INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN PROGRESSIVE EDUCATION & DEVELOPMENT

OPEN ACCESS JOURNAL

Vol 13, Issue 4, (2024) E-ISSN: 2226-6348

Post-Covid Impact on Supply Chain Risk Management: A Case Study of a Semiconductor Company

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To Link this Article: http://dx.doi.org/10.6007/IJARPED/v13-i4/23473 DOI:10.6007/IJARPED/v13-i4/23473

Published Online: 03 November 2024

Abstract

Purpose – This study examines the impact of the COVID-19 pandemic on the operations and supply chains of a semiconductor firm, as well as the risk management practices implemented by the company to address these challenges.

Design/methodology/approach – A case study of a semiconductor company was used in this research. Data was gathered through interviews with key members of the organisation specifically those related with supply chain and risk management.

Findings The company experienced major disruptions due to the health pandemic, which had a significant impact on workforce availability and product demand. As a result, there were production slowdowns and delays, material shortages, and increased costs. The company has implemented robust risk management measures to address these challenges. This includes diversifying its supplier base, enhancing supplier evaluation, and improving inventory management. The company implemented advanced technologies to enhance its supply chain risk management. The use of these technologies have greatly improved communication, efficiency, and adaptability, which has resulted in increased resilience in the face of current and future disruptions.

Research limitations/implications – The research is based on a single organization, thus, limiting the generalizability of the findings.

Originality/value – The study provides empirical data from a case study of a semiconductor company, offering a detailed examination of the company's risk management strategies during the post-pandemic period. It also highlights the critical role of technology and digitization in mitigating supply chain risks and ensuring visibility amidst ongoing uncertainties.

Keywords Post-Covid, Risk Management, Supply Chain, Semiconductor Company, Resilience, Pandemic, Qualitative Research.

Introduction

In 2024, the global semiconductor market was valued at around USD 611.23 billion and it is expected to reach to USD 611.23 billion by 2033 (Statista, 2024). Semiconductors are integral

to the operation of numerous essential products and processes, making the semiconductor industry a critical component of the global economy (Singh et al., 2024). However, the sector is highly vulnerable to supply chain risks. For example, the 2011 Japanese earthquake and tsunami caused substantial losses, as many electronics manufacturing facilities were damaged (Kt & Sarmah, 2021). These shutdowns resulted in a significant worldwide disruptions lasting several months (Kt & Sarmah, 2021). During the recent period, the global supply chains have faced significant challenges due to the COVID-19 pandemic. This has led to adverse financial consequences for numerous companies, including those operating in the semiconductor industry (Duong et al., 2022; Hasan et al., 2022).

The post-pandemic era has seen further disruptions exacerbated by geopolitical conflicts and war. As global supply chains become more complex, geographically dispersed, and vast in reach, companies are compelled to implement strategies that effectively manage risks while maintaining agility to respond to market demands (Bak, 2018; Khan and Creazza, 2009; Wieland and Wallenburg, 2012). The adoption of effective risk management strategies is thus crucial for organizational resilience.

Supply chain risk management include the identification of potential risks that could potentially interrupt operations, evaluating their probability and consequences, and formulating solutions to mitigate their impact (Wang et al., 2020). The objective is to minimize the negative effects of risk events on overall supply chain performance (Habani & Kamaruddin, 2021). Companies that successfully implement such strategies can reduce disruptions, lower costs, improve operational efficiency, and gain a competitive advantage. Research further supports that in the Industry 4.0 era, effective risk management is critical for maintaining competitiveness (Wang et al., 2020). Thus, post-pandemic success depends on enhancing operational resilience and accelerating end-to-end digital transformation (Duong et al., 2022).

This paper focuses on the semiconductor sector due to its complex global supply chains, distinct market dynamics, and heavy reliance on technology. It explores three key areas: (i) the impact of the COVID-19 pandemic on the case organisation operations and supply chains, (ii) the major risks that emerged in supply chains during the post-COVID period, and (iii) how risk management strategies, particularly through the adoption of new technologies, have evolved in response to these challenges. By examining these issues, the study aims to provide insights into how semiconductor companies can better prepare for future disruptions, ensuring both the sustainability of their supply chains and the resilience of their business operations.
The structure of the paper is as follows: the next section reviews the literature, focusing on risk management in supply chains. The research approach is outlined in the following section. A discussion of the research findings and their implications is then presented. The paper concludes by addressing the study's limitations and the need for further research in this area.

