
LITERATURE SURVEY ON TRAFFIC AND CAPACITY ANALYTICS FOR MAJOR PORTS

ABSTRACT

Before the COVID-19 pandemic, Indian firms have focused on interconnected and lean supply chains to ameliorate the gaps through increased efficiency of supply chains. However, the pandemic has exposed most Indian firms to severe supply chain disruptions (SCDs) due to undiscovered supply chain vulnerabilities. Against this background, we reviewed the existing relevant literature on SCDs and transportation disruption in general context and pandemic specific context and identified that there exists very little research on this issue especially in the context of Indian firms, and offered policy options by developing a new model of robust transport and advanced logistics system (ALS) for speedier supply chains recovery (SCR). We have utilized and analyzed the rich available literature on SCDs, transport intelligence (TI), and ALS using gray literature. The study revealed that many Indian firms have experienced major disruptions in transportation and logistics services, including impact on transportation and logistics data, time delays, and cargo cancellations due to cramped freight capacity, restricted circulation, closure of ports, and slow customs clearances. This has also impacted adversely the production and transport consignments including logistics services and led to delays and rerouting to final consumers. With the gradual removal of restrictions, firms are making concerted efforts to recover from SCDs; however, with weak applications of robust TI and ALS, the SCR is relatively very slow. This called for a review of current transport and ALS used by priority firms. Therefore, we offered a new model for addressing the SCDs using robust intelligence transportation systems and ALS.

INTRODUCTION

The COVID-19 pandemic has spread across the world and infected a huge population (Sohrabi et al., 2020). Major production centers have been closed due to worldwide lockdown, which led to severe supply chain disruption (SCDs) in all manufacturing sectors. SCDs referred to the unplanned and unpredicted events that disturb the flow of goods and services across the supply chain (Craighead et al., 2007). With the shutdown in production activities and transportation disruption, the global prices of raw materials and intermediate supplies have increased Sudan and Taggar Recovering Supply Chain Disruptions (Maffioli, 2020). Border restrictions have led to a temporary stoppage in human mobility and transportation activities, which resulted in unparalleled pressure on shipping and road freights, and created severe impediments for international trade. Transportation disruptions have led to substantial interruptions in actual goods flows, product mobility, and have affected the entire supply chain, thereby

leading to operations shutdown, sales loss, late deliveries, and reputational loss. Strong links between transport freight and trade have been observed. The surge in transport freight costs had significantly impacted the supply chain. Therefore, transportation has been considered a vital logistical driver, which impacted the responsiveness, efficiency, and performance of supply chains. A responsive supply chain and transport flexibility can deliver products to customers more effectively (Ghavamifar et al., 2018).

There are a variety of factors and sub-factors, which led to transportation disruptions in supply chains, for instance, adverse weather mostly disrupted transportation and adversely affected the supply chains (Sheffi, 2015). But a disruption like the COVID19 pandemic is a potent risk to transportation in the supply chain and brought a meta-uncertainty. As an outcome of the COVID-19, supply chains in the transportation industry have been hampered, though differently across air, rail, road, and sea sectors. Therefore, there are various potential consequences for the supply chain due to transportation disruptions, which called for identifying the potential threats caused by transportation disruptions using innovative SCM practices through robust mitigation strategies via supply chain risk management (SCRM) to recover from business slowdown. The firms should design an effective mitigation and recovery plan in the event of logistics and transportation disruptions. However, relatively little research has been conducted on the impact of the COVID19-induced transportation disruptions on SCDs. Against this background, we reviewed the related literature on supply chains, SCDs, and SCM vis-à-vis pandemics such as the COVID-19 to identify the research gaps and accordingly offered mitigation strategies including a logistics and transportation recovery model and prescribing the short-term and long-term measures for speedier recovery of firms from transportation disruptions in the Indian context.

