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Resilient Supply Chain Management in Manufacturing Sector: A Qualitative Study

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ABSTRACT
This study acknowledges that today's business environment is dynamic and prone to unanticipated changes. The study aims to understand the implications of such disruptions in the supply chain especially in manufacturing sector. The main goal is to understand the challenges faced and the versatile practices followed to stay resistant to such dynamic environment. The study also focuses on the new practices businesses adopt to form resilient supply chain. Qualitative approach was done to capture the rich essence of the subject matter. The study used focus groups and in-depth interviews as techniques and interviewed members from different nodal points of a supply chain including manufacturers, logistic service providers and mid players in logistics. As a result, it was found out that Multinational companies are well equipped, and they have much better mitigation plans while small scale and mid-scale players need to work more on resiliency instead of just surviving the situations.

Keywords: Supply Chain Resiliency, Dynamic, Disruptions, Mitigation.

1. INTRODUCTION

In today's dynamic business environment, the impact of disruptions on supply chains has become a critical consideration for organizations across industries. This study delves into the profound implications that disruptions of any kind can have on the supply chain, with a specific focus on the manufacturing sector in South India. The overarching goal is to examine the challenges posed by disruptions and explore the various practices and strategies adopted by businesses to mitigate these challenges, particularly in the aftermath of significant events such as the COVID-19 pandemic.

The manufacturing sector, being a cornerstone of South India's economic landscape, faces numerous challenges when supply chain disruptions occur. This study will delve into the specific problems encountered during disruptions, analysing how factors such as natural disasters, geopolitical events, or pandemics can create cascading effects, leading to production delays, inventory shortages, and logistical bottlenecks. This exploration will provide a comprehensive understanding of the vulnerabilities within the supply chain and lay the foundation for identifying potential solutions.

As the world grapples with the aftermath of the COVID-19 pandemic, this study will shed light on the best practices and adaptive measures implemented by manufacturing businesses in South India to sustain their supply chains. These practices may include the adoption of technology, diversification of suppliers, and the establishment of contingency plans. Additionally, the study will emphasize the growing importance and necessity of resilient supply chains, underscoring their role in ensuring business continuity

and long-term success for manufacturing enterprises in the region. The ability of the supply chain to adjust quickly and recover from disruption is referred to as resilient supply chain management (RSCM).

As we move into this growing landscape, change is not a luxury but a necessity for survival and growth. Conceptual design of supply chain resilience is a priority (Uta Jüttner, et al., 2003). The ability to adapt quickly, make data-driven decisions, and get stakeholders to execute them is very important in building flexible supply chain management. This study aims to highlight critical factors, providing organizations with a strategy to build robust, adaptive, and agile supply chains that can weather the world's unpredictable storms.

While existing literature extensively covers the challenges and best practices related to supply chain disruptions in the manufacturing sector, there remains a notable research gap concerning the nuanced impact of disruptions on the manufacturing landscape in South India. Numerous studies, such as those by (Sunil Chopra, et al., 2004) has provided valuable insights into the general challenges faced by global supply chains during disruptions. However, there is a scarcity of in-depth research specific to the manufacturing sector in South India, which is a crucial hub for various industries.

This study aims to bridge this gap by examining the unique disruptions experienced by businesses in the region and understanding how these challenges differ from global trends. The study will not only identify the vulnerabilities specific to South India but also explore the resilience strategies that are most effective in this context. This study aims to fill this research gap by offering a detailed examination of the practices and strategies implemented by businesses in the region to navigate the challenges posed by the COVID-19 pandemic.

The post-pandemic era is uncertain, but it provides opportunities for organizations to innovate, change and emerge stronger. By adopting the principle of resilient supply chain, businesses will not only be able to mitigate risks but also provide a competitive advantage to advance in the global market (Martin Christopher, et al., 2004). The scope of the study is the post-pandemic resilience of supply chain improvements in manufacturing sector. Such disruptions have weakened the global supply chain, destabilized supply chain flows, and has tested organizational resilience as never before. Especially the manufacturing industry has been severely affected, with many businesses facing challenges such as factory closures, supplier shortages and infrastructure disruptions.

This study will focus primarily on manufacturing, as it is one of the most important vulnerable sectors of the economy. The manufacturing sector accounts for the largest share of global GDP and employment. It is also a key driver of innovation and technological progress. Digital technologies have also played an important role in facilitating supply chain flexibility in the industry (Balakrishnan A.S, et al., 2021)

1.2 OBJECTIVES OF THE STUDY

1. To understand the unique problems in supply chain management in the manufacturing industry encountered during pandemic.
2. To analyse the opportunities that are born out of pandemic and areas of improvement that need emphasis on post pandemic era.
3. To understand better practices for enhancing supply chain resilience in the manufacturing industry in the context of global disruptions.

1.3 LIMITATIONS OF THE STUDY

1. The survey sample size has been confined to only 12 respondents.
2. The study was limited to South India.

3. The study has been carried out in South India, so the findings may vary accordingly, as in the other parts of the country there may be a different impact.

