

REVIEW ARTICLE

ADVANCED PROJECT AND LOGISTICS MANAGEMENT ASSESSMENT TITLE: A CHAIN REACTION

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ABSTRACT

Supply chains, the lifeblood of modern corporations, harbor a hidden peril that threatens resilience. In today's interconnected world, uncertainties loom, casting shadows over the stability of supply networks. This study peels back layers within the manufacturing sector, unveiling vulnerabilities that jeopardize supply chain efficacy. It navigates the perilous dance between visible and invisible risks, shedding light on issues often overlooked. Among these risks lies the threat of innocuous buyers encountering substandard goods along the supply chain. The dynamic nature of global networks underscores the need to scrutinize how problems propagate across diverse supply chains, as depicted in the Wall Street Journal documentary "Why Global Supply Chains May Never Be the Same." This study meticulously examines internal and external factors impacting supply chain effectiveness, offering valuable insights for navigating today's complex landscape. Balancing susceptibility and efficiency is paramount in manufacturing, where vulnerabilities lurk despite operational prowess. Through a blend of theoretical frameworks, empirical research, and practical insights, this study enhances supply chain resilience and foresight. It serves as a strategic guide, providing actionable recommendations grounded in credible data. While these recommendations hold promise, potential hazards must be acknowledged. The manufacturing supply chain, efficient yet fragile, demands a preemptive approach to risk management. By offering strategic counsel, this study empowers businesses to fortify their chains against unforeseen disruptions, fostering resilience across dynamic industries. In essence, this research advocates for a balanced and proactive stance towards risk management, revitalizing supply chains to thrive in today's turbulent environment.

KEYWORDS

Dynamic supply chains; Global supply networks; Manufacturing vulnerabilities; Risk management strategies; Supply chain resilience

1. INTRODUCTION

There have been worries that as the modern supply network becomes more complex and interconnected, it may lose its resilience. For example, a component of supply chain risk involves the possibility that hazardous materials will be inadvertently fed into the system and unknowingly expose consumers to dangerous products (Minas et al., 2019). Risks which may undermine supply chain responsiveness and efficiency must be identified and eliminated. Supply chain risk, vulnerability, and disruption have now emerged as critical components in any ever-changing environment for effective supply chain management. Such unforeseen disturbances can undermine the supply chain's smoothness adversely. The perspectives from the Wall Street Journal movie, "Why Global Supply Chains May Never Be the Same A WSJ Documentary," as well as additional sources, draw attention to an important issue statement: however, the nature of global supply chains makes it hard for these impacts to be overlooked. The challenge highlights the importance of preventive measures and continuous adjustment, otherwise, it can affect the intactness of the whole supply chain network.

This study aims to examine threats, assess weak points, and propose remedies to resuscitate the manufacturing industry supply chain. It caters for all the risks involved in the entire chain and the consequences thereof if any player fails in the system. Extensive research has been done to

support the recommendations on how to manage and resolve the identified problems that are based on contemporary cases and situations. Besides this, the research also identifies some problems likely to arise during action for these proposed solutions.

The transportation of materials from primary suppliers to ultimate customers is overseen by supply chain management. Any event that could disrupt the planned transfer of resources in the supply chain is considered a risk. These risks may lead to delivery failures, delays, goods damage, or disruptions in smooth operations. However, these initial effects are just the starting point, and the consequences are generally more far-reaching. A shortfall in raw material delivery, for example, can interrupt production, increase work-in-progress stockpiles, force partners to reassess their trading agreements and drive up prices by requiring a shift to alternate modes of transportation, supplies, or operations (Donald, 2007). An interruption to the supply chain might have far-reaching consequences. According to researchers, the announcement of disruption often results in a 7-8% drop in shareholder return on the same day, a 42% drop in operating income, and a 35% drop in return on assets (Hendricks and Singhal, 2003).