LITERATURE REVIEW

In recent years, supply chain risks have received increasing attention in SCM research (Zsidisin, 2003) due to growing business uncertainty and vulnerability, which significantly lowered business practices like outsourcing, production, supplies, and inventories and in turn caused supply chains to become more susceptible to disruptions due to business risks (Craighead et al., 2007). This is linked to upstream and downstream supply agents, which caused supply chains more sensitive and complex than ever before (Blackhurst et al., 2005).

Companies should strategically collaborate with their key suppliers and customers to survive and prosper. SCD risks have severely impacted the operational and financial performance of the firms based on their intensity (Hendricks and Singhal, 2003), which plays a significant role in building resilience against SCDs (Bode et al., 2011). Disruption in supply chains motivated the researchers to understand such risks and their impact on supply chains (Kleindorfer and Saad, 2005). The lean and globalized business structures of many firms are currently affected by the COVID-19 (Ivanov, 2020).

The pandemic hampered the resilience of supply chains and made the firms more vulnerable to SCDs due to a halt in production and logistics activities. With longer lockdown, the consumer demand has slowed down along with reduced demand for labor, supplies, and delivery, thereby severely impacting the supply chains without the established SCR mechanisms such as risk mitigation inventories, subcontracting capacities, backup supply and transportation infrastructures, robust channel distribution systems, and flexible production technologies (Araz et al., 2020).

The COVID-19 has affected about 94% of the Fortune 1,000 companies due to SCDs in affected areas (Linton and Vakil, 2020). Both the demand and supply have declined substantially due to the pandemic-induced prolonged lockdown, which needed the governments' support to overcome the impact. SCR can be achieved by developing risk mitigation inventories, subcontracting, backup supply and transportation apparatus, and digital monitoring and visibility systems (Dolgui et al., 2020; Xu et al., 2020).

The COVID-19 pandemic has not been limited to a particular region or confined to a particular time. Different components of manufacturing, distribution centers, logistics, and markets have impacted the supply chains. The COVID-19-induced lockdown, economic shutdowns, and the SCDs have pushed many firms into bankruptcy (Tucker, 2020). For instance, many prominent US companies such as Sears, Hertz, and J. Crew have faced severe financial pressures. Besides manufacturing, the pandemic has caused widespread damage to the airline, tourism, and hospitality sectors (Asmelash and Cooper, 2020). For instance, Fiat Chrysler Automobiles NV and Hyundai temporarily have suspended production due to the harsh COVID-19-induced restrictions and SCDs (Ivanov, 2020).

This has caused ripple effects in the industry and required robust SCRM strategies (Chen et al., 2019; Pournader et al., 2020) including sound data and more digitally enabled supply chains (Choi, 2020; WEF, 2020a,b) to improve the quality of the response (Ivanov et al., 2019). The impact of the COVID-19 pandemic on SCDs is still to be adequately investigated (Sarkis et al., 2020). The unique nature of the COVID-19 crisis required robust policy challenges to address the SCDs, which must be different from earlier experiences of dealing with similar risks.