Literature review

The COVID-19 pandemic significantly impacted supply chain management across various industries (Hasan & Bellenstedt, 2022; Baveja et al., 2020). Lockdowns and government-imposed restrictions directly disrupted supply chains and operations, creating widespread challenges (Baveja et al., 2020). These disruptions affected micro, small, and medium-sized

enterprises (SMEs), leading to reduced production outputs (Prambudi et al., 2022). A survey of supply chain employees in Belgium and Germany further revealed that the pandemic caused substantial supply chain interruptions, impacted the performance of semiconductor companies (Hasan & Bellenstedt, 2022).

In a broader context, Fonseca and Azevado (2020) examined the pandemic's global supply chain impacts, emphasizing how these disruptions could shape post-COVID-19 operational performance. Their research suggests that companies prioritizing risk mitigation and enhancing operational performance are more likely to thrive. Additionally, the pandemic has triggered a shift in global value chains, with certain countries now prioritizing regional value chains over production efficiency (Srivastava et al., 2022). This transformation, combined with economic downturns and semiconductor shortages, has been particularly detrimental to various industries. Several studies have highlighted the importance of resilience, long-term sustainability, and adaptability in maintaining supply chain functionality during global crises.

The main goal of supply chain risk management is to identify possible sources of risk and develop strategies to minimise those risks (Kt & Sarmah, 2021). Various scholars advocate for a comprehensive approach to risk management in supply chains, particularly during crises (e.g., Blair et al., 2022; Bloom & Schoenherr, 2011; Colicchia and Strozzi, 2012; Mohammad & Khan, 2022). The geopolitical, logistical, and natural disaster risks impacting the semiconductor supply chain have necessitated more robust mitigation strategies (Mohammed & Khan, 2022). This need became particularly evident during the COVID-19 pandemic, which fundamentally altered the nature of risks faced (Blair et al., 2022).

Empirical studies highlight the importance of holistic supply chain risk management. For instance, Qiao & Zhao (2023) examined how supply chain risk management (SCRM) capabilities affect supply chain financing performance for SMEs in China. Their findings suggest that strong SCRM capabilities positively influence supply chain financing performance, with these effects varying based on the degree of supply chain integration. Similarly, Colicchia and Strozzi (2012) emphasized the necessity of a holistic approach to knowledge development within SCRM to promote sustainability.

Blair et al. (2022) underscored the increased complexity of risk management processes during a pandemic, noting that these risks are harder to identify and measure, rendering previous experiences less useful for comparison. Conventional risk management methods typically rely on historical data to classify and assess risks based on pre-established criteria, such as potential consequences for the company. Blair et al. (2022) stress the importance of "horizon scanning," where key organizational figures actively monitor external environments for signals of potential disruptions to business operations. In alignment with this, Blome and Schoenherr (2011) recommend that businesses adopt a holistic approach to managing supply chain risks, particularly by improving their methods for identifying and mitigating financial risks during crises.

Kt and Sarmah's (2021) research on the Indian electronics industry highlights the significance of systematic supply risk management (SRM), focusing on effective risk identification, assessment, reduction, and continuous monitoring as key components of the SCRM process.

Several studies have explored the impact of the pandemic on supply chains and recommend risk management strategies. Arunmozhi et al. (2021) analyzed the effects of the pandemic on semiconductor product demand, taking into account factors such as infection waves and government policies, and emphasized the need for adaptive risk management strategies to address supply chain disruptions in the semiconductor industry. Hasan et al. (2022) examined the effects of supply chain disruptions on a semiconductor company's financial performance

during the pandemic. Their study analyzed the impact of these disruptions on quarterly financial outcomes and proposed industry-specific risk mitigation strategies. Additionally, Chang & Wu (2021) explored the role of financial flexibility in managing enterprise risk within Taiwan's semiconductor industry, concluding that financial flexibility is crucial for enhancing firm performance during the pandemic.