The inherent challenge in addressing risks lies in their multifaceted nature, manifesting in diverse forms. Risks can appear at any point in the supply chain, from the first suppliers to the last consumers. They might interfere with the flow of resources or the market for goods, induce abrupt

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surges or collapses in demand, and vary widely in magnitude from minor delays to natural disasters. The ramifications of these risks can span from brief, only a few minutes long, to enduring and resulting in permanent damage. Moreover, their impact may be localized within a specific segment of the supply chain or transmitted to jeopardize the entirety of the chain.

Within the framework of a supply chain, researchers distinguish between two main types of risk: external risks and internal risks (Donald, 2007). Internal risks are those that arise naturally from day-to-day operations and include things like missed delivery dates, excess inventory, financial uncertainty, erroneous forecasts, small mishaps, human error, and malfunctions in IT systems. These can all be further divided into operational and supply risks. Conversely, external risks originate from sources beyond the supply chain and encompass events such as catastrophes caused by nature, hurricanes and storms, labour conflicts, battles, terrorist attacks, outbreaks of disease, changes in prices, issues with commerce partners, shortfalls of raw materials, illicit activity, and anomalies in funding.

A study suggested a classification framework in their research project (Gupta et al., 2021). According to the study, risks related to operations and supply should be categorised as internal risks, and risks related to demand and security should be classified as external risks. With the help of this suggested classification framework, risk management may become more sophisticated and focused by fostering a more nuanced awareness of the complex nature of hazards inside the supply chain.

2. NAVIGATING RISKS AND VULNERABILITIES IN MANUFACTURING SUPPLY CHAINS

2.1 Comprehensive exploration of risks in manufacturing supply chains

Supply chains encounter many obstacles in the modern corporate environment because of growing globalisation and continuous process digitization. Aspects that are both internal to bigger global business settings and external to supply chain networks are included in the intricate web of uncertainty. Supply chain hazards are the collective term for these elements. Researchers define supply chain risk as an organization's or its operations' vulnerability to events with uncertain or unpredictable outcomes (Kirilmaz and Erol, 2017). Through a thorough analysis of the literature and expert consultation, this study investigates the many risks associated with the current business environment. These include risks related to operations and manufacturing processes, demand, behaviour, government and financial, systemic, organisational, and product recovery risks, supply, disruption, environmental and social, cybersecurity, and safety (Shipra et al., 2023). The critical division of these risks into internal and external domains underscores the importance of methodical risk prioritisation and is necessary for the strategic development of risk mitigation strategies (Gupta et al. 2021).

As indicated in 2015 research, these risks involve adverse events, whether expected or unexpected, with negative implications for manufacturing supply chains (Kleindorfer and Saad, 2015). The manufacturing sector, including companies engaged in production, is not immune to the difficulties and hiccups in their supply chain operations. Large-scale interruptions in a manufacturing company's supply chain can have negative consequences that include decreased operational income, increased logistics costs, delays, and a decrease in user interest, among other things (Oluajo, 2021).

It is commonly acknowledged that the manufacturing sector is important to the complex web of the global supply chain. Additionally, the industry adapts to shifts in customer tastes, global regulatory compliance, global market dynamics, and information technology improvements (Mangan et al., 2020). To ensure operational efficacy and efficiency in manufacturing

processes, a robust framework for supply chain risk management must be established.

Many levels of uncertainty, including those about supply, demand, products, manufacturing, and technology, have been studied in a large body of research on supply chain risk (Sreedevi and Saranga, 2017). There are three main ways that supply chains deal with uncertainty: supplier or supply uncertainty, which includes things like supply irregularities and difficulties with timely performance; manufacturing unpredictability resulting from variations in the efficiency of processes, malfunctions of machinery, and different production requirements (quantity, variety, IT, etc.); and the uncertainty surrounding demand, which results from shifts in demand and the inability to predict these shifts (Davis, 1993). Production inefficiencies and inaccuracies in supply and demand forecasts increase because of these supply chain risks (Wiengarten and Longoni, 2018).

