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SELECTION OF THE BARRIERS OF SUPPLY CHAIN MANAGEMENT IN INDIAN MANUFACTURING SECTORS DUE TO COVID-19 IMPACTS

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Research Paper

Abstract. *The coronavirus (COVID-19) pandemic is having a clear impact on the supply chains of virtually all manufacturers. Whether frozen foods and grocery items or emergency items, or even the services, the supply chain has been facing multiple obstacles. For manufacturing industries with complex supply chains, it is indeed critical to identify strategies to deal with such a crisis. With demand high and supply unavailable, some products became more desirable causing price hikes and price extorting because the manufacturing sectors are facing some barriers during lockdown. This research has identified the five essential barriers of supply chain such as lack of man power, local laws enforcement, lack of transportation, scarcity of raw materials and deficiency in cash flow for Indian manufacturing sectors during lockdown. This paper proposed a methodology based on a fuzzy analytical hierarchy process (Fuzzy-AHP) with use of triangular fuzzy numbers for the pairwise comparison matrices. It has been seen that lack of man power is a higher weight barrier than others. Moreover, the managerial implication about the results is also provided, which will be useful for manufacturing sectors to take suitable decisions to overcome these obstacles.*

Keywords: COVID-19, Manufacturing sectors, Barriers, Fuzzy AHP, SCM

1. Introduction

At present time, the world is facing the coronavirus disease known as Covid-19. The first case of the coronavirus was reported in December, 2019 in the Wuhan city of China which is known as the major transportation hub of China (Mayo clinic, 2020). Many countries have shut down their sea docks and airports after the spread of the virus. They have banned the import and export activities. World Health Organization (WHO) has declared the COVID-19 outbreak as a global pandemic on March 11, 2020 (Cucinotta & Vanelli, 2020). The virus has affected the lives of many

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people and also affecting the global economy more than that happened during the outbreak of severe acute respiratory syndrome (SARS) (WHO, Situation Report-92, 2000). The first case of Covid-19 in India was reported in January 30, 2020. On 23rd of March, 2020, the Government of India has declared the lockdown in the whole country to minimize the spread of Covid-19 (Jamwal et al., 2020). Within a month, unemployment has risen from 6.7% on 15 March to 26% on 19 April (Vyas, 2020). During the lockdown, estimated 140 million people lost employment while salaries were cut for many others (Goyal, 2020). More than 45% of households across the nation have reported an income drop as compared to the previous year (Research, Centre for Policy, 2020). Since the last couple of months, the fast spread of the COVID-19 disease is creating huge uncertainty and indefinable disruptions in the global supply chain. According to WHO (2020), the global supply chain is experiencing a big challenge to keep smooth supplies of food and medical instruments including masks and medicine highly required to the treatment, protection, and control of the pandemic. In India, the supply chain (SC) has also been put under stress with the lockdown restrictions which disrupted the SC across the nation (Chaudhry, 2020). Major companies in India such as Larsen & Toubro, Bharat Forge, UltraTech cement, Grasim Industries, Aditya Birla Group, BHEL and Tata Motors have temporarily suspended or significantly reduced operations. Young startups have been impacted as funding has fallen (Singh, 2020). Fast-moving consumer goods companies in the country have significantly reduced operations and are focusing on essentials. The Indian Express, 2020 showed that stock markets in India posted their worst losses in history on 23 March 2020. Almost all two-wheeler and four-wheeler companies put a stop to production till further notice. Hindustan Unilever, ITC and Dabur India shut manufacturing facilities except for factories producing essentials (Mudgill, 2020). Foxconn and Wistron Corp, iPhone producers, suspended production following the 21-day-lockdown orders (Wu, 2020). Following the lockdown, certain essential supply chains (SCs) broke down. Britannia Industries, supporting the lockdown, urged the government to ensure inter-state movement of the raw material for the food processing industry was not hampered. During the lockdown, inter-state logistics has been banned, it does not apply to essentials, and in places like Maharashtra, the state police are yet to streamline the process and disrupt the SCs. (Parth, 2020). Vidya Krishnan writes in The Atlantic that due to the lockdown, even movement of medical goods were affected (Krishnan, 2020). On 29 March, 2020, the government of India permitted the movement of all essential goods across the country during the lockdown. The milk and newspaper SCs are also allowed to function. Chemicals, automotive, electronics and other industries are shut down due to supply disruption and restriction of logistics/shipment (Kumar et al., 2020). On another note, the pandemic control measures taken by countries worldwide have interrupted flows of finished goods and raw materials from plants to many parts of the world. For instance, Wuhan, the epicenter of the COVID-19 outbreak, is an automobile factory hub with global brands such as General Motors, Hyundai, and Toyota (Yu & Aviso, 2020). Aside from these car manufacturing plants, multinational companies such as Apple, Alphabet, Starbucks, McDonald's, and Proctor & Gamble have closed production facilities. Presently, the country is suffering from recession in the third quarter of fiscal year (FY) 2020. The economic impact of the 2020 coronavirus pandemic in India has been largely disruptive. India's growth in the fourth quarter of the FY 2020 went down to 3.1% according to the Ministry of Statistics. In India, manufacturing industry is

