS) software. Descriptive statistics are conducted to examine the data for any potential violations of assumptions underlying the statistical techniques used to address the research questions. In addition, descriptive analysis aims to summarize and simplify the interpretation of data collected through questionnaires, allowing a clearer understanding of respondents' characteristics and overall response patterns. The Kolmogorov-Smirnov test and Shapiro-Wilk test are used to assess the normality of the data by comparing the research sample to a normal distribution with the same mean and standard deviation. The main purpose of conducting normality tests in this study is to ensure that appropriate statistical methods are applied and to support accurate inference based on the data obtained. Correlation analysis is applied to examine the relationship between the independent variables and the dependent variable in this study. This analysis helps to determine the strength and direction of the relationships between the selected risk management strategies and supply chain resilience.

# 4. Results and Discussion

## 4.1 Reliability Analysis

Reliability analysis was conducted to assess the internal consistency of the independent variables for pilot study with 51 samples. The Cronbach's alpha values for the four variables which are diversification, redundancy, collaboration with supply chain partners, and proactive risk identification were 0.859, 0.812, 0.871 and 0.828, respectively, indicating acceptable reliability. The overall Cronbach's alpha for all variables was 0.932, suggesting that the set of variables is suitable for further analysis. The actual study's Cronbach's alpha values for the four variables with 100 samples which are diversification, redundancy, collaboration with supply chain partners, and proactive risk identification were 0.886, 0.859, 0.895 and 0.855, respectively, indicating acceptable reliability. The overall Cronbach's alpha for all variables was 0.952, suggesting that the set of variables is suitable for further analysis.

## 4.2 Demographic Analysis

A total of 120 questionnaires were distributed to industry participants, of which 100 valid responses were collected, resulting in a response rate of 83.33%. The respondents were drawn from a wide range of sectors

within the electrical and electronics (E&E) industry. The largest group of respondents was from the consumer electronics sector (16%), followed by electrical equipment (14%), semiconductor/IC (13%), electronic components (13%), and electronic assembly/EMS (13%). Other sectors represented include display technology (11%), industrial electronics/automation (8%), power electronics (5%), LED/lighting (4%), and printed circuit board (PCB) fabrication (3%). This distribution indicates that the sample reflects a diverse range of E&E industry segments. In terms of company size, the majority of respondents (63%) were employed in organizations with 100–499 employees. This was followed by firms with 1,000 or more employees (15%), 500–999 employees (13%), and companies with fewer than 100 employees (9%). This suggests that most respondents are working in small to medium-sized enterprises (SMEs), with representation from larger organizations as well. Regarding job position, managers formed the largest group (37%), followed by general managers (26%), senior managers (24%), and executives (13%). The distribution indicates that the majority of respondents hold managerial or decision-making roles, which is appropriate for a study focusing on risk management strategies. In terms of working experience, more than half of the respondents (51%) reported having 2–5 years of experience, followed by 6–10 years (27%), less than 2 years (13%), and more than 10 years (9%). This indicates that most respondents possess sufficient industry experience to provide informed insights into supply chain risk management practices.

## 4.3 Descriptive Analysis

Descriptive analysis was conducted to assess the level of supply chain resilience among respondents in the semiconductor industry in Malaysia. Table 2 presents the mean and standard deviation for the items measuring supply chain resilience. The results show that the overall mean score for supply chain resilience is [M =4.35], with a standard deviation of [SD = 0.0541], indicating a high level of resilience among the surveyed organizations. This suggests that the respondents generally perceive their organizations as capable of responding to, recovering from, and adapting to supply chain disruptions.

**Table 2** *Mean result of supply chain resilience*

| No | Statements | Mean | Standard deviation | Level |
|---|---|---|---|---|
| 1 | Our supply chain can quickly adjust its operations when disruptions occur. | 4.36 | 0.674 | High |
| 2 | Our company can reconfigure resources and processes to continue operations during disruptions. | 4.31 | 0.647 | High |
| 3 | Our company's supply chain can maintain its service levels despite unexpected disruptions. | 4.36 | 0.704 | High |
| 4 | Our company is able to recover quickly after a major supply chain disruption. | 4.38 | 0.678 | High |
| 5 | Our supply chain can adapt to long-term changes in the business environment. | 4.34 | 0.714 | High |

## 4.4 Correlation Analysis

The Kolmogorov-Smirnov test showed that the data were not normally distributed ($p < 0.05$). Hence, non-parametric analysis using Spearman's rho was employed. Correlation analysis using Spearman's rho (refer Table 3) indicated that redundancy ($r = 0.734$, $p < 0.001$), collaboration with supply chain partners ($r = 0.726$, $p = 0.033$), proactive risk identification ($r = 0.655$, $p = <0.01$) have significant positive relationships with supply chain resilience.

