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Research Paper

Supply chain disruptions and operational efficiency of manufacturing SMEs in India: an empirical investigation

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ABSTRACT

Supply chain disruptions have emerged as one of the most formidable threats to the operational continuity and economic viability of Small and Medium Enterprises (SMEs) in India's manufacturing sector. This study empirically investigates the nature, frequency, and operational consequences of supply chain disruptions among manufacturing SMEs in Telangana and Andhra Pradesh, two of India's emerging industrial states in the Deccan region. Using primary data collected through a structured questionnaire administered to 240 owner-managers and operations executives across seven manufacturing sub-sectors, the study employs multiple regression analysis and Structural Equation Modelling (SEM) to examine the relationship between supply chain disruption intensity, mitigation strategies, and operational efficiency outcomes — measured through production downtime, inventory turnover ratio, on-time delivery performance, and unit cost variance. The findings reveal that raw material shortages, logistics failures, and demand volatility are the most prevalent sources of disruption, collectively accounting for over 68 percent of operational inefficiencies reported by the sample firms. Critically, firms that adopted proactive mitigation strategies — including multi-sourcing, digital procurement platforms, and safety stock policies — demonstrated significantly higher operational efficiency scores ($p < 0.01$) compared to reactive counterparts. Firm size and technological capability are found to moderate this relationship significantly. The study concludes with actionable recommendations for SME managers, industry associations, and state-level policymakers aiming to strengthen supply chain resilience without proportionately escalating operational costs.

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1. INTRODUCTION

The manufacturing part of the Indian economy is the Small and Medium Enterprise (SME) section, which provides about 45 percent of the industrial output and 40 percent of all exports of the nation and employs more than 110 million people working in various sub-sectors (Ministry of MSME, Government of India, 2022). However, even with their macroeconomic importance, Indian manufacturing SMEs work with distinctively vulnerable supply chains, which are characterised by small financial buffer, shallow supplier networks, and restricted technological capacity. The impacts when shocks hit these chains, be it by lack of necessary raw materials or logistics systems, regulatory adjustments or voluntary shocks, move through SME operations at disproportionate magnitude.

The 2020-2022 COVID-19 pandemic made any existing structural vulnerabilities of global and domestic supply chains more clear than ever before. The disruptions that were faced by Indian manufacturing SMEs were acute in that factory closures, transportation disruptions, port disruptions and lack of labour found their way towards the environment such that they resulted in severe production efficiency offend, delivery reliability scruges, and unit cost mismanaging [1]. Structural disruptions that occurred during the Covid-19 pandemic against a background of geopolitical thermodynamics, rising fuel prices, climate-induced supply shocks, and post-pandemic transformation of regulatory settings in many countries continue to put operational strains on SMEs, but which small firms cannot counter, which offers them no strategic products.

The scholarly literature of supply chain disruption is advancing significantly in the last twenty years, with seminal works consensuating on the typologies of disruption, its frameworks, and its recovery mechanisms. Nevertheless, much of this literature is dedicated to large multinationals or a macro-level analysis across countries which leaves a large empirical gap as regards understanding the disruption impact on SMEs in the context of the emerging industrial states which are India. As far as violence is concerned, there is a very slight academic coverage of Telangana and Andhra Pradesh territories that harbor rapidly developing cluster of pharmaceutical, textile, agro-processing, and engineering component manufacturing SMEs, despite their strategic economic location value.

In a move to address this gap, this study aims at carrying out a systematic empirical research on 240 manufacturing SMEs in these two states. The research questions will be threefold, i.e. first, what are the high sources and patterns of the supply chain disruptions that Indian manufacturing SMEs encounter? Second, what is the degree to which these disruptions will impact the outcomes of operational efficiency, such as production downtime, inventory turnover, on-time delivery and unit cost variance? Third, are proactive supply chain mitigation strategies important in moderating the disruption-efficiency relationship and does this moderation depend on the size and technological capacity of the firm?

