

Analyzing Competitiveness of Supply Chains: A Framework

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ABSTRACT

In today's business environment, individual organization cannot sustain its competitiveness without having competitive suppliers, distributors and retailers, etc. It implies that managing the supply chain has become core area of strategy for modern dynamic organizations. Very few frameworks are available to analyze the competitiveness of the supply chain. Now a day's competitiveness cannot be analyzed only by financial factors. Specifically in context of supply chain, performance of individual organization becomes irrelevant if other members of the supply chain are not competitive. In this study, an extensive literature review has been carried out to identify various factors for development of the framework. These factors are further grouped under three main categories viz. Assets, Processes and Performance. This framework can be used to quantify the competitiveness of the supply chain as well as to compare different supply chains with each other.

Keywords: Supply Chain, Competitiveness, Assets, Processes, Performance.

1. INTRODUCTION

Nowadays competition among companies is becoming keen and no longer between companies and companies, but supply chains to supply chains (Christopher, 1992). In order to enhance their competitive edge, companies must continuously strive to seek defensive and offensive approaches so as to increase their organizational effectiveness and better realization of organizational goals such as enhanced competitiveness, better customer care and increased profitability. The supply chain concept is theorized from the formation of a value chain network consisting of individual functional entities committed to providing resources and information to achieve the objectives of efficient management of suppliers as well as the flow of parts (Lau and Lee, 2000). Supply Chain Management (SCM) includes a set of approaches and practices to effectively integrate suppliers, manufacturers, distributors and customers for improving the long-term performance of the individual firms and the supply chain as a whole in

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a cohesive and high-performing business model (Chopra and Meindl, 2009). SCM and related strategies are crucially important to the success of a manufacturing firm. This is because the cost and quality of goods and services sold are directly related to the cost and quality of goods and services purchased. Therefore, supply chain policies such as procurement and supplier selection have an important role in the SCM (Cigolini *et al.*, 2004). Lean practices to improve the internal processes of an organization in line with the principles of Just In Time (JIT) supply are other highly recognized practices in SCM (Burgess *et al.*, 2006). Integration of internal processes of the organization with the suppliers and customers forms the essence of the whole idea behind SCM. With the widespread use of internet, web-based systems enable organizations to form strong customer and supplier integration for inventory management, demand forecasting, customer and supplier relationship management (Frohlich and Westbrook, 2002). Lee (2000) pointed out that SCM involves the flows of material, information, and finance in a network consisting of customers, suppliers, manufacturers, and distributors.

The forward-looking enterprises today are dynamic; they collaborate with suppliers, customers and even with competitors; share information and knowledge aiming to create a supply chain that is capable of competing if not leading the particular industry. Hence, gaining competitive edge under such a cut-throat environment becomes increasingly difficult, if not impossible. Survival and success of the industries depends upon the competitiveness of the supply chain, *i.e.*, the ability to compete in the marketplace.

2. FRAMEWORK FOR SCM COMPETITIVENESS

Supply Chain competitiveness has been described as a multidimensional concept. The significance of different criteria of competitiveness changes with time and context. Theories and frameworks must be flexible enough to integrate the change with key strategic management processes if their utility is sustained in practice. Competitiveness originated from the Latin word, *competer*, which means involvement in a business rivalry for markets. In simple terms, it is the ability to compete. Ambastha and Momaya (2004) define competitiveness as the firm's ability to provide goods and services more efficiently than others involved in the marketplace. For this purpose, organizations need to manage their resources and processes more efficiently than their competitors can.

To gain competitiveness, a framework is necessary to guide an organization. For making the framework, factors have been identified from the extensive literature survey and opinion of experts from both academia and industries. Further these factors are grouped under three main factors viz. Assets, Processes and Performance. This is the reason why the framework is also known as an A-P-P (Assets-Processes-Performance) framework for SCM competitiveness. By considering these factors, a framework has been developed as shown in Figure 1.