totally hampered due to lack of man power, logistics and SC due to lockdown restrictions. Although many companies are embracing more online shopping activities to deal with low foot traffic and extensive closure of many showrooms completely by trying to meet car buyer needs virtually. Changes in business models and the use of innovative practices and technologies also lead to changes in existing SC structures and relationships. Micro, small and medium-sized enterprises (MSME), the United Nations Industrial Development Organization in India, communicated 85 enterprises and enquired about the challenges they are facing and their expectations and plans for the revival of their businesses once the lockdown is lifted. The survey was conducted by telephone during the period 9-13 April, 2020 and included enterprises engaged in the automotive components, bicycle, paper, textile, ceramic, foundry, tea and rice milling sectors (rice milling sector where production has reportedly dropped by half) in clusters across the country. Some communications, sales, administrative and other support activities are being undertaken from home but on a limited scale. Workers who come from different states of India have returned in large numbers to their hometowns. In this situation, some manufacturers are involved in the manufacturing of ventilators, but small quantities and small fraction of its regular workforce. The movement of materials (raw materials/finished goods) is standstill. The disruption of the flow of materials and goods is having negative implications on other aspects of business, in particular an abrupt end to incoming cash flows and the migration of workforce across all skill levels. The blockage of people and material movement disrupted every SC.

There are different critical barriers found out which affected the SCs in India during this period. It is expected that this paper will be helpful to the manufacturing sectors to overcome this issue. Covid-19 pandemics suddenly projected those SC change scenarios onto a level of dramatic uncertainty. The susceptibility to which regional and global SCs are subjected to extreme events raises several concerns in terms of analysis and transport and logistics scenarios. Irrespective of significant benefits, the implementation of supply chain management (SCM) is stimulating, and industries continue to meet barriers that prevent them from implementing effective SCM (Meehan & Muir, 2008). Benefits of SCM execution can be achieved when companies are able to identify and overcome these barriers to stay competitive in today's changing environment (Stank et al., 2011). These barriers are complex in nature, and thus it is crucial for industries to understand them well. Therefore, multi criteria decision making (MCDM) techniques may be used in selecting the best one among criteria. In the present paper, quality of performance of five critical barriers of SCM such as lack of man power, local laws enforcement, lack of transportation, scarcity of raw materials and deficiency in cash flow in Indian manufacturing sectors has been analyzed using a modified Fuzzy AHP method (Shaw et al., 2012), (Arikan, 2013) for their subsequent ranking. In this paper, we use the Fuzzy AHP method to determine the weights associated with criteria under study.

The paper is organized as follows: after the introduction and barriers of SCM in manufacturing environment, section 3 presents the Fuzzy AHP methodology with mathematical formulation of the method. Section 4 contains the application of Fuzzy AHP method for calculating the weights. Section 5 presents the discussion and concluding remarks, and directions for future research is presented in section 6.