2. REVIEW OF LITERATURE

Global upheavals such as pandemics, natural disasters, and geopolitical conflicts have exposed shortcomings in the supply chains of many industries. Companies were particularly surprised by the sophistication of suppliers, manufacturing facilities and distribution channels. This literature review is to provide a comprehensive review of existing research on supply chain management in the face of global disruption, with special emphasis on the Indian context. It also aims to identify research gaps and potential areas for further research for students and practitioners in the field.

2.1 The Impact of Global Disruptions on Manufacturing Supply Chains

The COVID-19 pandemic's effect on the Indian raw material supply chain was the subject of a major study (Siva Kumar, et al., 2019) The study conveys clear effects of disruptions on distribution and production in several Indian businesses. For numerous manufacturing businesses, issues included lack of raw materials, transportation issues, and labour shortage. This research provides insight into how the global crisis may affect India's industrial supply chain (Siva Kumar, et al.,2019). Examination of supply chain management in the Indian industrial sector offers a crucial additional viewpoint on the issue. Finding vulnerabilities early on and creating mitigation strategies is crucial, as the results show.

In times of global unrest, they discuss how vital risk assessment and mitigation are important in achieving resilience, which is critical for supply chain management. These findings underscore the need for risk management investments for Indian manufacturing enterprises to weather global periods of turbulence. Shortage and delay of raw materials are the main consequences of disruptions. For products like electronics and cars that are a part of intricate supply networks, this has proven particularly true. The supply chain disruption can be blamed for an additional rise in producer expenses. This is a result of several things, such as rising labour prices, higher transportation costs, the need to pay more for rare commodities, and supply chain problems that occasionally prohibit producers' goods from being sold.

2.2 Resilience Strategies and Technological Integration

Closing the research gap requires focusing on long-term responses and finding strategies for developing resilient supply chains in the Indian manufacturing sector. A study must be done to investigate the long-term impact of global turbulence on India's manufacturing supply network. This study can provide insights into how Indian manufacturing firms adapt and innovate to remain globally competitive in the wake of major upheavals. Understanding evolving strategies and responses will be important in designing resilient supply chains. Integrating modern technologies to improve supply chain flexibility is a new discipline in supply chain management. (Vincent Charles, et al.,2023) proposes the use of Industry 4.0 technologies such as the Internet of Things (IoT) and blockchain to increase supply chain visibility and responsiveness. Industry 4.0 technology enables the real-time collection of data from multiple points in the supply chain, such as manufacturing facilities, warehouses, transportation systems and retailers. This data provides organizations access to the entire supply chain a comprehensive view, allowing them to track trends, identify potential breakdowns and predict future problems.

Vast amounts of data collected by IoT sensors and other Industry 4.0 technologies can be analysed using advanced analytics tools and AI algorithms These tools can identify patterns, trends and anomalies in supply chain data, enabling companies to make informed decisions more on inventory management, production planning and logistics optimization and predictive psychoanalysis by doing so you will be able

to anticipate potential risks and disruptions in the supply chain. This allows for mitigation of disruption by taking precautions such as adjusting inventory levels, using alternative delivery methods, or finding alternative suppliers. For example, robots and automation can help streamline many supply chain activities from warehouse unpacking and loading to transportation and distribution. This type of automation reduces manual errors, improve efficiency and free up human resources to focus on more important tasks. Studies can be carried out to see how this technology can be successfully applied in the Indian manufacturing sector. Research could look at how Indian businesses have implemented Industry 4.0 technologies to improve supply chain resilience. Furthermore, to examine how these policies and the Indian government's "Make in India" policy affected supply chain management in domestic and global markets could be a fruitful research avenue (B.N Balaji Singh, 2016) recommend that we look at the impact of the "Make in India" initiative on domestic supply chain management. This study can shed light on how Indian manufacturers have aligned their supply chain strategies with the government's objectives.

2.3 Government Policies and Supply Chain Resilience

The role of the government in determining supply chain tactics amid global disruptions is an important topic of research. (Charles Baah, et al., 2023) investigated the influence of government policies on supply chain resilience. They discovered that government assistance in the form of regulatory flexibility and financial incentives had a considerable impact on firms' ability to adjust to shocks. A study subject worth investigating is the impact of Indian government policies in establishing resilient supply networks during global shocks.

2.4 Supplier Relationship Management

Supplier relationship management is crucial to supply chain resilience. (Adithya Kumar, et al.,2016) discuss the significance of good supplier relationships in the Indian industrial setting. According to their findings, collaborative supplier partnerships are related with greater supply chain flexibility and resilience. Research can go deeper into the dynamics of supplier relationships and evaluate how Indian manufacturing firms create and maintain excellent partnerships with their suppliers.

2.5 Supply Chain Digitization

Another topic that has gained prominence in recent years is the digitization of supply chain procedures. (Jose Antonio Marmolejo-Saucedo, et al.,2018) analyse digital technology penetration in Indian supply chains. Their research offers an overview of digitization developments in Indian manufacturing supply chains. This study might investigate how digital technologies have been integrated and their impact on supply chain resilience in the face of global disruptions.