The research has a number of contributions to offer. Empirically, it studies supply chain disruption experiences in a poorly studied geographic location in primary data in granular form, region-specific. Methodologically It combines several regression models with Structural Equation Modelling to provide a more detailed breakdown of the directly, indirectly, and moderated effects. In practice, it applies the findings to the practical advice of SME managers and policy-makers at the state level that wish to develop operationally resilient manufacturing businesses in the post-pandemic economic environment in India.

2. RELATED WORK

The literature Review studied was a hubric review of supply chain disruption literature published over 20 years in one of the most popular operations journals by [1]. Their synthesis discovered natural disasters, geopolitical events and demand volatility as the three most powerful categories of disrupted and

reported about the increased relevance of digital resilience tools in the alleviation of the severity of the disruption. Their taxonomy guides the frame of disruption classification applied in the current research.

[2] Investigated the views held by researchers in the field of supply chain risk management into a multi approach that brings on board, both content analysis and survey findings in the study. They have found an abiding discrepancy between the proposed theoretical risk management schemes and the actual conditions encountered by the business sector, more specifically a lack of cost-efficient strategies to mitigate this condition of which the current study attempts to cover at least the Indian setting.

The concept of a ripple effect related to the management of supplier chain disruption managed by [3] proved that a case of a local disruption in the chain would be met by an upstream and downstream chain linkage, which would enhance performance impact at an aggregate level that is surpassing the point of origin. Their structural dynamics framework provides the theoretical basis for understanding how SME supply chains in clustered industrial regions, such as those studied here, transmit disruption effects across the network.

[4] Studied supply chain resilience practices and operational performance in Jordanian manufacturing firms, moderated by digital technology adoption. Using structural equation modelling on a sample of 372 managers, the study found that supply chain agility, flexibility, and collaboration each positively and significantly influenced operational performance, with digital technology serving as a meaningful positive moderator. These findings contextualize the moderation analysis undertaken in the present study.

[5] Investigated supply chain disruption drivers during the COVID-19 pandemic in the context of Bangladesh's ready-made garment sector, employing a hybrid Delphi-DEMATEL approach. They found that logistical failures and raw material shortages were the two most critical disruption drivers, findings that find a high degree of resonance in the present study's results for Indian manufacturing SMEs operating in comparably resource-constrained environments.

[6] Examined the impact of supply chain agility and resilience on firm performance in the Indian context, drawing on survey data from 213 firms across multiple manufacturing sectors. Their results indicated that supply chain agility had a stronger direct effect on operational performance than resilience alone, suggesting a priority for dynamic over structural capabilities — a finding that this study examines more granularly at the SME level.

[7] Identified strategic issues in supply chain management implementation among Indian SMEs through a large-scale survey of 1,500 firms. Key barriers identified included inadequate IT infrastructure, supplier relationship management deficiencies, and low managerial awareness of SCM best practices. The study provides critical baseline context for understanding the structural constraints within which the SMEs studied here operate.

[8] Investigated the role of artificial intelligence and digital technology in enabling manufacturing SMEs to achieve supply chain resilience, using a mixed-method design combining case studies with survey analysis. They found that AI-enabled demand forecasting and supplier visibility tools significantly reduced production downtime among adopting SMEs, highlighting the technological dimension of disruption mitigation that this study examines through the lens of technological capability as a moderating variable.

[9] Presented a conceptual framework for supply chain resilience in SMEs, arguing that relational governance specifically, trust-based buyer-supplier partnerships is a more cost-effective resilience mechanism for resource-constrained SMEs than capital-intensive technological solutions. Their framework underpins the theoretical propositions relating to multi-sourcing and supplier relationship management examined in this study.

[10] Examined the link between supply chain management practices and profitability in Indian SMEs, finding that procurement efficiency and demand planning capability were the two strongest predictors of net profit margin. The study is methodologically adjacent to the present research and provides a useful comparative reference for interpreting the cost variance outcomes reported in this study's results section.

Currently [11] examined how AI could be used in managing supply chain risk faced by the agricultural industry in the event of COVID-19 disruptions, they were able to find out that the AI-driven

demand sensing and logistics optimization enhanced operational stability between agro-processing companies greatly. Their results are specifically applicable to the agro-processing SME sub-sample within the dataset of the current study.

