

Impact of Supply Chains Agility on Customer Satisfaction

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Abstract— In a bid to cope with market instability, companies now look beyond cost advantage. Speed, quality and flexibility are being emphasized as means of responding to the unique needs of customers and markets. A supply chain adapts the changes if it is agile in nature. Agility is all about creating that responsiveness and mastering the uncertainty. The aim of this paper is to represent the effect of agility in supply chains on customer satisfaction. In this article interpretive structural modeling has been used to evolve relationships among variables. The study concludes with a discussion on these variables and the managerial implications.

Keywords- *Agility; Supply Chain; Interpretive Structural Modeling (ISM).*

I. INTRODUCTION

In markets it is becoming impossible to remove or ignore sources of turbulence and volatility. Hence, supply chain managers must accept uncertainty, but still need to develop a strategy that enables them to match supply and demand at an acceptable cost. The ability to achieve this has been termed supply chain agility.

In this paper, the factors of agile supply chain have been identified and interpretive structural modeling has been used to evolve relationships among variables. The aim of this paper is to understand the mutual influences so that those enablers which are at the root of few more variables (called driving variables) and those which are most influenced by others (called dependent variables) are identified.

II. FACTORS AFFECTING AGILITY IN SUPPLY CHAIN

The requirement for organizations to become more responsive to the needs of customers, the changing conditions of competition and increasing levels of environmental turbulence is driving interest in the concept of "agility". What it really means for an organization to be "agile", as opposed to just being efficient, effective, lean, customer-focused, able to add value, quality-driven, proactive rather than reactive, etc., has been the source of considerable debate and academic conjecture. The issues of leanness versus agility, as a business characteristic, have been argued to be two distinct concepts that should not be confused. Christopher [10] makes the point that some organizations that are lean in their operations are far from agile in their supply chain. The notion of agility is therefore recognized to be holistic rather than functional, and of strategic rather than tactical importance.

The factors under consideration in this study have been identified from literature review and questionnaire survey of the experts from industry and opinion from academia.

A. Organizational Integration and Willingness for Improvement

Organizations face a requirement to become more agile, the role and techniques of human resource management will also need to be reviewed. Lancioni [11] supports this view by highlighting the need for coordination within companies seeking to be more agile. He points at the fact that agility will largely be a function of the ability of disparate functions to cooperate by working as teams with common goals. Organizations have used many different methodologies to optimize the use of their resources e.g. radio frequency identification (RFID), smart card, electronic data interchange (EDI), enterprise resource planning (ERP) systems etc.

B. Outsourcing

To make the supply chain agile, companies need to focus on their core competencies, hence outsourcing plays an important role. The outsourcing of logistics activities to third-party logistics service providers (3PL) has now become a common practice. 3PL provide a wide range of benefits depending on the needs of the company. The advantages include lower costs, improved expertise, market knowledge, and data access. 3PL also improves operational efficiency, customer service, provides an ability to focus on core business objectives, and provides greater flexibility.

C. Collaborative Relationships

In order to manage effectively in a supply chain, organizations are moving to adopt closer relationships with key suppliers. This collaboration leads to a high degree of interdependence along the supply chain. Collaborative supply chain partnerships support the development of flexibility, responsiveness, and low-cost/low-volume manufacturing skills and also collaboration among organizations on the management of various supply chain activities can lead to a competitive advantage over other supply chains [6]. The importance of close supplier relations in striving toward an agile supply chain has also received considerable support in the literature. Arshinder et al. [5] reviewed various perspectives on SC coordination issues, understand and appreciate various mechanisms available for coordination.

D. Lead Time Reduction

Agile supply chain requires minimum total lead-times defined as the time taken from a customer raising a request for a product or service until it is delivered [10]. Lead time reduction within the supplier-production-distribution chain is the mechanism for time based competition. Management of lead time can be competitive advantage. Managing time may be the mirror image of managing quality, cost, innovation, and productivity. For reducing lead time it is essential to adopt Just in time philosophy and need of continuous improvement focus on issues i.e. flexible manufacturing cells (FMC) or flexible manufacturing systems (FMS), automation tools and efficient information technology tools.

E. Information Sharing and Trust

Mutual trust based information sharing between the partners is necessary not only for the continuance of the agreement but also for the continuous improvement of the service. Information sharing is crucial to successful partnerships. Unless the partner has complete information about a firm's business, it cannot work effectively toward achieving the company's goals. Trust is that intangible attitude that is widely recognized as a prerequisite to supply chain success. A framework presented by Agarwal and Shankar [1] is helpful in establishing trust-building environment among the supply chain members.