Research Method

This research employs a case study approach, specifically utilizing qualitative methods through interviews, to examine the post-COVID-19 impacts on risk management within the supply chain of a semiconductor company. Qualitative methods, such as in-depth interviews, provide rich and detailed insights into the phenomena under study. The case organisation was chosen for its strong risk management strategy and excellent reputation in the semiconductor industry. The company has received industry recognition, awards, and certifications for its supply chain management and risk mitigation efforts.

Background of the Case Organization

The organization under study is Nex Innovate (a pseudonym), which specializes in developing hardware and software tools for engineers and scientists. Known for its solutions in test and measurement, automation, and embedded systems, Nex Innovate has been operating in Malaysia since the mid-2000s. This site is the company's third-largest operational facility and hosts one of its largest research and development centers outside of its headquarters in the United States. The company employs approximately 1,000 individuals..

Data Collection and Analysis

For this research, seven key informants were chosen based on two important factors: (1) the interviewees were key members of their company and have a thorough knowledge of the supply chain; thus, having some level of direct or indirect involvement in the management or oversight of the supply chain within their organisations. The details of those interviewed is shown in Table 1.

Table 1.0
Details of the Respondents

No.	Position	Years in Company	Key Responsibilities
1	Manufacturing Manager	12	Oversees the production processes within a manufacturing facility
2	Operations Manager	10	Manages overall operational aspects of the organization, including both manufacturing and non-manufacturing functions
3	Supply Chain Manager	5	Manages end-to-end supply chain activities, including strategic planning, procurement, logistics, and distribution
4	Procurement Manager	8	Manages the sourcing of materials and negotiates contracts with suppliers
5	Warehouse Lead	3	Manages inventory and storage of materials within a warehouse
6	Production Lead	11	Supervises the production processes, ensuring timely and quality manufacturing of products
7	Shipping Lead	7	Coordinates outbound logistics and ensures timely and accurate deliveries of products

The data was collected in October 2023 with six face-to-face were conducted with the key respondents except with Manufacturing Manager. As for the Manufacturing Manager out for business travel, a virtual interview was done. The data collection and analysis were guided on Ritchie and Brindley (2007)'s Supply Chain Risk Management Framework as shown in Figure 3.

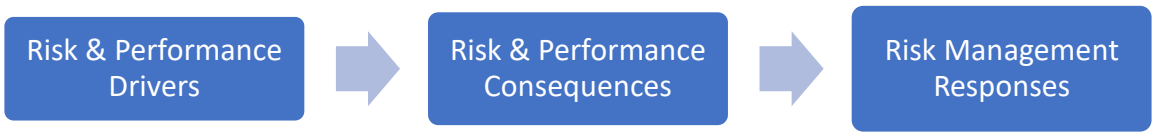

Figure 3. Supply Chain Risk Management Framework
Source: Ritchie and Brindley (2007)

As such, the issues discussed during the interviews mainly related to the following: (i) the role and experience of the respondent and their company in supply chain management, (ii) the impact of COVID-19 on supply chain operations and the major challenges faced during the post-COVID period, (iii) key risks and vulnerabilities in the company's supply chain post-COVID, along with the adaptation of risk management strategies, (iv) engagement with suppliers to mitigate risks during the pandemic, and (v) how technology and digitization have been leveraged for risk management and supply chain visibility post-COVID.

This framework is primarily focused on the factors that drive risk and performance, as well as the resulting consequences and risk management strategies. The elements of the framework are as follows:

(i) Risk & Performance Drivers - The process of identifying the drivers in this study are the impacts of the pandemic in the supply chain operations in semiconductor company.

(ii) Risk & Performance Consequences- The process of evaluating the drivers will yield in assessment risk and performance consequences for the organization where the consequences are to the key risks emerged in the supply chain in the post-COVID period.
(iii) Risk Management Responses -The process of evaluating the consequences will yield in risk management responses where the focus will be on the organization adaptation of its risk management strategies in response to the challenges posed by the pandemic.

