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COVID-19 Global Pandemic: Impact on Management of Supply Chain

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***Abstract*— To understand more about the global impact of (corona virus disease, detected in December, 2019, hereafter named) COVID-19 on supply chain management, a set of questionnaire is designed which addressed four pertinent themes focusing on product classification including export product, import product, elective product and emergency product. The questionnaire consisted of ten multiple choice questions including three open-ended questions (appendix A). The questionnaire was targeted at those organizations which were practicing supply chain management function as a core or a department of organization and was distributed online in interest groups using various social media platforms. The questionnaire was open from 26th March 2020 to 20th April 2020 and did not collect any identifiable data. Valid responses were represented as categorical data and presented in percentages.**

***Keywords*— COVID-19; supply chain management, product classification**

I. INTRODUCTION

The global downturn's speed and harshness due to COVID- 19 have significant implications for the supply chains of global manufacturers. That kind of volatility wreaks havoc on traditional supply chain planning: the process for determining production levels, raw-material purchases, transport capacity, and other vital factors, largely by examining historical patterns of demand. Indeed, the forecasting challenge is particularly acute because in many upstream industrial settings, as supply partners along the chain anticipate that demand will fall, the supply chain appears to be decoupling from downstream consumption—the focus of most forecasting models. In fact, risk managers and other executives fail to anticipate the effects, both negative and positive, of events that occurred. At first glance, for instance, a thunderstorm in a distant place wouldn't seem like cause for alarm. It was initially reported to the World Health Organization (WHO) on December 31, 2019 about Coronavirus disease 2019 (COVID-19) identified amid an outbreak of respiratory illness cases in Wuhan City, Hubei Province, China. On January 30, 2020, the WHO declared the COVID-19 outbreak a global health emergency. On March 11, 2020, the WHO declared COVID-19 a global pandemic.

The appeal of Janata Curfew on March 22,2020 by Hon'ble Prime Minister of India that the nation is set to observe an unprecedented shutdown and on March 24,2020 India imposed a 21-day lockdown, which was announced, comes after a call from the UN health agency, WHO, for the country to take "aggressive action".

What can companies do to prepare themselves for this sort of situation? True, there's no easy formula for anticipating the way risk cascades through a company or an economy. But we've found that executives who systematically examine the way risks propagate across the whole value chain—including competitors, suppliers, distribution channels, and customers—can foresee and prepare for second-order effects more successfully. Especially China, Korea, Japan, Germany and the US are also at of global value chains, so their woes will produce 'supply-chain contagion' in virtually all nations, Richard Baldwin and Beatrice Weder di Mauro apprehended this fact in their e-book on Economics in the Time of COVID-19. These nations are central to the global supply chains in many manufactured goods. The near term impacts—missed shipments, border-crossing delays, and communications problems—are easily understood. Less clear is the longer-term effect of increased uncertainty on lead times and demand and what that means for supply chain strategy. "Risk is something you can predict. If you flip a coin, over time you know that half will be heads and half will be tails. The nature of choice between heads and tails involves a risk because you can bet with these probabilities. So, in conditions of risk, you can distribute your investment into certain proportions against different outcomes that you may expect," Kim said (Minyoung Kim, associate professor of strategy and international business at the University of Kansas)."But uncertainty means there's nothing you can do about it beforehand. You know neither the outcomes nor the probability. I would call that the 'unknown unknown.' This could be a natural disaster or Brexit. If you knew, you might prepare against it. But you don't know that you don't know." The new uncertainty COVID-19 will require companies to rethink their supply chain strategy. For many, that effort begins with a reassessment of their demand-based strategy, which in recent years has been touted as the preferred approach to supply chain management.

