



IMPACT OF INFORMATION SHARING ON SUPPLY CHAIN MANAGEMENT: A STUDY OF INDIAN AUTO-COMPONENT MANUFACTURERS

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Abstract

Information sharing on supply chain management (SC) has become a potentially significant way of information sharing and improving organizational performance since competition is no longer between organizations, but among supply chains. This research conceptualizes and develops in two ways of SC practice and tests the relationships between extent of information sharing, and impact of information sharing strategies on SC performance. Data for the study were collected from 100 organizations and the relationships proposed in the framework were tested using structural equation modeling. The results indicate that higher levels of SC practice can lead to enhanced improved organizational performance.

Keywords: *Supply Chain Management; Managerial Implications; Original Equipment Manufacturers; Organizational growth; Structural Equation Modeling.*

Introduction

With the announcement of New Industrial Policy in July 1991 Indian automotive industry has grown with compounded annual growth rate of 15 percent per annum. Along with development of home grown Original Equipment Manufacturers (OEMs), world renowned companies like General Motors, Toyota, Honda, Mercedes, Ford and Volkswagen have also established their manufacturing plants in India. This has increased expectations from domestically located auto-component and ancillary manufacturers. Industry promotion agencies like Department of Heavy Industries, Ministry of Heavy Industries and Public Enterprise, Society for Indian Auto Component Manufacturers (SIAM) and Auto Component Manufacturer Association (ACMA) are facilitating opportunities and incentives for their growth. In view of this, factors affecting its sustainable development on a global canvas cannot be left unnoticed. Herein, Supply Chain (SC) management is ranked as a most vital challenge in development of this sector of economic significance (Gunasekaran and Ngai, 2004; NASSCOM, 2007¹).

The operations in automotive industry rely greatly on information shared between SC partners. Information if not shared on time becomes futile (Bowersox, Closs and Stank, 2000). Thus information sharing is widely observed tool for SC performance. Thus, the present study aims to establish the significance the information sharing in automotive component SC in Indian context. The two main research objectives are: a) prioritization of SC performance indicators which typically get influenced by extent of information sharing, and b) study of the impact of information sharing strategies on SC performance. Succeeding sections of the paper are organized as follows: Section 2 reviews the literature to identify existing research gap and to ascertain the relationship between information sharing and SC performance. Section 3 outlines the research methodology adopted to conduct the study. It explains the research instrument, data analysis technique and profile of respondents and responding firms. Section 4 discusses findings and managerial implications. Section 5 delineates the theoretical implications. Section 5 concludes the research while suggesting the future research direction.

Literature Review

Fierce competition due to globalization has enhanced business dependency. Success of an industry no longer depends on the performance of an individual organization. Firms operate in collaborative environment as SC member to influence the material flow (Bannett and O'Kane, 2006). Herein, information sharing about the various aspects of SC can lead to success (Handfield and Bechtel, 2002). Successful coordination among SC partners is needed to share information concerning status of production, delivery, inventory, R&D, and demand (Khurana et al. 2010). This ensures effective decision making for efficient utilization of resources.

Supply Chain Competitiveness Structure

Firms usually identify competitiveness as profit centric activity. Instead, competitiveness is attributed to a variety of costs distributed at each stage of business activity (Morgan, 2004). For manufacturing business sector like automotive, this comprises of administration cost, labor cost, manufacturing cost, facility cost, logistic cost, distribution cost and cost of inventory (Balakrishnan, et.al., 2007 Majumdar, 2010). Organizations can reduce such cost by assisting their suppliers (Naude and Badenhorst, 2011). Research done on Indian auto component industry delineate that cost estimation also depends upon qualitative parameters of performance. For example, quality management system, buyer/supplier relationship,



employees' skills and capabilities, well planned scheduling techniques, system flexibility and perfect sourcing and delivery decisions, which are information dependent (Zhao and White, 2010; Nayak and Ray, 2010; Joshi et al., 2013).

With increasing concern about frequently changing needs of buyers, flexibility has become critical issue in SC performance (Nayak and Ray, 2010). Series of studies have been carried out to highlight the influence of information sharing in SC flexibility (Chan and Chan, 2009). Few researches describe this as a mechanism to cope up with uncertainty (Stevenson and Spring, 2007). Another study consider it to determine the extent and rate with which firms adjust their SC speed and volume (Lumms, 2003). Such definitions broaden the organizational view of SC flexibility and can primarily be identified as volume flexibility, delivery flexibility, process flexibility and product flexibility (Pujawan, 2004; Joshi, et al., 2013). Certainly, it adds extra cost and efforts. But intelligent selection of buyer/supplier and lining each other's strategies according to changing business needs, makes a firm more responsive than its competitors.

