Analysis of Logistical Barriers Faced by MNCs for Business in Indian Smart Cities Using ISM-MICMAC Approach

Nikhil Gandhi, Abid Haleem, Mohd Shuaib and Deepak Kumar

Abstract India is predicted to be one of the world's fastest-growing large economies for this decade, according to projections from the World Bank and the International Monetary Fund. A lot of this growth is attributed to the operations of various multinational companies (MNCs) setting up their businesses in the country. Additionally, the plan set in place by the Indian Government to bring up numerous Smart Cities augurs well for the MNCs from a business point of view. But, most MNCs face logistical problems in connection with transportation of their material and the flow of information. The research objective of this paper is to describe the current state of Indian logistics service and identify the logistics barriers that foreign firms have encountered in India. Identification of the barriers in the system is a good first step towards rectifying the logistical systems. This work lays an affirmation to the observation that an 'Incompatible Supply Chain Model', along with 'Poor Skills of Logistics Professionals' and 'Low Rate of Technology Adoption' collectively act as the primary driving barriers to the Indian logistical system. This paper portrays the interdependence between various factors in the logistics industry that act as barriers for MNCs while carrying out business in India. After listing out the barriers, a hierarchy is formed using the Interpretive Structural Modelling (ISM) and MICMAC techniques to find the individual importance of each barrier and in what capacity it contributes to the problem.

Keywords Logistics service · MNCs · Smart cities · Logistical barriers · ISM · MICMAC

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1 Introduction

Logistics is the management of the flow of things between the points of origin and consumption in order to meet the requirements of customers or corporations [1]. In India, the logistics sector is fast becoming an area of huge focus and also a concern. The arrival of MNCs has further enhanced the need for an efficient logistics structure in the country. The fact that the volume of freight traffic moved has seen a tangible increase over time comes from the recent growth in the Indian economy. The increasing amount of freight movement has spurred the construction of better highways and expansion of railways so as to penetrate deeper into the remote areas of the country. The consistently growing economy invites an even better prospect for trade and operations of the best MNCs of the world.

India's economy has been growing at over 8% for the past few years. The nation spends around 14.4% of GDP on logistics. India's logistics sector is touted to be worth around US$ 307bn by 2020. The sector would witness a CAGR of 15–20% in FY 2016–2020 [2]. Business is booming with the arrival of various home-grown as well as foreign E-commerce firms such as Amazon. It can be safely said that the logistics sector in India is one of the massive opportunities and shows the potential for immense growth.

Despite the positivity that is reflected through statistics, the ground reality continues to stay bleak. Present-day scenario is actually quite negative, taking into account the financial liabilities incurred upon the company because of the delays and logistical shortcomings of the company's ground zero operations. A number of problems occur, both organizational as well as operational, which affect the functioning of MNCs in India. These problems range from very basic shortcomings like selection of an incompatible supply chain model to fundamental issues like poor skills of professionals to everyday operational issues such as transport delays due to traffic. All these problems, when combined, can harm a company's reputation. And in a country like India, where finding a vendor for a lesser price is one of the easiest tasks because of the sheer multitude of service providers, such barriers can act as deal breakers of the highest order.

The entire logistics framework, from warehousing up to last-mile distribution, suffers from a large number of problems, which make these seemingly strong points look like barriers. One would normally assume that with one of the world's most elaborate railway and roadway networks, India would be an efficient transportation market. But going by World Bank's Logistics Performance Index of 2018, India is ranked 44th in the world as a logistics market, dropping 9 places from 35th in 2016. This work should go a long way in listing out the barriers that affect the efficient functioning of MNCs in India so that all the loopholes can be pointed out and acted upon to improve the logistics sector in the country.

