

Developing a Framework for New-Normal Supply Chain Management

Journal of Development Research
2022, 15(1) 23–34
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DOI: 10.1177/22297561221125260
drj.ves.ac.in



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Abstract

COVID-19 has exposed the risks of complex and disconnected supply chain. Many businesses have realised that they need to reach a state of greater visibility and agility across their supply chain. This crisis has forced practical, agile thinking, giving the courage to test, fail fast and try again. Digital transformations that would have taken months or years are being done in a matter of weeks.

In view of the above perspective, this article first studies the various initiatives taken by companies to make their end-to-end supply chain resilient, agile and robust. Then it identifies various factors for a new age technology that are evident for new-normal supply chain management. Using New Rough Stepwise Weight Assessment Ratio Analysis (SWARA) approach, the factors are evaluated for most appropriate factor required for implementation.

Keywords

New-normal, supply chain management, digital supply network, e-procurement, new age technologies

Introduction

On December 2019, the first case of COVID-19 was found in Wuhan city of China, which subsequently spread across the world by the end of March 2020. The outbreak of coronavirus was a sudden and unexpected incident. Almost the entire world is affected by the working of various industries coming to a halt. Situations such as lockdown, quarantine, mental distraction and job loss are the major outcomes of the pandemic. This has also created a huge burden on medical

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facilities. Due to job losses, medical facilities are not reaching the lower strata of society. There is a demand–supply mismatch where the demand for certain goods such as face shields and pharmaceutical products is very high but the supply is negligible compared to this demand. On the other hand, there is no demand for goods such as cars, jewellery and shoes but the supply is high. Due to this, the global supply chain (SC) is disturbed. Due to the pandemic, 12,000 facilities of more than 1,000 SC companies are under quarantined areas in China (Ivanov & Dolgui 2020). Manufacturers of SC lack labour to perform production activities, despite ample availability of raw material.

India has faced the worst recession due to the outbreak of coronavirus after the great depression in 1930. The GDP growth rate is 1.9%, which is the lowest recorded figure due to coronavirus. International trade has drastically declined and companies majorly dependent on trades have suffered huge losses.

The two main objectives of any corporate in the current scenario are:

- Managing the cash flow which is the most important chunk of operating capital during this pandemic and surviving in this lockdown with sharp downturn.
- Designing the supply chain for the new normal.

On advice of the World Health Organization, the Government of India announced an unanticipated lockdown, which led to a spike in demand for groceries and fast-moving consumer goods. It was a challenge for the outbound SC to function smoothly as consumers were buying the available products without considering the brand. This forced retail distributors to increase the speed of replenishment, for satisfying the customer demand.

The scenario was opposite in the Inbound SC. Organizations were trying their best to cover up their inventory for a longer lead time. There was a short supply due to the sudden lockdown announced by government authorities. Organisations were looking for alternative resources. Most of the industries were focusing on protecting the businesses until the pandemic got over, by acquiring their supplies either through local or global sources to sustain their business activities.

The key impact of the pandemic on SC planning was to apply different strategies for the forward and backend/backward SC. In the normal conditions, the forward and backend/backward SC were working in congruence.

As we look ahead, there is no ‘one-size-fits-all’ model and companies will have to work closely with their manufacturing, logistics, distribution, marketing and sales department to define their future SC. This is where the need for designing SC for the ‘new normal’ comes into the picture.

Objectives of the Study

- To understand the initiative taken by organisations to make their end-to-end supply chain resilient, agile and robust.
- To identify the factors to redesign the supply chain.

Literature Review

Supply Chain Management

Various definitions of supply chain management (SCM) have evolved, thereby making it a very important process. SCM is the management of business processes in organisations that handle SC (Croxtton et al., 2001). Traditional SC was linked with purchasing and logistics management but with the advancement over traditional ways of purchasing and logistics, SCM is management of materials and distribution (Tan, 2001). The main role of SCM is to convert raw materials into finished goods and deliver the same to end users in a timely manner (Vincent & Venkataramanan, 2007). The whole of SC majorly consists of retailers, distributors, manufacturers and suppliers who give goods and services to end users and add value to upstream and downstream channels through movement of information and resources. It also aims at improving product or service attractiveness (Machowiak, 2012). For the development of economy, creating a demand and supply balance is very crucial. This is where SCM plays a role. It incorporates supply and demand management inside and across companies (Randall & Mello, 2012). Apart from demand and supply management, it regulates the relationship within the chain of people involved in the process (Min & Mentzer, 2011).