2. Barriers of supply chain management (SCM) due to COVID-19

As reported in literature (Moktadir et al., 2018), (Sirisawat & Kiatcharoenpol, 2018), SCM barriers are lack of top management commitment and support, an unclear organizational objective, employee empowerment and training, insufficient funds, poor corporate culture, mistrust among employees and SC partners, lack of education and training to employees and suppliers, poor information and communication technology infrastructure, unwillingness to implement SC practices, lack of integration among SC partners, lack of collaboration among SC partners, lack of responsiveness, lack of customer satisfaction index, etc. These barriers are complex in nature, and thus it is crucial for decision makers to understand them well, so that the barriers can be curtailed. It has been seen that supply chains are always influenced by some barriers. Now in India, Covid-19 has disrupted the supply chain in manufacturing sectors. The barriers for the Indian SC caused by the Covid-19 are found out with the discussion with academic experts and industrial experts and they sort out many barriers of SCM in manufacturing sectors like lack of man power, lack of raw materials, unavailability of imported goods, a bottleneck in last mile delivery, lack of transportation, slow movements of goods, restriction on overseas transportation, lack of buyers, lack of cash flow, slow credit flow from the financial sectors and local laws enforcement. In this study, five serious barriers are considered which are further discussed in Table 1 because these five barriers are the most important in this pandemic situation and these five barriers are directly or indirectly connected with all other barriers. The five barriers are lack of man power, local laws enforcement, lack of transportation, scarcity of raw materials and deficiency in cash flow in the market, found out as critical in the SCs in India. It is expected that this study will be helpful for the researchers to develop the conceptual models to overcome this issue. These barriers have a great influence on Indian SC. Although these issues in the SC are very generalized, which needs further study, the prioritization of these barriers will help the industries to overcome the SC issues due to the Covid-19.

Table: 1 Description of the barriers

Barriers	Description of the variables
Lack of man power	Man power in any sectors is defined by the supply of people who are able to work. Any sector suffers from a lack of man power. This is an important variable or criterion for any industry or service sectors and it directly affects the productivity, which reduces the revenue and profit.
Local laws enforcement	Government of India is taking all necessary steps against the spread of CORONA Virus 19. The most important factor in preventing the spread of the Virus locally is to empower the citizens with the right information and taking precautions as per the advisories being issued by government. In India, the government has decided a nationwide lockdown to battle the spread of the Covid-19 virus.
Lack of transportation	Due to COVID 19, India has restricted or stopped the transport system in the country and globally, which

	directly affects the SC of manufacturing sectors.
Scarcity of raw materials	Industries in the country are facing shortages of raw materials because of the graded lifting of the ongoing nationwide lockdown. Due to restricted capacity at the main ports in India, both for sea and air freight, industries are facing a scarcity of import of material for which a locally-produced alternative is extremely difficult to find.
Deficiency in cash flow in the market	A lockdown of this magnitude puts immediate pressure on the cash flow and pandemic has significantly impacted the cash flow at organizations.

3. Methodology

There are a number of multiple criteria decision making (MCDM) tools, such as AHP, ENTROPY, CRITIC (Saaty, 1980), (Biswas et al., 2019), (Biswas et al., 2020), etc., available for prioritization of criteria in a set. In this paper, the fuzzy AHP method has been used to determine the weights/performance evaluation of the different barriers. This method works with the development of pairwise comparison matrix to determine the subjective weights or relative importance of each criterion. To capture the vagueness or imprecision in the judgments rendered by decision makers, triangular fuzzy membership function has been used (Chang, 1996) with AHP theory. There are a good number of advantages of this method such as: it is simple to understand and comprehend, it can capture imprecision in judgments, it can return to a crisp value at the end, etc. A fuzzy scale as proposed by Chang (1996) has been considered for pairwise comparisons of one criterion over another and the same is shown in Table 2.

Table 2. Fuzzy Scale

Preference of pairwise comparisons	Fuzzy numbers
Equal	(1,1,1)
Moderate	(0.67,1,1.5)
Strong	(1.5,2,2.5)
Very strong	(2.5,3,3.5)
Extremely Strong	(3.5,4,4.5)

In this work, the extent fuzzy AHP (Chang, 1996) is utilized for defuzzification.