2   Literature Review

The importance of an efficient logistics system in a growing country like India is massive. With the aforementioned arrival of MNCs, the scenario has become much more elaborate and sophisticated. The relationship between logistics performance and customer loyalty is generally very close and crucial to a company [3]. For example, online purchases are generally small in quantity but the delivery schedules of these orders are more intricate, so the role of logistics is quite large, and the final customer always has a high expectation from the logistics domain [4]. Many studies show that the average customer considers logistics performance as an important subset of the overall service provided by a company [5, 6]. And a company's logistics capacity has a significant role to play in the logistics performance of an E-commerce firm [7]. Considering fundamental factors like financial stability, operational flexibility, and competency, companies find that outsourcing is the most effective way to fulfil all customers' logistics service requirements [8]. But with an extremely fragmented Indian market functioning on less than sophisticated ware-housing and equipment, outsourcing can often become more of a problem than a solution. According to recent successful case studies and relative research works [8–13], the future of logistics should consider classifying logistical services primarily based on the specified company's operational barriers. Comparing this to the viewpoint of MNCs operating in India, and with the expansion of business into newer upcoming smart cities, it comes out as a result of the observation that a lot of bottlenecks are yet to be loosened to take the logistics sector in India to newer heights. And as it is essential for the betterment of any business, the first step, as explored in this work, is to recognize the concerns in each segment.

3   Adopted Approach

This work employs Interpretive Structural Modelling as a tool for creating a hierarchy of the identified barriers. The ISM methodologies' mathematical basis is a structural model used to analyze the complicated relationship between the barriers to logistical performance [14, 15]. The opinions of a selected group of professionals for the study and their practical knowledge decide whether and how the barriers are interactive and thus make it interpretive [16]. On this foundation, relationships between the enlisted barriers are established and an overall structure is portrayed in a graphical model. ISM generally has the following steps:

- Identify and list the barriers affecting the system as shown in Table 1.
- Establish a contextual relationship among the barriers.
- Develop the Structural Self-Interaction Matrix (SSIM) to indicate pairwise relationships among the barriers.
- Construct the reachability Matrix from the SSIM and verify it for transitivity.
- Segregate the Reachability Matrix into different level partitions.

Table 1 Identification of barriers

Barrier	Explanation	References
Inefficiencies in transport (B1)	Inefficiencies in transport are characterized by delays at various points in the supply chain. These delays stem out of excessive use of roadways as a method of transportation, overloading of trucks and unsophisticated trucking systems	[17–22]
Poor condition of storage infrastructure (B2)	All kinds of warehouses in India are still in a developmental curve and require a major facelift. Several bottlenecks exist in all departments that lead to various inconveniences to all parties in the chain	[23–26]
Low rate of technology adoption (B3)	Many new technologies that are already in motion in other countries are yet to be implemented in India. This means less compatibility between the Indian supply chain and logistics systems and the logistics and supply chain systems of other countries	[4, 27]
Poor skills of logistics professionals (B4)	An average Indian logistics professional is much less skilled than an average logistics professional of any country having a better-established logistics framework. This is because of lack of dedicated academic courses solely for logistics and a less sophisticated scenario to apply the logistics principles on	[2, 28–31]
Lack of business process improvement (B5)	Failure to meet deadlines is always a good indication of loopholes in the business process of a firm. The fact that very few deadlines are met on ground level in India, this points to a host of business process issues like need for excessive paperwork, unrealistically large loading/unloading times and so on	[32, 33]
Environmental issues (B6)	Many Governmental and International environmental regulations apply to logistical operations, which are the borderlines in which all companies have to work. Adhering to these regulations can lay some roadblocks that companies may have to meander around time and again	[34, 35]
Poor customer service (B7)	Customer experience is one of the most important barometers to measure a company's success or failure in a region. Last-mile distribution, accurate tracking facilities, feasible prices and on-time performance are some tasks to be taken care of for this	[36, 37]
Disregard of safety regulations (B8)	Be it failure to comply with traffic rules or overloading trucks, disregard of safety regulations always adds an unnecessary element of risk in the supply chain. This irregularity comes from the fact that there are traffic restrictions and other operational shortcomings which service providers look to cover up by ignoring safety rules and laws	[18, 21, 23]

(continued)

Table 1 (continued)

Barrier	Explanation	References
Incompatible supply chain model (B9)	A major factor of any operation is its think tank and the basic blueprint laid down by the company. A supply chain model could work wonders in one region and could completely fail in another region, and these sensitive details should be looked upon very seriously by firms	[38, 39]

- Based on the contextual relationships in the reachability matrix, remove transitive links and draw the ISM Model for the barriers.
- Replace barrier nodes and check model for conceptual irregularities.
- Prepare the MICMAC Analysis chart to check the driving and dependence tendencies of the barriers.