F. Flexibility in System

Flexibility is the ability of a manufacturing system to cope with changes in the nature, mix, volume or timing of its activities. Flexibility in operations and delivery may enable the user to give customized service to its customers, particularly in special or non-routine requests. Sanchez and Perez [4] found a positive relation between a superior performance in flexibility capabilities and firm performance, although flexibility dimensions are not equally important for firm performance. Voigt et al. [8] Shows that German OEMs, especially the premium OEMs overestimate the value of change flexibility and short delivery times for their customers.

G. Customer Sensitivity and Responsiveness

Customer sensitivity means that collaborative initiatives should be driven by quick response to customer requirements. High levels of logistics service have a significant impact on customer satisfaction. The primary relational requirement for improved responsiveness is the development of greater levels of trust between purchasing organizations and their suppliers. Storey et al. [7] suggested the barriers to customer responsive supply chain management.

H. Customer Satisfaction

Customer satisfaction is the customer's reaction to the value received from the purchase or utilization of the offering. Customer satisfaction represents the customer's reaction to his or her perception of the value received as a result of using a particular product or service. That reaction

will be influenced by the desired value (ideal standard) as well as by the perceived value of competitive offerings (industry norms, expectations based on use of competitor products). Thus customer satisfaction is influenced by the perception of the value delivered as well as by the perception of the value offered by competition. Today customers are from every corners of the world; the supply chain strategy should have focus towards satisfying the customers. Without satisfied customer, the whole exercise of applying the supply chain strategy could be costly and futile [2]. For improving performance, supply chain metrics must be linked to customer satisfaction.

I. Commitments by Top Management

Top management commitment is the dominant driver of corporate endeavors. Efficient leadership is needed to provide clear vision and value to supply chain. The top management should demonstrate commitment to the agile activities in supply chain on par with other organizational goals by integrating all the members of the supply chain. They should provide continuous support for agility in the strategic plans, action plans for successfully implementing them.

J. Cost and Quality of Service

Ellarm [9] suggests that the goal of SCM is to improve customer service at reduced overall cost. The SC must strive to manage costs associated with their products/service delivery system. The goal should be to increase customer satisfaction with lower supply chain cost. Management of worldwide business enterprises recognizes the requirement to improve product and service quality to succeed in the competitive marketplace. Involvement of supplier is critical to improve quality and meet customer specification. Organization concentrates on its core activities and thus may result in lower costs and better customer service, which leads agility in supply chain. However, to achieve this, one must have proper mechanisms to measure, monitor and control quality of service.

III. ISM METHODOLOGY AND MODEL DEVELOPMENT

Interpretive structural modeling (ISM) is an interactive learning process in which a set of different and directly related elements are structured into a comprehensive systemic model. The model so formed, portrays the structure of a complex issue or problem, a system or a field of study, in a carefully designed pattern implying graphics as well as words. ISM methodology helps to impose order and direction on the complexity of relationships among elements of a system. Various steps involved in ISM modeling are as follows.

- (1) Identifying of the variables that are relevant to the problem or issue.
- (2) Establishing the contextual relationship among variables.
- (3) Developing a structural self-interaction matrix (SSIM)

- (4) Developing a reachability matrix from the SSIM, and check the matrix for transitivity.
- (5) Partitioning the reachability matrix into different levels.
- (6) Based on the relationships in the reachability matrix, removal of the transitive links.
- (7) Constructing the ISM model by replacing element nodes with statements.
- (8) Review of the ISM model to check for conceptual inconsistency, and make the necessary modifications.

A. Structural Self-Interaction Matrix (SSIM)

ISM methodology suggests the use of the expert opinions based on various management techniques such as brain storming, nominal group technique etc in developing the contextual relationship among the variables. In this research, experts from the industry and academia were consulted in identifying the nature of contextual relationship among the variables of agility. In order to analyze the relationship among the agility variables, a contextual relationship of “lead to” type is chosen. Four symbols are used to denote the direction of relationship between the variables (i and j):

- V = Variable i will help achieve variable j;
- A = Variable j will be achieved by variable i;
- X = Variable i and j will help achieve each other; and
- O = Variables i and j are unrelated.

Based on the contextual relationships the SSIM is developed for the variables Identified to enable the agility shown in Table 1

B. Reachability Matrix

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

. 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 becomes 1.