2.6 Regional Variations in Supply Chain Resilience

Regional variations in supply chain resilience within India could be a topic of prospective research. The country's significant geographical and demographic diversity might result in a variety of supply chain management issues and methods amid global disruptions. (Liliana Abelar, et al.,2019) investigated regional variations in supply chain resilience in India. Their findings can be used to help guide future research into the particular issues and techniques encountered in different parts of the country.

2.7 Humanitarian Supply Chains

Given the scale of the interruptions, humanitarian supply networks are an important subject of study. The function of humanitarian supply networks in disaster relief activities in India is discussed by (Lijo John, et al., 2012). The study of how manufacturing enterprises might link their supply chain strategies with humanitarian efforts to offer help during global disruptions can be conducted.

2.8 Sustainability and Supply Chain Resilience

The importance of sustainability in supply chain management is growing. (Blanka Tundys, 2020) investigate the relationship between supply chain resilience and sustainability in the Indian manufacturing industry. A potential research subject would be to examine how sustainable practises might improve supply chain resilience during global shocks while taking environmental and social considerations into account. Finally, the literature sheds light on the short-term effects of global disruptions on Indian industrial supply chains, emphasising the significance of risk management and resilience. However, a huge study gap exists in understanding the long-term effects of such disruptions and how Indian manufacturing firms may adapt, innovate, and construct resilient supply networks. Furthermore, the integration of technology, the involvement of government regulations, and regional variances are issues that need to be researched further. Academics and practitioners can help to the development of effective strategies for managing supply chains during global disruptions in the Indian manufacturing industry by addressing these research gaps.

3. RESEARCH METHODOLOGY

A QUALITATIVE APPROACH

The selection of a qualitative research strategy is evidence of its capacity to offer more in-depth information, context, and thorough comprehension of nuances. The aforementioned intricacies of organisational behaviour, leadership style, and decision-making processes were examined through qualitative research by scholars like (Dariusz Jemielniak, et al., 2018), which is relevant because these nuances are frequently crucial in understanding organisational dynamics. When trying to capture the subjectivity of participant experiences and the richness of social interactions, scholars advise using qualitative approaches. It was contended that qualitative research is an excellent method for analysing intricate organisational dynamics in management studies. Additionally, the qualitative technique aligns with a semantic model, facilitating the investigation of many viewpoints and interpretations assigned to organisational phenomena. Adopting a qualitative approach supported by these references, the study aims to delve deeply into the subjective experiences and perceptions of key stakeholders in organizational contexts, contributing to a comprehensive understanding of the research problem at hand.

3.1 SELECTION OF RESEARCH TECHNIQUE

Focus groups and one – one interviews are the methodologies used in this study. Focus groups involve conducting group discussions with a small number (5-7) of participants to explore their shared experiences and perspectives on a particular topic. In depth interview method offers flexibility in questioning and probing. Researchers can adapt their questions based on participants' responses, allowing for a more dynamic and personalized interaction. The open-ended nature of in-depth interviews facilitates the exploration of unexpected or unanticipated themes. Participants often feel more comfortable sharing personal and sensitive information in a one-on-one setting. This comfort level encourages open and honest responses, leading to a deeper insight into their thoughts and feelings. After choosing the suitable method, in depth interviews with manufacturers from different companies from all over south India were carried out to learn about their challenges and best practices for building resilient supply chains.

3.2 SELECTION OF RESEARCH SUBJECTS

To understand the challenges during disruptions in manufacturing sector, it was understood that the study should analyse perspectives from different nodes of a supply chain. The participants were consciously chosen from different nodes of supply chain to get holistic understanding. Interview selection process

involved identifying potential supply chain managers, top level executives, small and medium business owners by conducting secondary research by assessing company's performance during pandemic, strategies adopted and based on R&D invested for resilient supply chain management. The list of participants comprises manufacturers of small scale, medium scale and multinational level, logistics service providers and intermediary logistic service providers. The planned sample size was 20 but during the process, saturation was reached after 12 samples and hence the sample size.

3.3 SAMPLING DESIGN

Table 3.1: Interviewees details

INTERVIEWS	CATEGORY	DESIGNATION OF INTERVIEWEE	OPERATIONS
Wheels On logistics Pvt limited	Logistic Service Provider	Cofounder	FMCG products, DC cargos, Iron steel, Metals ,Agri and construction equipment, textile materials.
Connect Om logistics	Logistic Service Provider	Manager	Freight forwarding, freight services, custom clearance services
Marigold logistics	Logistic Service Provider	Assistant Manager	Import & Export, warehousing
Ocean Freight logistics	Logistic Service Provider	Assistant manager	Customs brooking, Freight forwarding, Fumigation services
Kasturi breeding farm	Manufacturer	Co-founder	Feed and pellet manufacturing, poultry farming
Textile industry manufacturer 1	Manufacturer	Founder	Garment production, wet processing, exports
Textile industry manufacturer 2	Manufacturer	Founder	Fabric manufacturing, garment production
Weaving industry manufacturer 1	Manufacturer	Founder	Knitting, Dyeing, warping, sizing
Weaving industry manufacturer 2	Manufacturer	Founder	Yarn processing, winding, warping, sizing, weaving
Automotive industry manufacturer	Manufacturer	Senior manager	Metal solutions for automotive industry
Filtration industry manufacturer	Manufacturer	Executive manager	Separation technologies and services
Pulp & paper industry manufacturer	Manufacturer	Managing director	Equipment and services for pulp and paper industry

3.4 DATA COLLECTION

After selection of candidates, the next step was connecting with potential candidates either face to face or over call by approaching them over cold call, mail or LinkedIn. The actual process of interview involved

conducting semi-structured or unstructured interviews with them to learn about their perspectives, challenges and opportunities on resilient supply chain.

