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MODELING THE ENABLERS OF QUICK RESPONSE IN SUPPLY CHAINS

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ABSTRACT

In today's competitive environment, markets are becoming more international, dynamic, and customer-driven. Customers are demanding more variety, better quality and service, including both reliability and faster delivery. Technological developments are occurring at a faster pace, resulting in new product innovations and improvements in manufacturing processes. The resulting competitive environment requires low cost, high quality products in increasing varieties. One of the key attributes of a successful player in today's highly competitive marketplace seems to be the ability to respond rapidly to end-customer demand .Quick Response refers fundamentally to speed-to-market of products which move rapidly through the production and delivery cycle, from raw materials and component suppliers, to manufacturer, to retailer and finally to end consumers. In the present paper, using interpretive structural modeling, interrelationships of the variables, influencing quick response, have been derived. These variables have been categorized according to their driving power and dependence. This methodology provides a means by which order can be imposed on the complexity of such variables. The insight from model would help supply chain managers in strategic planning for improving the quick response.

Keywords: *Quick response, Flexibility, Supply Chain, Textile Supply Chain.*

Introduction

The gap between demand for consumer goods and their efficient supply is greater now than at any other time, and is widening as consumers' wants become less predictable, and suppliers struggle to meet them. Quick Response (QR) refers fundamentally to speed-to-market of products which move rapidly through the production and delivery cycle, from raw materials and component suppliers, to manufacturer, to retailer and finally to end consumers. QR is both a management paradigm and a methodology that allows supply systems to react quickly to changes while improving their performance.

QR supply chains are those that are flexible enough to meet the demand of the changing customer markets. This need greater flexibility within supply chain and all its extensions. Many enablers support the quick response. Some of those variables that enable quick response are top management commitment, trust among supply chain partners. So managers in textile/apparel

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industry need to be equipped to identify, analyze and manage various enablers of quick response in the context of textile industry.

Interpretive structural modeling (ISM) can be used for identifying and summarizing relationships among specific variables, which define a problem or an issue (Warfield, 1974; Sage, 1977). The ISM methodology is an interactive learning process. In this, a systematic application of some elementary notions of graph theory is used in such a way that theoretical, conceptual and computational leverage are exploited to explain the complex pattern contextual relationship among a set of variables. It provides us a means by which order can be imposed on the complexity of such variables (Jharkharia and Shankar, 2004; Jharkharia and Shankar, 2005; Ravi and Shankar, 2005). Therefore in this paper, the enablers of quick response have been analyzed using ISM methodology, which shows the interrelationship of the enablers and their levels. These enablers are also categorized depending on their driving power and dependence.

The main objectives of this paper are to:

identify and rank variables of quick response in Indian apparel industry find out the interaction among identified variables and understand the managerial implications of this research

This paper is further organized as follows; the next section discusses the identification of some of the major variables for quick response in retail industry, which is followed by the discussion of ISM methodology. MICMAC analysis of developed ISM model is carried out subsequently to understand the driving power of their variables. Finally, the results of this research are presented, which is followed by discussions and conclusions.

Identification of Variables of Quick Response in Textile/Apparel Industry

In this model, there are ten important variables under the “enablers” and “results” categories. These have been derived from the literature and selected after a thorough discussion with experts from industry and academia. The industry experts are logistics heads of two reputed apparel company in India, procurement head of an apparel manufacturer and an apparel supplier redevelopment manager.

Alignment of Supply Chain Strategy with Business Strategy

Any company to be successful, its supply chain strategy and competitive strategy must fit together. That is there is a need for consistency between the customer priorities and the competitive strategy willing to fulfill and the supply chain capabilities that the supply chain strategy aims to build (Chopra and Meindl, 2005).

Risk and Reward Sharing

According to Mentzer et al. (2000), a key component of supply chain management is sharing risk and rewards between members of the supply chain. Spekman, Kamauff and Myhr (1998) argue that collaborating firms share benefits with their upstream and downstream partners in order to create competitive advantage. Sahay and Mani (2002) have emphasized the importance of risk sharing for collaborative relationships. In supply chain collaboration it is essential that channel participants share risks and rewards (Kaufman, Wood and Theyel, 2000; Kotabe, Martin and Domoto 2003).