**Table 3** *Nonparametric correlation*

| Variable | Supply chain resilience |
|---|---|
| Diversification | 0.556** |
| Redundancy | 0.457** |
| Collaboration with supply chain partners | 0.539** |
| Proactive risk identification | 0.587** |

** Sig (2-tailed) p at <0.001

**Table 4** *Summary of the results of hypothesis testing*

| Hypothesis | Results |
|---|---|
| H1: Diversification has a positive and significant relationship with supply chain resilience. | Supported |

| | |
|---|---|
| H2: Redundancy has a positive and significant relationship with supply chain resilience. | Supported |
| H3: Collaboration with supply chain partners has a positive and significant relationship with supply chain resilience. | Supported |
| H4: Proactive risk identification has a positive and significant relationship with supply chain resilience. | Supported |

Based on the descriptive analysis, the findings indicate that the level of supply chain resilience among respondents in the Malaysian semiconductor industry is generally moderate to high. This suggests that organizations are implementing capabilities to respond, recover, and adapt to disruptions, aligning with recent research that highlights the importance of flexible strategies in enhancing supply chain resilience (Paul & Saha, 2025). Moreover, risk management strategies have been recognized as key enablers of resilience in environments characterized by uncertainty and complex risk profiles (Wu *et al.*, 2025). These results support the achievement of Objective 1 by demonstrating that supply chain resilience is not only acknowledged but actively practiced within the industry context. The correlation analysis indicates that risk management strategies are positively associated with supply chain resilience, suggesting that organizations with stronger risk management practices tend to demonstrate higher resilience against disruptions. This finding aligns with recent literature showing that proactive approaches such as supplier diversification, redundancy mechanisms, strategic collaboration, and early risk identification are fundamental components of building resilient supply chains (Roshani *et al.*, 2024). Similarly, effective risk mitigation strategies have been found to enhance organizational resilience capability by enabling firms to better absorb and recover from uncertainties and external shocks (Han & Um, 2024). These results support the achievement of Objective 2 and reinforce the view that integrated risk management practices play a critical role in strengthening supply chain robustness and adaptability in dynamic industrial environments.

## 5. Conclusion

In conclusion, this study demonstrates that supply chain resilience among organizations in the Malaysian semiconductor industry is generally at a moderate to high level. The findings indicate that organizations have developed various capabilities to respond to, recover from, and adapt to supply chain disruptions. The correlation analysis further shows that key risk management strategies, namely diversification, redundancy, collaboration with supply chain partners, and proactive risk identification, have positive and significant relationships with supply chain resilience. These findings highlight the importance of adopting an integrated approach to risk management in strengthening the ability of organizations to withstand uncertainties and disruptions. Overall, the study confirms that effective risk management practices contribute significantly to the development of a more resilient supply chain within the Malaysian semiconductor industry. Organizations should therefore continuously strengthen their risk identification, mitigation, collaboration, and resource management practices to improve their preparedness for future disruptions. Although the study is subject to limitations related to sample size, self-reported data, and generalizability, its findings provide useful insights for both practitioners and researchers. Future studies could expand the scope and sample size and incorporate qualitative approaches to provide a deeper understanding of risk management strategies and supply chain resilience across the wider Malaysian E&E industry.

## Acknowledgement

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

## Conflict of Interest

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

## Author Contribution

*The authors confirm contribution to the paper as follows:* ***study conception and design:*** *Chow Xin Ying, Siti Anisah Atan;* ***data collection:*** *Chow Xin Ying;* ***analysis and interpretation of results:*** *Chow Xin Ying, Siti Anisah Atan;* ***draft manuscript preparation:*** *Chow Xin Ying, Siti Anisah Atan. All authors reviewed the results and approved the final version of the manuscript.*

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