The increasing number of actors and their interconnection in supply chains contribute to their complexity and unpredictable nature (Wu and Pagell, 2011). Supply chain risk is a significant environmental factor that compels companies to develop sustainable manufacturing systems, claim Shan et al. (2021). This demonstrates how crucial it is for companies to recognise and adapt to the intricate network of risks present in their supply chain operations.

2.2 Navigating vulnerabilities in manufacturing supply chains

Vulnerability is an outside element that analyzes the impact of certain consequences related to risk. In the present competitive business environment, management of the supply chain is critical for organizations competing globally (Ketchen and Hult 2007). Offshore and outsourcing have also contributed to a more serious incidence of supply chain disruptions (Mudambi and Venzin, 2010). This involves striking between efficiency and sensitivity when navigating global supply networks (Bode and Wagner, 2015). It entails identifying supply chain segments that can easily be disturbed, as well as their ability to affect the smooth flow of operations in the supply chain (Blackhurst et al., 2018).

According to Bode and Wagner, it is characteristic that risk sources/drivers overrun the risk-mitigating ones (Bode and Wagner, 2015). It will result in undesirable results and affect the capability of a supply chain to respond to customer requests. Vulnerability encompasses the capacity and preparedness of the system to face anticipated hazards or consequences in this arrangement. The investigation of factors contributing to supply chain vulnerability has been explored in empirical studies conducted by (Wagner et al., 2012). Simultaneously, (Wagner et al., 2012) delved into the identification of strategies to mitigate supply chain vulnerability.

In the realm of supply chain vulnerabilities, as highlighted by numerous researchers and the insights presented in the WSJ documentary includes

- inadequacies in inventory management,
- suboptimal sourcing strategies,
- unpredictable pricing,
- disruptions in facilities,
- shortages of truck drivers, and
- transportation challenges

These difficulties all show up as crucial motivators. When combined, these variables represent a serious risk to the manufacturing sector's supply chain's efficiency. The vulnerabilities are displayed in the following figure 1.

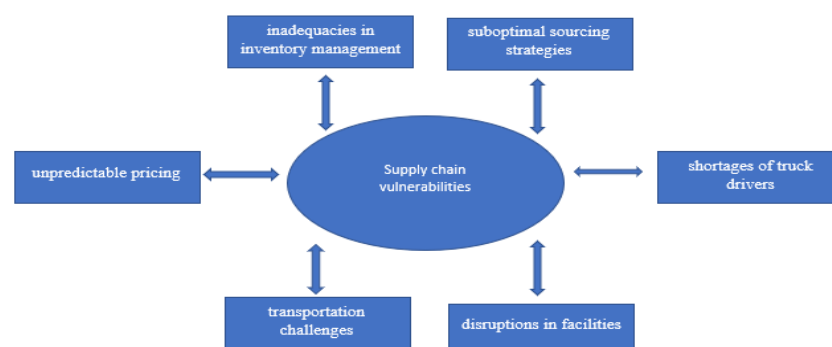


Figure 1: Supply chain disruptions

Expanding on this empirical base, it was presented a basic model for a robust supply chain (Christopher and Peck, 2004). To create a resilient supply chain, the authors outlined four key concepts: (1) creating a culture of risk management; (2) promoting high levels of collaboration to identify and manage risks; (3) emphasising agility for quick responses to unforeseen events; and (4) incorporating resilience into the system ahead of disruptions. According to researchers, secondary variables included attributes including visibility, speed, agility, redundancy, availability, efficiency, and adaptability (Pettit et al., 2010).

It is essential to get ready for any future supply chain disruptions because of how frequently they occur (Pettit et al., 2019). Ready companies can react quickly, strengthening their resilience to shocks and decreasing their susceptibility (Scholten, 2014). A study defines resilience as an organization's or supply network's ability to withstand shocks from calamitous events and adjust to evolving conditions (Brunset and Teller, 2017). The functioning and survival of a firm depend on this ability. However, if the flow of goods or information is stopped, suitable action must be taken swiftly to avoid losses due to the inherent unpredictability of all risks and consequences (Kamalahmadi and Parast, 2017). Consequently, companies need to have adaptive capacities for effectively handling disasters through both proactive and reactive actions to maintain competitiveness and minimise repercussions (Giunipero, 2015).