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Observing the scenario of Indian market S. Srinivasamurthy, Research Director, Enterprise Solutions and ICT Practices, IDC India says, "While the actual impact of COVID-19 on India market will be evident by middle of 2020, we expect a slowdown in terms of discretionary IT spending, contract renewals and new deals getting signed as enterprises recalibrate by cost structure in coming months. Existing project executions have also taken a hit due to travel restrictions in place. Corporates across the country implementing alternative ways of working, i.e. work from home, it is generating a parallel corporate line that demands to be connected from where they want, when they want and to who they want. But the different sets of challenges that the IT teams within the organization are grappling with - how to secure data and assets from cyber threats. Companies can meet most challenges noted above with a sound supply chain strategy, with IT as the key enabler. Though the complexities of India's supply chain may appear overwhelming, understanding and mastering them is a critical success determinant for an organization attempting to serve customers in India. An efficient review of supply chain design will help better position companies in what is becoming an increasingly competitive marketplace.

Supply chain in Indian Economy

Supply chain costs in India represent as much as 13 percent of the Gross Domestic Product (GDP). This is almost twice the percentage in developed countries: in the U.S., supply chain costs amount to 8.5 percent of the GDP. ARC Advisory Group categorizes supply chain challenges in India into two groups: demand side challenges and supply side challenges. Demand side supply chain challenges in India relate to price and variety. With 28 States and 7 Union Territories, differing considerably in dress, food tastes, customs, traditions and purchasing habits, it's almost impossible for a single manufacturer to address the wide variety of consumer requirements. Thus, it is important for manufacturers to partner with local distributors and retailers who can help develop products that will appeal to local consumers, at appropriate price points. When it comes to COVID-19's immediate aggregate demand shock (i.e purchases drop) is observed, for which, two aspects are to distinguish: real-world and emotional. Real-world since some consumers are or will be prevented from getting to stores, so their demand disappears from the market. Similarly, some home delivery services are suspended, so goods and consumers are approaching together less frequently.

Emotional since – as happened in the wake of the Global Crisis – consumers and firms tend to embrace a 'wait-and-see' attitude when faced with massive Knightian uncertainty (the unknown-unknowns) of the type that COVID-19 is now presenting to the world. This, quite naturally, makes trade flows susceptible to demand shocks (purchases drop) and supply shocks (production drop). The supply shock aspects of COVID-19 – factory closures, travel bans, border closings and the like – will reduce exports across the border. Many vendors have been successful in selling "no-frills," standardized products to rural segments in India only. Big Bazaar, Hindustan Unilever, Maruti, Tata Motors and Hero have offerings relevant to this price-sensitive segment of the population. Other successful examples of localized low-price products include Siemens' pacemakers, Godrej's Chotukool refrigerator, and General Electric's ECG. Supply side supply chain challenges in India mainly relate to poor infrastructure, complex tax infrastructure, weak distribution system, fragmented market, and lack of technology adoption. Richard Baldwin and Beatrice Weder di Mauro as responsible editor mentioned in their recent e-book on Economics in the Time of COVID-19, the disruptions that companies, individuals and governments are experiencing imply that globalisation and integration may be at risk from such health shocks i.e. COVID 19. Firms will probably take into account the lesson they are learning that global supply chains can be abruptly broken by this health shock.

II. Literature Review

Businesses dependent on global sourcing are facing hard choices in crisis management amid the supply chain disruptions due to COVID-19. The impact of the coronavirus pandemic on global supply chains is a major disruption, along the lines of having an earthquake or a tsunami. This is an unprecedented type of disruption. The uncertainties ahead swing between extremes. The main target of managing the supply chain is to realize and neutralize the uncertainties in the supply chain. Uncertainties in the supply, process and demand are recognized to have a major impact on the manufacturing function. As this paper focuses on the impact of COVID-19 on the supply chain management, the literatures were reviewed nearby similar context of reputed journals related to the flexibility, agility and pro-activeness of the supply chain.

Angkiriwang, R. et al. (2014) in his study obtain insights into the typology of uncertainty and relevant strategies adopted by manufacturing companies to achieve better supply chain flexibility.