The data analysis was coded and structured into three key themes, following the Ritchie and Brindley (2007) supply chain risk management framework. The first theme focused on identifying risks and performance drivers, with a particular emphasis on analysing the impact of health pandemics on supply chain operations. The second theme assessed the consequences of these risks and performance drivers, through an examination of key risks that emerged in the supply chain during the post-COVID-19 period. Finally, the third themes focuses on organizational responses to risk management, analysing how companies adapted their risk management strategies in response to the challenges posed by the pandemic. This also included the analysis of how technology and digitization were employed by the organisation to enhance its risk management and improve supply chain visibility.

Findings

The global health pandemic has profoundly affected the case organization's supply chain operations, revealing vulnerabilities and challenges across multiple areas, in warehousing, production floor, procurement, machinery sustainability.

(i) Disruptions in Transportation and Material Supply

Lockdowns and other safety measures disrupted transportation networks, causing significant delays in receiving essential raw materials and components. These delays led to shortages, production halts, increased procurement costs, and revenue losses. The ripple effects of these disruptions created a challenging environment for maintaining operational flow.

(ii) Workforce Disruption and Operational Continuity Challenges

Workforce availability became a major issue due to illness, mandatory quarantines, and the adoption of remote work policies. Social distancing and enhanced health protocols further strained operations, forcing the company to quickly adapt. The reduction in workforce capacity had a direct impact on production continuity, necessitating agile strategies to cope with these changes as commented by the Production Lead

"Workforce disruptions due to illness or quarantine are hitting us hard. It's directly impacting our operational continuity, and we're having to come up with agile strategies to adapt to the ever-changing dynamics of our workforce."

(iii) Machinery Depreciation and Maintenance

Machinery sustainability emerged as a critical issue during production halts, with equipment depreciation rates increasing and return on investment (ROI) falling. Strategic planning for long-term machinery resilience became essential to safeguard future production capabilities. The Operations Manager highlighted the issues

The pandemic has really taken a toll on our operational efficiency. We've seen a noticeable increase in the depreciation value for machinery and a reduction in the return on investment (ROI) for our facilities. . . The paramount challenge we're facing is ensuring the sustainability of our machinery, especially during production halts. We need strategic planning for long-term machinery resilience amid these ongoing disruptions

(iv) Procurement Challenges and Price Volatility

Global supply chain disruptions and increased demand for specific components introduced volatility into procurement operations. Price fluctuations and material shortages complicated procurement strategies, pushing the company to develop agile and responsive approaches to ensure a consistent flow of materials amidst uncertainty. As the Supply Chain Manager observed:

The ripple effect has been quite significant with prolonged lead times and component shortages have driven up prices for the components we need to purchase. And to make matters worse, transportation disruptions have resulted in revenue losses that were supposed to come in for this quarter. . . It's a real intricate web of challenges we're navigating. We need adaptive strategies to maintain a robust and resilient supply chain in the face of all this uncertainty.

These complexities have intensified, particularly due to price volatility and increased demand for certain components. These factors have added considerable complexity to the company's procurement strategies. Despite these difficulties, we are actively developing agile and responsive procurement approaches to ensure a reliable flow of materials. Similar sentiment was also seen with the Procurement Manager as he has encountered significant challenges in securing a stable and sustainable supply of materials amid global disruptions

. . .The intricacies are no joke, especially with the price volatility and heightened demand for specific components. It's adding layers of complexity to our procurement strategies. . .Navigating this landscape is a challenge, but we're working on agile and responsive procurement approaches to ensure we maintain a reliable stream of materials.

(v) Inefficiencies in Inventory and Warehouse

Fluctuations in demand, coupled with the need for additional safety measures, led to inefficiencies in warehouse space utilization. Forecasted product availability often didn't match actual inventory, leading to empty stock and wasted space, which impacted financial performance and operational efficiency. The Warehouse Lead encountered challenges in managing fluctuations in demand and implementing additional safety measures, which led to inefficiencies in space utilization and financial losses as he explained:

"We've been dealing with demand fluctuations and the need for additional safety measures, which has caused potential wastage of allocated space for materials. This inefficiency in space utilization is hitting our bottom line, leading to financial losses."