The primary contention of this discourse is that considering the variety of challenges that disruptions provide to supply chains and businesses, resilience must be acknowledged as a strategic necessity. Proactive management of the intricate web of risks and uncertainties that characterises modern business environments is also necessary. According to researchers, as the image below illustrates, researchers conducted a thorough focus group discussion about the vulnerabilities and validation processes included in supply chain resilience frameworks (Syahri Nur Afif et al., 2022).

2.5 Theoretical foundation and conceptual framework development

It was claimed, that because of the fierce competition and quick advancements in technology in today's business world, companies are more exposed to risks in their supply chains, both internal and external (Lavastre et al., 2014). Furthermore, companies currently take part in integrated supply chains that show notable levels of interdependency, as stated by (Tang, 2006; Leat and Revoredo-Giha, 2013). Due of this intricate web of relationships, businesses are exposed to risks arising from both their own operational processes and those of their collaborative partners.

Chain participants must strategically use complementary resources to control risk (Yip and Cheng, 2012; Zhang and Cao, 2010). A wide range of tasks, such as goal congruence, incentive alignment, collaborative communication, information sharing, and decision coordination, are included in these resources (Cao et al., 2010). Several resources, each with

distinct qualities, are the foundation of supply chain collaboration, as stated by (Cao et al., 2010). Improving risk management practices amongst supply chain partners heavily depends on the importance of supply chain collaboration, which is defined by features like sharing, decision synchronisation, resource distribution, collaborative interaction, congruence of objectives, and incentive alignment. This phenomenon leads to a discernible enhancement in the firm's overall performance, as per the findings of study by (Yip and Cheng, 2012).

Building enduring cooperative relationships enhances organisational performance by successfully lowering risk, claim (Chen and Sohal, 2013). This is achieved by the application of a rigorous methodology that comprises identifying potential risk sources, developing backup plans, and keeping an eye on changes among chain participants (Wieland, 2013). According to Zhang and Cao, there can be significant cost savings and avoidance of needless efforts when there are collaborative dynamics involved in inter-firm cooperation (Zhang and Cao, 2010). It was claimed in as study that by encouraging operational improvements and eliminating duplication of effort, this strategic partnership increases profitability and improves the competitive edge (Zhang and Cao, 2010). The case study presented here illustrates the many benefits of ongoing collaboration in risk management and operational effectiveness inside organisational frameworks.

The conceptual framework presented by researchers is founded on the Relational View (RV) and Contingency Theory (CT) (Imran and Khalid, 2016). According to the Contingency Theory, as stated by few researchers, no management problem can be solved by a single management method (Lorsch and Lawrence, 1967; Morgan, 1986). This perspective holds that companies base their strategy decisions on situational elements that are both internal and external. Perceived risks are significant situational or contingency elements in this scenario. Diverse levels of risk perception led to diverse outcomes. On the other hand, the Relational View maintains that resource investments made inside a network—especially in the supply chain—create synergy to successfully handle risks and obtain a competitive advantage (Dyer and Singh, 1998). Within this framework, they proceed to differentiate between four types of relational resources: (1) assets specific to relationships; (2) protocols for exchanging knowledge; (3) complementing resources and abilities; and (4) efficient governance. This integration of relational perspective and contingency theory provides a solid theoretical foundation for researching how firms manage uncertainty and enhance their competitive position in a networked environment through strategic resource investments. A comprehensive survey and experimental investigation of the interactions between different variables can be carried out using the conceptual framework functions that was presented by (Imran and Khalid, 2016). Moreover, this paradigm can be applied to develop relations- and contingency-theoretic hypotheses to assess the moderating impact of cooperation.

