Interpretive Structural Modeling based Integrated Model for 3PL adoption in Indian Industries

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Abstract- Third Party Logistics (3PL) is adopted by manufacturing organizations to improve their overall business performance. In recent years Indian manufacturing firms have shown faster rate of 3PL practice adoption. This paper identifies the variables that are critical to 3Pl adoption. The variables are grouped as objectives and drivers, organizational obstacles and benefits of adoption. The study establishes contextual relationship between the variables. This study implements an interpretive structural modeling approach to analyze the mutual relationship between variables. To understand the relative influence of the variable, they are classified into four categories namely autonomous, dependent, linkage and driver. The variables which are most influenced by other variables (dependent variables) and those variables which greatly influence other variables (driver variables) are found with the help of ISM. The aim of this paper is to understand these interrelationships and interdependence and develop a framework. Such a generic framework would provide an insight of important issues while adopting 3PL practices in the Indian context.

Keywords – Supply chain management, Third Party Logistics, Interpretive structural modeling, Indian manufacturing industries.

I. INTRODUCTION

A supply chain network of facilities distribution centers' that carry out the functions of procurement of materials, conversion of these materials into intermediate and finished goods and distribution of these goods to end users. In recent past, an increasing number of manufacturers have adopted the Supply Chain Management (SCM) concept in their day to day business activities. For them transportation and logistics have become as important as product manufacturing [51]. SCM involves management of all critical business processes across a number of supply chains. It is an integrated approach which is very complex, interactive and calls for concurrent viewing of many trade-offs. Implementation and operation of integrated supply chain need continuous flow of information which ultimately helps in creating best product flow [53]. Logistics function in manufacturing industries covers the activities of inventory management, processing of orders, warehousing, material handling and physical distribution. Logistical strategies, implementation related to transportation modes, warehousing inventory management and order processing aims at moving the right material to right place at right time and at right price across the supply chain. Currently many industries are showing interest in outsourcing the logistic function to Third Party Logistic (TPL) service providers [11]

3PL provider outsourcing, Third Party Logistic (TPL), contract Logistics and Logistic Service Provider (LSP) mean the same thing. Functions performed by 3PL providers include the complete logistic process or selected activities from amongst the process. In today's world of globalization, leading manufacturing firms are compelled to develop products designed for global market and source components globally [13]. Normally manufacturing firms start with outsourcing of few logistic services & then shift to activities which are critical for logistics performance and then increase the usage of 3PL services for activities showing quantifiable impact on overall business performance [15].

In the earlier study researches have focused on adoption of 3PL in Indian manufacturing industries. The adoption of 3PL in Indian industries is slowly but steadily growing and showing significant increase in 3Pl adoption across majority of logistics functions. For every manufacturing firm 3Pl adoption issues such as reasons and drivers of adoption, obstacles to adoption and benefits of adoption are extremely critical and important [49][39][28].

Authors have observed that exhaustive work is done on various aspects of 3PL globally and enough evidences are available in Indian context also. But there is a need for identification of mutual correlation between variables and develop in integrated model or framework for adoption of 3PL practices in Indian manufacturing industries. This paper studies the factors affecting 3PL adoption & discusses relationship between variables resulting into literature enrichment on 3PL adoption in Indian manufacturing industries. It attempts to design an integrated model involving mutually interacting variables using an interpretive structural modeling approach.

The remainder of the paper is organized as follows. Section 2 covers the literature review focusing on 3PL adoption issues mentioned earlier. Section 3 explains the interpretive structural modeling (ISM) methodology. Section 4 discusses the results and managerial implications. Finally in section 5 conclusions are drawn based on results and directions for future research are suggested.

II. Review of Literature

It is observed that many firms are adopting 3PL practices in India depending on their specific needs. The objective of this research is to design 3PL adoption integrated model. So elaborate literature was surveyed to identify reasons and drivers of 3PL adoption, organizational obstacles to 3PL adoption and benefits/outcomes of 3PL adoption. Based on the literature survey, 22 variables were selected for developing model. To validate the selection of variables, the opinion of experts from both the industry and academia as well as result of survey of selected Indian manufacturing industries using 3PL was considered.

A. Objectives and Drivers of 3PL adoption

Researchers have varied views regarding objectives and drivers. According to Boyson et al [9] the main objectives of 3PL adoption are cost saving, outsourcing non core business, re-engineering the supply chain and outsourcing the activities which are identified as problem areas for the company, while Fernie [18] believes that the primary reason of outsourcing by the industries include their objectives of becoming more cost efficient, to provide more flexible system, to allow financial resources to be concentrated on mainstream business. Van Loarhoven et al [59] found that cost reduction, service improvement, strategic flexibility, focus on core and change implementation are the motives behind 3PL adoption. McGinnes et al [36] explored the reasons of 3PL adoption by firms. Lower cost of logistics, minimization of labor problems, better flexibility in operations, better overall logistics service and nature of logistics service and nature of logistics being noncore activity were found to be main driver of 3PL adoption.

Van Damme et al [58] identified four categories of drivers of 3PL adoption such as economic viability, market issues, personnel/Equipment availability and extent of supplier dependence. Sahay and Ramneesh Mohan [49] explored the drivers/reasons of 3PL adoption, for Indian shippers. They include focus, core competence, logistics cost reduction, flexibility in operations, improved customer service, productivity improvement, access to emerging technology, access to unfamiliar market, improve return on assets and to increase inventory turnover.

