Assessment of Supply Chain Risk in Manufacturing Sector

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ABSTRACT

This paper explores the diverse risks impacting supply chains within the manufacturing sector, particularly in an increasingly globalized and technologically interconnected world. Using real-world data and industry case studies, it evaluates key risk categories including operational disruptions,
financial volatility, geopolitical tensions, and cyber threats. The analysis highlights both the
vulnerabilities and resilience strategies of modern manufacturing firms, offering insights into how proactive risk management can sustain competitive advantage. Charts and risk matrices visually support the discussion. The paper concludes with practical mitigation frameworks to guide firms toward more agile and secure supply chains.

In the dynamic landscape of the manufacturing industry, sourcing decisions play a Pivotal role in
determining operational efficiency, cost-effectiveness, and overall business resilience. This abstract provides a concise overview of the evaluation of sourcing risk within the manufacturing sector,
highlighting key factors, methodologies, and implications. Manufacturers face multifaceted challenges in sourcing, ranging from geopolitical instability and supply chain disruptions to fluctuating market
demands and regulatory constraints. Evaluating these risks demands a holistic approach that integrates quantitative and qualitative assessments. Traditional risk assessment frameworks often focus on
financial metrics, supplier stability, and operational contingencies. However, contemporary approaches recognize the need for broader considerations, including environmental sustainability, ethical sourcing practices, and social responsibility. This abstract delves into the methodologies
employed for assessing sourcing risk, encompassing both pre-emptive risk identification and ongoing risk management strategies. It explores the role of advanced analytics, including predictive modelling and simulation, in forecasting and mitigating potential disruptions.

INTRODUCTION

Global manufacturing has evolved into a complex web of interconnected processes involving suppliers, logistics providers, regulatory bodies, and customers across continents. While this globalization has unlocked efficiencies and cost savings, it has also amplified vulnerabilities.
Disruptions such as the COVID-19 pandemic, trade wars, cyberattacks, and natural disasters have exposed the fragility of supply chains in stark terms.

In the manufacturing industry, assessing sourcing risks is an essential part of supply chain
management (SCM) and strategic procurement (SPP). Sourcing risks are any disruptions or challenges that a company may face from its raw material, component or other input suppliers. These risks can have a significant impact on a company's operations, financial performance and reputation.In order to assess sourcing risks, a company must consider several factors, such as supplier diversification (SDR), supplier evaluation and selection (SDR), risk assessment and monitoring (RAM), supply chain visibility (SVP), demand forecasting (DCP) and geopolitical risks. The Federal Reserve has developed the Sourcing Risk Index (SRI) for US Manufacturing Industries, which looks at risks to input access in three dimensions: geographic concentration of suppliers (SDRs), geopolitical risks (GSPs) and overall exposure to foreign shocks (GSPs).In addition to its taste and energy-boosting benefits, Sting
cold drink is also known for its convenient packaging, making it easy for consumers to enjoy on the go. The drink is

available in cans and bottles of various sizes, making it suitable for different consumption occasions.

Overall, Sting cold drink has established itself as a popular choice among consumers looking for a refreshing and energizing beverage. With its appealing taste, energizing properties, and convenient packaging, Sting cold drink continues to be a favored choice in the competitive energy drink market.

LITERATURE REVIEW

Chopra and Sodhi(2004) presents a comprehensive framework for evaluating sourcing risks within global supply chains. The article emphasizes the importance of proactive risk management in mitigating disruptions and enhancing the resilience of supply chain networks. The authors highlight the dynamic nature of sourcing risks, which encompass a wide range of factors such as supplier reliability, geopolitical instability, economic fluctuations, and regulatory changes.

Paul and Rahman (2017) the manufacturing industry is undergoing a paradigm shift towards sustainability, driven by environmental concerns, regulatory pressures, and consumer demand for eco- friendly products. In response to these challenges, manufacturers are increasingly adopting sustainable manufacturing practices across their operations.