Trust Among Supply Chain Partners

Supply chain management is built on a foundation of trust. The development of trust between the members of the supply chain was obviously a key success factor. Sohel (2001) argues that trust among supply partners is the one of the important enablers of quick response. Most

definition of trust involve a belief that one exchange partner will act in the best interest of the other partner and described as willingness to rely on an exchange partner in whom one has confidence. In management literature, there has been a noticeable increase in the importance of trust in different form of inter organizational relationship. Recent studies emphasis that need for trust between partners and it is considered an essential element of buyer-supplier relationship. Many researchers have studied how trust fosters greater cooperation, reduce functional conflict and enhance integration as well as decision-making under conditions of uncertainty and ambiguity.

Effective Information Systems

QR in total application involves on-line electronic communication of sales data from retailers to merchandise vendors, with the vendors promptly supplying retailers the merchandise needed to return the inventory in stores to levels previously determined cooperatively by the retailer and the vendor. In order to accomplish QR retailers must employ a variety of technologies. Electronic point of sale (EPoS), bar codes and radio frequency identification (RFID) and are classified as enabling quick response technologies (QRT).This exploratory study, based on a survey of fashion retailers trading in the UK, revealed that information technology is particularly important to the large, multiple "own brand" fashion retailers as it enables the various parties in the supply chain to communicate and to respond to demand. **(**Birtwistle et al. 2003.)

Supply Chain Collaboration

The importance of supply chain partnerships for Quick Response was established clearly by writers such as Blackburn (1991), Hunter (1994), Lowson (1995), Parker (1994), Pugh (1991) and Ward (1994). By the early 1990s, business communities realized the importance of creating an alliance with their upstream and downstream activities. Today many firms have taken bold steps to break down both inter- and intra-firm barriers to form alliances, with the objective of reducing uncertainty and enhancing control of supply and distribution channels for improving quick response.

Overall Supply Chain Flexibility

Fashion apparel products have great uncertainty of demand .Creating a responsive supply chain by means of supply chain flexibility is one method of avoiding uncertainty (Fisher, 1997). The operational definition of supply chain flexibility is "the ability of supply chain partners to restructure their operations, align their strategies, and share the responsibility to respond rapidly to customers' demand at each link of the chain, to produce a variety of products in the quantities, costs, and qualities that customers expect, while still maintaining high performance." Kumar et al.(2006). To achieve the level of flexibility that adds value to the customers, supply chain organizations must consider beyond manufacturing flexibility like product flexibility, sourcing flexibility, delivery flexibility and new product flexibility.

Quick Response

During the mid-1980s, quick response (QR) methods were developed in the USA between suppliers and fashion retailers in recognition that a new strategy had to be implemented to compete with off-shore manufacturers. A number of benefits result from implementing QR strategies. Previous research suggests that all or some of the following factors create not only financial benefits and competitive advantage to retailers but also provide some benefits to supply chain members (Giunipero *et al.*, 2001; Perry and Sohal, 2000): The benefits are shorter development cycle time, decreased lead time, reduced work-in-process, reduced inventory levels, improved productivity, lower costs, increased stock-turnover, reduced markdowns, improved flexibility to meet changing market demand, enhanced customer satisfaction and increased

loyalty, increased profits, Increased market share; and Increased return on assets.

Improved Customer Service

The adoption of QR makes it possible to achieve a considerable improvement in the level of service at the sales outlet (final customer in the chain) without compromising the variety of products offered. Forza and Vinelli, 1997). Additionally, customer service can be improved by sales staff being able to access information of where garments are in the supply chain and being able to process customer orders based on this information.

Competitive Advantages

The motive behind the adoption of quick response in textile supply chain arrangement is to increase supply chain competitive advantage. And to remain competitive, enterprises have to quick response strategy (Hunter et al. 1994).

Improved Value to Supply Chain Partners and Share Holder

The business benefits that stakeholders are able to get by embracing quick response include increased sales revenue and improved product offering. Some studies suggest that retail sales can be improved by up to 40 per cent where QR systems have been implemented between yarn, fabric and garment manufacturers as well as with the distribution companies (KSA, 1988). This is to a certain extent due to reduced stock-outs and increased stock turnover (Ko and Kincade, 1997) suggests that some progress has been made in providing customers with better choice, increased availability and lower prices while at the same time retailers have benefited from improved profitability (KSA, 1997).