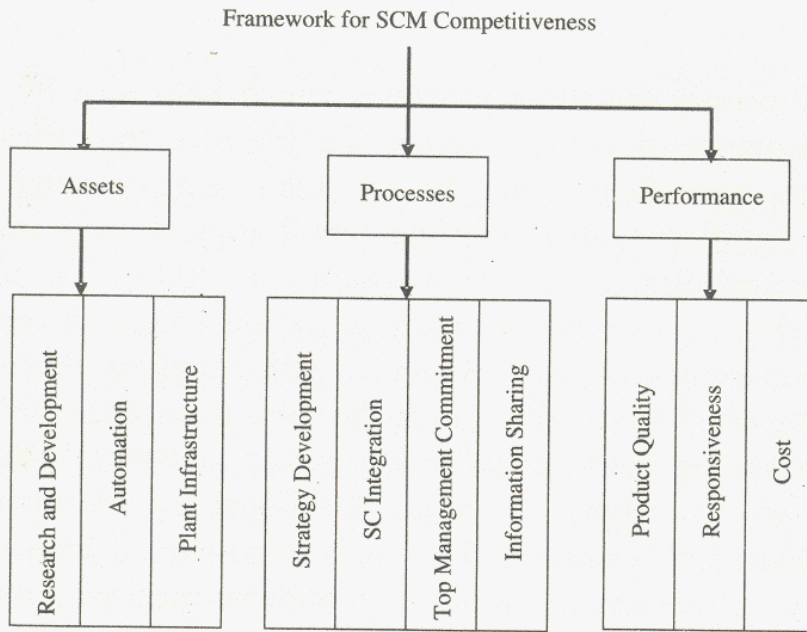


Fig. 1: The Framework for SCM Competitiveness

2.1 Assets

Anything tangible or intangible that is capable of being owned or controlled to produce value and that is held to have positive economic value is considered as an asset. Information and Communication Technology (ICT) is a very important strategic factor in determining whether the company is competitive or not. It acts as a disseminator and enabler for process and product communication along with reducing paperwork and lead times (Handfield and Nichols, 1999; Tummala *et al.*, 2006). E-mail/faxes, worldwide web (www), Electronic Data Interchange (EDI), Electronic Funds Transfer (EFT), Radio-Frequency Identification (RFID), etc. are the few that comes under the IT (Tummala *et al.*, 2006). Use of IT technology such as internet, intranet, software applications packages and discussion support system can be applied to facilitate the information flow within the supply chain members (Stanley *et al.*, 2009). The effective use of information and communication technology is essential in developing an IT infrastructure that operates quickly and efficiently (Jharkharia and Shankar, 2004). To meet rapidly changing product features and customer needs, company should build a dynamic capability to develop new to market products (Singh *et al.*, 2008). According to Mosey (2005), a company can compete with their larger rivals by developing new-to-market products. Investment in product research and development will also help in improving quality and in reducing cost. For the development of new product, employees must be skilled and properly trained. According to Pandey and Garg (2009), automation is the replacement of manual operations by computerized methods, or execution of decisions with the least human intervention. Some of the tools used in factory automation are CAD/CAM softwares, computerized controlled machine tools, material handling system and rapid prototyping (Pandey and Garg, 2009).

2.2 Processes

Competitiveness Processes are those processes which help identify the importance and current performance of core processes. To improve the efficiency of various processes, initiatives have to be taken by top management (Singh *et al.*, 2007a). Leadership plays a significant role in framing organization strategy and in shaping the quality focus of companies (Sila and Ebrahimpour, 2005). To achieve this, top management must develop a system that motivates workers to think and act flexibly and productively to meet company goals. Alliances with suppliers, customers and other external partners should be intensified to make the supply chain more effective. By aligning and coordinating the business processes and activities, overall performance and effectiveness of the supply chain can be improved (Sarmah *et al.*, 2006). According to Ganesan and Saumen (2005), it is important to have top management support, for cross functional training, integration of department within the organization, vendor development. Top management is also responsible for allocating resources in order to achieve an organization's purpose (Wu *et al.* 2009). Trust is a favorable attitude that exists when one supply chain (SC) member has confidence in another SC member (Anderson and Narus, 1990). It is required for flow of reliable and accurate information in the supply chain. Lack of trust is one of the major factors that contribute to supply chain risks (Sinha *et al.*, 2004). According to Faisal *et al.* (2006), risk and reward sharing is important for decision making and developing the trust and partnership among the supply chain members.