. 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 becomes 0. Following these rules, initial reachability matrix for the agility variables identified is shown in Table 2. The final reachability matrix is obtained by incorporating the transivities of the ISM methodology.

C. Level Partitions

The reachability and antecedent set for each variable are obtained from final reachability matrix. The reachability set for a particular variable consists of the variable itself and the other variables, which it may help achieve. The antecedent

set consists of the variable itself and the other variables, which may help in achieving them. Subsequently, the intersection of these sets is derived for all variables. The variable for which the reachability and the intersection sets are the same is assigned as the top-level variable in the ISM hierarchy as it would not help achieve any other variable above their own level. After the identification of the top-level element, it is discarded from the list of remaining variables. From level partitioning, it is seen that the customer satisfaction (variable H) is found at level I. Thus, it would be positioned at the top of the ISM hierarchy. This iteration is repeated till the levels of each variable are found out. The identified levels aids in building the digraph and the final model of ISM.

D. Formation of ISM-Based Model

The structural model is generated from the final reachability matrix and the digraph is drawn. Removing the transivities as described in the ISM methodology, the digraph is finally converted into the ISM as shown in Fig.1. It is observed from this figure that organizational integration and willingness for improvement (variable A) is a very significant factor for the agility as it forms the base of the ISM hierarchy, which lead to commitment by top management (Variable I), and outsourcing (Variable B). Commitment by top management lead to collaborative relationship among supply chain partners (Variable C), outsourcing (Variable B). Collaborative relationship among supply chain partners lead to Information sharing and Trust (Variable E). Outsourcing and collaborative relationship leads to lead time reduction (Variable D). Information sharing and trust lead to flexibility in the system (Variable F). Flexibility in the system, and lead time reduction leads to cost and quality of service (Variable J), which lead to customer sensitivity and responsiveness (Variable G). Customer sensitivity and responsiveness lead to customer satisfaction (Variable H).

IV. MICMAC ANALYSIS

The objective of the MICMAC analysis is to analyze the driving power and the dependence of the variables [3]. In this analysis, the agility variables described earlier are classified into four clusters (Fig. 2). The first cluster consists of the “autonomous variables” that have weak driving power and weak dependence. These variables are relatively disconnected from the system, with which they have only few links, which may not be strong. The “dependent variables” constitute the second cluster which has weak driving power but strong dependence. Third cluster has the “linkage variables” that have strong driving power and strong dependence. These variables are unstable due to the fact that any change occurring to them will have an effect on others and also a feedback on themselves. Fourth cluster includes the “independent variables” having strong driving power but weak dependence.

V. DISCUSSION & SUMMARY

The driver power-dependence matrix (Fig. 2) indicates that outsourcing, lead time reduction, Information sharing and flexibility in system are autonomous variables of agility. These variables appear as weak driver as well as weak dependent and do not have much influence on the other variables of the system. Customer satisfaction, customer sensitivity and responsiveness and cost and quality of service are weak drivers but strongly dependent on other variables. They are also seen at the top of the ISM hierarchy (Fig. 1). These Variables represent the desired objectives of supply chain management. No variable is seen as a linkage variable that has a strong driving power as well as strong dependence. Thus, it can be inferred that among all the ten variables chosen in this study, no variable is unstable.

The driver power dependence diagram indicates that independent variables of agility such as organization integration and willingness for improvement, collaborative relationship among partners and commitment by top management are at the bottom of the model having greater driving power. Thus the management needs to address these variables more carefully in the supply chains. It can be seen that these variables help to achieve the desired result variables, which appear at the top of the ISM hierarchy.