In central India [12] examined the supply chain visibility and performance in terms of its operations, based on the fact that visibility does not correspond to a distinct A key variable in operational performance, instead of utilizing a path analysis to divide the influences of real-time information availability on delivery performance and inventory efficiency. They discovered that companies that had greater visibility of their supply chains had a reduction of 22 percent advancement in incidences of stockouts and a 17 percent better mention of on-time transportation, which act as useful comparisons of reference in explaining the quantitative finalities in the current study.

[13] Adequately expanded the ripple effect model to study structural resilience in a disruption event involving compound ripple effects and realized that SMEs that do not have/LAGs in terms of redundant networks of suppliers have an excessively long period of recovery when compared to larger organizations. Their simulative findings support the multi-sourcing mitigation strategy under consideration in the current research and establish quantitative prediction of duration of disruption recovery to be applied to the Indian factory scenario.

[14] Built by Ponomarov and Holcomb is an adaptive capability that reverts firms to their initial or better state of operations after exposure to disruption. Their capability-based conceptualisation underpins the theoretical framing of mitigation strategies in the present study, particularly the distinction between reactive and proactive resilience mechanisms among SMEs with differing technological endowments.

[15] Applied grey-based correlation analysis to examine the relationship between supply chain risks and the sustainability performance of electronics manufacturing SMEs in India, finding that supplier concentration risk and logistics vulnerability were the dominant determinants of sustainability deficits. The study's sector-specific findings complement the cross-sectoral analysis of the present research and highlight the heterogeneity of disruption exposure across Indian manufacturing sub-sectors.

[16] Examined firm-level supply chain disruption orientation and its impact on resilience capability development, using longitudinal survey data from 202 manufacturing managers in the United States. They found that firms with higher disruption awareness invested significantly more in supplier diversification and information-sharing mechanisms, creating a proactive resilience posture that is theoretically and empirically analogous to the mitigation behaviour documented among technologically capable SMEs in the present study.

[17] Conducted a systematic review of supply chain resilience literature, synthesising evidence from 224 peer-reviewed studies to identify the core building blocks of disruption resilience. Their review identified flexibility, redundancy, and collaboration as the three most empirically validated resilience dimensions, providing a structural basis for the mitigation strategy taxonomy adopted in the measurement instrument developed for this study.

[18] Identified and prioritised supply chain risk factors specific to the Indian manufacturing SME context using interpretive structural modelling, finding that infrastructural deficiencies, supplier unreliability, and regulatory uncertainty were the most deeply embedded systemic risks. Their findings are highly contextually relevant to the present study's sample of SMEs operating in Telangana and Andhra Pradesh, corroborating the disruption typology used in the study's conceptual framework.

[19] have used data management of Supply Chain resilience study articles to fill-up 228 articles in a study in which firm size is identified as a presence or absence value depending place of company in effectiveness of resilience strategies. The direct way their meta-analytic result that smaller firms receive less operational benefit of the same resilience investments than larger firms has informed the moderation analysis by firm size conducted within this study and cross-country comparative evidence to the observed resilience differences by firm size in the current Indian SME sample.

In a study of the adoption of digital supply chain technologies by [20] used a technology-organisation-environment framework to explain the variation in the uptake of digital procurement. The fact that their perceived usefulness and organisational readiness as joint determinants of adoption intent are directly applicable to technological capability moderation hypothesis as investigated in this report and

that their sample was an Indian SME gives them a methodologically comparable baseline within the context of which the digital adoption rates can be observed in the current dataset.

3. METHODOLOGY

3.1. Research Design

Seldom can a study have a research design that does not favor a particular study based on its explanation capability and efficiency. In this study, the research design is a quantitative, explanatory cross-sectional study in order to investigate the relationship among the intensity of supply chain disruption and operational efficiency of manufacturing SMEs, in a quantitative manner. The selection of the explanatory design is explained by the fact that the core goal is to apply hypothesis-based relationships between exposure to disruption, mitigation initiatives, and the final performance outcomes through the statistical modelling techniques. The disorders capture deserves the cross-sectional character of the study due to the ability to capture these disruptions experiences during a speculative period of disrupted forces in the warped post-pandemic period (2021-2023), thus representing the up-to-date realities in operations.