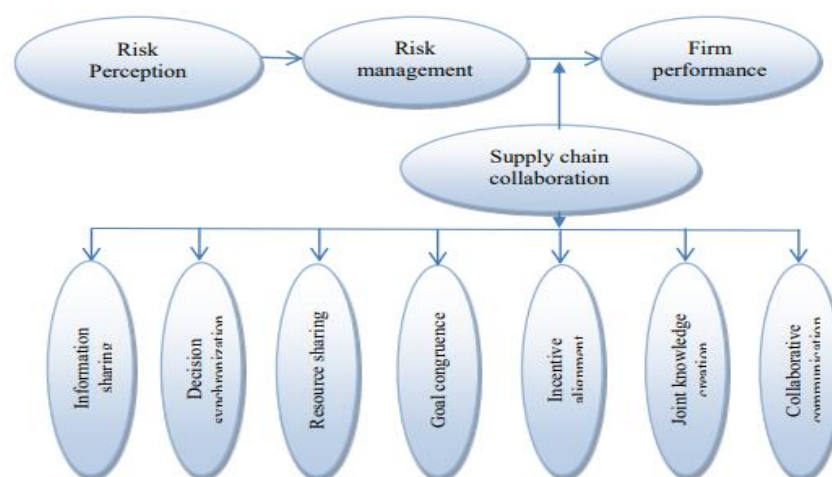


Figure 3: Conceptual framework presented by (Imran and Khalid, 2016)

3. PROPOSED RECOMMENDATIONS TO ALLEVIATE THE IDENTIFIED RISKS WITHIN THE SUPPLY CHAIN.

3.1 Agile six sigma for management of operation risk (internal risks)

Variance-based approaches to risk management, particularly regarding

internal performance measurement and process control, are highlighted in a sizable corpus of supply chain management literature that has been influenced by operations research. Researchers brought to light the realization by several writers of the necessity of addressing uncertainty in company operations strategically (Childerhouse and Towill, 2003). Improving decision-making processes' effectiveness, efficiency, and control is the main objective. The concepts from business process

engineering, statistical process control, and total quality management (TQM) are included in this extensive body of literature. These concepts are most prominently displayed in the modern Six Sigma framework (George 2002).

Six Sigma was initially developed as a methodology for the ongoing improvement of manufacturing processes, but it has now been modified to improve the reliability and effectiveness of transactions and processing in manufacturing organizations (Tennant, 2002). A more modern version, called "Agile Six Sigma," was put forth as a method to methodically lower time-related variability to reduce risk and improve supply chain resilience (Christopher and Rutherford, 2004). This methodology is based on solid statistical data and adheres to the principles of both scientific management and traditional risk management techniques.

In the context of supply chain management, Christopher and Rutherford contend that overall cycle durations can be shortened when dependability rises across a range of activities and processes, improving customer responsiveness and lowering costs. Specifically, they stress how crucial it is to keep redundancy—that is, extra capacity—to mitigate or overcome highly disruptive incidents. Expanding upon the concept proposed by researchers conducted an empirical study to see whether Six Sigma might be applied to the management of materials handling time in the UK defence supply chain (Christopher et al., 2005). His results emphasised the method's positive qualities, especially in terms of making improved supply chain management implementation easier. As a result, by taking this strategy, organisations get one step closer to reducing the uncertainty surrounding prompt delivery to frontline consumers.

3.2 Collaboration, multiple sourcing and reduction of redundancy for management of supply risk (internal risks)

Increasing collaboration with supply chain partners, employing different sourcing techniques, and adding redundant suppliers are some of the most effective ways to reduce risks, according to the 2009 Advanced Market Research (AMR) supply chain risk study results. (Schöenherr and Tummala 2011). Furthermore, supply chain risk management (SCRM)