4 Structural Self-Interaction Matrix

Four symbols namely *V A X O* are used to show the direct relation that exists between the two sub-variables or barriers under consideration.

V: for the relation from *i* to *j*, but not in both directions
A: for the relation from *j* to *i*, but not in both directions
X: for both direction relations from *i* to *j* and *j* to *i*
O: if there's no relation from *i* to *j* or *j* to *i*.

For studying the variables, a contextual relationship is chosen such that one variable leads to another. Based on this contextual relationship, a SSIM has been developed and shown in Table 2.

Table 2 Structural self-interaction matrix

	B9	B8	B7	B6	B5	B4	B3	B2	B1
B1	O	A	V	O	O	A	A	O	–
B2	A	X	V	O	O	A	A	–	
B3	O	V	O	V	X	A	–		
B4	V	V	V	O	X	–			
B5	X	A	V	O	–				
B6	O	A	O	–					
B7	A	A	–						
B8	A	–							
B9	–								

5 Reachability Matrix

The SSIM format is transformed into the reachability matrix format by the following method:

- If the (a, b) relation in the SSIM is V, the (a, b) input is 1 and the (b, a) input is 0;
- If the (a, b) relation in the SSIM is A, the (a, b) input is 0 and the (b, a) input is 1;
- If the (a, b) relation in the SSIM is X, the (a, b) input is 1 and the (b, a) input is also 1;
- If the (a, b) relation in the SSIM is O, the (a, b) input is 0 and the (b, a) input is also 0.

Based on the above procedure, the transitivity rule is applied to the initial reachability that is obtained from the SSIM and it is hence converted into the final reachability matrix. The final reachability matrix is as shown in Table 3.

6 Level Partitions

The formulation of the final reachability matrix enables the reachability and antecedent sets for each barrier to be found. The reachability set is found to consist of the barrier itself and the other barriers which it drives, whereas the antecedent set comprises of the barrier itself and the other barriers on which it depends. After that, the intersection of these sets is found. The top-level barrier in the hierarchy, for which the reachability and antecedent sets are the same, would not drive any other barrier above itself and is disassociated from the rest of the barriers. Then, the same process is repeated until the level of each barrier is found. These level partitions help in developing the complete model (Tables 4, 5, 6 and 7) [40, 41].

Table 3 Reachability matrix

	B1	B2	B3	B4	B5	B6	B7	B8	B9	SUM
B1	1	0	0	0	0	0	1	0	0	2
B2	1	1	0	0	1	1	1	1	0	6
B3	1	1	1	1	1	1	1	1	1	9
B4	1	1	1	1	1	1	1	1	1	9
B5	1	1	1	1	1	1	1	1	1	9
B6	0	0	0	0	0	1	0	0	0	1
B7	0	0	0	0	0	0	1	0	0	1
B8	1	1	1	1	1	1	1	1	1	9
B9	1	1	1	1	1	1	1	1	1	9
SUM	7	6	5	5	6	7	8	6	5	

Table 4 First-level iteration

	Reachability	Antecedent	Intersection	Level
*B*1	1,7	1,2,3,4,5,8,9	1	
*B*2	1,2,5,6,7,8	2,3,4,5,8,9	2,5,8	
*B*3	1,2,3,4,5,6,7,8,9	3,4,5,8,9	3,4,5,8,9	
*B*4	1,2,3,4,5,6,7,8,9	3,4,5,8,9	3,4,5,8,9	
*B*5	1,2,3,4,5,6,7,8,9	2,3,4,5,8,9	2,3,4,5,8,9	
*B*6	6	2,3,4,5,6,8,9	6	1
*B*7	7	1,2,3,4,5,7,8,9	7	1
*B*8	1,2,3,4,5,6,7,8,9	2,3,4,5,8,9	2,3,4,5,8,9	
*B*9	1,2,3,4,5,6,7,8,9	3,4,5,8,9	3,4,5,8,9	