4. Data and Computation

In order to rank the different barriers of SCM due to COVID-19 for Indian manufacturing sectors, 15 respondents were contacted and their demographic information was collected. It has been seen that the majority of the respondents are Bachelor degree, Master's degree or PhD degree holders. All the respondents comprised are in manufacturing sectors, SC sectors and professors/associate

professors in colleges/universities. All the academicians involved in the survey either teach engineering or management and by virtue of their profession, they have practical experiences in dealing with SC activities in Indian manufacturing industries. It has been observed that all the respondents have working experiences of 5 years or more. So, overall, it can be concluded that all the respondents participated in the present survey have sufficient expertise in SC management.

After identification of evaluation barrier, with the help of expert committee, fuzzy linguistic values are used to determine weights of criteria.

4.1 Priority of criteria

Considering the feedback of the experts from various fields, we form a pairwise comparison matrix of 5 criteria to get their relative weight over others. Table 3 shows the fuzzy evaluation of the criteria.

Table 3. Pairwise comparison matrix

Criteria	Lack of man power	Local laws enforcement	Lack of transportation	Scarcity of raw materials	Deficiency in cash flow in the market
Lack of man power	(1,1,1)	(1.5,2,2.5)	(0.67,1,1.5)	(2.5,3,3.5)	(0.67,1,1.5)
Local laws enforcement	(0.4,0.5,0.67)	(1,1,1)	(0.67,1,1.5)	(0.67,1,1.5)	(1.5,2,2.5)
Lack of transportation	(0.67,1,1.5)	(0.67,1,1.5)	(1,1,1)	(0.67,1,1.5)	(2.5,3,3.5)
Scarcity of raw materials	(0.29,0.33,0.4)	(0.67,1,1.5)	(0.67,1,1.5)	(1,1,1)	(1.5,2,2.5)
Deficiency in cash flow in the market	(0.67,1,1.5)	(0.4,0.5,0.67)	(0.29,0.33,0.4)	(0.4,0.5,0.67)	(1,1,1)

Using the steps of extent fuzzy AHP mentioned in the literature (Chang, 1996) and fuzzy evaluation values in Table 3, we determine the triangular fuzzy number (TFN) values of five criteria as follows:

S_1(Lack of man power)
$=(6.33,8.00,10.00) \otimes (1/37.30,1/29.17,1/22.94)$
$=(0.17,0.27,0.44)$
S_2(Local laws enforcement)
$=(4.23,5.50,7.17) \otimes (1/37.30,1/29.17,1/22.94)$
$=(0.11,0.19,0.31)$
S_3(Lack of transportation)
$=(5.50,7.00,9.00) \otimes (1/37.30,1/29.17,1/22.94)$
$=(0.15,0.24,0.39)$
S_4(Scarcity of raw materials)
$=(4.12,5.33,6.90) \otimes (1/37.30,1/29.17,1/22.94)$
$=(0.11,0.18,0.30)$
S_5(Deficiency in cash flow in the market)
$=(2.75,3.33,4.23) \otimes (1/37.30,1/29.17,1/22.94)$

=(0.07,0.11,0.18)

Similarly as mentioned in literature (Chang, 1996), the degree of possibility of $S_j=(l_j,m_j,u_j) \geq S_i=(l_i,m_i,u_i)$ can be computed by comparing the values of S_i as determined above. Table 4 shows the values of $V(S_j \geq S_i)$.

Table 4. Values of $V(S_j \geq S_i)$

$V(S_j \geq S_i)$	Value	$V(S_j \geq S_i)$	Value	$V(S_j \geq S_i)$	Value
$V(S_1 \geq S_2)$	1.000	$V(S_2 \geq S_1)$	0.636	$V(S_3 \geq S_1)$	0.880
$V(S_1 \geq S_3)$	1.000	$V(S_2 \geq S_3)$	0.762	$V(S_3 \geq S_2)$	1.000
$V(S_1 \geq S_4)$	1.000	$V(S_2 \geq S_4)$	1.000	$V(S_3 \geq S_4)$	1.000
$V(S_1 \geq S_5)$	1.000	$V(S_2 \geq S_5)$	1.000	$V(S_3 \geq S_5)$	1.000
$V(S_4 \geq S_1)$	0.590	$V(S_5 \geq S_1)$	0.059		
$V(S_4 \geq S_2)$	0.950	$V(S_5 \geq S_2)$	0.467		
$V(S_4 \geq S_3)$	0.714	$V(S_5 \geq S_3)$	0.187		
$V(S_4 \geq S_5)$	1.000	$V(S_5 \geq S_4)$	0.500		

Calculate the minimum degree of possibility d´ (i) of V $(S_j \geq S_i)$ for i,j=1,2,3,....k.