(vi) Shipping Costs and Impact on Customer Satisfaction

Transportation disruptions and evolving customer demands presented ongoing challenges for the Shipping Lead. Delays in logistics and increased shipping costs were common issues, directly impacting customer satisfaction and reducing profit margins. Balancing logistical delays and managing cost structures became crucial for maintaining a resilient and customer-centric shipping operation. The Shipping Lead commented:

We've been confronting challenges left and right – transportation disruptions and evolving customer demands are no joke. . . Delays in logistics and increased shipping costs have become all too common. It's hitting us where it hurts, you know? Directly impacting customer satisfaction and eating into our profit margins. . . We're constantly juggling, trying to strike

that delicate balance between addressing logistical delays and managing our cost structures. It's become paramount to maintain a resilient and customer-centric shipping operation.

Key Risks Emerging in the Supply Chain During the Post-COVID Period

The post-COVID period has brought forth several critical risks within the supply chain, particularly in semiconductor manufacturing. These risks include workforce disruptions, fluctuating demand, transportation challenges, and supplier reliability issues. The following outline the key concerns from various managerial perspectives and their associated risk mitigation strategies.

Overall, the company faced risks post pandemic in its supply chain from to the operations in warehousing, production, and shipping presented several critical risks that could impact overall performance. The warehouse operations struggled with maintaining optimal inventory levels, driven by demand fluctuations and the risk of supply chain disruptions. In production, the company faced challenges associated with labour shortages, ensuring worker health and safety, and the need for flexible production schedules to accommodate shifting market demands. Similarly, the shipping operations were affected by transportation risks, including volatile global trade dynamics, rising shipping costs, and geopolitical tensions that disrupted key shipping routes. Collectively, these risks posed significant challenges to the company's ability to maintain efficient and resilient operations across its entire supply chain.

Operational Risks

The **Manufacturing Manager** identified critical risks such as workforce shortages, disruptions, and uncertain product demand in the semiconductor industry. These challenges have impacted production capacity and complicated planning efforts as he explained

This post-COVID period has really brought in a wave of increased risks for our manufacturing operations, especially in the semiconductor industry. . . We're facing shortages of skilled labour due to workforce disruptions, and it's really impacting our production capacity. It's a challenge we didn't foresee. . . And that's not all – managing the fluctuating demand for semiconductor products is a real puzzle. We're also dealing with potential bottlenecks in the supply chain, and it's making planning and executing our manufacturing processes a lot more complex than we anticipated.

The **Operations Manager** emphasized risks tied to maintaining operational resilience. Persistent supply chain disruptions, evolving customer demands, transportation issues, and the necessity for ongoing improvements in health and safety protocols were the main concerns.

Supply chain disruptions are still lingering, and we need to ensure our production environment stays flexible to adapt to the ongoing uncertainties. It's become crucial for our operations. . . We're dealing with risks like managing changing customer demands, potential disruptions in transportation, and the continuous need for improvements in health and safety protocols for our workforce. It's a whole new ball game, and we need to be on our toes.

Logistic and demand risk

The **company** faced ongoing transportation and logistics disruptions. Additional complexities arose from demand variability, supplier reliability concerns, and geopolitical tensions. Strategies such as dual sourcing, inventory optimization, and real-time supplier performance

monitoring became essential to maintaining resilience as commented by the Supply Chain manager:

We're still dealing with ongoing disruptions to transportation and logistics. . . In demand, questions about supplier reliability, and those geopolitical tensions are all adding complexities to our plate. . . We've got to keep our supply chain resilience intact. It's non-negotiable. We're focusing on risk mitigation strategies like dual sourcing, optimizing our inventory, and keeping a real-time eye on how our suppliers are performing. It's the only way we're going to navigate these ongoing uncertainties.

Supply Risks

The **Procurement Manager** outlined risks related to supplier stability, price volatility, and potential shortages of critical materials. These issues underscored the need for robust supplier relationships and diversification strategies to ensure procurement resilience. This further elaborated by the Procurement Manager:

Supplier stability, price volatility, and potential shortages of critical materials are at the forefront of our concerns. . . It's clear we need to build and maintain strong relationships with our suppliers. . . We're not leaving anything to chance. We're implementing risk management strategies like diversification of suppliers, and we've got to mitigate these vulnerabilities and ensure our procurement stays resilient in the face of uncertainties.