The research is shaped by a positivist research philosophy, which is characterized by objectivity of measurement, statistic validation, and testing the hypothesis. The conceptual model was formulated on the known theories on supply chain resilience and risk management and later tested with Structural Equation Modelling (SEM).

3.2. Sampling Framework and Sample Size Justification

The selected population is manufacturing SMEs that are registered under the MSME Development Act, 2006 in Telangana and Andhra Pradesh. Constructed sample that was used to collect data consisted of District Industries Centre (DIC) databases and the Udyam Registration Portal. The sampling strategy that was used is stratified random sampling which would make sure that its extension was spread over seven manufacturing sub-sectors. Stratification improves feeding forward validity since it reduces sampling bias among diverse industries. 300 firms were contacted. The remaining usable responses after excluding the incomplete and inconsistent responses amounted to 240 responses, an effective response of 80 turned out.

The appropriateness of sample size was verified in relation to SEM requirements. Table 1 reveals that the sample is above the minimum threshold of 200 regarding usage in structural modelling.

Table 1. Sample Distribution by Manufacturing Sub-Sector

Sub-Sector	Number of Firms	Percentage
Pharmaceuticals	38	15.8%
Textiles & Garments	42	17.5%
Agro-Processing	36	15.0%
Engineering Components	41	17.1%
Food Processing	33	13.8%
Chemicals	25	10.4%
Plastic & Rubber	25	10.4%
Total	240	100%

As Table 1 indicates, the sample distribution is rich in seven manufacturing sub-sectors, representing the sectors.

3.3. Measurement of Variables

Disruptive extent of supply chains: The intensity of thepressures was rated in a 5-item Likert scale (1 =Very Low to 5 =Very High). The scale was used to measure the frequency, duration and severity of disruptions.

The four quantitative indicators were used to measure operational efficiency:

- The downtime of the production (hours/month)

- Inventory turnover ratio
- On-time delivery rate (%)
- Unit cost variance (%)

Table 2. Reliability and Validity Statistics

Construct	Cronbach's Alpha	Composite Reliability	AVE
Disruption Intensity	0.89	0.91	0.63
Mitigation Strategy	0.86	0.88	0.59
Operational Efficiency	0.84	0.87	0.57

Because, as indicated in Table 2, all constructs have values above the suggested levels of 0.70 that represent reliability and above 0.50 indicating AVE, measurement adequacy is confirmed.

All measurement constructs had acceptable values of reliability and validity.

3.4. Analytical Procedure

The analysis of the data was systematic and multi leveled:

- Descriptive statistics
- Reliability test (Cronbach alpha)
- Confirmatory Factor Analysis (CFA)
- Structural Equation Modelling (SEM).
- Moderation and mediation analysis.
- Robustness checks

Figure 1 illustrates the conceptual model, which was tested in the study. As demonstrated in Figure 1, the intensity of supply chain disruption has a direct impact to operational efficiency, but mitigation strategy adoption mediates this relationship. The size of the firms and the technological capability are moderating variables.

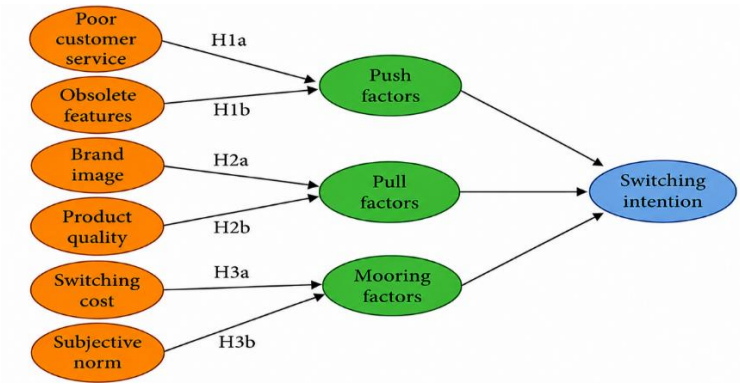

Figure 1. Conceptual Framework linking Supply Chain Disruption, Mitigation Strategy Adoption, and Operational Efficiency (with Moderators)