3.4 Strategies for effectively managing security risks in the supply chain

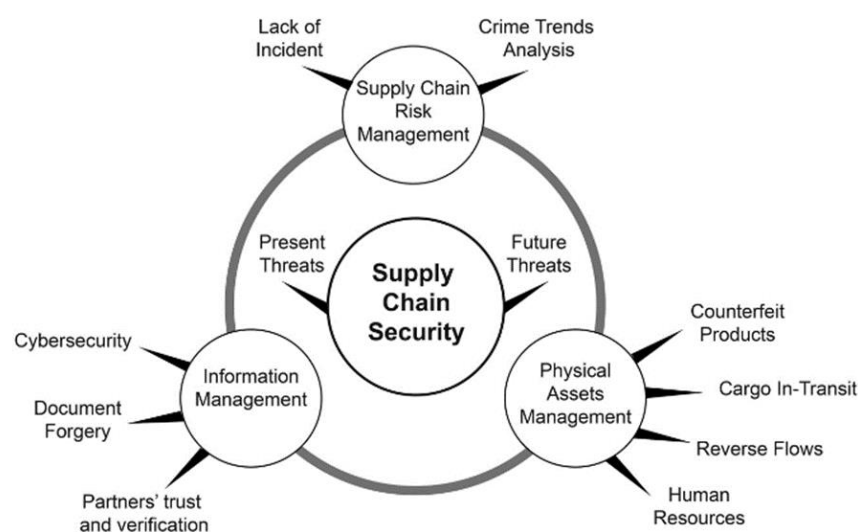


Figure 4: Summary of results clustered in the theoretical framework (Luca and Juha, 2017)

Supply networks are constantly at risk from rioting, vandalism, sabotage, and maritime piracy, which calls for a more thorough security strategy than only dealing with cargo theft (Urciuoli et al., 2014). Solutions must involve a wide range of illicit activities, such as money laundering, counterfeiting, and smuggling, to reduce these security risks. Supply chain risk management, information management, and physical asset management are the three main strategic management domains that companies seeking to improve security risk management must focus on (Luca and Juha, 2017). It was stated in 2009 that these strategies serve as the cornerstone for enhancing overall security risk resistance (Asbjørnslett, 2009). The primary objectives of supply chain risk management are the detection, assessment, and mitigation of security threats. The administration of tangible assets is closely related to this role. Given that goods circulating via supply chains are frequently targeted by thieves, effective asset management is essential.

strategies—particularly flexibility and collaboration—are crucial for reducing supply chain risks (SCRs), according to (Kleindorfer and Saad, 2005). Researchers also highlights the potential of slack resources as useful "shock absorbers" against SCRs (Tang, 2006a). These include increased stockpiles, adaptable product designs, adaptable production procedures, and redundant suppliers.

In contrast, it was emphasise that using a variety of sources, collaborate with others, share knowledge, and maintain safety supplies are all necessary to reduce risk exposure (Lavastre et al., 2012). According to a study in 2013, safety stocks, adaptable transportation, and diverse sourcing can all help reduce SCRs (Wieland, 2013). Finally, researchers advocate for comprehensive risk prevention strategies that include refining supply chains to include buffers or redundancies, enhancing partner participation (including risk sharing), and boosting supply, demand, and process flexibility (Sodhi et al., 2012).

3.3 Mitigating uncertainties: strategies for effectively managing demand risks ((external risks) in the supply chain

In the context of worldwide production networks, which are characterised by situations of both excess and scarcity, the supply chain is faced with complex problems regarding product availability. This means that managing demand risks requires collaborative decision-making that considers strategic components like pricing and capacity, making demand planning crucial. The primary objective of demand planning, which also searches for methods to reduce expenses and boost profitability, is to effectively meet customer requests in this complex situation.

To successfully complete this difficult task, two crucial components that must be carefully considered are accurate demand forecasts and effective inventory management. Accurate demand forecasting is essential for manufacturing decision-making, including capital expansion, technology migration, and capacity planning (Chien et al., 2022). For highly variable commodities, establishing an adequate back-end supply is essential to meeting client demands promptly and enhancing service quality (Lee et al., 2006).

Experts support a methodical strategy that includes the identification and mitigation of diverse security concerns, acknowledging the growing importance of cybersecurity. This strategy should include safe certification and verification of individuals, organisations, papers, and data along the supply chain (Fossi et al., 2011). The safety of goods, vehicles, and people during transportation, logistical handovers, and other processes is a crucial component of efficient supply chain security. Additionally, supply chain managers must proactively assess and secure services from companies with robust security measures.