Kwok Hung Lav et al [28] identified the drivers of outsourcing as cost reduction, capital investment (economic factors) acceleration of business process re-engineering, focus on core competence, flexibility enhancement (strategic factors), IT development, Globalisation, Capacity of supplier (Environmental factors). Thus it can be deduced on the basis of literature that following objectives and driver are very important and critical for 3PL adoption (Table 1)

Table 1- Objectives and Drivers of 3PL adoption

Serial No		References
1	Focus on core competencies	[49,60,51,19,3,9,59,36]
2	Logistics cost reduction	[9,18,59,60,51,19,3,49,36]
3	Improving flexibility in operations	[49,21,32,36,56,18]
4	Improve customer service	[23,45,29,36,50,21,49,18,59]
5	Productivity improvement	[40,18,10,49,61]
6	Access to emerging technologies	[45,58,41,54,60,19,3,49]
7	Capital investment reduction	[3,9,18,19,29,36,38,45,48,51,58]
8	Geographical Spread	[19,22,28,45,49,51,60]
9	Improvement in return on investment	[3,9,14,28,34,47,49,51,57]

B. Organizational obstacles

Researchers agree that organizational obstacles, their type and intensity vary with type of industry and size of industry. Survey by P.E.International [38] found that poor exchange of information, insufficient controls, poorly specified contracts are the main obstacles in 3PL adoption. Boyson et al. [9] strongly feels that unclear estimation of internal cost is prime hurdle in 3PL adoption. Investigations by Ellram and Cooper [16] revealed that loss of control over logistics function and loss of in-house capability and customer contact are major hurdles in adoption of 3PL by shippers. Whereas lack of responsiveness to customer needs is also identified as obstacle to 3PL adoption by Van Damme et al [58]. Van Laarhoven [59] observed that sometimes LSP's insufficient IT capabilities act as a hurdle in 3PL adoption. Beaumont and Sohal [5] found that loss of flexibility and loss of critical skills act as barriers to 3PL adoption whereas according to Razzaque and Sheng [47], difficulty in obtaining organizational support and fear of job loss prove obstacles in 3PL adoption. Jennings [24] observed that inadequate capabilities of service providers and loss of critical skills become major obstacles in 3PL adoption. Kwok Hung Lau et al. [28] found that major stumbling blocks in 3Pl adoption are lack of capable service providers, loss of control, poor IT infrastructure and lack of overall post outsourcing measurements. Lankford and Parsa [31] identified indecisiveness on which activities to outsource as main obstacle whereas Mclvor [37] found inadequate cost and benefit analysis system as an obstacle in 3PL adoption. Hence depending on type and size of industries, following organizational obstacles need to be understood and overcome (Table 2).

Table 2- Organizational obstacles to 3PL adoption

Serial No	Organizational obstacles to 3PL adoption	References
1	Loss of control over Business Process	[6,12,25,28,31,34,47]
2	Inadequate capability of LSP's	[1,16,20,24,27,28,47,52,55]
3	Indecision on activity to outsource	[9,28,31,38,61]
4	Fear of job loss	[17,28,47]
5	Inadequate cost and benefit analysis	[9,28,37,38,61]
6	Fear of loss critical skills	[5,24,28,43]
7	Difficulty in obtaining organizational support	[8,15,17,28,47,49]

C. Benefits of 3PL adoption

Researches explored the outcomes and benefits of 3PL adoption in the light of basic objectives of 3PL adoption and the organizational obstacles to its adoption. Foster and Muller [19] identified major benefits of 3PL adoption as reduction in capital investment in equipment and reduction in manpower cost. Whereas Richardson [48] claimed that improvement in inventory turnover rate and improvement in on time delivery are the positive outcomes of 3PL adoption. Bradley P. [10] observed that productivity improvement is the most welcome benefit of 3PL adoption. Sahay et al [49] observed strong positive impact on logistics system performance, customer satisfaction and employee morale due to 3PL adoption.

Langley et al [30] claimed that overall logistic efficiency, custom built solution and extended global reach are the direct benefits of 3PL adoption. Patricija Bajec [39] found that low cost, improved customer service, inventory reduction and reduced management time and efforts are the positive outcomes of 3PL adoption. Sahay et al [27] observed that 3PL adoption enables a firm to focus more on core business and achieve extended geographic reach. Wilding et al [61] observed that 3PL adoption has direct bearing on logistical cost reduction and benefit of getting expertise of 3PL providers for better logistical efficiency. Thus following benefits can be realized by adopting 3PL practices by manufacturing firms (Table 3).