Many researchers have realized the importance of time based competition in SC competitiveness. It can be achieved by proper information sharing (Naude and Badenhorst, 2011). Right information separates out non-value adding activities from value adding ones. Ultimately, it reduces the time taken in completion of value adding activities. Thus organization enhances flexibility; reduce cost, and on-time delivery. Research done by Tammela et al, in (2008) demonstrates that firms which are capable of keeping timely delivery system absorb a larger market/ profit share. Studies conducted in recent times have found synonymity between delivery decision and time-based competitiveness (Kaplan and Anderson, 2004; Sapkauskiene and Leitoniene, 2010). Any flaw in information sharing can disturb the response time thus influencing the productivity, inventory, overheads, and price premiums.

Literature indicates that during mid-1990s, quality was among the top priority for all production firms. With increasing customer expectations and influence of quality on sales performance and profitability, today it has become primary part of business activity. Earlier, due to tangibility of quality in form of product, was highly accepted (Narasimhan and Mendez, 2000). But the recent trends performance dynamics also depends on quality of information received by SC members (Li and Lin, 2006). Most recent studies conducted in this area recognized quality as the multi-functional attribute in SC performance. Adequacy, credibility of exchanged information, completeness, and timeliness are few of them (Holmberg, 2000). Douglas and Judge (2001) have analyzed the dependency of financial measures on TQM techniques. Further, the adoption of quality certifications like ISO 9001 or 9002 demonstrates better SC performance (Lima et al, 2000). Their empirical study on Brazilian firms showed strong positive performance of firms applying quality accreditations from the ones which do not.

Gradual development in information and communication technologies have integrated all SC members (Gunasekaran and Ngai, 2004). This facilitates timely sharing of information and reduces uncertainty. Graham and Hardaker (2000) unveiled that three major US auto makers implemented the standard method to obtain order information. IT-enabled SC has changed traditional SC and made customer service and staff training easy (Motwani et al. 2000). There research found that sustainable competitive advantage can only be achieved through R&D activities and regular innovations. Indian firms are increasing their technology access either by developing their in-house R&D centers or through Joint Ventures (Mishra and Sahay, 2010).

Study conducted by Piderit et al. (2011) on South African automotive industry concluded that information sharing is the key to healthy SC relationship. The authors found that lack of trust and information flow leads to disturbed cyclical relationship. However, use of information technology facilitates business collaborations through periodic assistance (Naude and Badenhorst, 2011). It reduces cost and makes business operations effective and efficient (Covey, 2008). Sharing information with right member in SC hierarchy indirectly improves firm's performance (Li and Lin, 2006). The authors believe that shared vision through proper information sharing have significant impact on SC performance.

Supply chain competition also arises due to business operations factors. Among these, the impact of worker's skills and capabilities are of considerable importance (Snell, 2001). Their inimitable and non-substitutable skills increase productivity by responding to unpredictable market requirement (Burke, 2005). However, the source of interruption could be related to inventory as well. A research conducted by Lee et al. (2000) found that shared information improves decision related to quantity. Balanced inventory reduce cycle time and lead to financial profits (Stank and Goldsby, 2000; Naude and Badenhorst, 2011). Another study conducted by Barron (2007) on multi-echelon SC found difference in cycle time leads to coordination problem. The author, through an analytical model, concluded that joint decision making through information sharing can minimize inventory cost.

Manufacturing industry is largely influenced by demand management capabilities of SC members (John et al. 2001). Zhao et al. (2002) presented the significance of information sharing in conditions of diverse demand pattern and capacity limitation. The authors developed a set of guidelines for companies to manage orders under different demand conditions. Even an



insignificant error in channelizing existing inventory often leads to order cancellation (Naude and Badenhorst, 2011). Unlike order cancellation, long material lead time leads to bullwhip effect. It can be ensured through constant supply of required product. Mismanagement of demand creates the problem of stock obsolescence and cash flow shortage (Joshi et al., 2013).

Research Gap

In last two decades, large number of studies have focused on significance of information sharing in SC management. A lot of such studies were carried out on wood pallet manufacturers, textile manufacturers, retailers etc. Few studies were also reported on automotive industry. The countries targeted were Malaysia, South Africa, China, and Japan. Despite the popularity of information sharing in SC competitiveness, not much of the studies been found to uncover this approach in Indian automotive industry. Thus, there is a need of empirical research and illustrations of its information sharing and related strategies.

Research Methodology

Our present research is focused on SC competitiveness enhancement by analyzing information sharing strategies and factors influenced by it. Based on literature survey, twenty-four SC performance indicators were identified. These elements belong to the eight diverse but internally related areas of SC management viz., demand management, cost, technology, delivery, quality, flexibility, buyer-supplier relationship, and operational factors. Identified elements along with their symbolic representation are listed in columns 2 and 3 of Table 1. To conduct the research, it was mediated through literature that these twenty-four performance elements are responsible for hassle free SC activity of automotive sector.