Table 5 Second-level iteration

	Reachability	Antecedent	Intersection	Level
*B*1	1	1,2,3,4,5,8,9	1	2
*B*2	1,2,5,8	2,3,4,5,8,9	2,5,8	
*B*3	1,2,3,4,5,8,9	3,4,5,8,9	3,4,5,8,9	
*B*4	1,2,3,4,5,8,9	3,4,5,8,9	3,4,5,8,9	
*B*5	1,2,3,4,5,8,9	2,3,4,5,8,9	2,3,4,5,8,9	
*B*8	1,2,3,4,5,8,9	2,3,4,5,8,9	2,3,4,5,8,9	
*B*9	1,2,3,4,5,8,9	3,4,5,8,9	3,4,5,8,9	

Table 6 Third-level iteration

	Reachability	Antecedent	Intersection	Level
*B*2	2,5,8	2,3,4,5,8,9	2,5,8	3
*B*3	2,3,4,5,8,9	3,4,5,8,9	3,4,5,8,9	
*B*4	2,3,4,5,8,9	3,4,5,8,9	3,4,5,8,9	
*B*5	2,3,4,5,8,9	2,3,4,5,8,9	2,3,4,5,8,9	3
*B*8	2,3,4,5,8,9	2,3,4,5,8,9	2,3,4,5,8,9	3
*B*9	2,3,4,5,8,9	3,4,5,8,9	3,4,5,8,9	

Table 7 Fourth-level iteration

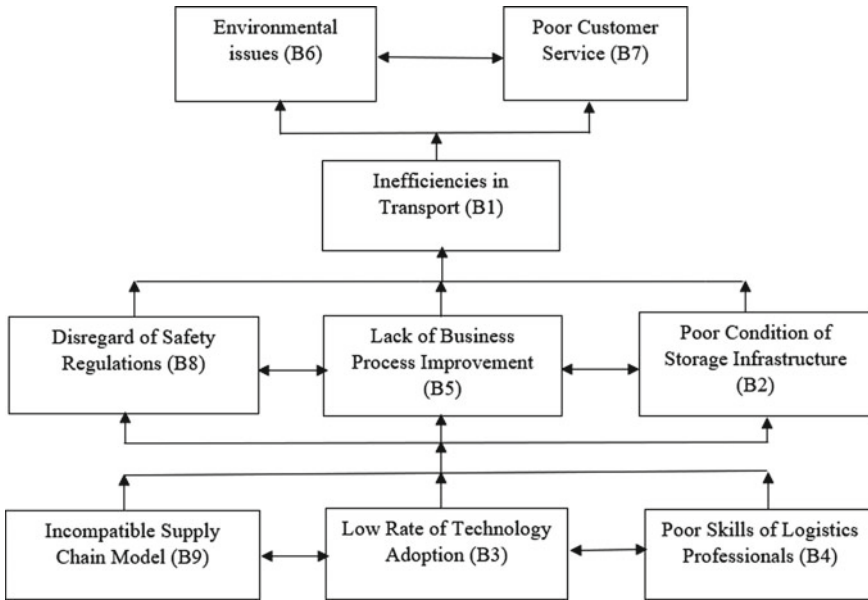|	Reachability	Antecedent	Intersection	Level
*B*3	3,4,9	3,4,9	3,4,9	4
*B*4	3,4,9	3,4,9	3,4,9	4
*B*9	3,4,9	3,4,9	3,4,9	4

Fig. 1 ISM model

7 Formation of ISM Model

This model represents the direct relationship among different barriers. It states that each barrier has its own importance at its own level as shown in Fig. 1.

The ISM model shows that Incompatible Supply Chain Model (B9), along with barriers Low Rate of Technology Adoption (B3) and Poor Skills of Logistics Professionals (B4), together interdependently acts as the base that enhances all the other barriers. Disregard of Safety Regulations (B8), Lack of Business Process Improvement (B5) and Poor Condition of Storage Infrastructure (B2) further exhibit internally interactive driving capacity towards Inefficiencies in Transport (B1). Environmental Issues (B6) and Poor Customer Service (B7) together show the maximum dependence on other aforementioned barriers. It shows that the root of the problems in the logistical setup in India lies in basic mistakes such as the selection of an incompetent and unfulfilling supply chain model and extends to a company's slow technology adoption pace and grassroots problems like poor skills of logistics professionals in the country.

8 MICMAC Analysis

The objective of the MICMAC analysis is to examine the driver power and the dependence power of the variables. The variables are classified into four clusters as given in Fig. 2.