Impact of COVID-19 in SCM

With the widespread of COVID-19 virus, multiple countries all over the world declared health emergency. India developed its first COVID-19 case on 30 January 2020. Various restrictions were imposed, leading to a halt in business processes and affecting the business cycle of almost all organisations.

The coronavirus pandemic showed a huge impact on SC of almost all organisations, which in turn affected the functioning of manufacturers, retailers and wholesalers. Companies were struggling to uphold the sound movement of goods and services during this difficult time. Goods such as frozen food, medicines, masks and grocery items that were in huge demand faced obstacles due to disrupted SC. This led to an interruption in manufacturing, procurement, distribution and supplies. Previously forecasted demand and budgets remained unworkable. Due to the lockdown manufacturing plants were forced to shut down and special permission was required to operate plants manufacturing special goods required during the pandemic. Movement between inter and intra-state was at a halt leading to absenteeism of workforces, less staff at warehouses and shops and interrupted procurement of domestic raw materials. The use of existing infrastructure drastically reduced as it remained unused.

Various literature on 'lean supply chain' were developed to enhance the effectiveness of SCM. It is a linking of companies for managing movement of information, products, services and money upstream and downstream also

enabling low cost and meeting customer demands (Vitasek et al., 2005). Many companies all over the world implemented this for an efficient SC. The major advantage of lean SCM is reduction in inventory level helping companies to keep their inventory and hence the storage costs low. Due to the pandemic, companies were building up their inventory and in turn faced the disadvantages of lean supply chain (Roy, 2020).

Initiative by Organisations During the Pandemic

With the pandemic disturbing and disrupting the SCM, many organisations have taken various initiatives to improve the SCM and bring it back on track. Using various literatures, this article has listed the initiatives.

1. Majority of the offices are in metro cities, such as Kolkata, Bangalore and Mumbai, but due to the pandemic, companies are considering the options of work from home or working once a week from office. Due to this, people are moving towards non-metro cities considering them as low-income cities. In addition, many organisations are looking forward to moving their offices to non-metro offices.
2. For fulfilling the desired positions in organisations, companies are recruiting people from anywhere in the world. Hence, location is not a constraint for job since people will work from home. This has also attracted highly talented people.
3. With lower travelling and more time saved, organisations are giving more growth options in terms of training and development.
4. The pandemic has made organisations believe that having one or multiple specialisations of the same product is not enough. Hence, many companies are now opting for multiple variations in the product line. Manufacturing and selling hand sanitisers by a liquor company, making masks for all occasions by the fashion industry and manufacturing medical equipment like ventilators by an auto company are some of the initiatives.

Robust SCM and Use of New Age Technologies

SC has to undergo tremendous change in its way of functioning. The robust implementation of SC can be implemented by the use of new-age technology and drastic ways of processing.

SC's first and primary element is manufacturing. Laborers play a significant part in the production process in the labor-intensive industry of manufacturing. The demand of the hour is for motivated as well as skilled labour. However, we have noticed a change in labourers' behaviour recently. Production is not crucial to them. They determine that the product they make is not necessary, so they skip work. Some are influenced by their family's decision not to go back to work. Traveling might be challenging for certain people because of restrictions and lockdowns.