Table 3- Benefits of 3PL adoption

Serial No	Benefits of 3PL adoption	References
1	Overall Logistics efficiency/Low cost	[9,30,39,59,61]
2	Custom built solution/Improved customer service	[4,30,27,39,58]
3	Inventory reduction	[18,30,39,48,49,60,61]
4	Reduced management time & effort	[30,39,48,49,59,61]
5	Extended global reach	[4,27,30,39,49]
6	Enable company to focus more on core business	[27,30,39,49,52]

For developing framework we have selected Interpretive Structural Modeling (ISM) because it allows developing hierarchical structure of elements and helps in studying relationships between variables and their classification. But this tool also has a limitation. If the direction of relationship goes wrong, the structural self interaction matrix & diagraph goes wrong

III. INTERPRETIVE STRUCTURAL MODELING (ISM)

To accomplish research goal, interpretive structural modeling (ISM) developed by Warfield (1973) was employed. The method is interpretive as the opinion of group decide whether and how variables are related and it is structural as on the basis of relationship, an overall structure is extracted from the complex set of variables [44] Some of the applications of ISM methodology includes Total Predictive Maintenance (TPM) [2] analysis of vendor selection criteria [7][35], determination of key reverse logistics variables [46][2], to model key variables of logistics outsourcing [44]. As discussed in review of literature, authors have identified 22 variables related to 3PL adoption by Indian manufactures. The various steps involved in ISM technique are as follows [42]

1. Identification of elements, which are relevant to the problem or issues, this could be done by survey or any group problem solving technique.
2. Establishing a contextual relationship between elements with respect to which pairs of elements will be examined.
3. Developing a structural interactive matrix (SSIM) of elements, this indicates the pair wise relationship between elements of the system.
4. Developing a reachability matrix from the SSIM and checking the matrix for transitivity. Transitivity of the contextual relation is a basic assumption in ISM, which states that if an element A is related to B and B is related to C, then A is necessarily related to C.
5. Partitioning of Reachability matrix into different levels.
6. Based on the relationships given above in the reachability matrix, draw a directed graph and remove transitive links.
7. Convert the resultant diagraph into an ISM based model by replacing element nodes with statements.
8. Review the ISM model to check for conceptual inconsistency and make the necessary modifications.

The various steps which lead to the development of an ISM model are illustrated below.

A. Structural Self Interaction Matrix (SSIM)

For analyzing the 3PL adoption variables in developing an SSIM, following four symbols have been used to denote the direction of relationship between the variables

V Variable i will help to achieve variable j
A Variable j will help to achieve variable i
X Variable i and j will help to achieve each other
O Variable i and j are unrelated

Based on contextual relationships, the Structural Self Interaction Matrix for Objectives and Drivers, organizational obstacles and benefits is developed as shown in Tables 4,5,6

Table 4. SSIM for Objectives and Drivers of 3PL adoptions

Variable No.	Criteria	OBJ9	OBJ8	OBJ7	OBJ6	OBJ5	OBJ4	OBJ3	OBJ2
1	OBJ1	V	V	V	X	V	V	V	V
2	OBJ2	V	A	V	A	X	A	A	
3	OBJ3	V	X	V	A	V	V		
4	OBJ4	V	A	V	A	X			
5	OBJ5	V	A	V	A				
6	OBJ6	V	V	V					
7	OBJ7	V	A						
8	OBJ8	V							
9	OBJ9								

Table 5 SSIM for obstacles to 3PL adoption

Variable	Variable	OBT7	OBT6	OBT5	OBT4	OBT3	OBT2
1	OBT1	A	A	A	A	A	A
2	OBT2	V	A	A	O	O	
3	OBT3	V	A	A	A		
4	OBT4	V	X	A			
5	OBT5	V	V				
6	OBT6	V					

Table 6 SSIM for Benefits of 3PL adoption

Variable No	Criteria	BFT6	BFT5	BFT4	BFT3	BFT2
1	BFT1	V	V	V	V	V
2	BFT2	V	V	V	V	
3	BFT3	V	O	V		
4	BFT4	V	V			
5	BFT5	V				
6	BFT6					

B. Reachability Matrix

The SSIM has been converted into a binary matrix called the initial reachability matrix by substituting V, A, X, and O by 0 and 1 as per the case. The substitutions 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 becomes 1
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 becomes 0.
As there is no transitivity in this case so initial reachability matrix (Table 7, 8, 9) will be used for further calculations.

Table 7. Initial Reachability matrix for Objectives and Drivers of 3PL adoptions

Variable No.	Variable	OBJ9	OBJ8	OBJ7	OBJ6	OBJ5	OBJ4	OBJ3	OBJ2	OBJ1	Driving Power
1	OBJ1	1	1	1	1	1	1	1	1	1	9
2	OBJ2	1	0	1	0	1	0	0	1	0	4
3	OBJ3	1	1	1	0	1	1	1	1	0	7
4	OBJ4	1	0	1	0	1	1	0	1	0	5
5	OBJ5	1	0	1	0	1	1	0	1	0	5
6	OBJ6	1	1	1	1	1	1	1	1	1	9
7	OBJ7	1	0	1	0	0	0	0	0	0	2
8	OBJ8	1	1	1	0	1	1	1	1	0	7
9	OBJ9	1	0	0	0	0	0	0	0	0	1
Dependence power		9	4	7	2	7	6	4	6	2	

Table 8. Initial Reachability matrix for Organizational obstacles

Variable No.	Variable	OBT7	OBT6	OBT5	OBT4	OBT3	OBT2	OBT1	Driving Power
1	OBT1	0	0	0	0	0	0	1	1
2	OBT2	1	0	0	0	0	1	1	3
3	OBT3	1	0	0	0	1	0	1	3
4	OBT4	1	1	0	1	1	1	1	6
5	OBT5	1	1	1	1	1	1	1	7
6	OBT6	1	1	0	1	1	1	1	6
7	OBT7	1	0	0	0	0	0	1	2
Dependence power		6	3	1	3	4	4	7	

Table 9. Initial reachability matrix for benefits of adoption of 3PL

Variable No	Variable	BFT6	BFT5	BFT4	BFT3	BFT2	BFT1	Driving Power
1	BFT1	1	1	1	1	1	1	6
2	BFT2	1	1	1	1	1	0	5
3	BFT3	1	0	1	1	0	0	3
4	BFT4	1	1	1	0	0	0	3
5	BFT5	1	1	0	0	0	0	2
6	BFT6	1	0	0	0	0	0	1
Dependence		6	4	4	3	2	1	

Driving power and dependence of each variable are shown in Table 7,8, and 9. The driving power for each variable is the total number of variables (including itself), which it may help achieve. Dependence power is the total number of variables (including itself), which may help achieve it. These driving power and dependencies will be later used in the classification of variables into four groups of autonomous, dependent, linkage and independent variables.