Table 1: Enablers of Quick Response

Sl. No	Enablers
1	Business/Supply Strategy
2	Risk and Reward Sharing
3	Trust among Supply Chain Partners
4	Effective Information Systems
5	Supply Chain Collaboration
6	Overall Supply Chain Flexibility
7	Quick Response
8	Improved Customer Service
9	Competitive Advantages
10	Improved Value to Supply Chain Partners and Share Holder

ISM Methodology and Model Development

The Interpretive Structural Modeling (ISM) methodology is an interactive learning process. ISM is intended for use when desired to utilize systematic and logical thinking to approach a complex issue under consideration. It helps to impose order and direction on the complex relationship among elements of the system (Sage, 1977). The model so formed portrays the structure of a complex issue, a system of a field study, in a carefully designed pattern employing graphics as well as words. For complex problem like the one under consideration a number of enablers may be affecting the collaboration of supply chain partners. However, the direct and indirect relationship between the enablers describes the situation far more accurately than the individual factor taken in isolation.

The various steps involved in ISM methodology are as follows.

Step 1 : Variables affecting the system under consideration are listed, which can be Objectives, Actions, and Individuals etc.

Step 2 : From the variables identified in step 1, a contextual relationship is established among variables with respect to which pairs of variables would be examined.

Step 3 : A Structural Self-Interaction Matrix (SSIM) is developed for variables, which indicates pair wise relationships among variables of the system under consideration.

Step 4 : Reachability matrix is developed from the SSIM and the matrix is checked for transitivity. The transitivity of the contextual relation is a basic assumption made in ISM. It states that if a variable A is related to B and B is related to C, then A is necessarily related to C.

Step 5 : The reachability matrix obtained in Step 4 is partitioned into different levels.

Step 6 : Based on the relationships given above in the reach ability matrix, a directed graph is drawn and the transitive links are removed.

Step 7 : The resultant digraph is converted into an ISM, by replacing variable nodes with statements.

Step 8 : The ISM model developed in Step 7 is reviewed to check for conceptual inconsistency and necessary modifications are made.

Structural Self Interaction Matrix (SSIM)

ISM methodology suggests the use of the expert opinions based on various management techniques such as brain storming, nominal technique, etc. in developing the contextual relationship among the variables. Thus, in this research for identifying the contextual relationship among the enablers of collaboration in a supply chain two experts from academia with research interests in the area of retail industry and two supply chain managers working for retail industry were consulted for the same. For analyzing the enablers of the supply chain collaboration, a contextual relationship of "leads to" type is chosen. This means that one variable helps to ameliorate another variable. Based on this, contextual relationship between the variables is developed.

Keeping in mind the contextual relationship for each variable, the existence of a relation between any two enablers (i and j) and the associated direction of the relation is questioned. Four symbols are used to denote the direction of relationship between the enablers (i and j):

V : enabler i will ameliorate enabler j;

A : enabler j will be ameliorate enabler i;

X : enabler i and j will ameliorate each other; and

O : enablers i and j are unrelated.

The following would explain the use of the symbols V, A, X, and O in SSIM Table 2.

Table 2: A Structural Self-Interaction Matrix (SSIM)

Sl.no	Enablers	10	9	8	7	6	5	4	3	2
1	Alignment of Supply Strategy with Business Strategy.	V	V	V	V	V	V	V	V	V
2	Risk and Reward Sharing	V	V	V	V	V	V	X	X	
3	Trust among Supply Chain Partners	V	V	V	V	V	V	X		
4	Effective Information Systems	V	V	V	V	V	V			
5	Supply Chain Collaboration	V	V	V	V	X				
6	Overall Supply Chain Flexibility	V	V	V	V					
7	Quick Response	V	V	V						
8	Improved Customer Service	V	X							
9	Competitive Advantages	V								
10	Improved Value to Supply Chain Partners and Share Holder									

- Enabler 1 (Alignment of supply strategy with business strategy) would ameliorate enabler 9 (Competitive advantages). Alignment of supply chain strategy with business strategy would facilitate for competitive advantage over other supply chain and so the relationship is V (Table 2).
- If any enabler is ameliorated by any other enabler then relations is A.
- Enabler 4 (Effective information systems) and enabler 5 (Supply chain collaboration) ameliorate each other so the relationship is X (Table 2).
- If no relationship seems to exist between any enabler then the relationship is O.