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Strategies are classified into reactive (buffering) and proactive (redesigning). A framework is developed that links supply chain uncertainty, as result the two types of strategies for achieving supply chain flexibility and the relevant objectives to be achieved. The research is endorsed by four case studies and are compared in terms of uncertainty typology and strategies being adopted to improve supply chain flexibility. supply chain flexibility (SCF) entails the implicit requirement of flexibility within and between all partners in the chain (Duclos *et al.*, 2003). Vickery, S.(1999) to establish the linkage, examined dimensions of supply chain flexibility and their relationships with environmental uncertainty, business performance, and functional interfaces. Prater et al. (2001) used five case studies to show the techniques of better trade-off between vulnerability (uncertainty) and supply chain agility by creating a link between the two called supply chain exposures. They considered and found two main problems of European industries, that is, in accurate forecasting and in developing an efficient and effective supply chain (SC) structure. The work described exposure as the degree to which an agile supply chain must be overextended (i.e. vulnerable) and, therefore, should be restructured or adjusted to address the issues in international SCs. To obtain high service levels at a low cost for emergency supply options in terms of lateral transshipments and direct deliveries, Alfredsson, P. et al. (1999) consider a two-echelon inventory system. An analytical model is used to calculate relevant performance measures. Comparison of the results of the model with the results of other models indicates that the combined use of lateral transshipments and direct deliveries can lead to significant cost savings. Agrawal, S. et al. (2019) emphasized about the segregation of products into different classified categories is essential for reverse supply chain also.

Like COVID-19, the earthquake and tsunami that struck Japan in March 2011 directly impacted over 27000 businesses whose production, warehousing, and retail facilities were destroyed or disabled by the natural disaster. Supply chain disruption is defined MacKenzie, C. A (2014) as a disruptive event that causes production difficulties for multiple suppliers and in which at least two of these suppliers deliver non-identical goods or services to at least two competing firms. The severity of a supply chain disruption can be measured by the number of entities that encounter difficulties in receiving or delivering materials or goods due to an unplanned event (Craighead et al., 2007).

A number of authors have tried to develop a framework for relationship between the typology of uncertainty and the type of strategies chosen for better supply chain. The study proposed in this article follows real time approach of the disruption COVID-19. The survey based work analyzes what supply chain firms should do during a severe supply chain disruption under uncertain conditions.

III. Motivation For The Research

The current COVID-19 global effect greatly motivated for this work. As India goes into a 21-day lockdown, there is some confusion arises about the e-commerce delivery of essential goods. According to lockdown rules, delivery of essential goods and groceries from e-commerce sites is allowed. Services like Grofers, BigBasket and Milkbasket allege their delivery people have been beaten up on the road. Facing difficulties, Flipkart has temporarily shut down service. Others too vary(www.indiatoday.in). The three East Asian manufacturing giants – China, South Korea, and Japan – account for over 25% of US imports, and over 50% of US imports of computer and electronics products. Apparel and footwear companies are particularly vulnerable to East Asian supply disruptions. The Economist magazine pointed to the vulnerability of the electronics industry with its practice of keeping very lean inventory levels and the lack of alternative sources for many electronic components. The optics sector is likewise highly exposed. The heart of the outbreak, Hubei province, is known as China's 'optics valley' since so many firms manufacturing fiber optic components are located there (these are essential inputs for telecoms networks). The automobile sector, especially in East Asia, is already significantly disrupted by ruptures in international supply chains. For example, a shortage of parts coming from China has forced Korean carmaker Hyundai to shut all its car plants in Korea. The Japanese firm Nissan closed a factory in Japan temporarily. The shock has even reached Europe. Fiat-Chrysler has recently warned that it could soon halt production at one of its European factories. Jaguar Land Rover, a UK-based auto company, announced it might to run out of parts from the end of February,2020. To stave this off, it had flown in emergency supplies from China in suitcases [7].