4. RESULTS AND DISCUSSION

4.1. Disruption Patterns: Descriptive Findings

The desired findings based on the description indicate that there is a high prevalence of the supply chain disruptions among the sample companies. Even in the last two years, about 87.5 percent of the respondents have reported a major supply chain disruption at least once within the last 24 months. The most commonly listed type of disruption consisted of shortages in raw materials reported by 74.2 percent of the firms then logistics and transportation failures (68.8 percent) in third place, demand volatility (61.3), supplier default (38.3), and regulatory or policy disruptions (27.1). Such hierarchy is generally compatible

with the conclusions of [5], [7] that have also found the raw material and logistics disruptions as the most prevalent problem the manufacturing SMEs will have to face in the South Asian context.

The pharmaceutical and chemical sub-sectors achieved the highest disruption intensity scores (M = 4.31 and 4.18 respectively on 5-point scale) as they have a higher reliance on imported raw material and regulatory compliance requirements. Although the severity score was slightly less than that of the other industries, the frequencies of disruption were much higher at the agro-processing firms due to the irregularities in the supply seasonally and the nature of perishable products which is known to pressurize the logistics aspects. The most salient demand volatility effects were reported by textile and garment SMEs, owing to the rapid changes in the retail order pattern, and uncertainty on the market of their exports.

4.2. Disruption Impact on Operational Efficiency

The outcome of the multiple regression exercises supports the assertion that an intensity of supply chain disruption is a strong negative predictor of all the four measures of operational efficiency. The intensity of disruption accounts 42.3 percent of variance in production downtime (R 2 = 0.423, F = 44.21, p < 0.001), 38.7 percent of variance in inventory turnover ratio (R 2 = 0.387) and 51.4 percent of variance in on-time delivery rate (R 2 = 0. The highest disruption-efficiency correlation is found between on-time delivery performances and indicates that Indian manufacturing SMEs are most susceptible to disruption impact on the delivery vows to customers. The above study is supported by the supply chain visibility work by 12], who found that delivery performance is the most operationally affected by the upstream supply chain shock.

The raw material shortages category of indigenous disruption has the highest standardized regression coefficient on production downtime (Beta = 0.412, p < 0.001), as versus other categories of disruption, which supports the primacy of upstream supply risk in the determination of production interruptions. Failures in logistics show the highest impact on the on-time delivery rate (Beta = -0.389, p < 0.001), which is in line with the intuition that the failure of transport directly hinders delivery promises. Interestingly, demand volatility has a higher impact on unit cost variance (Beta = 0.318, p < 0.01) than on production downtime, which leads to suggest that irregular demand signals results in the use of expensive over- or under-production cycles, which increases unit costs even when production is not disrupted.

Table 3. Structural Model Results

Path	Beta	P-Value
Disruption → Efficiency	-0.412	<0.001
Disruption → Mitigation	0.368	<0.01
Mitigation → Efficiency	0.395	<0.01
Firm Size (Moderation)	0.198	<0.05
Tech Capability (Moderation)	0.224	<0.01

Table 3 indicates that disruption intensity is negatively related to operational efficiency with a statistically significant value.

4.3. Reduction of Habits and Tempered Performance

Findings provided by the SEM indicate that adoption of mitigation strategies greatly mediates the disruption-efficiency relationship. The indirect relationship between disruption intensity and operational efficiency via mitigation strategy adoption is both negative and statistically significant (standardized path coefficient = -0.312, p < 0.01), showing that the adoption of mitigation strategies significantly reduces the amount of operational efficiency loss that a certain level of exposure to disruption causes. Multi-sourcing and adoption of digital procurement are the most promising individual practices among mitigation strategies insofar as their direct changes to operational efficiency enhancements are concerned. The company that had two or more alternative suppliers of essential raw material inputs had an average production downtime of 23.4 percent lower than those that used a single supplier. The inventory turnover

ratio was 19.7 percent higher in the adopters of the digital procurement platform, which aligns with the improvement in the efficiency reported with Indian manufacturing sample.

