

Interpretive Structural Modeling of Information Sharing Barriers in Indian Manufacturing Firms

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ABSTRACT

This paper highlights the barriers encountered mainly in Indian manufacturing industries during their information sharing in supply chain management. Here we have identified the barriers as well as modeled them for finding out the dependency power and driving power of all the barriers encountered in all types of manufacturing industries by using interpretive structural modeling (ISM) technique. Information sharing is the power of supply chain. Today's need is to make effective information sharing (IS) but the main difficulty occurs when a lot of barriers come into existence and there exists an ambiguity when it is not known which barriers to be eliminated or reduced first. This paper helps to identify and makes hierarchy of barriers according to their dependency and driving power.

Keywords: Information Sharing, Interpretive Structural Modelling, Barriers.

1. INTRODUCTION

Information sharing is the main strength of supply chain management. The explosion of information availability has given decision makers of supply chains a lot of possibilities and opportunities for improvements in their supply chain performance. As knowledge is power, information is power in supply chains. It provides the decision maker the power to get ahead of the competition, the power to run a business smoothly and efficiently, and the power to succeed in an ever more complex environment (Hyun-cheol Paul Choi and Fullerton C. A., 2010). The performance of a supply chain depends critically on how its members coordinate their decisions. Sharing information is the most basic form of coordination in supply chain. There are a number of new emerging technologies available to connect the members of a supply chain to support information sharing. But there are a lot of obstruction comes into the path of information sharing. So managers always try to eliminate or reduce the IS barriers from the supply chain, so that its wastage can be deducted. Thus level of barriers and their mutual rank helps to root-off the causes of barriers. Here we attempt to level the barriers according to their driving and dependency

power. Some issues such as inventory management, IT-enablement of supply chains, and buyer-supplier relationships are at the core of supply chain research (Sanjay Jharkharia and Ravi Shankar, 2004). Research has shown information technology to be an effective means of promoting collaboration between collections of firms, such as groups of suppliers and customers organized into networks. Moreover, information technology is touted as having a profound effect on collaborative relationships by facilitating cross-functional interactions between the supply chain partners. It eliminates the barriers between functional areas and among firms for a smooth information flow. It also facilitates the integration of suppliers into new product development and joint planning. Thus, Information technology has a positive impact on supplier integration (Injazz J. Chen and Antony Paulraj, 2006).

An integrated model of information sharing enablers has been developed which may be helpful to supply chain managers to employ this model in order to identify and classify the important criteria for their needs and to reveal the direct and indirect effects of each criterion on the trust building process in supply chain (Khurana et al., 2010). Here we attempt to level the barriers according to their driving and dependency power.

2. ISM (INTERPRETATIVE STRUCTURED MODELING)

It is generally felt that individuals or groups encounter difficulties in dealing with complex issues or systems. The complexity of the issues or systems is due to the presence of a large number of elements and interactions among these elements. The presence of directly or indirectly related elements complicates the structure of the system which may or may not be articulated in a clear fashion. It becomes difficult to deal with such a system in which the structure is not clearly defined (Raj T. et al., 2008).

ISM “is used here to refer to the systematic application of some elementary notions of graph theory in such a way that theoretical, conceptual, and computational leverage is exploited to efficiently construct a directed graph, or network representation, of the complex pattern of a contextual relationship among a set of elements.” (David W. Malone, 1975). The ISM technique helps prioritize the strategic issues in quality assessment qualitatively, so as to propose a hierarchical structure through prioritizing, sequencing and categorizing of ideas. The elements are classified as drivers, enablers and dependents and the hierarchically structured (Neena Sohani and Nagendra Sohani, 2011).

ISM is an interactive learning process. In this technique, a set of different directly and indirectly related elements are structured into a comprehensive systematic model. The model so formed portrays the structure of a complex issue or problem in a carefully designed pattern implying graphics as well as words. Interpretive structural modelling (ISM) is a well-established methodology for identifying relationships among specific items, which defines a problem or an issue. For any complex problem under consideration, a number of factors may be related to an issue or problem. However, the direct and indirect relationships between the factors describe the situation far more accurately than the individual factor taken into isolation. Therefore, ISM develops insights into collective understandings of these relationships. ISM starts with an identification of variables, which are relevant to the problem or issue, and then extends with group problem solving technique. Then a contextually relevant subordinate relation is chosen. Having decided on the element set and the contextual relation, a structural self-interaction matrix (SSIM) is developed based on pair-wise comparison of variables. In the next step, the SSIM is converted into a reach ability matrix (RM) and its transitivity is checked. Once transitivity embedding is complete, a matrix model is obtained. Then, the partitioning of the elements and an

extraction of the structural model called ISM is derived (Attri R. et al., 2013).