IV. Problem Description

The basis used by marketers to classify the products are: (i) On the basis of durability and tangibility of the product (ii) On the basis of Consumer Shopping Habits and (iii) On the basis of use in industry.

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Traditionally products have various classifications, consumer products and industrial/business products is based on use is classified. Consumer product is further classified as: convenience products, shopping products, specialty products and unsought products and industrial product is classified as: material and parts (these goods enter the product directly), installation, accessory equipment, operating supplies. In general, the consumer goods directed to ultimate end-users, but the buyers seek product and marketing is important for it, but the industrial products used to produce other products and services, and usually vendors seek buyers. Based on durability it's classified as durable and non-durable and few classified products on the basis of tangibility, tangible and non-tangible also. But It is vital to design a product classification method in order to support global supply planning and improve the supply chain performance.

A. Product classifications

With respect to the present study and to measure the impact of COVID-19 on SCMs, the products are classified on basis of exigency as export products, import products, elective products and emergency products. Categorization of the product is important one for those organizations which were dealing with supply chain, the basis they can maintain it in their data base and exploit it at the time of need. This categorization helps to do planning accordingly by evaluating its gravity to the present situation of the demand.

Export products: those products which is manufactured by manufacturer for the specifically export purposes.

Import products: The product which will arrive from other country.

Elective products: Also called optional product which have substitute for the customer.

Emergency products: In this category those products will lie which are critically necessary for providing care for people. Viz. medical devices, medical products, productive equipment, masks, screeners, disinfectants and so on.

Companies use to handle complicated supply chain operation but lacks in product classification system. It is vital to design a product classification method in order to support global supply planning and improve the supply chain performance. That part of this research for future work. Also, Product Classification System is supposed to be applied in supply planning prioritization, inventory management and workforce balancing, etc.

The things which are considered as mechanism for the propagation of economic shocks, or economic contagion are: Products (tangible), people, services, know-how(skill), financial capital, foreign direct investment (FDI), international banking, and exchange rates. The flow of global economies dependencies is connected by cross-border by these mechanisms, and product is considered at top priority among all the above. Companies are learning the lesson that global supply chains can be abruptly broken by a health shock and will adjust accordingly. Financial intermediaries and regulators are likely to incorporate pandemic shocks into their future risk assessments and stress tests.

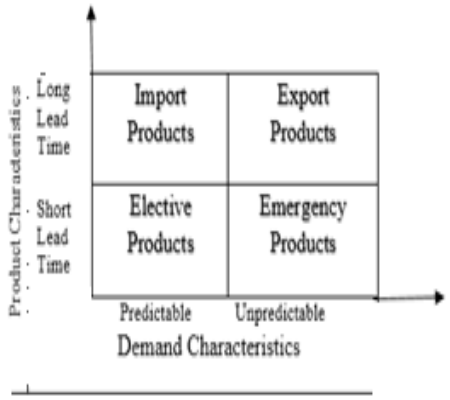

Figure 2. Characteristics of Export, Import, Elective and Emergency Product

V. Data Collection And Analysis

A. Questionnaire development

A questionnaire was developed based on the practical practice of supply chain in various organizations proposed for the study and aimed at gathering information related to dealing with the basis of classification of the product and its impact in context to Indian supply chain industry. With the help of available literature and telephonically talk with the experts the questionnaire is developed and suggestions were incorporated and questionnaire was improved before distribution for data collection. Survey form was developed with the help of google forms. The survey questionnaire is available in Appendix A. The survey was sent to the top management person who was handling these organizations via mail as well as in person asking people to participate in the survey. The given deadline for data collection for the responses was of 26th March to 20th April 2020.