The participants were informed in advance through e-mail. Each participant was checked for availability and then interviews were scheduled. At the start of the session a consent was obtained from each participant to document the interviews and then each participant was asked questions based on the questionnaire protocol prepared but it was personalised according to each participant's response and follow up questions were asked to make use of the in-depth interview method. The questionnaire protocol involved the following questions.

1. How does your manufacturing process account for potential disruptions in the supply chain?
2. What strategies do you have in place to mitigate the impact of supplier shortages or delays?
3. Can you describe your contingency plans for critical components or materials in your supply chain?
4. How do you assess and manage risks associated with geopolitical factors affecting the supply chain?
5. What technology or tools do you leverage to enhance visibility and traceability in your supply chain?
6. In the event of a natural disaster, how quickly can your manufacturing operations adapt and recover?
7. How do you collaborate with suppliers to ensure mutual resilience and continuity?
8. What steps have you taken to diversify your supplier base and reduce dependency on a single source?
9. Can you share an example of a successful response to a supply chain disruption in the past?
10. How regularly do you review and update your supply chain resilience strategies to address evolving challenges?

After the completion of interviews, the responses were transformed from verbatim to e-form like excel for further coding and analysis.

4. DATA ANALYSIS AND INTERPRETATION

Participants in the study were challenged by various problems and they used different strategies to cope up with the challenges.

4.1 CHALLENGES

4.1.1 Challenges faced by large scale (Multinational companies)

The top management of the Multinational companies (MNC) were interviewed and since they had to deal beyond India, they had a lot of say in the context of disruptions. They named important disruption times as The Covid -19, The Russia - Ukraine war, The red sea crisis etc. For example, during lockdown there was a semiconductor shortage because China was the major supplier of semiconductors. The semiconductor shortage had a great impact not only on engineering goods but mostly affecting pretty much every industry. This semiconductor shortage had a direct impact on manufacturing industries. The most important problem was procurement of critical components.

"For instance, during the Russian war, we needed high-end steel which we always procure from Russia before the war. After the war we decided to stop sourcing from Russia and chose Germany as an alternative even though we did that, we had to rely on Russia for the raw materials".

People management was of course a problem during the covid due to infectious nature of the disease. During covid, another potential problem encountered was the rise in price of air and sea freight. Also, during Russia war, the company was not able to import from European nations from which they source their critical components regularly. Another issue was any problem had an impact not only on the company

but also on the society as well. Major example was that one of the companies produces machines that process and give edible oil as a final product.

"During Lockdown most of the state governments namely Tamil Nadu, Andhra Pradesh, Karnataka announced 1 kg free edible oil per household. Our company is one of the largest players of manufacturing those machines, and if companies like us don't function, then the government will not be able to provide such huge amounts of edible oil".

4.1.2 Challenges faced by medium scale industries

Most of the medium scale industries we enquired were from the weaving industry hence the problems will be related to the same.

"In the textile industry unlike perishables we were able to stock up inventory, so there were not many issues in the weaving industry. As medium scale companies we were able to endure the holding cost resulting from the imbalance of demand and supply"

Another statement made was that companies of small scale would not have survived this holding cost of inventory. There were issues related to procurement of raw materials. Labour shortage was one of the major problems encountered because 80% of workers were north Indians and they wanted to go to their homelands. Unavailability of certain specific materials was one another important problem.

4.1.3 Challenges faced by small scale industries

On small scale, most of the companies interviewed were textile export companies. They export apparels to foreign countries, because of the pandemic the whole supply chain got disrupted and the orders were cancelled in bulk. Companies began to stock and most of them could not bear the inventory cost for holding.

"The post pandemic effect was heavy on this segment because most countries other than India wear seasonal clothes, they don't wear same kind of clothing throughout the year, so we couldn't sell the stock even after the pandemic simply because of seasonal clothing concept".

Logistics costs rose up and the number of containers to India was also reduced. There are different types of logistics involved in this process. One type is where a logistics company takes up all the costs involved after reaching harbour like import/ export duty, demurrage, clearance etc. Filing charges is usually paid by the manufacturers. Till the goods reach the warehouse it's the cost of the manufacturer. In some others, all the costs involved in delay of the goods is taken by the logistics players and it does not impact the manufacturers in this case. There is mutual understanding between buyer and seller here and if any unexpected delay happens due to the manufacturer's fault. In countries like the United States, if a delay happens then the order automatically gets cancelled. These cases happen with the leading buyers. Export business is always dependent on timing and season. There was a huge price hike in raw materials, and it stayed the same even after the covid.