Different organizations have formed different supply chain management strategies to compete in the market. They have learnt that to be successful, they must be focused, as they cannot be best and outperform their rivals in all areas (Laura *et al.*, 2007). Some of the important SCM practices are discussed in following sections:

1. *Vendor Development*: Vendor development is a technique by which OEMs train their supplier or provide technical support to them to achieve certain level of quality in their product (Wikianswers, 2010a). A large number of industries operate with poor forecasting and planning systems and operate with long cycle times. They also have problems with unreliable inventory control systems, with no stock tracing and poor cost control. This can lead to excess obsolete stock and eroding customer service levels (Gunasekaren *et al.*, 2000). Manufacturing industry need to improve their production and material management systems (Ulusoy, 2003). For this development of vendors is essential. Vendor development helps in improving the performance of not only buyers but of vendors also. By vendor development, buying firm helps their vendors for increasing their capabilities to improve their performance. It was found that higher rated vendors emphasize process management and employee satisfaction to a greater degree than the lower rated vendors (Park *et al.*, 2001).

2. *Product Design and Development*: To meet rapidly changing product features and customer needs, company should build a dynamic capability to develop new-to-market products. According to Mosey (2005), a company can compete with their larger rivals by developing new-to-market products. Investment in product research and development will also help in improving quality and in reducing cost. According to Chorda *et al.* (2002), cost of product development and uncertainty of the market were found to be the major determinants that confront the product development. Most of the research focuses on factors that contribute to their survival such as financing, rather than a greater understanding of the growth process and the achievement of sustainable competitive advantage. However, according to Karlsson and Olsson (1998), small firms not only spend more on fundamental research but also account for a high proportion of innovations in products and services. For higher growth firms should focus on research and innovation in the longer term.
3. *Customer Relationship Management (CRM)*: Customer relationship management (or CRM) is a broadly recognized, widely-implemented strategy for managing and nurturing a company's interactions with customers, clients and sales prospects. It involves using technology to organize, automate, and synchronize business processes—principally sales activities, but also those for marketing, customer service, and technical support (Wikipedia, 2010b). Li *et al.* (2006) defined CRM as “the entire array of practices that are employed for the purpose of managing customer complaints, building long-term relationships with customers, and improving customer satisfaction”. Tan *et al.* (1998) consider customer relationship management as an important SCM practice. An organization's customer relationship practices can affect its success in SCM efforts as well as its performance (Scott and Westbrook, 1991). Successful SCM involves customer integration at the downstream and supplier integration at the upstream, considering that each entity in a supply chain is a supplier as well as a customer (Tan *et al.*, 1999). In this global competition and mass customization era, personalized attention and better relationship management with individual customers is of utmost importance for organizational success (Wines, 1996).
4. *Web-based IT Tools*: Apart from basic communication tools such as e-mails, faxes and telephone, other Web-based information technologies (IT) are quite useful for supply chain members. Internet-based World Wide Web (WWW), intranet, extranet, and electronic data interchange (EDI) are being used for information sharing in computer-to-computer and business-to-business transactions (Chin *et al.*, 2004; Tummala *et al.*, 2006). The intranet is popular within an organization to provide immediate, cost-effective, and more secure information (Strader *et al.*, 1999). Benetton, the Italian sportswear manufacturer, uses an EDI network to link agents with production and inventory information, and order transmission to

headquarters and air carriers. This resulted in an earlier shipment of orders than most of its competitors (Simchi-Levi *et al.*, 2000). In addition, Web-based information technologies can facilitate accurate, frequent, real-time and seamless exchange of information, both internally and inter-organizationally.

5. *Strategic Supplier Partnership*: It is defined as “the long term relationship between the organization and its suppliers. It is designed to leverage the strategic and operational capabilities of individual participating organizations to help them achieve significant ongoing benefits” (Li *et al.*, 2006). Gunasekaran *et al.* (2001) assert that a strategic partnership emphasizes long-term relationship between trading partners and “promotes mutual planning and problem solving efforts”. Strategic partnerships between organizations promote shared benefits and ongoing collaboration in key strategic areas like technology, products, and markets (Yoshino and Rangan, 1995). Globalization (includes global sourcing) has forced companies to manage their supply, manufacturing, and logistics more effectively. Mentzer *et al.* (2001) suggests that the key to effective management in the global environment is to have closer relationships with suppliers. Through close relationships supply chain partners are willing to (1) share risks and reward and (2) maintain the relationship on a long term.
6. *Postponement*: Postponement is a business strategy that maximizes possible benefit and minimizes risk by delaying further investment into a product or service until the last possible moment. Zinn and Bowersox (1988) describe different types of postponement that could be implemented in the supply chain, and these include labeling, packaging, assembly, and manufacturing. According to Li *et al.* (2006) Postponement is the practice of moving forward one or more operations or activities (making, sourcing and delivering) to a much later point in the supply chain. Two primary considerations in developing a postponement strategy are: (1) determining how many steps to postpone, and (2) determining which steps to postpone (Beamon, 1998). Postponement allows an organization to be flexible in developing different versions of the product in order to meet changing customer needs, and to differentiate a product or to demand function (Waller *et al.*, 2000). Keeping materials undifferentiated for as long as possible will increase an organization’s flexibility in responding to changes in customer demand. In addition, an organization can reduce supply chain cost by keeping undifferentiated inventories (Li *et al.*, 2006).
7. *e-Procurement*: Procurement is the acquisition of goods and/or services at the best possible total cost of ownership, in the right quality and quantity, at the right time, in the right place and from the right source for the direct benefit or use of corporations, individuals, or even governments, generally via a contract. Simple procurement may involve nothing more than repeat purchasing. Complex