REFERENCES

- [1] A. Agarwal, and R. Shankar , “On-line trust building in e-enabled supplies chain”, Supply Chain Management: An International Journal, Vol. 8 (4), 2003, pp. 324-334.
- [2] A. Gunasekaran, C. Patel, and E. Tirtiroglu, “Performance measures and metrics in a supply chain environment, International Journal of Operations and Production Management, Vol.21, 2001, pp.71-87.
- [3] A. Mandal, and S.G. Deshmukh, “Vendor selection using interpretive structural modeling (ISM), International Journal of Operations & Production Management, Vol. 14 (6), 1994, pp.52-59.
- [4] A.M. Sanchez, and M.P. Perez, “Supply chain flexibility and firm performance: A conceptual model and empirical study in the automotive industry”, International Journal of Operations and Production Management, Vol. 25 (7), 2005, pp.681 – 700.
- [5] Arshinder, A. Kanda, and S.G. Deshmukh, “Supply chain coordination: Perspectives, empirical studies and research directions”, International Journal of Production Economics, Vol. 115(2), 2008, pp.316-335.
- [6] J. Hoyt, J. and F. Huq, “From arms length to collaborative relationship in the supply chain”, International Journal of Physical Distribution & Logistics Management, Vol. 30 (9), 2000, pp.750-764.
- [7] J. Storey, C. Emberson, and D. Reade, “The barriers to customer responsive supply chain management”, International Journal of Operations and Production Management, Vol. 25, 2005, pp.242-260.
- [8] K.I.Voigt, M. Saatmann, and S. Schorr, “Flexibility and revenue management in the automotive industry”, Journal of Enterprise Information Management, Vol. 21 (4), 2008, pp. 424 – 439.
- [9] L.M. Ellram, “A managerial guide for the development and implementation of purchasing partnerships”, International Journal of purchasing and Materials Management, Vol. 27 (3),
- [10] M. Christopher, “The agile supply chain competing in volatile markets”, Industrial Marketing Management, Vol. 29 (1),2000, pp. 37-44.
- [11] R.A. Lancioni, (2000), “New developments in supply chain management for the millennium”, Industrial Marketing Management, Vol. 29 (1),2000, pp. 1-6.

TABLE I. STRUCTURAL SELF-INTERACTION MATRIX (SSIM)

Variables	J	I	H	G	F	E	D	C	B
A. Organizational Integration and willingness for improvement	V	V	V	V	V	V	V	V	V
B. Outsourcing	V	A	V	V	O	O	V	O	
C. Collaborative relationships	V	A	V	V	V	V	V		
D. Lead time reduction	V	O	V	V	O	O			
E. Information sharing and trust	V	A	V	V	V				
F. Flexibility in system	V	A	V	V					
G. Customer sensitivity and responsiveness	A	A	V						
H. Customer satisfaction	A	A							
I. Commitments by top management	V								
J. Cost and quality of service									

TABLE II. REACHABILITY MATRIX

Variables	A	B	C	D	E	F	G	H	I	J	Driving Power
A Organizational integration and willingness for improvement	1	1	1	1	1	1	1	1	1	1	10

B	Outsourcing	0	1	0	1	0	0	1	1	0	1	5
C	Collaborative relationships	0	0	1	1	1	1	1	1	0	1	7
D	Lead time reduction	0	0	0	1	0	0	1	1	0	1	4
E	Information sharing and trust	0	0	0	0	1	1	1	1	0	1	5
F	Flexibility in system	0	0	0	0	0	1	1	1	0	1	4
G	Customer sensitivity and responsiveness	0	0	0	0	0	0	1	1	0	0	2
H	Customer satisfaction	0	0	0	0	0	0	0	1	0	0	1
I	Commitments by top management	0	1	1	0	1	1	1	1	1	1	8
J	Cost and quality of service	0	0	0	0	0	0	1	1	0	1	3
	Dependence	1	3	3	4	4	5	9	10	2	8	

Driving Power

10
9
8
7
6
5
4
3
2
1

A												
	I	IV				III						
		C										
		B	E									
			D	F								
		I				II	J					
										G		
											H	

1 2 3 4 5 6 7 8 9 10

Dependence

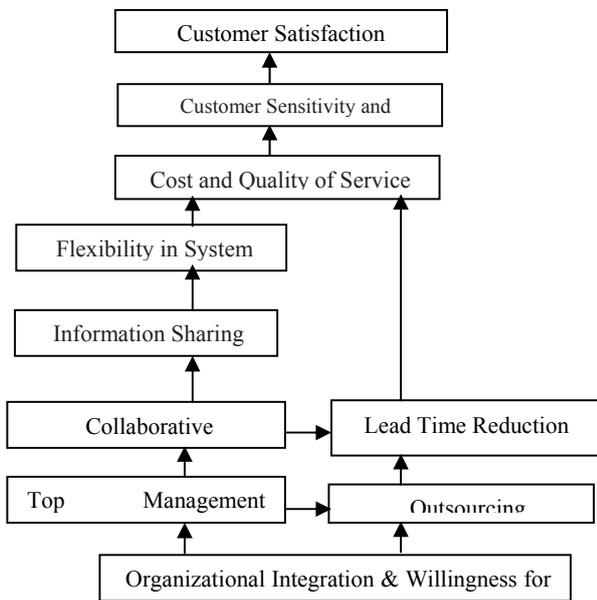


Figure 1. ISM Model of agility variables

Figure 2. Driving Power and Dependence Diagram