3. LITERATURE REVIEW

Sanjay Jharkharia and Ravi Shankar (2005) have identified that information technology is increasingly being used towards the effectiveness of supply chains and barriers influence one another and also adversely affect the IT-enablement of a supply chain, whereas A, Ramesh et al. (2010) show that there exists a group of barriers having a high-driving power and low dependence requiring maximum attention and of strategic importance.

Jitesh Thakkar et al. (2008) suggested that ISM delivers interrelationships among the factors which were utilized for deriving managerial insights. These factors are classified into four categories, namely, autonomous, driver, dependent, and linkage to understand their relative impact on the implementation of information technology in Indian SMEs.

Fawcett, S. E. and A. J. Williams (2003) have suggested that supply chain members should share information with open mind and put all of their cards on the table because mixture of trust requires open communication not just selective information exchange. Supply chain members should understand that all the information that affects competitiveness may be shared for efficient and effective supply chain. Free and open flow of information is essential for trust building and successful management of supply chain.

Christopher, M. (2000) has concluded that there is a high level of trust and commitment where information is transparent. The members of the supply chain share information only when they are confident that the information will be used appropriately by the other supply chain members. Information sharing in the supply chain includes the sharing of knowledge of the production status, process planning and goals of the companies among partners to serve customers effectively and efficiently. Cetindamar, D et al. (2005) have suggested that supply chain partners should share information not only on simple operational and financial data such as cost of goods, scheduling, etc., but they should also share strategic information such as forecasting, strategic goals, new product designs, etc. to maximize the potentials from the supply chain alliances. They have reported that establishment of efficient and effective communication mechanisms in supply chains facilitate sharing of information which in turn consequently build the trust and that leads to effective supply chain management.

Table 2: Reachability matrix

No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	DRP
1	1	0	1	1	0	1	0	1	1	0	0	0	1	0	1	8
2	1	1	1	1	0	1	0	1	1	0	1	0	1	0	1	10
3	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	3
4	0	0	0	1	0	1	0	0	1	0	0	0	0	0	1	4
5	1	0	1	1	1	1	0	0	0	0	0	0	1	0	1	7
6	0	1	1	0	0	1	0	0	1	1	0	0	0	1	0	6
7	0	0	0	1	0	1	1	1	0	0	0	1	1	1	0	7
8	0	1	1	0	0	1	0	1	0	0	1	1	1	1	1	9
9	0	0	1	1	0	0	1	1	1	0	1	1	1	1	1	10
10	1	0	1	1	0	1	0	0	0	1	1	1	1	1	1	10
11	0	0	1	1	0	1	1	1	1	0	1	1	1	1	1	11
12	0	1	1	1	1	1	0	0	0	0	0	1	0	0	1	7
13	0	0	1	1	0	0	0	0	1	0	0	1	1	1	1	7
14	0	0	0	1	0	1	0	0	0	1	0	0	0	1	1	5
15	0	0	1	1	0	1	0	0	0	0	0	1	1	0	1	6
DEP	4	5	12	12	2	13	3	6	7	3	5	8	10	8	12	

Based on contextual relationships, the SSIM is developed.

4.3 Reachability Matrix

The SSIM has been converted into a binary matrix, called the initial reachability matrix by substituting V, A, X and O by 1 and 0 as per the case given. The substitution of 1s and 0s are as per the following rules:

1. If the (i, j) entry in the SSIM is V, the (i, j) entry in the reachability matrix becomes 1 and the (j, i) entry becomes 0;
2. If the (i, j) entry in the SSIM is A, the (i, j) entry in the reachability matrix becomes 0 and the (j, i) entry becomes 1;
3. If the (i, j) entry in the SSIM is X, the (i, j) entry in the reachability matrix becomes 1 and the (j, i) entry also becomes 1; and
4. If the (i, j) entry in the SSIM is O, the (i, j) entry in the reachability matrix becomes 0 and the (j, i) entry also becomes 0.