C. Level Partitions

From the final reachability matrix, the reachability and antecedent set for each variable is obtained. The reachability set consists of the variable itself and the other elements which it may help achieve, whereas the antecedent set consists of the elements itself and the other elements that may help in achieving it. Thereafter the intersection of these sets is derived for all the variables. The variables for which the reachability and intersection set are same occupy the top level in the ISM hierarchy. Top level element in the hierarchy would not help achieve any other element above its own level. Once top level element is identified it is separated out from the other elements (as shown in the initial iteration of Tables 10,11and 12). 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 (as shown in the final iteration of Tables 10,11 and 12).

Table 10. Artition of Reachability matrix for Objectives and Drivers

Variable	Reachability set	Antecedent set	Interaction set	Level
First Iteration				
OBJ1	**1,3,4,5,9**	**1**	**1**	
OBJ2	**2.5.7.9**	**2,3,4,5,6,8**	**2,5**	
OBJ3	**2,3,4,5,7,9**	**1,3,6**	**3**	
OBJ4	**1,4,5,7,9**	**1,3,4,5,6,8**	**1,4,5**	
OBJ5	**2,4,5,7,9**	**1,2,3,4,5,6,8**	**2,4,5**	
OBJ6	**2,3,4,5,6,7,8,9**	**6**	**6**	
OBJ7	**7,9**	**2,3,4,5,6,7,8**	**7**	
OBJ8	**2,4,5,7,8,9**	**6,8**	**8**	
OBJ9	**9**	**1,2,3,4,5,6,7,8,9**	**9**	**I**
Final Iteration				
OBJ7	**7**	**2,3,4,5,6,7,8**	**7**	**II**
OBJ2	**2,5**	**2,3,4,5,6,8**	**2,5**	**III**
OBJ4	**1,4,5**	**1,3,4,5,6,8**	**1,4,5**	**III**
OBJ5	**2,4,5**	**1,2,3,4,5,6,8**	**2,4,5**	**III**
OBJ3	**3**	**1,3,6**	**3**	**IV**
OBJ8	**8**	**6,8**	**8**	**IV**
OBJ1	**1**	**1,**	**1**	**V**
OBJ6	**6**	**6**	**6**	**V**

Table 11 Artition of reachability matrix for organizational Obstacles

Criteria	Reachability set	Antecedent set	Interaction set	Level
First Iteration				
OBT1	**1**	**1,2,4,5,6,7**	**1**	**I**
OBT2	**1,2,7**	**2,**	**2**	
OBT3	**3,7**	**3,4,5,6**	**3**	
OBT4	**1,3,4,6,7**	**4,5,6**	**4,6**	
OBT5	**1,3,4,5,6,7,**	**5,7**	**5,**	
OBT6	**1,3,4,6,7**	**4,5,6**	**4,6**	
OBT7	**1,5,7**	**2,3,4,5,6,7**	**5,7**	
Final Iteration				
OBT7	**5,7**	**2,3,4,5,6,7**	**5,7**	**II**
OBT2	**2**	**2**	**2**	**III**
OBT3	**3**	**3,4,5,6**	**3**	**III**
OBT4	**4,6**	**4,5,6**	**4,6**	**IV**
OBT6	**4,6**	**4,5,6**	**4,6**	**IV**
OBT5	**5**	**5,7**	**5**	**V**

Table 12 Artition of Reachability for Benefits of 3PL adoption

Variable	Reachability set	Antecedent set	Interaction set	Level
First Iteration				
BFT1	**1,2,3,4,5**	**1**	**1**	
BFT2	**2,3,4,5,6**	**1,2**	**2**	
BFT3	**3,4,5**	**1,2,3**	**3**	
BFT4	**4,5,6**	**1,2,3,4**	**4**	
BFT5	**1,5,6**	**1,2,4,5**	**1,5**	
BFT6	**5,6**	**2,3,4,5,6**	**5,6**	**I**
Final Iteration				
BFT5	**1,5**	**1,2,3,4**	**1,5**	**II**
BFT4	**4**	**1,2,3,4**	**4**	**III**
BFT3	**3**	**1,2,3**	**3**	**IV**
BFT2	**2**	**1,2**	**2**	**V**
BFT1	**1**	**1**	**1**	**VI**

These levels help in building the diagraph and the model. For our study, the variable at the highest level is found in the first iteration and then by adopting the process discussed above, the final artition of reachability is found for reasons and drivers, organizational obstacles and benefits (Table 10, 11 and 12). Lower Triangular matrix for Objectives and Drivers, Obstacles, Benefits are developed on the basis of level partitioning obtained in artition of reachability matrix (Table 13,14 and15) as shown below