Adaptation of Risk Management Strategies and Leveraging Technology

The case organization has proactively adapted its risk management strategies through several measures. A key initiative involved leveraging advanced technologies to enhance operational resilience and efficiency across multiple departments.

Risk management Strategies for Supply Chain Disruption

To address risks in the supply chain, the organization implemented a comprehensive set of strategies, specifically targeting disruptions in the supply of critical components. A key initiative was the development of a robust risk assessment protocol, accompanied by an increase in safety stock levels for vital components. Additionally, the organization formulated contingency plans to manage potential disruptions caused by shipping route disturbances, improved communication with logistics partners, and integrated real-time tracking systems. These systems provided enhanced transparency and security, while agile processes—such as automated customs clearance and electronic documentation—minimized delays and improved overall visibility across the supply chain.

Both Supply Chain and Procurement Managers effectively utilized the technologies provided by the organization to create transparent and traceable supply chains. For instance, the Supply Chain Manager employed Kinaxis RapidResponse to enhance security and mitigate the risk of counterfeit products, while the Oracle E-Business Suite facilitated real-time data access on the location and condition of goods. This significantly improved logistics visibility, enabling quick responses to disruptions. On the procurement side, managers used Kinaxis RapidResponse and Oracle APEX platforms to analyze demand and supplier performance, streamlining workflows and reducing the risk of errors.

In addition to these technological advancements, the company negotiated flexible contracts with suppliers to enhance adaptability. Strengthening collaborative relationships with key suppliers, the organization incorporated real-time monitoring tools to identify potential disruptions early. A supplier diversification strategy was also adopted, with a particular focus

on engaging local suppliers. This approach not only mitigated transportation-related risks but also reduced reliance on international suppliers. As a result, proactive communication with local suppliers became a central aspect of the company's risk management framework, ensuring operational continuity and minimizing the impact of potential disruptions.
The effectiveness of these risk management strategies was further emphasized through insights shared by the company's management team

We've implemented some comprehensive strategies to mitigate risks in the supply chain. The organization wanted us to diversify our supplier chain, and I made sure we took the initiative by employing robust risk assessment protocols and increasing safety stock levels for critical components….

We've been harnessing the technology made available by the organization to create transparent and traceable supply chains. . . And on our end, Oracle E-Business Suite and Kinaxis Rapid Response has been a game-changer. It provides real-time data on goods' location and condition, improving logistics visibility and enabling quick responses to disruptions
(Supply Chain Manager)
Absolutely, and in addition to that, we've been strengthening collaborative relationships with key suppliers. We adopted real-time monitoring tools to detect potential disruptions early on. Our team also developed contingency plans for supplier disruptions, negotiated more flexible contracts, and the organization has been exploring local sourcing options to reduce our reliance on international suppliers.

… we've been using Kinaxis Rapid Response and Oracle APEX platforms to analyse demand and supplier performance. It's really streamlining our workflows and reducing the risk of errors

(Procurement Manager)
In shipping, we've been proactive too. We've developed contingency plans for shipping route disruptions, intensified communication with logistics partners, and implemented real-time tracking systems for proactive problem-solving in case of delays or challenges
(Shipping Lead)

Risk Management For Operational Resilience
In response to post-pandemic challenges, the organization has adopted a multifaceted approach to ensure operational resilience and adaptability. A key focus has been the implementation of advanced technologies for real-time monitoring of production processes, enabling the swift identification and resolution of issues that affect output. Cross-training programs and flexible production schedules have been integrated with these technologies to mitigate the risks associated with labour shortages and operational disruptions. This comprehensive strategy has allowed the organization to remain agile in the face of unprecedented challenges.

Workforce Adaptability and Remote Work Integration
To address the challenges brought by labour shortages due to remote work policies, the organization introduced several measures aimed at fostering workforce adaptability. These included cross-training, flexible production schedules, and leveraging digital technologies to

enable virtual collaboration. Cross-functional teams were established to respond to emerging challenges, enhancing collaboration across departments. The Operations Manager explained: We've been really homing in on implementing those remote work policies as advised by the organization. Leveraging digital technologies for virtual collaboration has been key, and we're forming cross-functional teams to tackle the dynamic challenges that come our way. We've also put together some robust contingency plans to ensure operational continuity in the face of disruptions, really emphasizing adaptability and flexibility in our workforce.