Numerous studies have investigated supply chain risk management over the past two decades. According to a 2022 McKinsey report, nearly 75% of global manufacturing firms experienced at least one supply chain disruption in the past two years, with losses exceeding $100 million in many cases. Scholars like Christopher and Peck (2004) have emphasized agility and flexibility as crucial for navigating turbulent conditions.

Zhang and Sun (2014) the importance of effectively managing sourcing risks in manufacturing operations to ensure the resilience and efficiency of supply chains. They highlight the dynamic and interconnected nature of sourcing risks, which encompass factors such as supplier reliability, quality issues, lead time variability, transportation disruptions, and geopolitical factors.

Michelis and Delve (2023) into the development of a Sourcing Risk Index (SRI) to evaluate risks to input access in U.S. manufacturing industries. The study focuses on three key dimensions: exposure to foreign shocks, supplier concentration, and input substitutability. By aggregating SRI values at the industry level, the authors propose a measure of industry-level sourcing tail risks that pinpoint the riskiest inputs for each industry.

Gunasekaran et al. (2009) presents a comprehensive analysis of sourcing risks within manufacturing supply chains, employing the Analytical Network Process (ANP) as a methodological framework. The article delves into the critical importance of systematically evaluating sourcing risks to enhance supply chain resilience and mitigate disruptions.

Choi and Lam (2013) provides a comprehensive overview of strategies and practices for effectively managing risks in global supply chains. The book addresses the inherent complexities and uncertainties associated with global supply chain operations, emphasizing the need for proactive risk management to mitigate potential disruptions.

Bayer and Öberg, (2013) discusses how to implement a risk management process in a manufacturing industry setting. The authors highlight the importance of a systemic approach to risk management and draw on the model suggested by the Institute of Risk Management (IRM). The key steps of the risk management process include: Identifying potential risks and disturbances Risk analysis, which

involves identifying, describing, and estimating the probability and consequences of risk evaluation.

Sharma and Bhat (2014) examine the drivers of supply chain vulnerability in the manufacturing industry. The authors emphasize the importance of assessing and prioritizing the factors responsible for supply chain vulnerability, especially in light of the increasing frequency of natural and man-made disruptions. It highlights the growing body of research on supply chain risk management (SCRM) and supply chain vulnerability (SCV). It notes that SCV is a precondition to supply chain risk, as it exposes the supply chain to both internal and external risks.

Shahriari and Azizipour(2021) offer a comprehensive framework for systematically assessing risks in the context of supplier selection within manufacturing industries. The article underscores the critical role of supplier selection in mitigating sourcing risks and enhancing the overall performance and resilience of manufacturing operations.

Kumar et al. (2013) presents an extensive framework for evaluating risks within global manufacturing supply chains. The article emphasizes the complexities inherent in global supply chains and
underscores the need for a comprehensive approach to risk assessment to ensure resilience and
continuity of operations. . Kumar, Singh, and Garg highlight the multitude of risks faced by global manufacturing supply chains, including but not limited to geopolitical instability, natural disasters, transportation disruptions, supplier dependencies, and regulatory changes.

Table 1: Sourcing Risks in the Manufacturing Industry identified from the literature review.

S.NO	RISKS	AUTHOR
1	Supplier Reliability	Chopra and Sodhi(2004)
2	Supply Chain Disruption	Paul and Rahman (2017)
3	Lead Time Variability	Zhang and Sun (2014)
4	Supplier Reliability	Michelis and Somale (2023)
5	Quality Issues	A. Gunasekaran et al. (2009)
6	Financial Instability of Partners	Choi and Lam(2013)
7	potential risks and disturbances Risk analysis	Bayer and Öberg, (2013)
8	Inventory Management	Sharma and Bhat (2014)
9	Cost Fluctuations	Shahriari and Azizipour(2021)
10	Labor Issues	S. Kumar et al. (2013)