Table 13 Lower triangular matrix for objectives and Drivers

Variable	OBJ9	OBJ7	OBJ2	OBJ4	OBJ5	OBJ3	OBJ8	OBJ1	OBJ6	Driving Power
OBJ9	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
OBJ7	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**
OBJ2	**1**	**1**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**4**
OBJ4	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**5**
OBJ5	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**5**
OBJ3	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**7**
OBJ8	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**7**
OBJ1	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**9**
OBJ6	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**9**
Dependence Power	**9**	**7**	**6**	**6**	**7**	**4**	**4**	**2**	**2**	

Table 14 Lower triangular matrix for obstacles

Variable	OBT1	OBT7	OBT2	OBT3	OBT4	OBT6	OBT5	Driving Power
OBT1	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
OBT7	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**2**
OBT2	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**3**
OBT3	**1**	**1**	**0**	**1**	**0**	**0**	**0**	**3**
OBT4	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**6**
OBT6	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**6**
OBT5	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**7**
Dependence Power	**7**	**6**	**4**	**4**	**3**	**3**	**1**	

Table 15 Lower triangular matrix for Benefits

Variable	BFT6	BFT5	BFT4	BFT3	BFT2	BFT1	Driving Power
BFT6	1	0	0	0	0	0	1
BFT5	1	1	0	0	0	0	2
BFT4	1	1	1	0	0	0	3
BFT3	1	0	1	1	0	0	3
BFT2	1	1	1	1	1	0	5
BFT1	1	1	1	1	1	1	6
Dependence Power	6	4	4	3	2	1	

D. Classification of Variables

All the variables have been classified based on their driving power and dependence power into four categories as autonomous, dependent, linkage and independent variables. The driving power and dependence power diagram for objectives and drivers for 3PL adoption is shown in Fig 1.

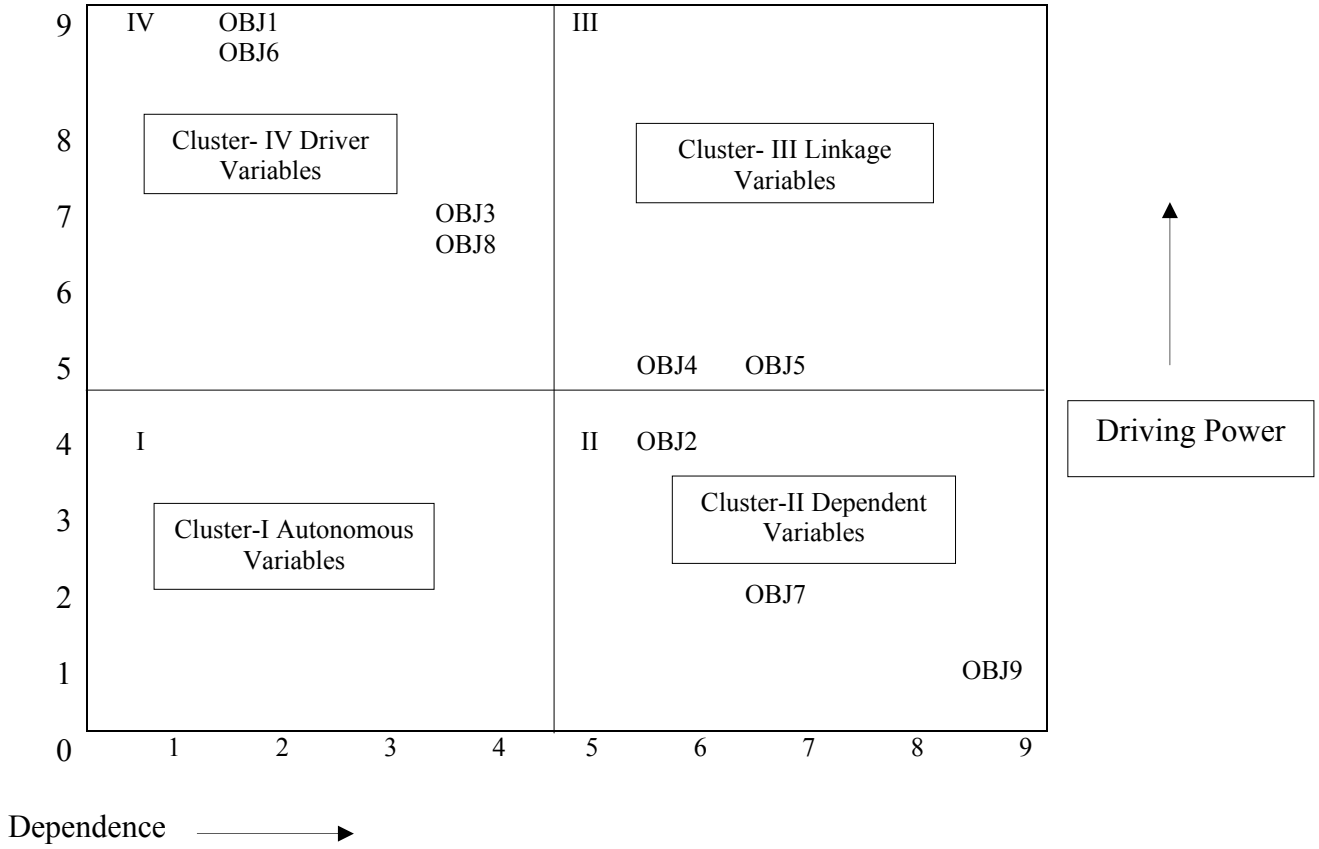

Figure 1. Figure 1 Driving Power and dependence diagram for Objectives and Drivers

The reason of 3PL adoption 'Improving flexibility in operation "RDR 3" has a driving power 6 and dependence power of 3 (see Table 7), hence it is kept at a position which corresponds to a driving power of 6 and dependence power of 3 as shown in fig 1. The driving power and dependence power diagram for 'organizational obstacles' and 'benefits' are shown in Fig.2 and Fig.3 respectively.