Profile of responding firm and respondents: Hundred medium scale auto component manufacturing firms were targeted for conducting the research. These firms are located in National Capital Region of India. Their average capital investment is USD 10 billion per year. Few of them supply their products to international market as well. On contacting the 100 manufacturers, only 70 agreed to take part in research process. Participation was confirmed through telephone calls and questionnaires were sent via e-mails. However, any query related to survey was solved by conducting in-person meetings with responders. Respondents from upper-middle level of organizational hierarchy with average experience of 7 years in the discipline of SC management were targeted. Filled questionnaires were received in 3-4 months time duration. It was seen that only 25 firms answered for the full questionnaires. Rest 35 firms, which left the questionnaires incomplete, were eliminated from research process. This was done to avoid inconsistency. Wherever required, firm specific secondary data like profitability, turnover, employee strength was collected through annual reports and informal telephonic discussions.

Development of Research Instrument

A well structured questionnaire was prepared using the same set of twenty four variables. The questionnaire was divided into two different sections. Section I contains a pair wise comparison matrices and Section II was composed of open ended questions. This mainly includes questions related to profitability, turnover, and company's position in supply chain, business category and responsibilities. Open ended questions helped to gather rationale behind the responses of pair wise comparison matrices. During the entire study, dynamic nature of auto-component industry was discussed in detail with the respondents. Vast knowledge of respondents in the area of SC decisions facilitated the descriptive analysis of obtained results.

Data Analysis Technique

To analyze the responses of a loosely coupled network structure, ANP technique of multi criteria decision making was used. "ANP is a theory of measurement generally applied to the dominance of influence among several stakeholders or alternatives with respect to an attribute or a criterion" (Saaty, 2001). It considered the non linear relationship of one element with other elements. One criterion is compared with other criteria on ratio scale. ANP facilitates prioritization without making assumptions about dependence among hierarchical and non hierarchical structure. As the entire pool of variables used in pair wise comparison questionnaire are dependent, a application of ANP is the best suited technique to solve such entropy (Saaty, 2001).

As used by Joshi et al. (2013) for prioritization, here also ANP technique is implemented on programming platform of MATLAB software suit. Twenty-five limit super matrices, each corresponding to one responding firm, were formed. In this type of ANP matrix each column indicates the weight of individual element in the overall performance. Finally, 25 Priority Indexes (PIs) from 25 limit super matrices were averaged to obtain industry specific Priority Index (PI). Column 4 of table 1 represents the same. This averaged priority index is considered as the consolidated view of Indian auto-component industry.

Findings and Managerial Implications



This section presents the outcome of the empirical research conducted to analyze the influence of information sharing on SC performance indicators. To achieve this objective, an ANP technique is implemented and obtained results are listed in Table 1, column 4.

The Priority Index in table 1 shows the weight of individual SC performance indicator. Variation in their weight reveals the varied influence of information sharing on each of them.

- Flexibility elements are found to be the most affected ones with 16 percent weight. Respondents indicated that OEMs are following flexible manufacturing system. To meet their diverse requirements component manufacturers are also maintaining flexibility on their production line. Herein, any flaw in dissemination of information can disturb the cycle time of both the parties and thus increasing the opportunity cost.
- Demand being the major reason for bullwhip-effect cause massive deviation in SC. Research findings indicates that poor information cascading initiates frequent order cancellation leading to outage capacity utilization and increased material lead time. Due to mismatch of demand and supply patterns, inventory piles up at various stages of SC. This either creates delays or shortages ultimately leading to disturbed buyer-supplier relationship.
- Respondents mentioned that instead of buying components from too many suppliers, OEMs develop stable partnership with limited suppliers which can adhere to a given delivery schedule. Pertaining to this, managers rated delivery decision as most significant (weight of 0.058755) of the elements required for delivery competency. It differentiates competitors from their counterparts in terms of reduced response time, on-time delivery, improved service level and balanced cost.