As outlined in the provided framework by Luca and Juha, a research study was conducted. The figure below encapsulates the findings of this investigation. The examination of supply chain security delves into existing and anticipated threats. The discerned gaps are categorized into three primary pillars, signifying strategies aimed at enhancing performance and minimizing the vulnerability of supply chains.

4. SET OF RISKS ASSOCIATED WITH THE RECOMMENDATIONS

The goal of the agile Six Sigma strategy is to maximise operational effectiveness and risk awareness by combining the fundamental concepts of Six Sigma with flexibility. Nevertheless, it's critical to be aware of any potential risks and downsides related to this integration. It takes careful balancing for these two enhancement paradigms to coexist. Excessively simplified methods that closely follow the Lean Six Sigma paradigm might make it more difficult to adjust to shifting market conditions and have a detrimental effect on value creation. Similarly, obsessing about variance reduction beyond customer requirements when pursuing Six Sigma concepts may result in energy waste. On the other hand, an excessive emphasis on adaptability may be detrimental to the company, particularly when it comes to the extra costs related to risk reduction (Alipour et al., 2018).

In the event of an interruption, collaboration in the supply chain raises the possibility of an over-reliance on one another, which could leave a partner vulnerable. To lessen this dependence, careful partner selection is stressed (Tucker et al., 2019). While using multiple suppliers reduces the risk of depending too much on one, it also presents difficulties in terms of maintaining consistent product quality and managing supplier relationships well. In the context of diversified sourcing, strong supplier management methods are essential (Knowledge Centre, 2023). Reducing redundancy in the supply chain could weaken its resilience and increase its susceptibility to interruptions. Strategic redundancy is advocated as a

buffer against disruptive events, emphasizing the importance of a balanced approach (National Counter-Intelligence and Security Centre, 2022).

Precise demand forecasting is essential, but the risk lies in forecasting errors, potentially leading to suboptimal inventory levels. Inaccuracies in demand forecasting contribute to manufacturing inefficiencies (Heckmann et al., 2015). Supply chain risk management, information management, and physical asset strategies carry risks such as potential cybersecurity threats from increased information sharing and challenges in managing physical assets efficiently. Information security and asset management are two comprehensive strategies that are advised to reduce vulnerabilities (CIPS, 2023).

In conclusion, even though these supply risk management techniques work, each has unique dangers, therefore it is important to take a balanced strategy.

4.1 Risk assessment matrix

The risk assessment matrix mentioned above offers an organised and measurable method for comprehending, ranking, and reducing the risks that were found throughout the investigation. By visualising and ranking risks according to their likelihood and impact, this matrix enables us to concentrate on the most important components of the supply chain risks that have been discovered.

Identified Risks	Type	Impact	Probability%	Risk Scores (Impact x Probability)
Operation Risk	Internal	High (3)	20%	60%
Supply Risk	Internal	High (3)	20%	60%
Demand Risk	External	Moderate (2)	15%	30%
Security Risk	External	High (3)	20%	60%