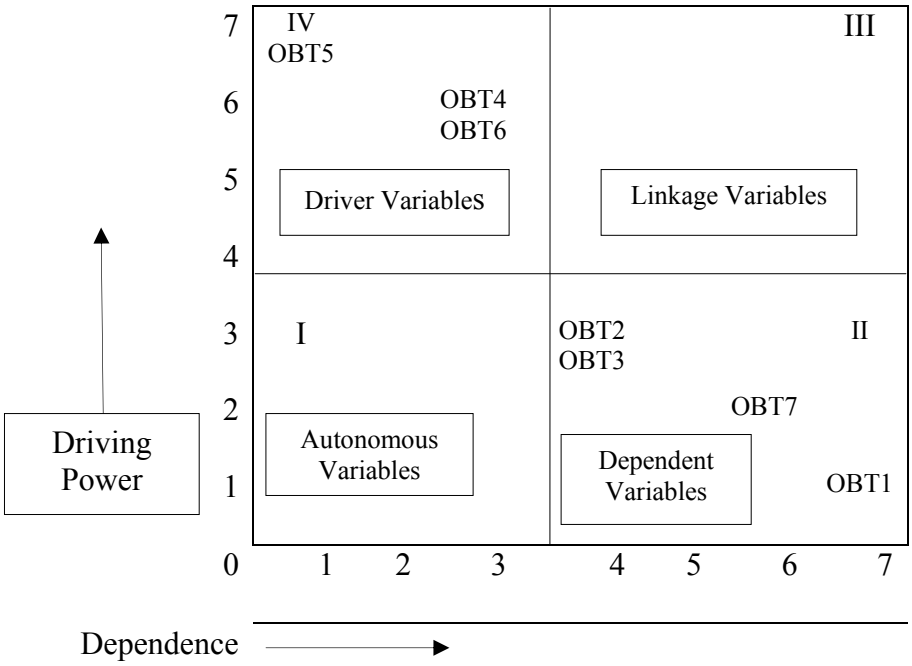

Figure 2. Driving Power and Dependence for organizational Obstacles

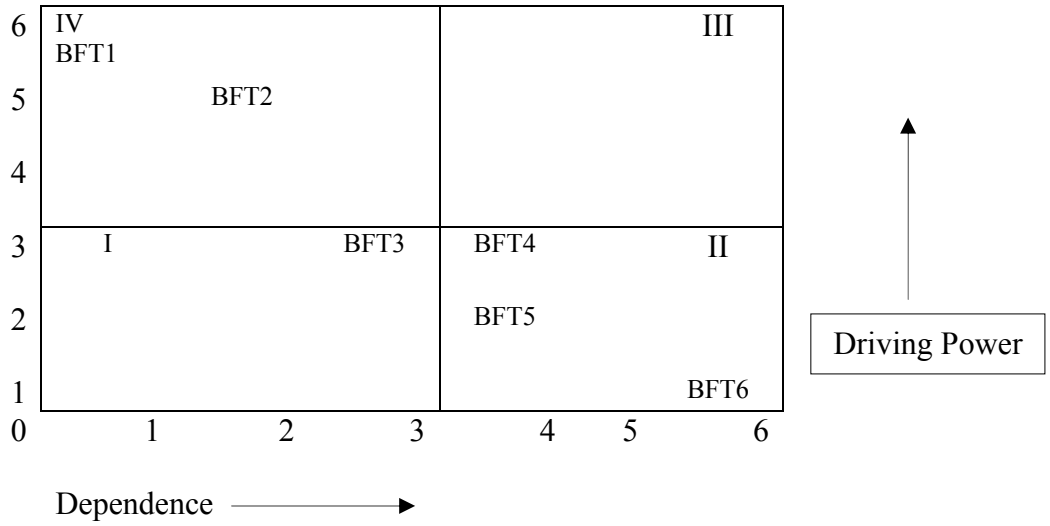

Figure 3. Drive Power and Dependence diagram for Benefits

The objective behind classification of variable is to analyze driving power and the dependence power of the variables. In this classification the first cluster is of 'autonomous variables' that have weak driving power and dependence power. These variables are relatively disconnected from the system. The second cluster consists of the dependent variables that have a weak driving power but the strong dependence. Third cluster includes the linkage variables that have strong driving power and strong dependence. Any action on these variables will have an effect on the others and the feedback effect on themselves. The fourth cluster includes independent variables with strong driving power and weak dependence. The classification of variables in our study after application of ISM technique is as follows:

Cluster 1: autonomous variable

BFT3

Inventory reduction

Cluster 2: dependent variable

OBJ2, OBJ7, OBJ9, OBT1, OBT2, OBT3, OBT7, BFT4, BFT5, BFT6

Logistics cost reduction, capital investment reduction, and improvement in return on assets, loss of control over business processes, inadequate capabilities of LSP's, Indecisiveness on activities to outsource difficulty in obtaining organizational support.