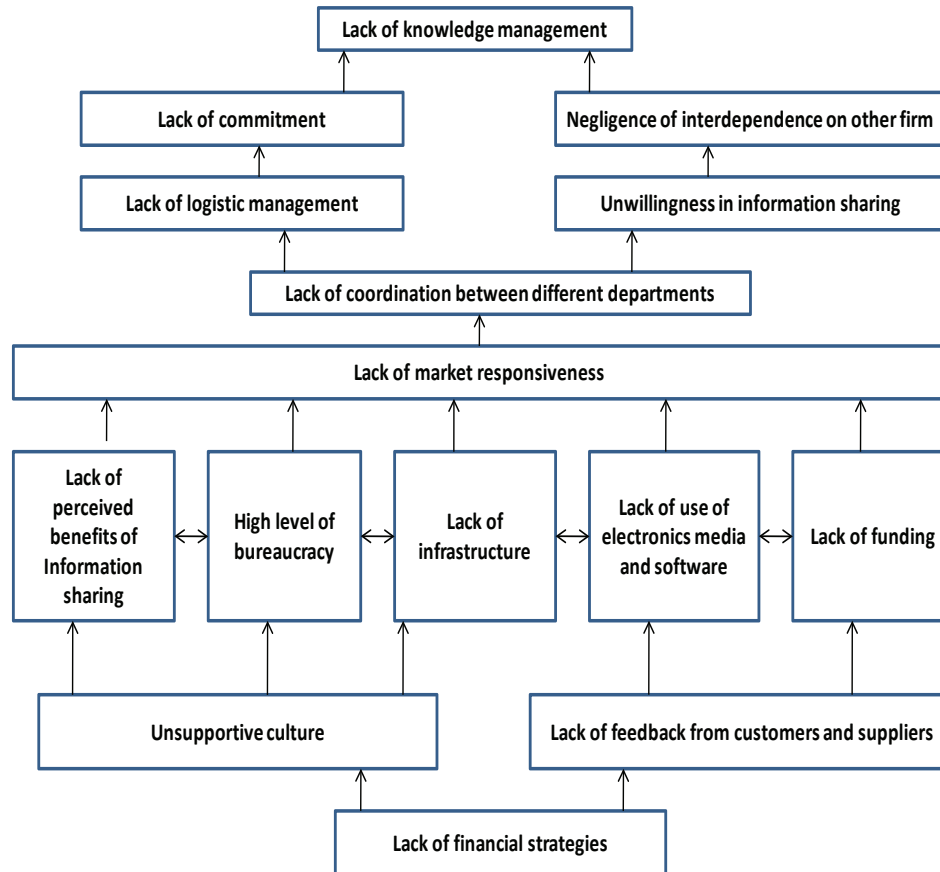
Final reachability matrix will be prepared after checking for transitivity, the driving power, and the dependence of each ISB. The driving power for each ISB is the total

number of ISBs (including itself), which it may help achieve is the total number of ISBs (including itself), which may help achieving it. (DEP = Dependence power, DRP = Driving power and 1* entries are included to incorporate transitivity to fill the gap if any in the opinion collected during development of (SSIM).

4.4 Level of Partitions of Barriers, Diagraph and ISM Model

From the reachability matrix, the reachability and antecedent set for each ISB are found. The reachability set consists of the element itself and the other elements which it may help achieve, whereas the antecedent set consists of the element itself and the other elements which may help in achieving it. Thereafter, the intersection of these sets is derived for all the ISBs. The ISBs for whom the reachability and the intersection sets are the same occupy the top level in the ISM hierarchy. The top-level element in the hierarchy would not help achieve any other element above its own level. Once the top-level element is identified, it is separated out from the other elements. Then, the same process is repeated to find out the elements in the next level. This process is continued until the level of each element is found. These levels help in building the diagraph and the final model (Pujara, A. et al., 2011).

Figure 1: Final ISM Model



barriers whose dependence power is highest i.e. lack of knowledge management, mainly depend upon the managerial actions and decisions taken within the firm. Secondly the moderate barriers such as lack of funds, lack of perceived benefits of information sharing, lack of infrastructure, use of electronic media and software come in the category of technical and infrastructure barriers, which are also important in hindering the information sharing processes. So from our analysis, we should reduce or eliminate technical and infrastructure barriers first because the other root barriers that are lack of financial strategies, are inherent in nature, it can only be improved in the supply chain but can't be completely removed. So after that if we can remove/eliminate the technical and infrastructure barriers in the supply chain then the other barriers such as lack of knowledge management, lack of commitment, lack of logistics management etc. automatically weaken.

6. CONCLUSION

The conclusion that we have derived from the ISM model of the manufacturing and telecom firm is that financial strategies should be regularly improved as lack of financial strategies as highest driving power. Technical and infrastructure barriers should be removed as soon as possible during the supply chain in operation as they mainly depend upon the funding approved by the firm for information sharing in supply chain. Barriers with highest driving power as well as barriers with highest dependence power should require high management skills from the top management in order to attack on them. In this work the relationships among the barriers are not validated statically. Structured equation modeling (SEM) will also be referred to as a linear structural relationship approach, has the capability for testing the model statically.

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