4.1.4 Challenges faced by the logistics service providers

- People management (finding the right talent who stay for a long duration is always a challenge in this sector.)
- Most Logistics service providers interviewed were small scale, most of them were not fleet owners, they act as middle players between fleet owners and customers. Mostly in this particular segment ethics is not followed greatly, there is no standardized process in cost fixation hence a great threat.
- Not owning a fleet and performing a logistics business model is so easy to enter and because of this competition is so high and every day new players are entering the market. This is a big challenge. Easy

replacement available for customers due to many players in the market. In short, the switching cost is very low.

- Bringing business to the table was a greater challenge, since the covid time was extremely challenging, most companies recruited only reputed players because of the risk involved in it. The government had some regulations which helped logistics players in the execution part, but the actual challenging part was acquiring order. For already well established and reputed companies, it was a cake walk.
- Driver monitoring was an issue stated by few LSP's. Delays happen due to driver's negligence, but the additional cost is reflected on the company. There is no standardized method or technology for this issue.
- As a result of poor driver monitoring, drivers cannot be tracked properly, and this is creating operational inefficiency. There is no proper dynamic driver allotment system and idle vehicle tracking system available in India. The problem faced by the LSP's is that they could not accurately track the idle vehicle and free driver in nearby locations. If this could be tracked both free drivers and idle vehicles could be dynamically matched and allotted. This could increase their operational efficiency and reduce the cost of bringing empty vehicles to distant warehouses for picking up load. Partial truck load (PTL) vehicles can also be tracked and loaded to make it as full truck load (FTL).
- Another challenge was payment terms. In small scale, this sector is very unorganized and here all payments happen in credit. During covid there were huge disruption in the supply chain and in terms of payment, the logistics players were the last priority in the whole supply chain. Since the production process cannot be stopped, priority in payment is given to manufacturers.
- Since LSP's in small scale is an unorganized sector, there are no standardized communication procedures followed which in turn is a great threat.
- There is a problem in the government website for international cargo and this creates issues in creating waybill number, AI etc. Now this problem in the website can cause withholding the cargo in the airports which stops them from moving further, which will result in extra charges. The LSP's are charged extra for every extra day the cargo is stuck.
- The logistics industry mostly operates on credit and usually credit periods of 30, 60, 90 and 120 days are given for the payment, and it is mostly based on the credibility of the customer. Due to the lack of working capital for the LSP's their operations are impacted, and they get loans from banks for running their operations. Logistics companies are borrowing working capital at the rate of 18% which will further cut existing very thin margins in this space. In reality on the ground, many logistics companies are facing severe working capital issues due to increasing credit cycle of payment which is on average is more than three months. These kinds of payment issues create huge operational issues for logistic companies and losing goodwill in the market in front of truckers and brokers.

4.2 COPING STRATEGIES

4.2.1 Logistic service providers

The coping strategy's part was not really focussed by most logistic service providers. They had only focused on the surviving part but not on the resiliency part. When asked about the coping mechanisms or how they overcame the situations, they did not have much to say about it.

"We didn't have much to do about the delays, since we don't have control over the situation. We just wait for the issue to get solved until then the charges are reflected on us. Yes, it is sad, but we have no other option"

One issue stated was that bringing business to the table was a challenge. To cope up with that, companies targeted on transporting essentials so that the need is unavoidable. Other than that, there was not much done by LSP'S.

4.2.2 Large scale manufacturers (MNC level)

The MNC's approached the disruptions in quite effective ways because they had to deal with international affairs quite frequently. Unlike companies that have operations within India, they have faced such kind of disruption time to time. Most impactful disruptions are the Russian -Ukrainian war, the covid -19 and most recently the red sea crisis. When asked about coping strategies the first step was to communicate to their customers because customers are their primary stakeholders. All these issues mentioned above are not only related to the company, but it concerns the whole world, so everyone in market is also aware of the circumstances and their impact.

"Our first step is always communicating with our customers, because their satisfaction is our priority. We ensure to be very transparent about any issue to give them an exact picturisation of the situation so that they can plan their operations accordingly. This is our mandatory step in case of any disruptions"

So the second step done was stocking up in advance, for this companies had to track the availability of materials, location and the quantity available. This process took about one month of time. For the issue of semiconductor shortage, one of the companies opted for alternative sourcing other than China and started sourcing from Germany, Austria. So, if stocking up happens, it comes with cost of holding inventory. When asked about the managing such costs, it was clearly stated that the top priority of both the parties i.e. both the manufacturers and the customers was to get the customers satisfied, so they agree upon a common decision that there will be extra costs, and it is okay. The multinational manufacturing companies also have a task force an emergency team which comprises of 7-8 members, one from each department e.g. Sales, marketing, procurement etc. This group is especially for disruption times. The companies had a clear vision as to there will be delays for sure but not to an extent of stopping the production. In case of edible oil problem mentioned previously in the study, the company got permission from government to send their engineers all over India to get the operations going. For the problem of labour shortage , the first measure by company is that , they reduced the labour force by 50% only for the time being .They set up a medical team inside the company by having tie ups with hospitals , the ambulances were made available 24/7 .All these facilities were introduced in Covid awareness meetings conducted in the companies .A particular company stated that employee loyalty was their driving force.