Cluster 3: Linkage variables

OBJ4, OBJ5

Improvement in customer service, productivity improvement

Cluster 4: Independent Variables

OBJ1, OBJ3, OBJ6, OBJ8, OBT4, OBT5, OBT6, BFT1, BFT2

Focus on core competencies, improvement flexibility in operations, access to emerging technologies, geographical spread, fear of job loss, inadequate cost and benefit analysis, Fear of loss of critical skills, overall logistic efficiency, custom built solutions.

3.5 Formation of ISM based Model

Using lower triangular matrix a structural model is developed by means of nodes and arrows. The variables connected by arrows shows the relationship between variables. If there is relationship between variables, if there is relationship between element i and j, this is shown by an arrow which points from i to j. This graph is called direct graph or diagraph. The diagraphs for objectives and drivers, organizational obstacles, benefits are shown in the Figure 4, Figure 5, Figure 6 respectively. Based on ISM methodology diagraphs are converted to ISM based framework for 3PL adoption (Figure 7)

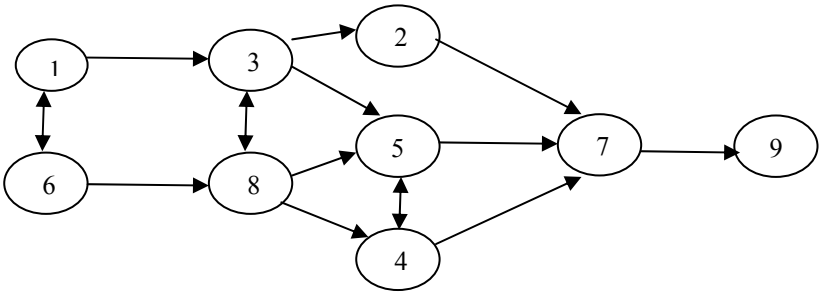

Figure 4. Digraph for Objectives and Drivers

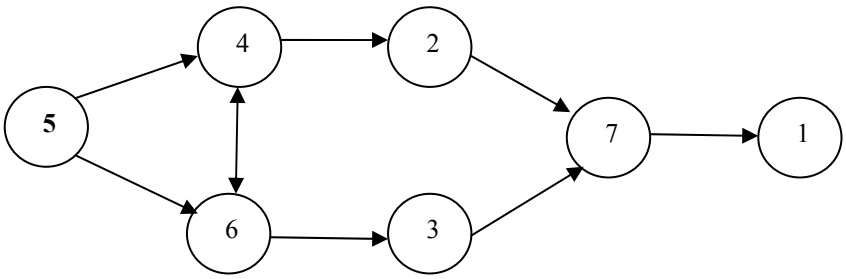

Figure 5. Digraph for Organizational Obstacles

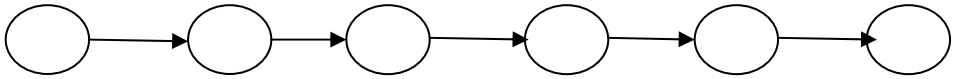

Figure 6. Digraph for Benefits

Table 10 shows that improvement in return on assets Is level 1 objective (OBJ9). Capital investment reduction is level 2 Objective (OBJ7). At level 3 objectives such as "logistics cost reduction (OBJ2), productivity improvement (OBJ5) and improving customer service (OBJ4) are kept. At level 4 objectives such as improving flexibility in operations (OBJ3) are placed. Finally at level 5, focus on core competencies (OBJ1) and access to emerging technology (OBJ6) are kept. All objectives are finally connected through arrows to show the hierarchy. So on the basis of results obtained through Table 10,11and 12 an ISM based framework for 3PL adoption is prepared as shown in figure 7.