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B. Questionnaire administration

The questionnaire was self-administered, and the survey for the study with target population of supply chain industries were conducted through google form, online. The survey link was sent on email addresses of the respondents with a cover letter. Nowadays, web-based survey is being widely used by researchers because of less time required, ease of availability, real time data compilation, and lower cost than other surveys. With the help of google search engine, the dedicated organization were searched with their e-mail address to consult for the survey. Justdial.com helps more to lean the time of searching to those companies. To cover the entire India, the companies of Delhi, Kolkata, Mumbai, Chennai, Bangalore, Hyderabad and Ahmedabad were selected, besides these cities Pune, Goa, Nagpur, Coimbatore, Indore, Nashik, Vadodara, Jaipur, Mysore, Vizag, Chandigarh and Surat, many companies are there which associated with supply chain operations. The questionnaires were sent to the respondents in single phases. 300 forms were sent to different organizations through google forms and responses were analyzed. Total 130 responses were received 35 were incomplete so discarded. An effective response rate of 43.3% was achieved which is found adequate for the present study.

C. Respondent's profile and non-response bias

Due to time constraint, in single phases, total 300 e-mails were sent to the selected supply chain dedicated organizations for the survey. Overall, 130 responses were found suitable for the study. Participating organizations in the survey belong to (Original Equipment Manufacturer) OEM, Fast Moving Consumer Goods (FMCGs) and SCM consultant. Respondents who have participated in the survey represent different levels of management including top position to middle level and executive level employees and mostly belong to logistics department, marketing & sales, corporate strategy, and supply chain departments. Non-response bias with web-based survey was accessed by splitting the sample into two groups based on receiving date of the responses. Early response group consisted of 67 responses and late response group consisted of 63 responses. The t-test was performed on the difference in early response group and late response group. It yielded no statistically significant difference between the mean of two groups ($p > 0.05$). In addition, statistical tests show that there is no significant difference among samples.

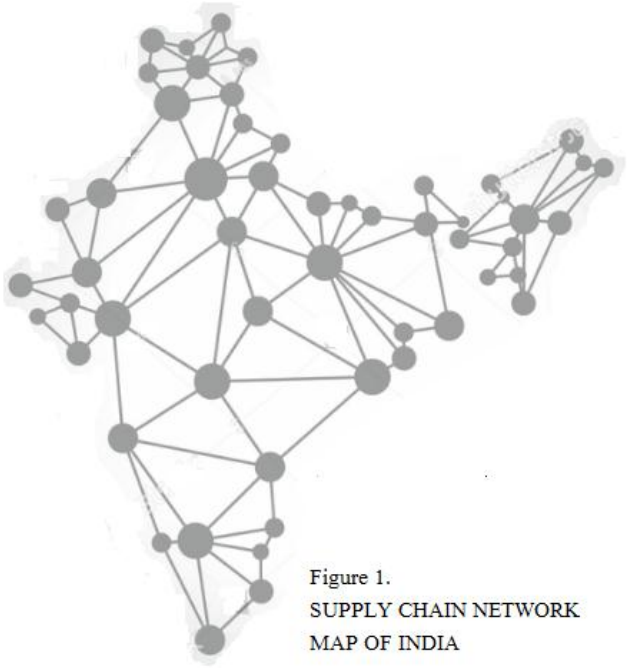

Figure 1.
SUPPLY CHAIN NETWORK MAP OF INDIA

VI. Result And Discussion

To understand more about the global impact of COVID-19 on supply chain management, we designed a questionnaire that addressed four pertinent themes including export product, import product, elective product and emergency product. The questionnaire consisted of 7 multiple choice questions and three open-ended questions (appendix A). The questionnaire was targeted at supply chain organizations and was distributed online in interest groups using various social media platforms. The questionnaire was open from 26th March to 20th April 2020 and did not collect any identifiable data. Valid responses were represented as categorical data and presented in percentages.

Impact studies with individual SCM organization data

This section describes a new wave of research that is based on samples of organization collected precisely to study strength of chain of supply with the help of product classification. The sampling was designed to examine organizations in different product category zones and to select organizations within country across a wide range of product. The survey instrument was designed to measure accessibility of products in places without barriers and hindering when situation is unfavorable.