Instead of sticking to conventional ways of procurement networks, having a digital SC is the way out. Digital supply chain networks are fast. There is continuous flow of information with the supply network and due to its integrated nature and use of analytics, it helps organisations remain connected with all the stages of SC. E-procurement is one of the techniques used nowadays by companies to overcome the problems of manufacturing (Chang et al., 2013). Olig and Spears (2001) mentioned various advantages of it. Electronic procurement or e-procurement, defined in its basic form, is the usage of electronic resources such as the internet and email for buying and selling goods or rendering services (Carayannis & Popescu, 2005). It includes ordering through electronic means, use of portals, extranets and Electronic Data Interchange (EDI) for bidding processes (Dooley & Purchase, 2006); purchasing cards and reverse auctions are also included (Moon, 2005). Connecting multiple organisations electronically to handle the purchasing procedure is the main motive (Dooley & Purchase, 2006).

Electronic sourcing or e-sourcing is the identification of new suppliers over the Internet, including tendering in which requests for prices and related information are sent (Boer et al., 2002).

Further to adding new technologies, Artificial Intelligence (AI) holds space in SCM. It is the ability of machines to communicate with humans and reproduce the capacities of humans (Holsapple & Whinston, 1990). It is helpful in various areas to solve problems, has high accuracy, higher speed and can take large amount of data. Artificial neural network (ANN) which is a variant of AI helps in forecasting techniques (Ketter et al., 2011), used for pricing of products and services (Peterson & Flanagan, 2009) combined with k-means which is used for customer segmentation. Genetic Algorithm (GA) conducts sales promotion and other promotional activities. Taratoukhine and Yadgarova (2018) suggested a technique to handle product life cycle using multi-agent systems (MASs). Lee et al. (2011) suggested a way to handle logistics workflow using AI in combination with radio-frequency identification (RFID). AI is also used to control and suggest improvements in quality of products and services.

Use of robots in SC is now picking up demand. SC integrated with robotics is the future of SCM. With options of relocation due to the pandemic, success in terms of quality and productivity is achieved. The e-commerce giant Amazon in 2012 acquired Kiva systems. The only reason was to increase its pace of picking and packing using robots used by Kiva Systems, though it had to invest heavily for the acquisition. Within two years of the acquisition, Amazon started using automated robots in its various centres. The robots transport goods from one inventory store to another being picked up manually and others being automatically returned to the shelves in the store. In future, robots will be used for truck unloading, collecting orders, inventory examining and transportation of goods. Robots will also be used to deliver goods to customers and customers can track the robots using mobile applications. For a robot failure, there would be a backup robot, and for repairing the broken robot, fixing would be done using cloud where the data are stored.

The concept of blockchain is widely discussed in the SC organisation. It is a database, which can be accessed by a peer-to-peer network. In this, sequential

blocks are linked together, for a timely transaction to happen and are secured by a cryptographic key on a network that is verified. Once a component is added, it cannot be changed or altered which makes blockchain a reliable source for past records (Seebacher & Schüritz, 2017). Blockchain is highly beneficial for SCM as it is traceable, trusted and reliable for all members of SC. It can also help in reducing the operational cost by eliminating intermediaries.

Although there is great potential for IoT in SCM, the real business value of IoT in the SC has not yet been fully recognised or thoroughly addressed. According to a survey by Accenture of large global companies with more than 1,000 senior managers, most companies (about 90%) still have difficulty understanding how the IoT can benefit their SC. By linking machines, products, people and SC members, the IoT provides a new environment for supply chain managers. It enables process integration and information communication, allows machine-enabled decision-making and fosters more efficient and effective SCM. In this entirely new business and technology environment, supply chain managers need to innovate their traditional SCM practices and strategies (Li & Li, 2017).

Various other providers of services and models would be created in the upcoming future. The only criteria for them to continue in the market would be the extent to which they can keep up their promises. There can also be a change in the behaviour of competitors. The only way to understand and survive in the changing environment is to do scenario analysis. It implies how to innovate your operations, what model fits the best and what ecosystem the business should have.

Research Methodology

New Rough Stepwise Weight Assessment Ratio Analysis (SWARA) (Zavadskas et al., 2018) developed is a relatively new method used to solve problems in various areas. In this method, experts play a major role in evaluation. Using their own expertise, they rank all the criteria with Rank 1 as the most significant and the least significant is given the highest rank. The ranking of the experts is the main component of this method. In addition, this method is easy to apply. The decision-making process using this technique is achieved quickly and accurately. This research is undertaken to assess the factors for a robust SCM post-pandemic situation.