"Our company has been in operations for 20 plus years and 70% percent of our employees are together in this company for almost 17-18 years. To be precise, I want to say that the trust that the company had instilled in the minds of employees have paid off in times of disruptions like this."

For people management, the top management e.g. The Managing director of the company stayed in the company for 3 days until every facility was arranged and to boost the confidence and trust of the employees. As far as white-collar employees are concerned, they were asked to do work from home. All employees even at home were asked to follow the regular office timings 8.30am - 5pm, this was done to develop a feeling that all the employees are in this together. All meetings that generally happen in a day in office happened without any delays. In case of blue collar employees, first step was that the top management communicated with the labour union representative to understand the situation, the seriousness and the impact .On mutual terms it was decided that the rest of 50% employees will be made to stay at company premises and all necessary amenities like cot , bed were arranged on the same day of the announcement of the lockdown. The clothes and other essential requirements of employees were

picked from their houses on the same day. A cooking team was set up inside company to serve nutritious meals throughout the disruption. During covid the cost of containers rose up to 10%, hence the cost of air and sea freight were increased, in this case there was not much to be done by LSP (logistic service providers). Some LSP's could not run operations because of problems in fund management. So, most manufacturing companies supported the LSP's since their priority is their better operations.

"As manufacturing companies, we split the extra cost of shipping with LSP's like 50-50 or even 60-40 to get the operations going. After the disruption reaches its calm, our company and LSP's we sit together and decide on what terms the LSP's can settle the extra charges. This kind of compromise is done only because of our long-term relationship with the logistic players."

All the LSP's involved in this segment are top players and hence it was made possible. Another issue was that during Russia war , there was a huge energy crisis , power costs went up to 40% and Europe was not able to supply certain machines so companies looked for alternative sourcing and started manufacturing in India .The problem here was that the materials used in the making of machines were not in Indian standard , hence won't be a fit .Since this MNC level companies had their own designing software , they redesigned the machineries such a way to fit with components of Indian standard. There might be changes in design but the output by the machine was maintained the same. Another important problem was the procurement of critical components. One such example is that most components were procured from China but during lockdown it was not possible. So, they decided to make the components in India. The issue here was even after they decided to make components in India, the problem was the procurement of raw materials. For instance, titanium is available in India but in scarce and cannot be used for commercial purposes. All along covid and during Russian war the company decided not to rely on China, Russia and Europe instead they shipped from US even though it was costly in US. This decision again traces back to their top priority their customer satisfaction. When asked about the problems in credit payment systems, the answer was coming out very clear.

"We don't have any problems regarding payment terms since we deal with giant players. For an example companies like Tata follow a very strict protocol in payment terms. Even in case of delays the payment may be extended to 65 days from 60 days but it won't be hundred right"

When asked about post event learnings, transparency with customers was the first uncompromisable step, second being alternative sourcing, during covid they had 1 alternative option, now with red sea crisis which will have its impact for another few years to come, they are now ready with 2 alternative options. Third being make in India and redesigning according to Indian standards. Stocking up was another learning, with the red sea crisis at least 50 % of components for upcoming projects in next 5 years are getting ready. With the semiconductor shortage issue, the machines take about 8 months to be manufactured but the semiconductor which is of not more than 2% of total machines costs take about 12-14 months to deliver, this delays the whole process, hence spending the extra 2% on such integral components was made as standard decision. Companies also form a team for forecasting inventory, this team forecasts how much inventory to be made if at all any kind of disruption happens. This process is carried out by collaborating with sales team by looking at the previous sales records to arrive at forecasted figures.

4.2.3 Medium scale manufacturers

One important problem addressed in this segment was the people management. In most of the companies 70% of employees were north Indians in this segment, those employees wanted to return to their homelands and there was chaos among the local workers, the whole system collapsed. To solve the issue,

the companies left the north Indians who wanted to leave, they also asked the local workers to stay at home, because it is through them the communicability of the disease may happen. The main objective was restricting the movement of employees.

"As a next step we arranged covid awareness programs to reduce the panic and the fear. We educated them why staying here was the right decision to make at that point of time and explained the importance of isolation"

The management also conducted vaccine awareness programs in which the top management took vaccines to abolish fear and doubts among employees. This particular step was very important because most of the employees that is the north Indians 70% of workforce were illiterates, hence for them this demonstration and awareness programs were crucially important. Another problem stated was the procurement of raw materials.

"We decide to limit our sourcing inside our state, we followed this technique with so much ease because we operate in Tamil Nadu and TN is known for first class yarns"

Some companies located in other than Tamil Nadu also sourced within their states but in those a little bit of quality was compromised, but they had no other go. Some other companies from other than Tamil Nadu opted for yarns from Tamil Nadu not willing to compromise the quality. These are the companies that use latest technology machines that run at high speed and those machines require fine quality yarn but of course the transportation was riskier. This transportation issue was sorted with the help of government.