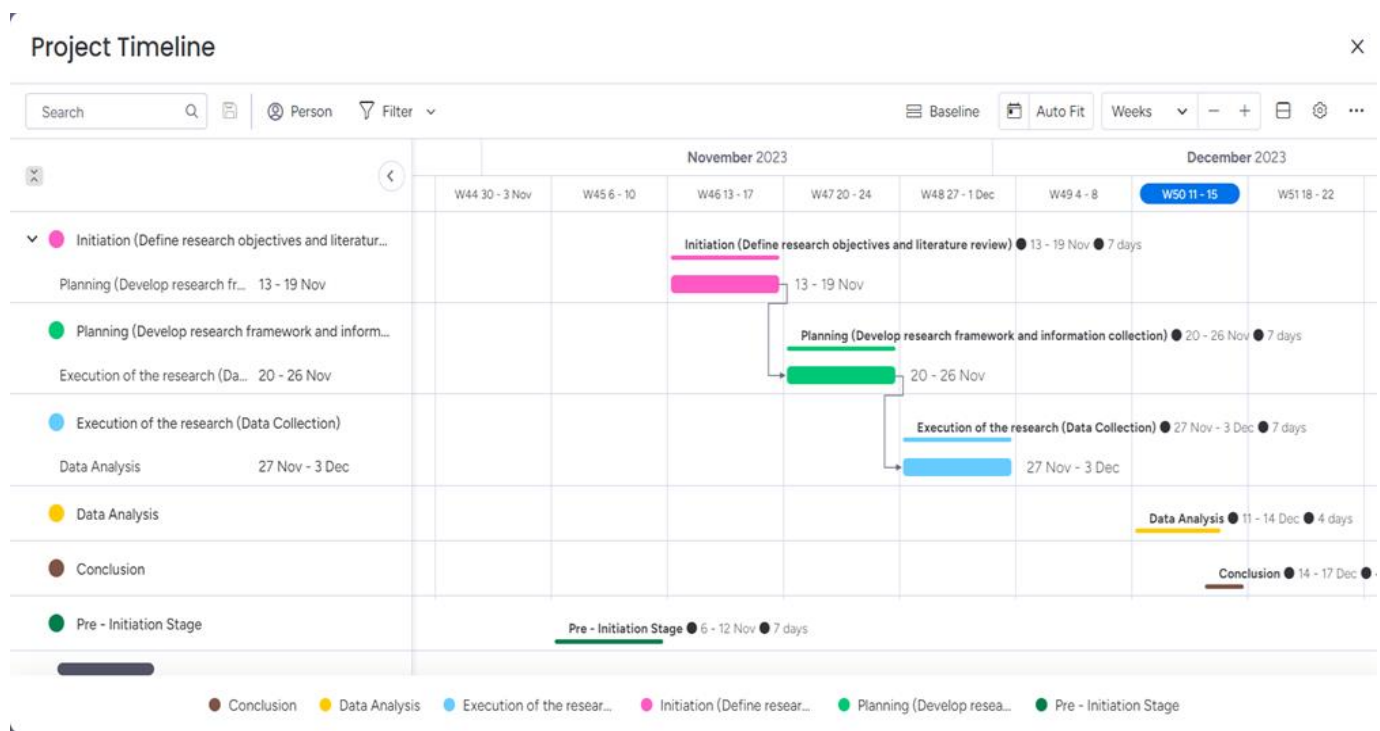


Figure 5: Project plan

5. CONCLUSION

In today's cutthroat economic climate, supply chain risk and vulnerability management has become essential, particularly for manufacturers. It is common knowledge that the first stage in risk management is to recognise vulnerabilities and acknowledge the existence of threats. Supply chain organisations are faced with an inherent challenge because of how readily processes can be affected and how difficult it is to restore them due to the multiple linkages throughout the supply chain. It is more difficult to comprehend supply chain risks because of its complexity. The intricate nature of supply chain risk management is further compounded by the substantial expenses involved in making repairs following losses. Supply chain risk management becomes even more important for businesses in

the present business environment when all these factors are considered. To protect against potential harm and effectively manage the complex network of difficulties presented by interdependent processes, it is critical to identify and address supply chain vulnerabilities.

This paper provides a thorough analysis of the intricate hazards and flaws found in contemporary manufacturing supply networks. The WSJ video illustrates how dynamic global supply chains are, highlighting the necessity of adaptability and proactive risk management. The paper lists some internal and external problems that may significantly affect supply chains' capacity to withstand shocks and operate effectively. For businesses looking to take the initiative in managing the complexities of modern supply chains, this report is a valuable resource. Combining theoretical models, actual research, and useful recommendations, it gives

decision-makers the information and resources they need to improve supply chain resilience, flexibility, and strategic planning in the face of shifting conditions.

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