The first cluster consists of the self-sufficient barriers that have weak driver power and weak dependence. These barriers are somewhat disconnected from the system. The second cluster is made up of the dependent barriers that have good dependence power but less driving power. The third cluster comprises of the linkage barriers that display both the characteristics of driving and dependence in a strong capacity. These barriers are unstable since any action on these barriers will affect all the barriers, including themselves, and cause instability in the system. The fourth cluster is made up of the independent barriers having high driving characteristics but weak dependence power [14, 15]. Variables with a strong driving influence are known as key variables and they are a part of the linkage barriers set [42]. Here, it is seen that Barriers 3, 4 and 9 (5,9) fall in the fourth cluster and show the strongest driving power. Barriers 5 and 8 coincide on (6,9) on the borderline between clusters three and four, exhibiting a stronger driving power than dependence. Barriers 1 (7,2); 6 (7,1) and 7 (8,1) are second cluster barriers that are heavier dependent than drivers whereas Barrier 2 (6,6) coincides with the intersection of the dependence power and driving power mean axes, showing moderate driving and dependence power.
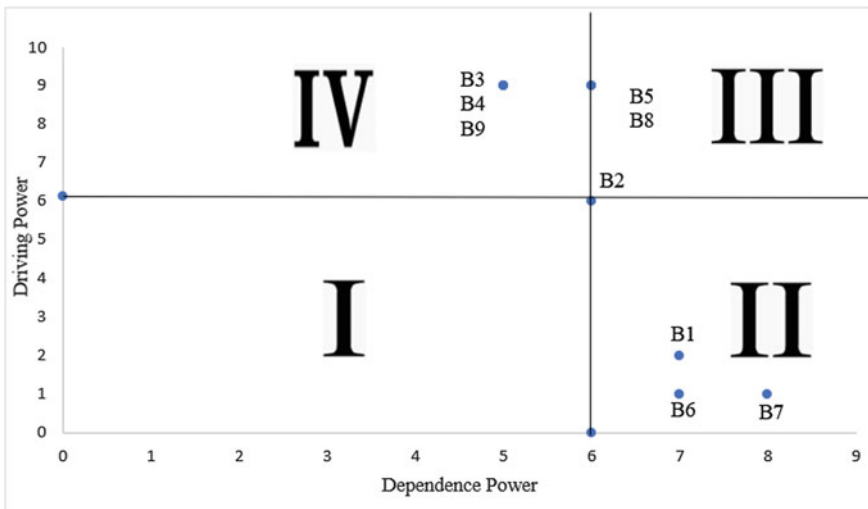

Fig. 2 MICMAC analysis

9   Conclusion

Logistics in India, going strictly by numbers, is on an upward trajectory. However, the ground reality of the same shows a rather negative outcome of the various governmental reforms like revamp of the tax structure with the introduction of GST. This is a cause of concern for MNCs operating in India since a negative logistical performance for especially E-commerce firms could prove to be detrimental to the company's image. The barriers highlighted in this work are, as agreed with industry experts, a broad aggregation of the problems faced by the companies operating in India. The highlighted barriers cover all domains, from grassroots problems like poor skills of professionals to company shortcomings like establishing an unsuitable supply chain model and operational roadblocks like lack of business process improvement. According to the ISM model that comes out of structural hierarchical analysis, Incompatible Supply Chain Model (B9), Low Rate of Technology Adoption (B3) and Poor Skills of Logistics Professionals (B4) are the interdependent base. The base drives the Level 2 barriers that are Disregard of Safety Regulations (B8), Lack of Business Process Improvement (B5), and Poor Condition of Storage Infrastructure (B2), which indicates that the problems faced by the MNCs are present at all levels from planning till execution of any company operation. Naturally, the implied Inefficiencies in Transport (B1) are driven by these core issues. The inefficiencies lead to components of customer service like last-mile distribution to be inadequate. Poor Customer Service (B7) and Environmental Issues (B6) are the barriers that are most dependent on the others, forming the head of the model. Collectively, these issues are the cause of misery for a large fraction of MNCs operating in India and with another wave of urbanization in full swing in the country, the ironing out of these barriers should be on the priority list for companies and the Indian authorities alike, to take business forward in the coming years.

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