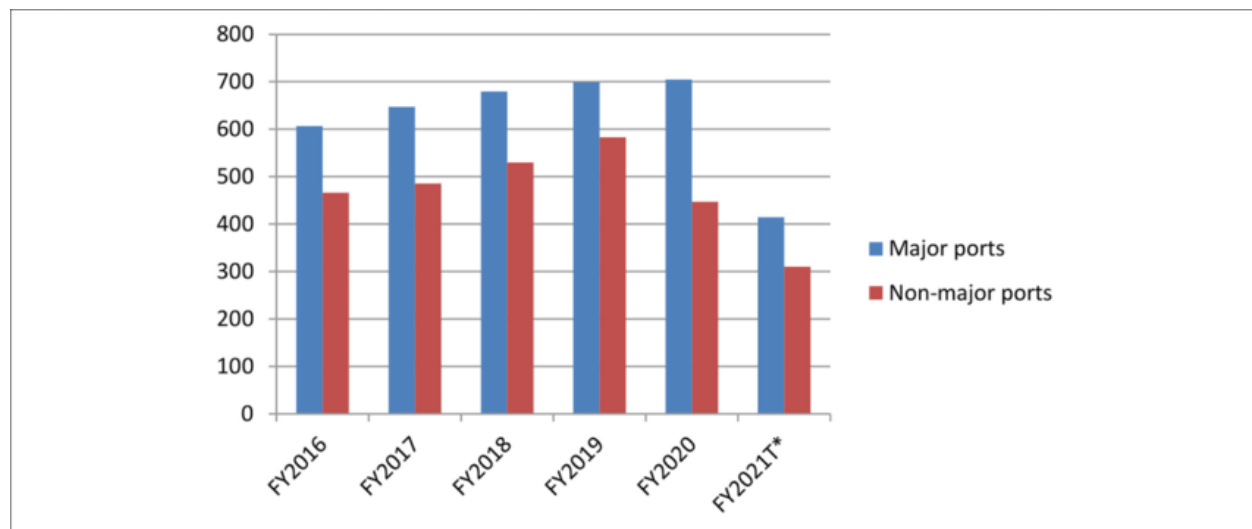
The demand and supply have declined substantially due to prolonged lockdown in almost all productive activities, which needed substantial governmental supports. In the contemporary scenario, the COVID-19 pandemic could be the first global SCD, which called for robust management of global supply chains (GSCs) and also addressing the associated risks. Researchers such as Mamani et al. (2013) and Büyüктаhtakin et al. (2018) have focused on epidemic outbreaks and business operations. The COVID-19 pandemic has confirmed that supply chains acted as the veins of economic activities (Ivanov, 2020) at a large scale (Lin et al., 2020).

The COVID-19 pandemic has threatened the global production network (GPN) severely and increased SCDs (Araz et al., 2020). Disruptions in manufacturing, distribution, and transportation have caused economy-wide repercussions, which are linked to reduced mobility and led to SCDs and normal functioning of businesses (Lin et al., 2020). In the recent past, disruptions such as natural disasters (Tang and Musa, 2011; Sheffi, 2015) have immensely caused transportation and logistics disruptions. Transportation disruptions referred to the interruption in the actual flows which delayed the delivery from one node of a supply chain to another (Zhen et al., 2016). Disruptions in transport and logistics systems have significantly impacted the normal operations in supply chains (Baghalian et al., 2013; Chen and Chen, 2014; Tan et al., 2020).

The COVID-19 pandemic-induced restrictions have led to the disablement of economical operations, and impacted transportation networks in maritime, rail, air, and trucking industries (de Vos, 2020; Gössling et al., 2020). Ultimately, trade restrictions, demand restraint, and transport disruptions have significantly impacted supply chains and consequently impacted freight volumes. The COVID-19 pandemic had caused a range of major disruptions in transport and logistics services, including flight cancellations,

which also cramped air-freight capacity, disrupted global circulation, caused labor shortages and temporary closure of ports, and slowed down the customs clearance.

This, in turn, delayed the production of goods and consignments in transit, which were rerouted or discharged short of their final destinations. With the rising economy of e-commerce and online shopping in recent years, express shipping services (e.g., FedEx, DHL, and UPS) have played an important part in supply chains and logistics. Despite the COVID-19 pandemic, e-commerce service providers have experienced rapid growth in their businesses. The e-commerce market in India is likely to surge at a compound annual growth rate of 19.6% between 2019 and 2023, to become a US\$98.4 billion market by 2023. E-commerce payments were expected to record a steep increase of 25.9% in 2020 due to a shift in consumers' preference from in-store to online store platforms (GD, 2020). Hence, transport and logistics services have a vital role in SCR from unpredicted pandemics like the COVID-19. Thus, transportation and logistics disruptions have been very sensitive to SCDs. In the context of the COVID-19, little attention has been paid to analyze the pandemic impact on transportation and logistics disruptions and its consequent effects on SCDs, specifically in the Indian context. Therefore, we made a modest attempt to fill the knowledge gap in this area and explored the impact of the pandemic on transportation and logistics systems of the Indian firms, and also offered an SCR mitigation model to tackle transport