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The instrument collected information about the choices that organizations made: which product to ship, which product to hold and which inputs to purchase. Precise Products classification give solutions and support decision-making for Global Supply Planning. For example, higher priority of products requires shorter lead time of supplying. The crisis never took place for time with the organization, but the plan was put in place and organization feel secure knowing that should it happen, they would be safe. For all the effort, resources, and consideration put into designing the most efficient manufacturing facilities and systems, it should be a natural next step to protect them by developing crisis response plans. Fisher is an acknowledged pioneer in the classification of supply chain strategies, claiming that there are basically two types of supply chain strategies, physically efficient and market responsive (Harris, 2007).

A total of 130 individual responses were obtained from the supply chain firms. Of these, 32(24.6%) were from the Delhi, 21 (16.1%) were from Kolkata, 10 (07.6%) were from Mumbai, 17 (13.0%) were from the Chennai, 17 (13.0%) were from Bangalore,19 (14.6%) were from Hyderabad and 14 (10.7%) were from Ahmedabad. Of the 130 respondents, 85(65.3%) were working Supply Chain as a part of OEM. When asked about export product, 102 (78.4%) replied that export product orders were either suspended or scaled down. When asked about import product, 118 (90.7%) replied that import product were either suspended or scaled down. With regards to elective products, 120 (92.3%) replied that at least some, if not all elective products orders were cancelled. The majority of orders cancelled were due to its availability of substitute product or not felt essential and emergency by the customer. On the contrary, 125 out of 130 respondents (96.2%) are still delivering all emergency products (Figure 1). For a large majority of respondents (113 out of 130, 87.0%), face-to-face multidisciplinary or team meetings have been reduced or cancelled entirely, and have been replaced by online messaging platforms, video conferencing, teleconferencing or email discussions. The rate of response also reflects the effect of lockdown.

As only 13% response from Mumbai and also we got news that Maharashtra counts highest death due to COVID-19. The impact of COVID-19 on supply chain services has been far-reaching. The majority of respondents have reported a reduction or cessation of export products orders and elective product orders, whilst continuing with emergency products.

Numbers from group purchasing organization Premier and data software companies show the supply chain gaps in getting needed personal protective equipment (PPE) to those on the front lines. Data on increasing orders of PPE in the hospital setting and the arc of COVID-19 calls compared to a typical flu season show the pandemic in a new light. Healthcare systems, distributors and purchasing organizations, along with state and federal governments, rely on real-time data to manage supplies and model their equipment and staffing needs. so manufacturers and their complex webs of suppliers, who in many cases lack that same experience or large-scale backup plans. The result: a chaotic scramble resulting in production delays, product shortages, and higher prices.

E-commerce giant Amazon has announced that it will only deliver high-priority products. In view of the challenges faced by the delivery executives, the Karnataka government on Monday issued a notice stating that e-commerce and home delivery fall under essential services and hence should be exempted from the restrictions imposed on citizens to curb the spread of the coronavirus. Following the suit, Maharashtra too issued an order stating that the e-commerce services such as food, medicine, etc should not be included in the restrictions that are imposed to contain the virus. Grofers founder had tweeted his apology to the customers for not being able to deliver their products on time. He stated “We @grofers are having a lot of trouble getting essentials to people who need them as our warehouses are asked to shut, and trucks and delivery partners are being stopped by the police. We apologize to our customers and are working hard to find a solution.” Flipkart also suspended its services temporarily.