D´(1)=min V$(S_1 \geq S_2,S_3,S_4,S_5)$ = min (1.000, 1.000, 1.000, 1.000)=1.000

D´(2)= min V$(S_2 \geq S_1,S_3,S_4,S_5)$ = min (0.636, 0.762, 1.000, 1.000)=0.636

D´(3)= min V$(S_3 \geq S_1,S_2,S_4,S_5)$= min (0.880, 1.000, 1.000, 1.000)=0.880

D´(4)= min V$(S_4 \geq S_1,S_2,S_3,S_5)$= min (0.590, 0.950, 1.000, 1.000)=0.590

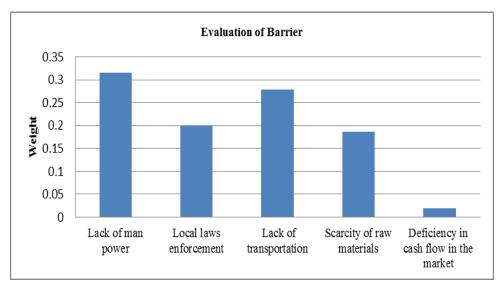D´(5)= min V$(S_5 \geq S_1,S_2,S_3,S_4)$= min (0.059, 0.467, 0.187, 0.500)=0.059

Therefore, the weight vector becomes

W´= (1.000, 0.636, 0.880, 0.590, 0.059)^T

Normalizing the weight vector, we get

W= (0.316, 0.201, 0.278, 0.186, 0.019)^T

Therefore, the final weights of lack of man power, local laws enforcement, lack of transportation, scarcity of raw materials and deficiency in cash flow in the market become 0.316, 0.201, 0.278, 0.186 and 0.019 respectively. The relative weights which are non-fuzzy numbers are described in the following figure (Figure 1).

Figure 1: Relative weights for evaluation of barriers

5. Result and Discussion

As mentioned above, the five essential barriers of SCM implementation in different manufacturing sectors were identified and subsequently validated by academicians and practitioners in order to see the importance of the different barriers of SCM in manufacturing sectors. The majority of the expert respondents belongs to either academic or industry area. All the academicians involved in the survey are aware of operations management and marketing management by virtue of their profession, and they have practical experiences in dealing with SC activities. So, overall, it can be concluded that all the respondents participated in the present survey have sufficient expertise in SC management. The figures also show the priorities of the factors compared. For clarity purpose, the five barriers and their corresponding priorities and ranks are shown in Fig. 1. It is observed that the five most critical barriers are (arranged in a descending order of criticality) the following:

1. Lack of man power,
2. Lack of transportation,
3. Local laws enforcement,
4. Scarcity of raw materials,
5. Deficiency in cash flow in the market.

From Figure 1, it is found that the most serious barrier is "Lack of man power" and the least critical barrier is "Deficiency in cash flow in the market". This does not mean that 'deficiency in cash flow in the market' is not serious; it merely shows that the other barriers considered are more serious compared to it because deficiency in cash flow directly or indirectly depends on logistics and SCM. Lack of man power affects production directly. Presently, the production level is already low due to unavailability of the raw materials because of the irregular transportation system. In

this present scenario, local law enforcement has played a major role in implementation of "the lockdown". So, the entire distribution channel is hampered and does not meet the demand supply equation. As a result, there is a scarcity of raw material items in the market. These emergency items are unnecessarily being stocked by some classes of people as they are thinking that there may be a crisis in the near future. Therefore, it widens the gap between demand and supply in the local market. As most of the businesses were entirely stopped due to the lockdown countering this pandemic, it resulted in the downfall of the economy and an increase in the unemployment level as well. It has been noticed that many people had lost their jobs in different sectors and some employees did not get their remuneration fully. Due to the loss of job, these people are having difficulties to meet their necessities. Consequently, all the above mentioned points directly affect the cash flow. It has been observed from the literature review that manufacturing industry has been hit in many ways due to the Corona effect. To begin with, lower production due to lack of raw materials, employees stop coming in to work due to government directives, thereby reducing the scale of operations, with a consequent effect on quality, cost and production volumes. Over a period, this adversely affects the turnover, which slows down to a drop. The uncertainties in the logistics leads to a flowing effect; transporters struggle to not only place vehicles for loading; they also are under pressure to adjust their quotes for carrying goods, as it also faced lower attendance, with their operational risks increasing steeply. Another side, the slower rate of banking operations, shorter working hours and jammed & overloaded communication lines lead to delayed money transactions, thereby elevating monetary risks.