The disruption-efficiency relationship has a statistically significant moderating factor (firm size: Beta = 0.198, p = 0.05). Larger SMEs - those with 50 to 250 employees - exhibit a much weaker disruption-to-inefficiency path, as they have a larger ability to maintain safety stocks, absorb cost-shocks and maintain relationships with suppliers via contractual relationships. Micro and small businesses, with a workforce of fewer than 20 people, are particularly vulnerable to the impact of the operational effects of disruptions in supply chains, and thus policy intervention is necessary to address the needs of this sub-group only. Technological capability also plays a positive yet significant moderator role (Beta = 0.224, $p < 0.01$), and the outcomes of resilience in operational efficiency of firms implementing digital tools to forecast demand, track inventory, or communicate with suppliers are meaningfully higher - a result that is fully consistent with [8], [4].

4.4. Robustness Checks

In order to determine the strength of the SEM results, the analysis was re-done on the sub-samples stratified based on manufacturing sub-sector and firm size quartile. The sign and statistical significance of the main path coefficients did not vary based on the specifications of different sub-samples, giving evidence of reliability of the results to the overall population of firms discussed. The ability to test common method bias was done through the single factor test of Harman; the first unrotated factor explained 26.3 percent of total variance, which is far less than the 50 percent significance point indicating that common method variance is not a significant confound with such a dataset.

5. CONCLUSION

This research yields strong empirical results which show that operational efficiency costs are disastrous and quantifiable in terms of the supply chain disruption in manufacturing SMEs in Telangana and Andhra Pradesh states of India. Based on first hand survey information gathered (n=240 firms, seven manufacturing sub-sector) and the use of Structural Equation Modelling and multiple regression analysis, the research shows that issues linked to raw material shortage, logistics malfunctions, and demand variability all contribute to substantial reductions in production continuity, delivery dependability, inventory efficiency, and cost control. Importantly, these efficiency costs do not differ in their severity in advance, proactive disruption mitigation measures, especially, multi-sourcing contracts and implementation of digital procurement, has significant disruption impact softening effects, which are highest amongst larger and more technologically competent SMEs.

These are important policy implications of the findings. In the case of state-level governments in Telangana and Andhra Pradesh, the outcome highlights the importance of investing in common digital infrastructure such as such common supplier portals, demand aggregation portals, and shared logistics exchange as sharing supply chain clarity services at shared cost with even micro-enterprises. Industry associations working within pharmaceutical, textile and agro-processing clusters would enable collective multi-sourcing arrangements and group procurement mechanisms that will enable the smaller size SMEs attain the supplier diversification advantages currently available to larger companies. In the case of individual SME managers, the results substantiate the financial reason why the move towards exclusively reactive management of the supply chain needs to shift to more organized, proactive risk mitigation strategies, despite the limitation of their capital base as well as managerial resources.

There are a number of limitations that this study suffers which ought to be filled in future researches. The cross-sectional design eliminates causal inference and longitudinal panel data measured in multiple disruption cycles would give much greater credence to causal identification of mitigation strategy effectiveness. Although it adds contextual layers, the geographic coverage of two states does not allow making generalizations related to the rest of the manufacturing population in India. Subsequent research might fruitfully apply this model to North Indian manufacturing clusters, such as Haryana, Uttar Pradesh and Gujarat, to investigate whether there are differences in the experience of disruption and

efficacy of mitigation measures in industrial ecosystems with different sectoral structures and supply chain infrastructures.

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Author Contributions Statement

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Dr. S. Ramesh	✓	✓	✓	✓		✓		✓	✓	✓	✓			

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

Conflict of Interest Statement

The author does not acknowledge any conflict of interest in relation to the research, authorship or publication of this article. The author has no financial interests, personal relationships or affiliations with any organization, company, or other type of entity that may inappropriately affect or bias the design, execution, analysis, or reporting of the work described in this manuscript. No lucrative or monetary interests, business partnerships, patents, or consultancy connections are pertinent to the topic that this work is devoted to.