The government rendered full support in logistics department, after registering and applying for special transport permissions. Companies also stated that the application process was also fully online and simple. In case of logistics related to delivering to customers, for most weaving industries the vehicles were arranged from customer side hence there were no issues pertaining to that. Another issue mentioned was availability of specific kind of yarns. During initial stages of lockdown, only companies who were ready to take risks operated.

"As far as weaving is concerned, according to customer requirements the weaving pattern will change, and each specific weaving pattern requires specific kind of yarn. For example, we need a particular kind of yarn but spinning companies producing that kind of yarn were not functioning. At the same time some spinning mills that had tonnes of stock of yarns didn't have the type of yarns we needed"

This created an unevenness in the demand and supply chain. So, companies had to do alternative sourcing. To solve this issue companies, spend about 20 days trying to locate the availability of yarns according to their requirements, the whole process was done via mail and phone, no other technologies were used.

4.2.4 Small scale manufacturers

With respect to the seasonal clothing problem mentioned previously in the study, it was stated that after the season is over, those orders were cancelled and piled as stocks.

"We exported the excess stocks to countries like South Africa, Kenya at a much lower margin. We also exported excess stocks to countries like Sri Lanka, Indonesia and Pakistan where there were no duty fees for export and import due to the impact of war".

Transportation was generally done through air and sea freight but during covid the cost of air freight rose so much higher so they had to opt for sea freight which will take more time than usual. The small-scale companies had to compromise the time of delivery if they wanted save costs by using sea freight as they could not bear the rising costs of air freight. This measure was only successful for certain orders, most customers cancelled their orders in case of delay and all the costs associated with it had to be borne by manufacturers.

"In case of sourcing, some customers will mention nominees for sourcing for example a customer may select Hong Kong as a nominee for the sourcing of buttons, then we had no other option but to source only from Hong Kong. In such cases, we were not able to do alternative sourcing as well".

5. FINDINGS AND SUGGESTIONS

5.1 FINDINGS

From the study it is found out that any disruption globally can cause great impact to the manufacturing industry. Every area of supply chain in manufacturing sector had faced serious threats right from manufacturers, logistics players, intermediary players etc. It is evident from the study that most logistics players had not focussed on the resiliency concept even though they are aware that such disruptions can happen anytime, they had not taken many steps towards developing a resilient supply chain. This may be because the LSP's are not aware of prevailing modern technologies that can solve many pain points mentioned by them. Again, most of the LSP's interviewed are small scale players and hence they do not have financial stability to acquire such modern solutions. In case of manufactures at MNC level, there are awareness about global disruptions and the serious impacts of such events, hence from the study it is evident they had effective contingency plans to survive the situations. Not only that MNC 's has carried out post disruption analysis but also equipped with contingency plans for upcoming disruptions. But as we move down the ladder this situation may not be true for medium scale industries and situation gets worser from medium to small scale manufactures. In case of medium scale, they had maintained or tried to move towards resiliency to some extent but it may not be enough. In case of small scale, they have not even closer to taking baby steps towards resilient supply chain. These are the findings from study with respect to it, the following are some suggestions companies can take into consideration

5.2 SUGGESTIONS

Table 5.1: Problem Solution Mapping

CHALLENGES	SOLUTIONS AVAILABLE
Driver Monitoring throughout the process is a problem (Not proper update, lying, Showing fake data etc)	Driver monitoring system as a part of software, Video telematics
No system for dynamic driver allotment in India	
There is requirement for freight financing in logistics industry for reducing credit period	Freight financing software e.g. Unang etc
There is no idle vehicle tracking system currently and demand area is facing vehicle unavailability issue.	Idle vehicle tracking system
Stagnant cargo during disruption like covid, natural calamities etc.	Load Monitoring system, warehouse management system.

There are numerous platforms on the market that connect independent software suppliers and logistical service providers in an aggregator model. Large-scale logistics service providers typically choose to pay for individual software, such as the Transport Management System (TMS), Vehicle Health Monitoring System (VHMS), Tyre Pressure Monitoring System (TPMS), and Fleet Management System (FMS), on a yearly or monthly basis. Even if these subscriptions are occasionally unnecessary, they nonetheless wind up paying for them, which adds to LSP's expenses. When using a platform-based paradigm, users can choose to utilise and subscribe to services only as needed. These services are coordinated and can be used and paid for dynamically based on user needs. This reduces their operating cost and increases the efficiency of their business. More visibility to independent software vendors in the market is provided by

aggregator platforms and their products will be listed in common platform by having partnerships. This platform-based models are also suitable for mid-sized players in the market as they are affordable and costs lesser than the individual software subscriptions. There is less awareness about the software-based solutions available in the.Most services available like FMS, TMS etc will not be required by small scale logistic service providers. So, they can opt for individual services and their problems can be easily solved with the help of software solutions available in the market. There is need for bringing awareness to the players in the market about the solutions as most of them unaware and ignoring the issues. Another issue in the platform model is that there is some resistance from LSP for letting in middle players inside their business. This happens due to the impact of some aggregator models in the market and their poor service quality. This can be addressed by proper prototyping, product explanation and validating their doubts by giving them a live demo.