Working of Rough SWARA Method

The rankings collected by the experts consist of the first two steps of the method. In the third step, individual responses of the experts are converted into group matrix c_j . In the fourth step, the previous matrix is normalised wherein the worst ranked criteria will have the highest value. Also, the first element is equal to one

while other elements are found by dividing the elements with the highest value. In the fifth step, all the elements except the first one which has Value 1, must be added with the number 1 and a new matrix ' kj ' is formed. In the sixth step, the weight matrix in terms of ' qj ' is recalculated by dividing ' $q(j-1)$ ' with kj retaining value which is the first element. In the seventh and the last step, relative weights of the criteria are obtained.

Data Collection

Data were collected from experts having experience of more than 10 years. Experts were practitioners of SC holding various strategic positions in production, procurement, sales, logistics and distribution of multiple industries. These experts were chosen with the intention that they are well versed in the existing problems and the changing pattern of the SCM industry. Data collection was done through a structured questionnaire distributed through emails. Out of 50 questionnaires distributed, 23 responses were received. The demographic profile is exhibited in the following table:

Demographic Details of Experts	
Gender	
Male	15
Female	8
Age	
30–35 years	3
35–40 years	18
40–45 years	2
Experience	
10–15 years	7
15–20 years	8
20–25 years	8
Department	
Purchase	4
Distribution	5
Sales	7
Pricing	3
Manufacturing	4
Industry	
FMCG	9
Logistics	5
Pharmaceutical	3
Retail	6

Factors Identification

Literature review explains various factors that are required for a robust and agile SCM. Using the Literature 4 main criteria and 14 sub criteria are identified. They are listed as per the following table and are validated by the experts.

Detailed Calculation Stepwise of Rough SWARA

The Rough SWARA calculation is first performed on the 4 main criteria followed by 14 sub criteria. A total of 23 experts were asked to rank the 4 main criteria in the range of 1 to 4, where 1 is the best rank and 4 is the worst rank. The same procedure is followed for 14 sub criteria. The following table describes the ranking by 23 experts where C_j stands for ‘criteria’ and E_j stands for ‘experts’.

Codes	Main Criteria	Sub Criteria
C1	Inventory buffering	
C1-a		Alternate sourcing
C1-b		Securing critical inventory
C1-c		Shared resources
C1-d		Diversification
C2	Digital supply network	
C2-a		Artificial intelligence
C2-b		Robots
C2-c		Internet of things
C2-d		Blockchain
C3	Work environment	
C3-a		Flexible
C3-b		Restricting non-essential travel
C3-c		Location tracking
C4	Alignment of IT systems	
C4-a		System stability
C4-b		Network robustness
C4-c		Data security

Main Criteria	Experts											
	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12
C1	4	4	4	4	4	4	3	4	4	4	3	4
C2	1	1	1	1	1	1	2	1	1	1	2	1
C3	3	3	3	3	3	3	4	3	3	3	4	3
C4	2	2	2	2	2	2	1	2	2	2	1	2

Main Criteria	Experts										
	E13	E14	E15	E16	E17	E18	E19	E20	E21	E22	E23
C1	4	3	4	4	3	4	4	4	4	3	4
C2	1	2	1	1	2	1	1	1	1	2	1
C3	3	4	3	3	4	3	3	3	3	4	3
C4	2	1	2	2	1	2	2	2	2	1	2

Sub Criteria	Experts											
	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12
C1-a	9	10	9	10	10	9	9	9	10	10	10	9
C1-b	13	14	13	14	14	13	13	13	14	14	14	13
C1-c	12	11	12	11	11	12	12	12	11	11	11	12
C1-d	10	9	10	9	9	10	10	10	9	9	9	10
C2-a	6	5	6	5	5	6	6	6	5	5	5	6
C2-b	14	13	14	13	13	14	14	14	13	13	13	14
C2-c	1	2	1	2	2	1	1	1	2	2	2	1
C2-d	2	1	2	1	1	2	2	2	1	1	1	2
C3-a	8	7	8	7	7	8	8	8	7	7	7	8
C3-b	11	12	11	12	12	11	11	11	12	12	12	11
C3-c	7	8	7	8	8	7	7	7	8	8	8	7
C4-a	4	3	4	3	3	4	4	4	3	3	3	4
C4-b	3	4	3	4	4	3	3	3	4	4	4	3
C4-c	5	6	5	6	6	5	5	5	6	6	6	5