Table 1: Priority Index of factors influenced by information sharing

	Supply chain performance indicators	Symbols	Priority index
Cost	Cost of manufacturing	Ca	0.04252
	Distribution cost	Cb	0.05561
	Cost of inventory	Cc	0.04114
Flexibility	Product flexibility	Fa	0.04109
	Process flexibility	Fb	0.06064
	Volume flexibility	Fc	0.06050
Delivery	Delivery decision	Da	0.05875
	Time-based competition	Db	0.03799
	Response time	Dc	0.04833
Quality	Quality certifications	Qa	0.02909
	Total quality management	Qb	0.04251
	Information quality	Qc	0.01727
Technology	Information and communication technology	Ta	0.03174
	Integrating technology between buyer and supplier	Tb	0.02596
	Research and development	Tc	0.02620
Buyer-Supplier relationship	Trust	BSRa	0.05614
	Assistance	BSRb	0.03457
	Level of information sharing	BSRc	0.02273
Demand management	Capacity utilization	Dma	0.05321
	Order cancellation	Dmb	0.05058
	Material lead time	Dmc	0.04669
Operational factors	Skill and capability	Opa	0.03413
	Inventory level	Opb	0.05254
	Cycle time	Opc	0.03000

- Auto-component manufacturers are facing huge pressure from OEMs to minimize product cost. This has made cost a critical element (weight of 14%) on priority index. In order to achieve cost effectiveness, suppliers have implemented various approaches. For example, inventory cost is majorly reduced by implementing KANBAN system, process and volume flexibility. This has reduced material handling cost, manufacturing cost, and



administration cost. Component manufacturers believe that overall system cost can be reduced only when buyers are willing to share planning information with them.

- Operational factors are firm specific with 12% weight on overall priority index. In open ended questionnaire, respondents indicated that labor skills are important due to human involvement at first and last stage of any production process. For example, trim cutting and stitching for seat manufacturing; visual inspection at the end of radiator and head light manufacturing is done manually. Similarly, inventory management techniques are solely a firm specific approach and have weight of 0.052545. Suppliers are also implementing just-in-time technique to meet similar requirement of their buyers. This reduces cycle time by delivering required auto-part on required assembly line, but exclusively depends on accessible information.
- Buyer-supplier relationship is critical to SC performance. This is often built around level of information shared among the SC partners. Dissemination of knowledge especially related to technical and managerial aspects provides assistance to suppliers. The result is lowered cost, reduced time structure, efficient operations, and enormous flexibility. Mutual commitment to share right information at right time between all levels of SC enhances trust level.
- Auto-component manufacturers are striving for continuous improvement in all functional domains through quality management programs. SC partners share information to perform comprehensive quality planning for ingraining total quality management. However, individual firms are obtaining quality standards/ certifications for quality up-gradation. One of the responding manager quoted that every member wishes to have quality SC but no one wants to accept their fault for improvement. Owing to which quality is been given weigh of 0.08888. They also made it clear that information quality is crucial for perfection but most difficult to detect.
- In present time, when suppliers are also contributing in component designing, technology with weight of 0.08391 becomes significant for information sharing. The state-of-the-art facilities related to information and communication technologies facilitate fast movement of information within SC. It integrates SC members by communicating market demand, change/cancellation of order, and inventory movement. However, managers justified its least weight on PI by saying that technology development is solely a firm based strategy. It is initiated by competition in industry but its enhancement depends on firm's vision to improve their R&D activities.

Theoretical Implications

As mentioned by Piderit et al. (2011), in order to be competitive the members of auto-component SC need to share information. In this process, the impact of information sharing on certain PIs is relatively greater than their corresponding variables. The present paper extends the past researches by prioritizing the list of performance indicators, collected from literature survey, through empirical research conducted at Indian auto-component manufacturers. Moreover, through personal interviews it was found that the impact of performance indicator on SC performance depends upon the way firms are implementing strategies. Unlike the SC challenges noted by Naude and Badenhorst-Weiss (2011) for South Africa, current research identifies critical performance factors in context of India. It will provide insights for Indian managers and researchers as every market is unique and suppliers and buyers are driven by local laws, existing industry status and future vision. The research puts forward critical role of competitive priorities, quality issues, technology development, business relationship, bullwhip effect and operations management factors in hassle free SC activity.

Conclusions and Future Research

This research sought to determine the impact of information sharing on SC performance. The sampling frame consists of 25 automotive component manufacturing firms from India. Considering the fact that Indian automotive industry is growing at 14.2 percent per annum and has huge economic importance, no study has been found on the role of information sharing in its effective SC management. The survey based results shown in this paper unveils the performance elements for competitive SC performance. The rating explains that insufficient information sharing can have massive impact on the elements of flexibility, delivery, demand management, and cost. This study views information sharing as a building block which firms can promote and evolve to leverage the operational capability of all SC members.

The study has shown positive impact of information sharing on SC performance, especially on supplier-side. Due to difference in local market dimensions the findings of this study are limited to auto-component manufacturing firms operating in India, thus not applicable to firms operating outside India. The next step to this study is the case study based research, which will validate the industry specific noting. Further longitudinal case study of competitive firms is recommended. This will render useful insights for developing firms or firms planning to operate into similar business. While major emphasis in this paper is given to SC operations happening between domestic partners, thus putting more focus on international SC can bring into distinguished results.

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