OBJECTIVES AND METHODOLOGY

To mitigate the negative effects caused by SCDs and transportation and logistics disruptions, a significant amount of work is required in the field of SCRM practices in the context of the pandemics such as the COVID-19 to suggest mitigation strategies. We reviewed the related literature on SCDs, transportation and logistics disruptions, and analyzed the COVID-19 impact on India's transportation and logistics

systems and SCRM, and offered mitigation strategies including a transportation risk management model using short-term and long-term measures for speedier recovery of firms from the SCDs and transportation disruptions. The recent performance of India's transportation and logistics sector has also been presented. We also analyzed the challenges and opportunities in operationalizing the suggested model along with optimization of transport and logistics resources by the firms.

In order to accomplish the intended goals, we analyzed the available literature using a web search and desk approach. The secondary data and information have also been analyzed using data triangulation and the theoretical method. We used the triangulation method to build a transportation risk management model by a systematic literature review to ensure a more comprehensive analysis. The application of the triangulation method increased the credibility and validity and improved the model creativity and validity by design and also clarified the concepts used for risk mitigation strategies and enhanced the testability of the model in the context of the COVID-19 pandemic-like future crisis.

RECENT PERFORMANCE OF INDIA'S TRANSPORTATION AND LOGISTICS

Transportation refers to the movement of goods from one place to the other, while logistics refers to the transportation and delivery of goods including the storage, handling, inventory, packaging, and various other aspects. Transportation is the mode to execute logistics planning. Sustainable SCM required efficient and low-cost transport and logistics. New technologies and improved business processes have impacted both the logistics and transport sectors worldwide and India is no exception.

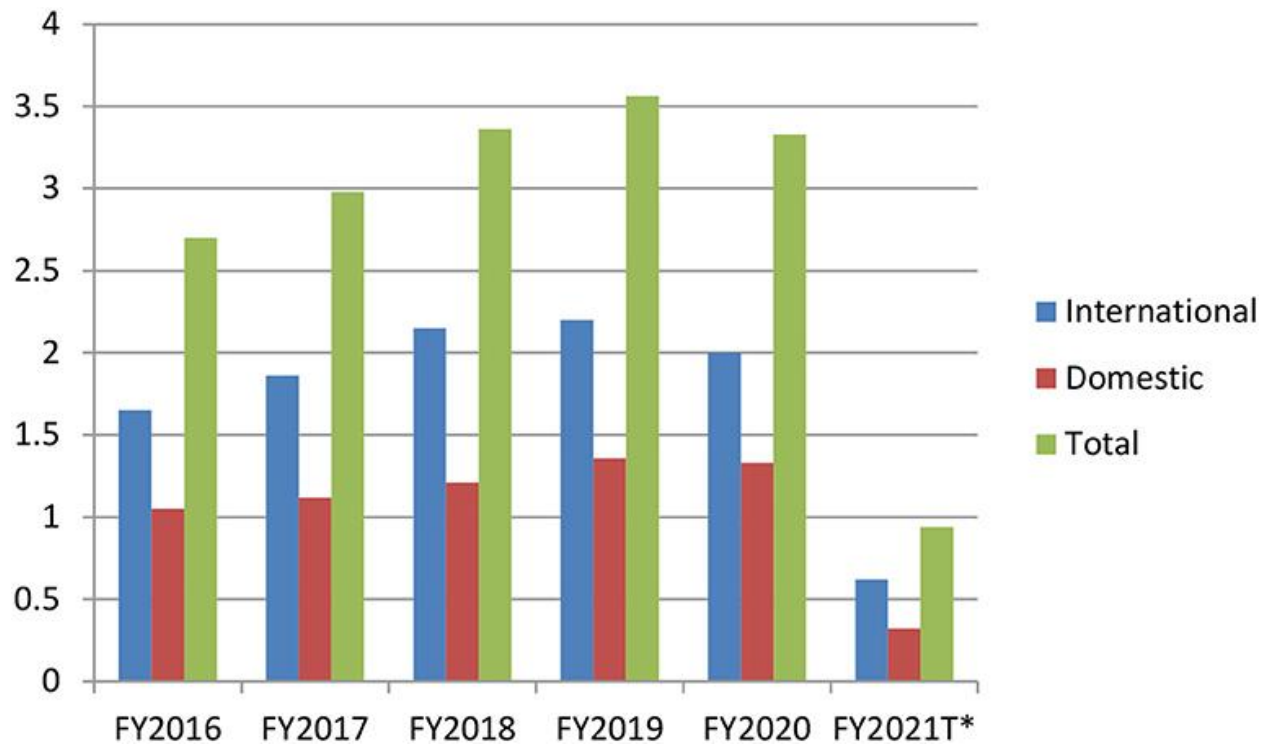
Performance of India's Transport Sector Maritime Transport