Sub Criteria	Experts										
	E13	E14	E15	E16	E17	E18	E19	E20	E21	E22	E23
C1s-a	9	9	10	9	10	9	10	9	9	9	9
C1-b	13	13	14	13	14	13	14	13	13	13	13
C1-c	12	12	11	12	11	12	11	12	12	12	12
C1-d	10	10	9	10	9	10	9	10	10	10	10
C2-a	6	6	5	6	5	6	5	6	6	6	6
C2-b	14	14	13	14	13	14	13	14	14	14	14
C2-c	1	1	2	1	2	1	2	1	1	1	1
C2-d	2	2	1	2	1	2	1	2	2	2	2
C3-a	8	8	7	8	7	8	7	8	8	8	8
C3-b	11	11	12	11	12	11	12	11	11	11	11
C3-c	7	7	8	7	8	7	8	7	7	7	7
C4-a	4	4	3	4	3	4	3	4	4	4	4
C4-b	3	3	4	3	4	3	4	3	3	3	3
C4-c	5	5	6	5	6	5	6	5	5	5	5

Using the steps described above of Rough SWARA, the relative weights matrix of Main Criteria and Sub Criteria are calculated and presented in the following table.

Main Criteria	Relative Weights
C2	0.471571
C4	0.324995
C3	0.178386
C1	0.090754

Sub Criteria	Relative Weights
C2c	0.248438528
C2d	0.223612025
C4b	0.180208816
C4a	0.14343341
C4c	0.103504648
C2a	0.073845359
C3c	0.048224612
C3a	0.031177907
C1a	0.018599148
C1d	0.010993993
C3b	0.006036588
C1c	0.003286744
C1b	0.001671758
C2b	0.00084371

As per the 'relative weights', in the above table, of 'main criteria', we can find out that 'digital supply network' received the high weightage as per experts followed by alignment of IT systems. Work environment and inventory buffering received the least weight.

Looking at 'relative weights, in the above table, of 'sub criteria', C2c that is criteria resembling IOT receives the highest weight followed by C2d which is blockchain. Network robustness and system stability received 3rd and 4th highest weights, respectively. The other criteria received lower weights as mentioned in the above table.

Implications of the Research

The spread of the COVID-19 pandemic has affected large number of companies. The SC cycle has also been affected and new avenues to revive it is necessary.

The study accessing the factors for a new normal SC reveals that use of ‘digital supply network’ is required for reviving the SCM cycle. Companies should re-examine their SC network. To infuse the agility in SC, scalable solutions combined with automation are the key. While going after agility, firms should also consider the cost, as no organisation wants its operational expenses to go up.

Conclusion

Development in technology should be considered the main source of survival in a pandemic-like situation. The focus of the organisation now should be to have a strong digital infrastructure to effectively communicate and manage future challenges.

The current scenario brings up the fact that companies cannot control the demand; therefore, to cope with the ever-changing demand pattern, they have to build flexible SC and production systems.

For accurate planning, precise forecasting is a must, and for precise forecasting, the use of big data and machine learning is a must. Further, firms cannot rely on available metrics, particularly for planning. Undoubtedly, it is time to move to the new metric—net promoter score—to measure the effectiveness of the SC to meet customer expectations.

This is the era where data are available in abundance right from the point of sale to consumer buying behaviour. Data-driven decision-making has enabled the demand planner to take accurate decisions. Tools such as AI and machine learning are aiding the decision-making process by extracting valuable information out of big data. Going forward, SC transformation will play a key role in enhancing the business performance.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

Funding

The authors received no financial support for the research, authorship and/or publication of this article.

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