Risk Mitigation in Operational Processes

The organization has also introduced contingency plans and implemented real-time monitoring technologies to minimize disruptions in production processes. The Manufacturing Manager has prioritized this real-time monitoring alongside cross-training programs and flexible production schedules to ensure that any potential disruptions, such as labor shortages, are effectively mitigated. In parallel, the Operations Manager extended these efforts by enforcing remote work policies and digital collaboration tools to maintain operational continuity. The organization's emphasis on adaptability and flexibility has become a key factor in navigating unforeseen disruptions.

Enhancing Supply Chain Visibility and Warehouse Efficiency

In parallel to managing production challenges, the organization took steps to improve supply chain visibility and efficiency across departments such as warehouse, production, and shipping. In the warehouse, layout optimization and regular training sessions were introduced to enhance staff adaptability and operational flexibility. Safety stock levels were reassessed, and advanced real-time tracking systems were implemented to enable proactive problem-solving in the event of delays. In shipping, contingency plans were developed to address potential route disruptions, and communication with logistics partners was intensified.

The company implemented the advanced the Oracle E-Business Suite system, which provided real-time tracking of inventory levels, demand forecasting, and order fulfilment which has greatly improving visibility across the supply chain. This system allowed the organization to make more informed decisions and swiftly adapt to shifts in demand and supply chain dynamics. The integration of RFID and barcode scanning systems in the warehouse further contributed to real-time visibility of stock levels, enabling the organization to respond more agilely to changing demand and supply chain disruptions.

The team been introduced to an advanced Oracle E-BIZ system. The organization requested its implementation, and it's been a game-changer. Now, we can track inventory levels, forecast demand, and fulfil orders in real-time. . . This system enhances visibility, allowing us to make more informed decisions. We can adapt swiftly to changes in demand and supply chain dynamics. It's really stepping up our efficiency and decision-making processes.
(Operations Manager)

Technological Integration for Operational Efficiency

The company embraced technological advancements to streamline production processes and supply chain management. Tableau and Overall Equipment Effectiveness (OEE) were employed to facilitate predictive maintenance, significantly reducing the risk of unplanned downtime. The introduction of the Fuji SMT line enabled continuous monitoring of equipment health, bolstering manufacturing resilience. The Manufacturing Manager mentioned that implementation of use of this technologies for predictive maintenance, reduced the risk of

unplanned downtime and allowed continuous monitoring of equipment health, contributing to overall manufacturing resilience and efficiency.

We've made some positive changes. Company has implemented Tableau and Overall Equipment Effectiveness (OEE) for predictive maintenance. It's really helping to reduce the risk of unplanned downtime. . . We've also set up the Fuji SMT line, which allows continuous monitoring of equipment health. This is playing a key role in enhancing our overall manufacturing resilience and efficiency.

(Manufacturing Manager)

Strengthening Production with Advanced Systems

On the production floor, automation technologies such as 3D printing and Smart Torque were incorporated to enhance flexibility and efficiency. The Oracle E-Business Suite provided real-time data on equipment performance, allowing the company to maintain high standards of operational efficiency. This suite facilitated predictive analytics, which proved instrumental in making informed decisions about inventory levels and demand forecasting, and improved overall supply chain visibility. further commented on the impact of these technological advancements:

The introduction of the Oracle E-Business Suite has been a game-changer. We can now track inventory levels, forecast demand, and fulfil orders in real-time. This enhanced visibility allows us to make more informed decisions and adapt quickly to changes in demand and supply chain dynamics. It has significantly improved our efficiency and decision-making processes.

The Operations Manager

There is implementation of automated systems for more efficient operations. We integrated RFID and barcode scanning for real-time visibility into stock levels.

Warehouse Lead

It's been quite a transformation. On the production floor, we're utilizing Oracle E-Business Suite for real-time data on equipment performance. We've also incorporated digital manufacturing technologies like 3D printing and Smart Torque for more flexibility and agility.