Hence, the main challenges for restarting manufacturing industries can be started, although COVID-19 will remain around and create a high degree of uncertainty in all aspects in manufacturing sectors. In particular, the need to avoid the further spread of COVID-19 in the workplace or through the movement of people and materials may result in further restrictions and a potential return to lockdown. When restrictions are lifted, the market is expected to be very tight and extremely cash-constrained. This is largely due to extreme uncertainties with regard to demand for manufacturing and consequent low or non-existing business income while expenses for labor, energy, rent and other business inputs will still be suffered.

Now, the different Indian govt. organizations (MSME, Confederation of Indian Industry) may consider the followings:

1. Manpower will be a constraint due to maintaining social distancing, therefore some percentage of workers have to bring back from their hometowns due to uncertainties of job and loss of income during the lockdown. Now, it will be a challenge to convince staff to return or to hire new staff for operation. Even though engagement with industrial training institutes and hiring of temporary workers on walk-in basis.

2. Machinery and stocks of raw materials, work in progress and final products become tainted. It needs to undertake outstanding maintenance and service, and clean out wasted stocks, before they can resume operations, at a significant cost and with likely write-offs of stocks currently trapped on-site.

3. Ensuring timely supplies of essential inputs without price hikes is a matter of concern. Those are sometimes critically dependent on specialized parts from other states or from abroad express concerns about their susceptibility to supply shortages.

4. Some emergency product industries had already started pre-lockdown with some measures for COVID-19 infection prevention and control, particularly through awareness-raising and communication (on hygiene, physical distancing, etc.) and, in some cases, the provision of hand sanitizers, masks and gloves. This forms the basis for stepping up preventive measures for post-lockdown. Common measures under consideration are health checks at the factory entrance, the provision of personal protective equipment (PPE), staggering of shifts and break times to minimize congestion of people, maintaining physical distancing during work and compulsory use of Aroygya setu app (COVID-19 contact tracing app launched by the Government).

5. Currently, the most immediate concerns are cash flow and working capital. Most are concerned that survival is only possible with a substantive financial and/or fiscal support package from the government.

6. Build digital SC & logistics and mandate and further drive digital payments.

6. Conclusion

The panic-stricken country has come to a standstill with nationwide lockdowns, mandatory quarantine, home confinement, job losses and economic woes. However, these restrictions have a severe impact on SCM in Indian manufacturing sectors. Notably, the restrictions disrupted the raw materials and finished goods SC that in turn made to experience huge losses and growth of market are facing too much problems. Adding to that, immense post losses due to shortage of labors and transportation bottlenecks were observed. In this paper, we have focused on five main barriers of SCM in manufacturing sectors and used the Fuzzy-AHP model to evaluate the weightage of different barriers due to COVID-19. It has been seen that lack of man power is the most serious barrier and the least weightage barrier comparing to others is deficiency in cash flow in the market because it depends upon the other barriers. This study can be extended by considering the other barriers with different multi-criteria decision making approaches. The proposed paper provides some useful information to manufacturing sectors in checking out the action plans in order to overcome those barriers. Once the barriers are overcome, the manufacturing sectors can start their production and continue in contributing to the country's GDP substantially.

References

Arikan, F., (2013). An interactive solution approach for multiple objective supplier selection problem with fuzzy parameters. Journal of Intelligent Manufacturing, DOI: 10.1007/s10845-013-0782-6.

Biswas, T., Chaki, S. & Das, M.C. (2019). MCDM technique application to the selection of an Indian Institute of Technology. Operational Research in Engineering Sciences: Theory and Applications, 2(3), 65-76.