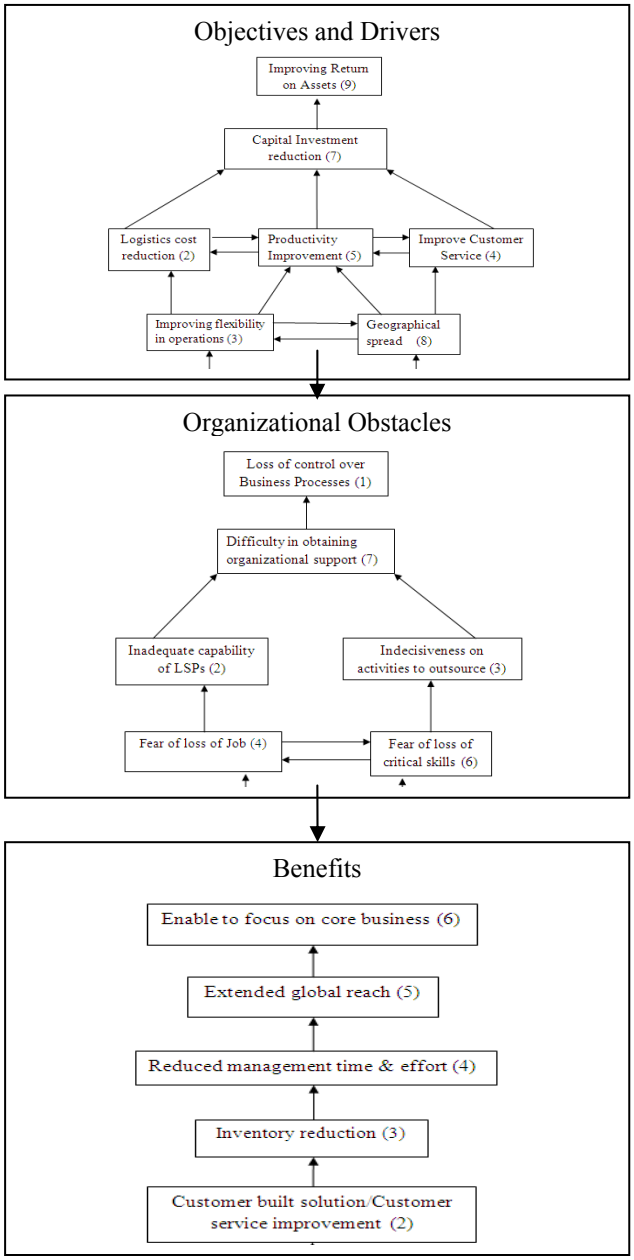

Figure 7. ISM based framework

IV. Discussion and Managerial Implications

It is found that for adoption of 3PL practices in Indian manufacturing industries some variables are more important than others. In present study, the variables selected were divided into three groups namely organizational objectives and drivers, obstacles and benefits of 3PL adoption. In order to have a common framework for 3PL adoption, an ISM model was developed. From figure 4 it is found that all the 22 variables are important for 3PL adoption although with varying intensity. By applying ISM, we found the level of variables in the hierarchy for objectives and drivers, organizational obstacles and benefits of adoption 3PL practices irrespective of type of industry. On the basis of driving power and dependence diagrams, 22 variables were grouped into four groups of variables.

The autonomous variables having weak driving power and weak dependence include only one benefit inventory reduction (BFT3) which does not drive any other variable. It has weak dependence so it may be treated as in control of the organization and require regular monitoring. This benefit may not be a direct outcome of adoption of 3PL.

The dependent variables with less driving power and high dependence include logistics cost reduction, capital cost reduction, improvement in return on assets (Objectives), loss of control over business processes, inadequate capabilities of LSP's, indecisiveness on activities to outsource, difficulty in obtaining organizational support (Organizational obstacles), reduced management time and effort, extended global reach, enable company to focus more on core business (Benefits). These variables take top position in ISM framework and are influenced by other variables so improper attention to them may lead to adverse effects on 3PL adoption. Hence manufacturing firms must understand how these variables get influenced by other variables.

The linkage variables having high driving power and high dependence include improvement in customer service and productivity improvement (Objectives). They occupy intermediate hierarchy in the ISM model and are placed between dependent and independent variables. These variables are vital because they strongly influence the adoption process but at the same time get influenced by other variables to a large extent. So they should be monitored critically by the organizations. Independent variables have high driving power and low dependence. They include focus on core competencies, improving flexibility in operations, access to emerging technologies, geographical spread (Objectives), fear of job loss, fear of loss of critical skills, inadequate cost and benefit analysis (Obstacles), overall logistics efficiency, custom built solutions (Benefits). As these variables possess strong driving power and influence all other variables so firms must give them high priority and understand the relevance of these variables. Independent variables require regular monitoring and review of their performance to initiate corrective actions at the right time.

As the ISM methodology is unique and generic in nature, the proposed framework is generic and not restricted to specific sector of manufacturing industries and/or geographical limits. The authors considered three groups of variables such as objectives and drivers, organizational obstacles and benefits of 3PL adoption by manufacturing industry. The hierarchy adopted in developing ISM framework shows that the objectives and drivers occupy top level , organizational obstacles is at middle level and benefits of adoption placed at bottom level. This type of ISM based framework was developed for Vendor Managed Inventory (VMI) adoption in Indian industries by Borade et al [7]. The logic for development of framework is a flowchart wherein objectives and drivers interact and overcome the organsational obstacles to ultimately achieve benefits of 3PL adoption.(Figure 4). The results of this study will prove helpful in identifying the important organizational obstacles is at middle level and benefits of adoption It will also act as a reference in prioritizing the variables and understanding contextual relationship between the number of variables or issues relating to 3PL adoption. ISM model developed in this study will assist managers to identify the hierarchical structure of 3PL adoption variables, their interrelationship and interdependence. This study will help in simplifying the complex judgments into logical components and assist us in analyzing priorities.

V. Conclusion

3PL practice adoption by manufacturing industries help in improving their business performance. This acceptance and adoption of 3PL practice is growing at a faster rate in India. Through literature survey and experts opinion objectives and drivers, organizational obstacles and benefits were found. After investigating contextual relationship between 3PL adoption variables an ISM framework was developed. From the study it is concluded that all 22 variables are important for 3PL adoption. It is found that most important objectives and drivers for 3PL adoption are focus on core competencies, access to emerging technologies, geographical spread and improving flexibility in operations. It is further concluded that the major organizational obstacles to 3PL adoption are inadequate cost and benefit analysis, fear of loss of job, and fear of loss of critical skills. Finally it is concluded that 3PL adoption will improve logistical efficiency and provide custom built solutions (Customer service improvement). Academicians and industry people could use results of this study for understanding 3PL practices adoption in Indian industry. In

this study 22 variables were identified and analyzed, however many more could be included to expand the canvas for developing a more broader and generic model

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