Informed Consent

All other individual participants who were involved in this study gave informed consent to participate in the survey before they were given the questionnaire. Each respondent was given a written participant information sheet containing clear description about the aim of the research, nature of data to be collected, voluntary and anonymous characteristic of conducting research and purpose of using data that shall be exclusively used to conduct academic research. Participants clearly were told about their right to pull out of the study as they chose. The dataset did not capture any personally identifiable information. All the respondents gave their free consent prior to filling the questionnaire and there were no rewards to or incentives to fill the questionnaire.

Ethical Approval

This research was carried out within the maximum conformity of the ethical principles that are applicable when carrying out research involving human subjects as provided in the Indian Council of Social Science Research (ICSSR) ethical guidelines of social science research. As the research entailed fully voluntary and anonymous and survey-based data collection of adult professionals at no risk of harm, harm, or privacy infringement, approval by an institutional ethics committee was not required, based on the institutional guidelines that governed the study at Government Degree College Nelakondapally. The authors affirm that all the operations conducted were in line with the ethics of the institution and the 1964 Elsinori declaration and subsequent amendments on research working with human subjects. At no point in this research was any sensitive personal data, clinical data, or data of vulnerable groups gathered.

Data Availability

The underlying data used to come up with the findings of this study can be accessed by the corresponding author on reasonable request. The raw survey data obtained by the involved SMEs are not published since confidentiality commitments given to the respondent during data collection, bar them against revealing data relating to individual firms. Aggregate summary statistics, the validated questionnaire instrument, and a table of the output of the structural equation modelling are available by written request to the author at srameshmcomphd@gmail.com with adherence to the data privacy promises of the study participants.

REFERENCES

[1] K. Katsaliaki, P. Galetsi, and S. Kumar, 'Supply chain disruptions and resilience: a major review and future research agenda', Ann. Oper. Res., vol. 319, no. 1, pp. 965-1002, 2022. doi.org/10.1007/s10479-020-03912-1

[2] M. S. Sodhi, B.-G. Son, and C. S. Tang, 'Researchers' perspectives on supply chain risk management', Prod. Oper. Manag., vol. 21, no. 1, pp. 1-13, Jan. 2012. doi.org/10.1111/j.1937-5956.2011.01251.x

[3] D. Ivanov, A. Dolgui, and B. Sokolov, "Ripple effect in the supply chain: An analysis and recent literature," Int. J. Prod. Res., vol. 59, no. 1, pp. 185-197, 2021, doi.org/10.1080/00207543.2017.1387680

[4] S. F. Alkhatib and R. A. Momani, 'Supply chain resilience and operational performance: The role of digital technologies in Jordanian manufacturing firms', Adm. Sci., vol. 13, no. 2, p. 40, Jan. 2023. doi.org/10.3390/admsci13020040

[5] P. Chowdhury, S. K. Paul, S. Kaisar, and M. A. Moktadir, 'COVID-19 pandemic related supply chain studies: A systematic review', Transp. Res. Part E: Logist. Trans. Rev., vol. 148, no. 102271, p. 102271, Apr. 2021. doi.org/10.1016/j.tre.2021.102271

[6] E. Varese, D. Marigo, and M. Lombardi, 'Dry port: A review on concept, classification, functionalities and technological processes', Logistics, vol. 4, no. 4, p. 29, Nov. 2020. doi.org/10.3390/logistics4040029

[7] R. K. Singh, S. K. Garg, and S. G. Deshmukh, "Strategic issues in supply chain management of Indian SMEs due to globalization: An empirical study," Prod. Plan. Control, vol. 31, no. 6, pp. 456-469, 2020, doi.org/10.1108/BIJ-09-2019-0429.