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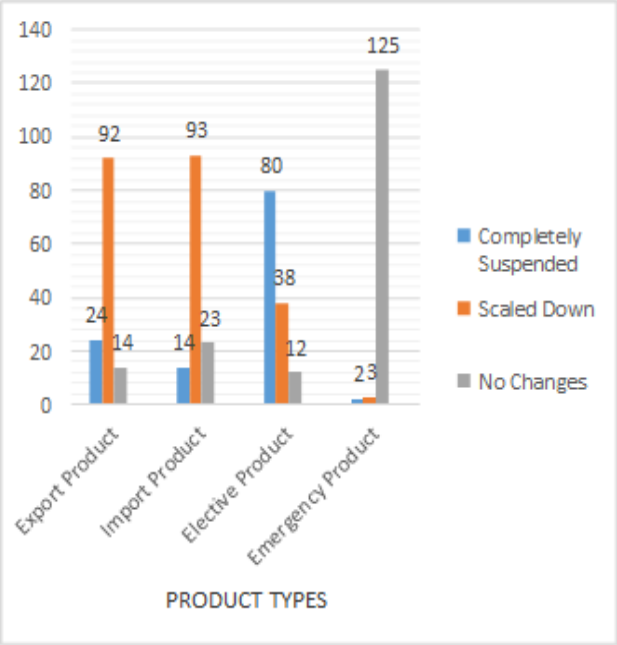

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Appendix A

Questionnaire

Name of the organization:

_____

Year of establishment:

_____

Annual Turnover (in Rupees):

_____

Number of Employees:

_____

1. What is your country of practice of supply chain

2. Is your company is dealing with Supply Chain as a part of OEM or as a consultant company?

a. Yes b. No c. Other (please specify)

3. How has COVID-19 affected your export product order demand?

a. export product order completely cancelled

b. export product order scaled down i.e. non-urgent products postponed/cancelled

c. export product order demands operate as per usual

d. Other (please specify)

4. How has COVID-19 affected your import product demand?

a. import product completely cancelled

b. import product scaled down i.e. reduction in number of orders

c. import product demand as per usual

d. Other (please specify)

5. How has COVID-19 affected your elective product demand?

a. All elective product demands are cancelled

b. Some elective product demands are cancelled

c. No elective product demands are cancelled

d. Other (please specify)

6. If elective product demands have been cancelled, what type of products are they? Leave blank if no elective product demands have been cancelled.

7. How has COVID-19 affected your emergency product demand?

a. All emergency product orders are rejected

b. Only some emergency product orders are rejected

c. No emergency product orders are rejected

d. Other (please specify)

8. If emergency product orders have been rejected, what type of products are they? Leave blank if no emergency product orders have been rejected.

9. How has COVID-19 affected face-to-face multidisciplinary meetings?

a. All face-to-face multidisciplinary meetings are cancelled

b. Some face-to-face multidisciplinary meetings are cancelled

c. No face-to-face multidisciplinary meetings are cancelled

d. Other (please specify)

10. What modality has replaced face-to-face multidisciplinary meetings? Leave blank if your face-to-face multidisciplinary meetings have not been cancelled. (You can choose more than 1 option)

a. Teleconference

b. Video conference

c. Online messaging platforms i.e. WhatsApp, Telegram, etc

d. Email e. Other (please specify)

About Author(s)

Mr. Rakesh Kumar received Bachelors in Industrial Engineering and Master's in Mechanical Engineering with specialization in Computer Integrated Manufacturing from India. He is currently a assistant professor at Delhi Technological University in Department of Mechanical Engineering. His research interest includes *Total Quality Management, Reliability Engineering, Operations and Supply chain, Fuzzy Logic, AI and Decision Science*.

R.S. Mishra (Professor) received the Ph.D. degree in Mechanical engineering from IIT Delhi, India and currently at Delhi Technological University serving since 1997. He having 150 research papers in peer reviewed in International journals and 75 research papers in proceedings of International and National conferences. Prior to joining DTU, he served 09 years at different engineering colleges of India, viz, REC Hamirpur, PAU Ludhiana (Punjab)and HAU, Hisar (Haryana.).His research area includes *Green Technology, Refrigeration & Air Conditioning, Metal Cutting Technology, Total Quality Management, Solar Energy Technology, Bio Fuels, power Plant engineering*.