Biswas, T., Chatterjee, P. & Choudhuri, B. (2020). Selection of commercially available alternative passenger vehicle in automotive environment. Operational Research in Engineering Sciences: Theory and Applications, 3(1), 16-27.

Chang, D. Y. (1996). Applications of the extent analysis method on fuzzy AHP. European Journal of Operations Research, 95, 649–655. DOI:10.1016/0377-2217(95)00300-2.

Chaudhry, S. A. (26 March 2020). Covid-19 puts India's food supply chain to a stress-test. The Hindu @businessline. Retrieved 26, March 2020.

Cucinotta, D., & Vanelli, M. (2020) WHO Declares COVID-19 a Pandemic. Acta Biomed, 91:157-160.

Goyal, M. (22 March 2020). "Covid-19: How the deadly virus hints at a looming financial crisis". The Economic Times. Retrieved 23, March 2020.

Jamwal, A., Bhatnagar, S., & Sharma, P. (2020). Coronavirus Disease 2019 (COVID-19): Current Literature and Status in India.

Krishnan, V. (2020). "The Callousness of India's COVID-19 Response". The Atlantic. Retrieved 2 April 2020.

Kumar, S.,Thombare, P. B., & Kale, P. A. Impact of coronavirus (COVID-19) on Indian economy. ISSN: 2581-8317, 2 (4), April 2020.

Mayo clinic. Coronavirus disease 2019 (COVID-19). 2020.

Md. Moktadir, A., Mithun Ali, S., Rajesh, R., & Paul, S. K. (2018). Modeling the interrelationships among barriers to sustainable supply chain management in leather industry. Journal of Cleaner Production, 181, 631-651

Meehan, J., & Muir, L. (2008). SCM in Merseyside SMEs: Benefits and barriers". The TQM Journal, 20:223-232.

Mudgill, A. (25 March 2020). "How will India lockdown play out for economy & markets: 4 scenarios". The Economic Times. Retrieved 25 March 2020

Parth, M.N. (26 March 2020). "Coronavirus Outbreak: In Maharashtra, police disrupting farm produce supply chains impairs farmers, lack of labour stalls harvest". Firstpost. Retrieved 26 March 2020.

Research, Centre for Policy. "Podcast: How has India's lockdown impacted unemployment rates and income levels?". Scroll.in. Retrieved 24 April 2020.

Saaty, T. L. (1980). The analytic hierarchy process (1st ed.). New York: McGraw-Hill.

Shaw, K., Shankar, R., Yadav, S.S., & Thakur, L.S., (2012). Supplier Selection Using Fuzzy AHP and Fuzzy Multi Objective Linear programming for developing low carbon supply chain. Expert Systems with Applications, 39(9), 8182-8192.

Singh, S. (1 April 2020). Covid-19 Pandemic Spoils Indian Startup Funding Party, Growth Stage Worst Hit in Q1 2020. Inc 42 Media. Retrieved 1, April 2020.

Sirisawat, P. & Kiatcharoenpol, T.(2018). Fuzzy AHP-TOPSIS approaches to prioritizing solutions for reverse logistics barriers. Computers & Industrial Engineering, 117, 303-318.

Stank, T.P., Dittmann, J.P. & Autry, C.W. (2011). The new supply chain agenda: A synopsis and direction for future research. International Journal of Physical Distribution & Logistics Management; **4**(10): 940-955.

The Indian Express. 23 March 2020. Stock markets post worst losses in history; Sensex crashes 3,935 points amid coronavirus lockdown". Retrieved 23, March 2020.

Vyas, M. (21 April 2020). "Unemployment rate touches 26%". Centre for Monitoring Indian Economy (CMIE). Retrieved 24 April 2020.

WHO. Coronavirus disease 2019 (COVID-19) Situation Report-92. 2020.

Wu, Debby (25 March 2020). "iPhone Makers Suspend India Production Due to Lockdown". Bloomberg. Retrieved 25 March 2020.

Yu, K.D.S., & Aviso, K.B. (2020). Modelling the Economic Impact and Ripple Effects of Disease Outbreaks. Process Integr Optim Sustain. https://doi.org/10.1007/s41660-020-00113-y.