RESEARCH METHODOLOGY

Failure mode effect analysis (FMEA) was developed by US Military at the end of the 1940s. The military developed the technique to turn down variation in sources and corresponding potential
failures in the production of munitions and it demonstrate a highly effective tool. the late 1970s, the Ford Motor Company introduced FMEA to the automotive industry for safety and regulatory
consideration. FMEA is a technique that identifies the potential failure modes of a product or a
process, the effects of the failures, and assesses the exigency of these effects. FMEA is broadly used in various industries, including medical, aerospace, automotive, consumer electronics, semiconductor processing. The manufacturing industry uses FMEA to expose potential failure modes in their manufacturing processes, such as contamination, improper handling, or packaging, and determine
their effects on the safety and quality of the manufacturing industry. .FMEA drives towards higher
reliability, higher quality, and enhanced safety. It can also be used to assess and optimize maintenance plans. It provides fundamental information for reliability prediction, and product and process design. FMEA help in resolving possible failures before they adversely affect the business by addressing issues early on so companies can improve product and process quality, increase customer satisfaction.

This study uses qualitative and quantitative analysis based on secondary data from industry reports, academic journals, and expert commentary published between 2018 and 2024. Key sources include McKinsey, Deloitte, the World Economic Forum, and logistics publications such as Supply Chain Dive. Risk categories were identified and prioritized based on frequency and severity across manufacturing case studies. Visual tools like heat maps supported the analysis. Examples from logistics firms are included given the author's specialization in logistics and supply chain
management.