Reachability Matrix

The SSIM is transformed into a binary matrix, called the reachability matrix by substituting V, A, X, O by 1 and 0 as per the case. The rules for the substitution of 1's and 0's are the following:

- if the (i, j) entry in the SSIM is V, then the (i, j) entry in the reachability matrix becomes 1 and the (j, i) entry becomes 0;
- if the (i, j) entry in the SSIM is A, then the (i, j) entry in the reachability matrix becomes 0 and the (j, i) entry becomes 1;
- if the (i, j) entry in the SSIM is X, then the (i, j) entry in the reachability matrix becomes 1 and the (j, i) entry also becomes 1; and

- if the (i, j) entry in the SSIM is O, then the (i, j) entry in the reachability matrix becomes 0 and the (j, i) entry also becomes 0.
- Following these rules, and after incorporating the transitivities the final reachability matrix is shown in Table 3.

Table 3: Dependjence and Driving power of Variables

Sl .No	Enablers	1	2	3	4	5	6	7	8	9	10	Driving Power	Rank
1	Alignment of Supply Chain Strategy with Business Strategy.	1	1	1	1	1	1	1	1	1	1	10	1
2	Risk and Reward sharing	0	1	1	1	1	1	1	1	1	1	9	2
3	Trust among Supply Chain Partners	0	1	1	1	1	1	1	1	1	1	9	2
4	Effective Information Systems	0	1	1	1	1	1	1	1	1	1	9	2
5	Supply Chain Collaboration	0	0	0	0	1	1	1	1	1	1	7	3
6	Overall Supply Chain Flexibility	0	0	0	0	1	1	1	1	1	1	7	3
7	Quick Response	0	0	0	0	0	0	1	1	1	1	5	4
8	Improved Customer Service	0	0	0	1	0	0	0	1	1	1	4	5
9	Competitive Advantages	0	0	0	1	0	0	0	1	1	1	4	5
10	Improved Value to Supply Chain Partners and Share Holder	0	0	0	0	0	0	0	0	0	1	1	6
	Dependence Power	1	4	4	6	6	7	7	9	9	10		
	Rank	6	5	5	4	4	3	3	2	2	1		

In Table 3, the driving power and the dependence of each enabler are also shown. The driving power for each enabler is the total number of enablers (including itself), which it may impact. Dependence is the total number of enablers (including itself), which may be impacting it. These driving power and dependencies will be used in the MICMAC analysis, where the enablers will be classified into four groups of autonomous, dependent, linkage, and independent (driver) enablers.

Level Partitions

From the final reachability matrix, the reachability and antecedent set (Warfield, 1974) for each enabler are found. The reachability set consists of the element itself and the other elements which it may impact, whereas the antecedent set consists of the element itself and the other elements which may impact it. Thereafter, the intersection of these sets is derived for all the enablers. The enablers 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 (Table 4). 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.

Results for iteration 1-6 are shown in Appendix 4 to 9. These levels help in building the digraph and the final model.

Table 4 : Iteration 1

Variable	Reach ability Set	Antecedent Set	Intersection Set	Level
1	1,2,3,4,5,6,7,8,9,10	1	1	
2	2,3,4,5,6,7,8,9,10	1,2,3,4	2,3,4	
3	2,4,5,6,7,8,9,10	1,2,3,4	2,3,4,	
4	2,3,4,5,6,7,8,9,10	1,2,3,4	2,3,4	
5	5,6,7,8,9,10	1,2,3,4,5,6	5,6	
6	5,6,7,8,9,10	1,2,3,4,5,6	5,6	
7	7,8,9,10	1,2,3,4,5,6,7	7	
8	4,8,9,10	1,2,3,4,5,6,7,8,9	4,8,9	
9	4,8,9,10	1,2,3,4,5,6,7,8,9	4,8,9	
10	10	1,2,3,4,5,6,7,8,9,10	10	Level 1

Table 5: Iteration 2

Variable	Reach ability Set	Antecedent Set	Intersection Set	Level
1	1,2,3,4,5,6,7,8,9	1	1	
2	2,3,4,5,6,7,8,9	1,2,3,4	2,3,4	
3	2,4,5,6,7,8,9	1,2,3,4	2,3,4	
4	2,3,4,5,6,7,8,9	1,2,3,4	2,3,4	
5	5,6,7,8,9	1,2,3,4,5,6	5,6	
6	5,6,7,8,9	1,2,3,4,5,6	5,6	
7	7,8,9	1,2,3,4,5,6,7	7	
8	4,8,9	1,2,3,4,5,6,7,8,9	4,8,9	Level 2
9	4,8,9	1,2,3,4,5,6,7,8,9	4,8,9	Level 2