Production Lead

Collectively, these technological advancements and risk management strategies strengthened the organization's ability to navigate complex operational landscapes, ensuring resilience, efficiency, and adaptability in the face of ongoing challenges

Discussion

The focus of this paper is to determine the effects of the pandemic on the operations and supply chain of a semiconductor company and the risk management strategies employed in response to the challenges faced. Various empirical studies have shown that the pandemic has had a severe impact on multiple economic sectors, including semiconductor companies (Hasan & Bellenstedt, 2022; Baveja et al., 2020). This paper highlights these impacts as well. The findings indicate significant disruptions caused by the pandemic, particularly in workforce availability and fluctuating product demand, which contributed to production slowdowns and delayed deliveries. Furthermore, the pandemic-related measures severely impacted the company's supply chains, leading to material shortages and transportation delays. These challenges resulted in increased costs and decreased revenue, as procurement processes faced severe pressure. These challenges have continued into the post-COVID period, affecting the organization's ability to maintain operational efficiency and resilience. Key risks that emerged included unreliable suppliers, extended lead times, and unpredictable demand

fluctuations, all of which further compromised the organization's operational efficiency and resilience.

Previous research suggests the need for a more holistic risk management framework to address risks arising from various crises and uncertainties, including health pandemics, geopolitical issues, and natural disasters (e.g., Blair et al., 2022; Bloom & Schoenherr, 2011; Colicchia & Strozzi, 2012; Mohammad & Khan, 2022). There is a call for more comprehensive and robust risk management approaches (Mohammed & Khan, 2022). In the case of health pandemics, the nature of risk is different and requires more innovative supply chain risk management strategies (Blair et al., 2022). Accordingly, the case company has adopted advanced technologies and digital tools to enhance risk management in their supply chain as part of their post-pandemic risk mitigation measures.

The company has made efforts to build and maintain a resilient supply chain by reducing vulnerabilities and establishing alternative sourcing options, including finding local suppliers. They have enhanced their supplier selection criteria, evaluation processes, and ongoing monitoring of supplier performance and risk. The organization seeks to diversify its supplier base and improve inventory management, providing greater flexibility and control over supply chain disruptions and ensuring better adaptability to ongoing and future challenges. Digital platforms have been used to improve communication with both suppliers and customers. Automation has enhanced efficiency, while real-time data analytics have enabled more proactive decision-making. The company has leveraged technology to strengthen its risk management practices, using tools such as Tableau and OEE for preventive maintenance and data analysis, and Kinaxis RapidResponse and Oracle E-Business Suite for real-time inventory tracking and demand forecasting. Investment in a new Global Supply Chain Distribution Hub has further enhanced the company’s productivity and sustainability outcomes.

This research contributes to the existing body of knowledge on supply chain risk management in several ways. First, it highlighted the global nature of supply chain disruptions caused by COVID-19, offering insights into the broader impacts of pandemics on supply chain operations. Second, it provides empirical data from a case study of a semiconductor company, offering a detailed examination of the company’s risk management strategies during the post-pandemic period. Finally, it highlights the critical role of technology and digitization in mitigating supply chain risks and ensuring visibility amidst ongoing uncertainties.

The study concludes that no single solution can fully address the complexities of supply chain risk management in the semiconductor industry. Instead, a combination of strategies is needed to build resilience and adaptability. Managers and decision-makers must consider all relevant factors when devising risk mitigation strategies, optimizing both costs and benefits. The study also emphasizes the importance of collaboration and information-sharing among supply chain stakeholders to foster collective resilience.

The paper makes a theoretical contribution by examining the effects of the post-COVID era on supply chain risk management, offering insights into both the immediate impacts of the pandemic and the adaptive strategies employed by the case company. It also highlights the importance of leveraging technology to enhance risk management practices and improve supply chain visibility in an increasingly complex and dynamic global environment. While the study provides valuable insights, it has certain limitations. It focuses solely on procurement and operations, without addressing financial risks or customer relationship management within the supply chain. Additionally, the research is based on a single organization, limiting the generalizability of the findings. Future research could involve multiple organizations across different industries to provide a broader perspective on supply chain risk management

strategies in the post-pandemic context. This paper serves as a resource for semiconductor industry stakeholders, offering practical insights into how companies can better mitigate supply chain risks and respond more effectively to disruptions caused by future pandemics.

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