6. CONCLUSION

The study employed a qualitative methodology to offer a comprehensive contextual account of the difficulties experienced, contributing reasons, solutions, and support required by the various nodes in the supply chain of South India's manufacturing industry. To sum up, this study has examined supply chain resilience and has uncovered significant information on how the supply chain's operational resilience is currently doing. The results show a glaring discrepancy in the organisations under study's adoption of resilient strategies. It is evident that a sizable fraction of the companies in our sample have not implemented robust plans to strengthen their supply networks against unforeseen obstacles, despite the evident vulnerabilities highlighted by the recent worldwide unrest. However, given the dynamic and uncertain global business climate, the significance of supply chain flexibility cannot be overstated the body of empirical data shows how urgently businesses must reconsider and improve their supply chain strategies to guarantee a more adaptable and flexible approach. Supply chain resilience is becoming more and more important as the business sector navigates unpredictability and crises. It is also a key component of sustainable growth and ongoing operations.

It's evident from navigating the current environment that supply chain management is where the phrase "adapt or perish" strikes the most resonance. Businesses are being compelled to reconsider conventional practices and switch from reactive to resilience-boosting tactics. Recent experiences demonstrate that simply enduring the destructive storms is insufficient; agile manufacturing processes are needed to build robust, adaptable supply chains that can survive the ups and downs of a volatile global economy. We thus suggest a paradigm shift in the direction of a more robust supply chain ecosystem because the research is in line with the present global business model. Our research's findings demonstrate the pressing need for these modifications as well as how resilience is valued throughout the whole supply chain. It is our aim that the information provided here will function as a stimulant for companies to take a proactive stance and understand the need of fortifying their supply chains in the face of failed crises to stay successful in a constantly changing economic climate.

REFERENCE

1. Uta Jüttner, Helen Peck, Martin Christopher (2003). Supply Chain Risk Management: Outlining an Agenda for Future Research. International Journal of Logistics : Research & Applications. 6. 197-210. 10.1080/1367556031000162701 6.

2. Sunil Chopra, Manmohan Sodhi (2004). Managing Risk to Avoid Supply-Chain Breakdown. MIT Sloan Management Review.
3. Balakrishnan A.S., Usha Ramanathan. (2021). The Role of Digital Technologies in Supply Chain Resilience For Emerging Markets' Automotive Sector. Supply Chain Management. 26. 654-671. 10.1108/SCM-07-2020-0342.
4. Martin Christopher, Helen Peck (2004). Case Study of a Resilient Supply Chain in the Manufacturing Industry: Toyota Motor Corporation. International Journal of Logistics: Research and Applications, 7(4), 345-369.
5. Ajay Jha, R. R. K. Sharma, Vimal Kumar, Pratima Verma (2021). Designing Supply Chain Performance System: a Strategic Study on Indian Manufacturing Sector. Supply Chain Management: An International Journal. ahead-of-print. 10.1108/SCM-05-2020-0198.
6. Siva Kumar, Ramesh Anbanandam (2019). Impact of Risk Management Culture on Supply Chain Resilience: An Empirical Study from Indian Manufacturing Industry. Proceedings of the Institution of Mechanical Engineers, Part O: Journal of Risk and Reliability.
7. Vincent Charles, Ali Emrouznejad, Tatiana Gherman (2023). A Critical Analysis of the Integration of Blockchain and Artificial Intelligence for Supply Chain. An Oper Res 327, 7–47 (2023).
8. BN Balaji Singh (2016). MAKE IN INDIA-"Contribution of Supply Chain Management Professionals in its Success". 10.13140/RG.2.1.3595.4803.
9. Charles Baah, Yaw Agyabeng-Mensah, Ebenezer Afum, Innocent Senyo Kwasi Acquah, Dacosta Essel (2023), "Government Influence on Logistics and Supply Chain Innovations: Assessing Implications for Firm Performance and Societal Impact in an Emerging Economy", International Journal of Emerging markets.
10. Jose Antonio Marmolejo-Saucedo, Scarlett Hartmann (2018). Trends in Digitization of the Supply Chain: A Brief Literature Review. EAI Endorsed Transactions on Energy Web. 7. 164113. 10.4108/eai.13-7-2018.164113.
11. Aditya Kumar, Lalit Pothal, Sushanta Tripathy (2016). Significance of Supplier Relationship Management towards Product Quality Development in Automobile Industries.
12. Liliana Avelar, Jorge Luis García-Alcaraz, Aide Maldonado (2019). The Role of Regional Factors on Supply Chain Performance. 10.1007/978-3-319-93876-9_12.
13. Lijo John, Ramesh Anbanandam, Rajagopalan Sridharan (2012). Humanitarian Supply Chain Management: A Critical Review. Int. J. of Services and Operations Management. 13. 498 - 524. 10.1504/IJSOM.2012.050143.
14. Blanka Tundys (2020). Sustainable Supply Chain Management – Past, Present and Future. Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu. 64. 187-207. 10.15611/pn.2020.3.15.
15. Dariusz Jemielniak , Malgorzata Ciesielska (2018). Qualitative Research in Organization Studies. 10.1007/978-3-319-65217-7_1.