Table 6 : Iteration 3

Variable	Reach ability Set	Antecedent Set	Intersection Set	Level
1	1,2,3,4,5,6,7	1	1	
2	2,3,4,5,6,7	1,2,3,4	2,3,4	
3	2,4,5,6,7	1,2,3,4	2,3,4	
4	2,3,4,5,6,7	1,2,3,4	2,3,4	
5	5,6,7	1,2,3,4,5,6	5,6	
6	5,6,7	1,2,3,4,5,6	5,6	
7	7	1,2,3,4,5,6,7	7	Level 3

Table 7: Iteration 4

Variable	Reach ability Set	Antecedent Set	Intersection Set	Level
1	1,2,3,4,5,6	1	1	
2	2,3,4,5,6	1,2,3,4	2,3,4	
3	2,4,5,6	1,2,3,4	2,3,4	
4	2,3,4,5,6	1,2,3,4	2,3,4	
5	5,6	1,2,3,4,5,6	5,6	Level 4
6	5,6	1,2,3,4,5,6	5,6	Level 4

Table 8: Iteration 5

Variable	Reach ability Set	Antecedent Set	Intersection Set	Level
1	1,2,3,4	1	1	
2	2,3,4	1,2,3,4	2,3,4	Level 5
3	2,4	1,2,3,4	2,4	Level 5
4	2,3,4	1,2,3,4	2,3,4	Level 5

Table 9: Iteration 6

Variable	Reach ability Set	Antecedent Set	Intersection Set	Level
1	1,2	1	1	Level 6

Building the ISM-based Model

From the final reachability matrix (Table 3), the structural model is generated by means of vertices or nodes and lines of edges. If there is a relationship between the enablers j and i this is shown by an arrow which points from i to j. This graph is called a directed graph or digraph. After removing the transitivities as described in ISM methodology, the digraph is finally converted into ISM as shown in Figure. 1

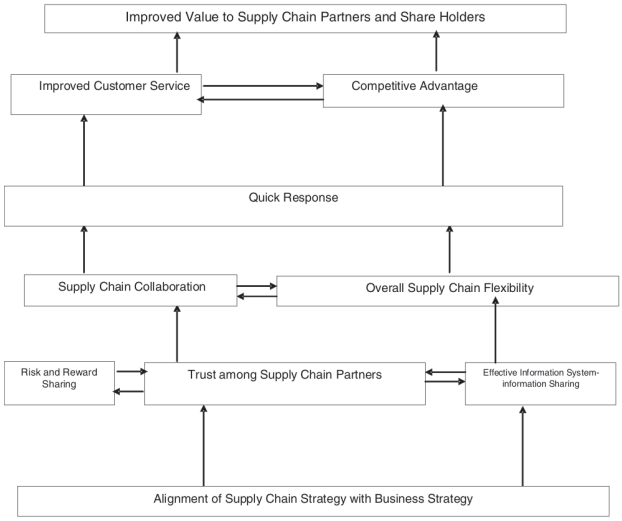

Figure 1: ISM Based Model for the Enablers of Quick Response in Supply Chain

From Figure 1, it is observed that alignment of supply chain Strategy with business strategy

(Variable 1) play significant driving role in quick response and it come at the base of ISM hierarchy. Once the alignment of supply chain strategy with business achieved by each partners in supply chain, they start to develop trust (variable 3) with each other. We are aware that trust is binding force for relationship and it is interrelated with sharing risk and reward sharing (variable 2) and information system (variable 4), which leads to supply chain collaboration (variable 5). Overall Supply chain flexibility achieved by trust, effective information system. Supply chain flexibility and collaboration results into quick response which helps to achieve improved customer service (variable 8), competitive advantage (variable 9.These above said two variables helps for achieving organization's primary goal of improved value to share holders and supply chain partners (variable 10).