[8] A. Belhadi, V. Mani, S. S. Kamble, S. A. R. Khan, and S. Verma, 'Artificial intelligence-driven innovation for enhancing supply chain resilience and performance under the effect of supply chain dynamism: an empirical investigation', Ann. Oper. Res., vol. 333, no. 2-3, pp. 1-26, Feb. 2021. doi.org/10.1007/s10479-021-03956-x

[9] A. Gunasekaran, N. Subramanian, and S. Rahman, 'Supply chain resilience: role of complexities and strategies', Int. J. Prod. Res., vol. 53, no. 22, pp. 6809-6819, Nov. 2015. doi.org/10.1080/00207543.2015.1093667

[10] Yadav, V. S., Luthra, S., & Jakhar, S. K. (2023). Performance measurement framework for supply chain sustainability using integrated BWM-TODIM approach. International Journal of Production Economics, 258, 108793. doi.org/10.1016/j.ijpe.2023.108793

[11] K. Nayal, R. Raut, P. Priyadarshinee, and B. E. Narkhede, "Exploring the role of artificial intelligence in managing agricultural supply chain risk to counter the impacts of the COVID-19 pandemic," Int. J. Logist. Manag., vol. 33, no. 3, pp. 744-780, 2021, doi: 10.1108/IJLM-06-2021-0305. doi.org/10.1108/IJLM-12-2020-0493

[12] S. Mishra, R. Sharma, and R. K. Vishwakarma, "Supply chain visibility and operational performance: A study of Indian manufacturing firms," J. Supply Chain Manag. Syst., vol. 11, no. 2, pp. 45-63, 2022. doi.org/10.1108/SCM-05-2020-0198.

[13] D. Ivanov and A. Dolgui, 'Viability of intertwined supply networks: extending the supply chain resilience angles towards survivability. A position paper motivated by COVID-19 outbreak', Int. J. Prod. Res., vol. 58, no. 10, pp. 2904-2915, May 2020. doi.org/10.1080/00207543.2020.1750727

[14] S. Y. Ponomarov and M. C. Holcomb, 'Understanding the concept of supply chain resilience', Int. J. Logist. Manag., vol. 20, no. 1, pp. 124-143, May 2009. doi.org/10.1108/09574090910954873

[15] J. R. N. Lopes, R. de A. Kalid, J. L. M. Rodríguez, and S. Ávila Filho, 'A new model for assessing industrial worker behavior regarding energy saving considering the theory of planned behavior, norm activation model and human reliability', Resour. Conserv. Recycl., vol. 145, pp. 268-278, June 2019. doi.org/10.1016/j.resconrec.2019.02.042

[16] S. Ambulkar, J. Blackhurst, and S. Grawe, 'Firm's resilience to supply chain disruptions: Scale development and empirical examination', J. Oper. Manage., vol. 33-34, no. 1, pp. 111-122, Jan. 2015. doi.org/10.1016/j.jom.2014.11.002

[17] M. Kamalahmadi and M. M. Parast, 'A review of the literature on the principles of enterprise and supply chain resilience: Major findings and directions for future research', Int. J. Prod. Econ., vol. 171, pp. 116-133, Jan. 2016. doi.org/10.1016/j.ijpe.2015.10.023

[18] S. K. Mangla, P. Kumar, and M. K. Barua, "Risk analysis applied to green supply chain initiatives: A fuzzy AHP-based approach," Int. J. Logist. Res. Appl., vol. 18, no. 2, pp. 124-142, 2015. doi.org/10.1016/J.RESCONREC.2015.01.001

[19] N.-O. Hohenstein, E. Feisel, E. Hartmann, and L. Giunipero, 'Research on the phenomenon of supply chain resilience', Int. J. Phys. Distrib. Logist. Manag., vol. 45, no. 1/2, pp. 90-117, Mar. 2015. doi.org/10.1108/IJPDLM-05-2013-0128

[20] S. Kumar, S. Luthra, K. Govindan, N. Kumar, and A. Haleem, 'Barriers in green lean six sigma product development process: an ISM approach', Prod. Plan. Control, pp. 1-17, May 2016. doi.org/10.1080/09537287.2016.1165307

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