In recent years, India's maritime transport contributed about 95% and 70% of trading by volume and value. India has 12 major ports and 205 notified minor and intermediate ports. In India, the cargo capacity at major ports remained underutilized over the period. Figure 1 shows cargo traffic at major ports and nonmajor ports in India from 2016–2017 to 2020 to 2021. Major ports handled more than half of India's maritime transport, which declined by 10.5%–414 million tons (MT) during April– November 2020 compared with last year.

The cargo traffic at non-major ports has declined by 10.8%–310 MT during April–October 2020. During the national lockdown period of April– May 2020, there has been a sharp decline in cargo traffic at both the major ports and non-major ports followed by a gradual improvement in cargo traffic since June 2020 due to a pickup in economic activity and trade both domestically and globally. In FY2012, the market share of major ports was recorded at 61% compared to non-major ports at 39%. Over the period, non major ports have gained their share to reach 45% in FY2019.

The growth in container traffic at major ports in India reached 9.98 TEUs (20-ft. equivalent units) in FY2020 at a growth of 1.12% year-on-year basis but declined to 4.93 TEUs during April–October 2020 due to the COVID-19-induced restrictions (Government of India, 2021). Massive investment in India's ports sector has been planned to improve maritime transport infrastructure. India's ports have received a cumulative foreign direct investment (FDI) of US\$1.63 billion from 2000 to 2020 and US\$1.9 billion were allocated for the upgrade of major ports from 2016 to 2019.

From 2020 to 2021, US\$257.22 million has been allocated for the development of the ports sector in India. The turnaround time at major ports stood at 64.69 h in 2019–2020. The additional port capacity is expected to reach 275–325 MT at a compound annual growth rate (CAGR) of 5–6% by 2022. India's cargo traffic at ports is likely to reach 1695 MT in 2021–2022 (IBEF, 2020a).



CONCLUSION

Indian firms have focused on interconnected and lean supply chains to overcome the supply gaps in normal business operations. The COVID-19 pandemic has led to massive SCDs due to undiscovered supply chain vulnerabilities caused by government-imposed economic restrictions including transportation disruptions worldwide including India, which adversely impacted the normal functioning of the firms. Many Indian firms have experienced severe disruptions in transportation and logistics services, including stronger impact on transportation and logistics data, time delays, and cargo cancellations due to drastically reduced freight capacity, limited mobility, ports shutdown, and problems in routine customs clearances. All this has also severely delayed the production of goods, transport consignments, and logistics services thereby caused massive delays and rerouting to final consumers. The suggested model of robust transport and ALS can be widely used by firms for speedier SCR in the context of economic crises like the COVID-19 pandemic.

Over the period, the government has gradually removed most of the restrictions and the firms have made concerted efforts to speedily recover from SCDs, however, inadequate applications of robust TI and ALS have delayed the SCR by the firms. This calls for reviewing current transport and ALS used by firms on

priority for speedier SCR. Therefore, the suggested model can be widely applied to address the SCDs using robust intelligence transportation systems and ALS. The challenges and opportunities in operationalizing the suggested model along with optimization of transport and logistics resources should also be considered by the firms.

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