MICMAC Analysis

The objective of the MICMAC analysis is to analyze the driver power and the dependence power of the variables (Mandal and Deshmukh, 1994). The variables are classified into four clusters (Figure 2).The first cluster consists of the "autonomous enablers" that have weak driver power and weak dependence. These enablers are relatively disconnected from the system, with which they have only few links, which may be strong. Second cluster consists of the dependent enablers that have weak driver power but strong dependence. Third cluster has the linkage enablers that have strong driving power and also strong dependence. These enablers are unstable

in the fact that any action on these enablers will have an effect on others and also a feedback on themselves.

Fourth cluster includes the independent enablers having strong driving power but weak dependence. It is observed that a variable with a very strong driving power called the key variables falls into the category of independent or linkage enablers. The driving power and the dependence of each of these enablers are shown in Table3. In this table, an entry of "1" along the columns and rows indicates the dependence and driving power, respectively. Subsequently, the driver power-dependence diagram is constructed which is shown in Figure 2. As an illustration, it is observed from Table 3 that enabler 7 is having a driver power of 5 and a dependence of 7. Therefore, in this figure, it is positioned at a place corresponding to a driver power of 4 and a dependency of 7.

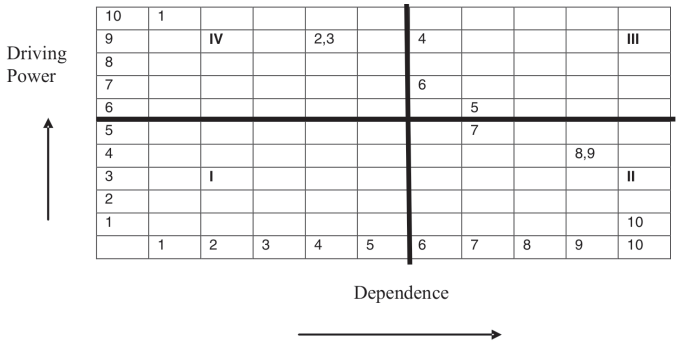

Figure 2: Driving Power- Dependence Diagram

Discussions and Conclusions

The objective of the ISM model in this research was to develop a hierarchy of variables that would help to improve the quick response in Indian textile/apparel industry. Successful companies of tomorrow will be those that respond to customer need more quickly. Apparel industries must therefore have the flexibility to respond quickly to changing consumer demands, having the desired product in store within weeks, sometimes days, before those demands change again, and more importantly, before the competition and also success of the company is underpinned by the over all supply chain flexibility. This flexibility can be achieved by if only the top management committed to adopt quick response strategies like sharing risk and reward, supply chain collaboration and effective information systems. Failure to react quickly enough to fashion demand can result in missing significant sales and/or demand may have abated by the time product reaches the store resulting in less time to make profit and a higher risk of obsolescence. Then the quick response leads to benefits like improved customer service and competitive advantage. These variables help for achieving organization's primary goal of improved value to share holders and supply chain partners.

The driver power-dependence matrix (Figure 2) gives some valuable insights about the relative importance and interdependencies among the supply chain collaboration variables. The managerial implications emerging from this study are as follows:

- There are no variables in the autonomous cluster (I), which indicates no variable can be considered as disconnected from the whole system and the management has to pay an attention to all the identified enablers of quick response.
- In the next cluster (II) we have dependant variables like quick response, competitive advantages, improved customer service and improved value to supply chain partners and

share holders those are weak drivers but strongly dependent on other variables. They are seen at the top of the ISM hierarchy (Figure 1). They represent those variables that are resultant actions for supply chain quick response strategies. Their strong dependence indicates that they require all the other enablers to come together so as to enable the quick response.

- The next cluster (III) consists of those variables that are termed as linkage variables that include supply chain collaboration, overall supply chain flexibility and effective information system which are, influenced by lower level variables and in turn impacts other variables in the model.
- The last cluster (IV) we have independent variables like alignment of supply chain strategy with business strategy , risk and reward sharing and trust among supply chain partners have high driving power but little dependence. These enablers play a key role to achieve supply chain quick response. Hence, managers have to give more attention to these variables, which form foundation of supply chain quick response in apparel industry.

Although in developing the model only a few apparel organization were considered but model can be generalized to other apparel organization also, because the overall environment setting in which the apparel supply chain operates are the same. But the model would require some modification as expert for other apparel organization may slightly differ in their opinion about the contextual relationship among the variables. A major contribution of this research lies in imposing direction to various enablers of supply chain quick response, which would help the decision makers to focus on these enablers in a hierarchical order.

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