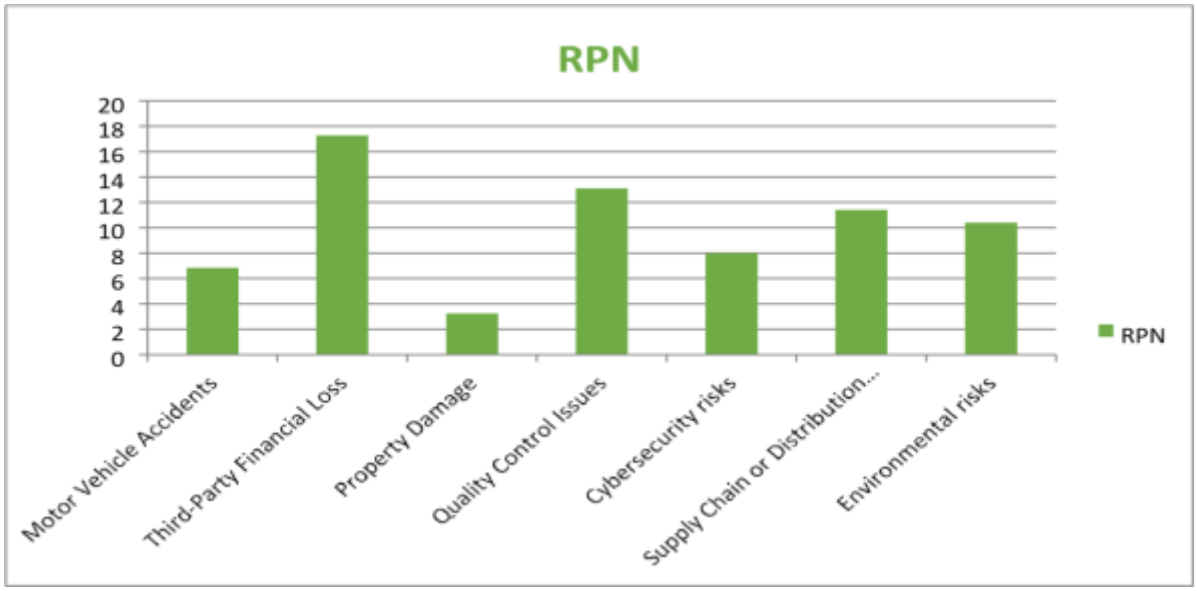
DATA COLLECTION

Escorts Kubota, a renowned name in the agricultural machinery sector, traces its origins to a strategic partnership between Escorts Limited and Kubota Corporation. The collaboration was initiated in [1944], when Escorts Limited, a leading Indian engineering conglomerate with a rich legacy, joined forces with Kubota Corporation, a global powerhouse in agricultural machinery based in Japan. The partnership between Escorts Limited and Kubota Corporation brought together complementary
strengths and expertise, leveraging Escorts' deep understanding of the Indian market and Kubota's
technological prowess and global footprint. This collaboration laid the foundation for Escorts Kubota to emerge as a formidable player in the agricultural machinery industry, blending innovation,
reliability, and customer-centric values. Since its inception, Escorts Kubota has undergone significant growth and expansion, fueled by a shared commitment to excellence and a relentless pursuit of
customer satisfaction. The company's journey has been marked by milestones in product innovation, market expansion, and service excellence, solidifying its position as a trusted partner to farmers worldwide. Escorts Kubota's impact extends beyond its products and services, shaping the trajectory of agriculture and rural development. . By empowering farmers with advanced machinery, efficient technologies, and comprehensive support solutions, the company has played a pivotal role in
enhancing farm productivity, livelihoods, and sustainability across diverse agricultural landscapes. As Escorts Kubota continues to evolve and innovate, it remains guided by the visionary leadership of
both Escorts Limited and Kubota Corporation.

DATA ANALYSIS AND DISCUSSION

Table 8: Aggregate Rating and RPN calculation

Risk	Manufacturing risk in industry	**O**	**S**	**D**	**RPN**
R1	Motor Vehicle Accidents	1.89	1.45	2.5	6.85
R2	Third-Party Financial Loss	3	4	1.44	17.28
R3	Property Damage	1	1.5	2.15	3.25
R4	Quality Control Issues	1.25	3.5	3	13.1
R5	Cybersecurity risks	2	2	2	8
R6	Supply Chain or Distribution Failure	2.35	1.55	3.15	11.4
R7	Environmental risks	2.75	1	3.80	10.4



RISK MITIGATION STRATEGIES

Diversification of Suppliers: Relying on a single supplier exposes manufacturing companies to significant risks. Diversifying the supplier base helps mitigate risks associated with supplier
reliability, quality issues, and geopolitical instability. By working with multiple suppliers for critical components or materials, manufacturers can reduce dependency on any single source and minimize the impact of potential disruptions. Supplier Relationship Management: Building strong relationships with suppliers is essential for proactive risk management. Collaborative partnerships enable
manufacturers to gain insights into their suppliers' capabilities, production processes, and potential risks. Transparent communication, regular assessments, and joint risk mitigation planning foster trust and enable quick resolution of issues when they arise. Supply Chain Visibility and Monitoring:
Enhancing visibility across the supply chain allows manufacturers to identify potential risks early and take preemptive action. Implementing advanced tracking technologies, such as RFID, IoT sensors, and supply chain analytics, enables real-time monitoring of inventory levels, production status, and transportation routes. This visibility empowers manufacturers to proactively address disruptions and optimize their supply chain operations.

CONCLUSION

In conclusion, the evaluation of sourcing risks in the manufacturing industry through the application of Failure Mode and Effects Analysis (FMEA) techniques, along with the utilization of the Risk
Priority Number (RPN) method, offers a robust approach to risk assessment and mitigation. Through the course of this study, we have demonstrated the efficacy of these methodologies in identifying
potential failure modes within the sourcing process, assessing their severity, occurrence, and
detectability, and prioritizing corrective actions based on their risk priority.The FMEA process serves as a structured framework for systematically analyzing the various stages of the sourcing process, from raw material acquisition to production and distribution. By breaking down the process into its constituent elements, identifying potential failure modes, and evaluating their potential effects,
organizations can gain valuable insights into areas of vulnerability and opportunities for improvement. Through collaborative cross-functional efforts, stakeholders can contribute their expertise to the identification and mitigation of risks, fostering a culture of continuous improvement and proactive risk management.Furthermore, the integration of the RPN method into the FMEA process enhances
the quantitative assessment of risk by assigning numerical values to the severity, occurrence, and detectability of each failure mode.

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