procurement could involve finding long term partners—or even ‘co-destiny’ suppliers that might fundamentally commit one organization to another (Wikipedia, 2009d). Online Procurement or e-procurement is a system for making purchases through internet. A properly implemented system can connect companies and their business processes directly with suppliers while managing all interactions between them. This includes management of correspondence, bids, questions and answers, previous pricing, and multiple emails sent to multiple participants. E-Procurement helps with the decision-making process by keeping relevant information neatly organized and time-stamped. Keeping track of all bids means leveraging your knowledge to obtain better pricing. Companies can focus on their most lucrative trading partners and contracts. Johnson and Whang (2002) divide E-business applications into three categories: E-commerce, E-procurement and E-collaboration. E-procurement allows companies to use the internet for procuring direct or indirect materials (Kim and Park, 2008).

8. *Warehouse Management System (WMS)*: Due to the effects of globalization, current supply chain networks are increasingly complex. Logisticians have to deal with numerous channel partners who may be located a great distance apart and who request a greater than ever diversity of products, and who need to deal with more statutory requirements and documentation than ever before (Vogt *et al.*, 2005). A warehouse management system (WMS) controls, manages, and regulates the movement of goods within a warehouse or distribution centre. Typical features of a WMS include inventory management, picking and put away, order visibility, and fulfilment (Blanchard, 2007). A warehouse is an essential link between the upstream (production) and downstream (distribution) entities, and most of the warehouse operations are either labour-or capital-intensive. The performance of these operations not only affects the productivity and operation costs of a warehouse, but also the whole supply chain. Thus, information systems such as WMSs were adopted for collecting data of warehouse operations in order to solve various problems in a warehouse, such as material handling problems (Poon *et al.*, 2009). Within logistics operation areas, warehouse management is the most important function for linking the supply chain partners to formulate the seamless integration of the whole supply chain and for ensuring the smooth flow of products inside the network (Gu *et al.*, 2007).
9. *Logistic Planning and Management*: *Logistics* can be defined as the science pertaining to the movement of materials and the services along with the information. The more comprehensive definition says, “Logistics is the process of moving and positioning inventory to meet customer requirements at the lowest possible total landed cost” (Altekar, 2009). According to Pandey and Garg, (2009), several strategies of logistics have been developed based on the principles of logistics management, such as collaborative logistics processes, operational flexibility, logistics

postponement and collaborative transportation. The collaborative logistic processes refer to joint decision making, such as assortment planning, joint forecasting, joint inventory management and replenishment (Simchi-Levi *et al.*, 2008). Proper logistic planning can assure delivery of product at the right place at the right time.

10. *Vendor Managed Inventory (VMI)*: VMI is a supply chain strategy whereby the vendor or supplier is given the responsibility of managing the customer's stock (Disney and Towill, 2003). According to Altekar (2009), vendor managed inventory is a streamlined approach to inventory and order fulfillment. With it, the supplier and not the retailer, is responsible for managing and replenishing inventory using an integral part of VMI, *i.e.* EDI, by electronic transfer of data over a network. It can also be seen as a mechanism where the supplier creates the purchase orders based on the demand information exchange by the retailer/customer. Cetinkaya and Lee (2000) believe that VMI is an important coordination initiative. It can be used as one of the initial steps in a supply chain streamlining exercise or as a stand-alone process between trading partners (Benedict and Margeridis, 1999). This is successfully used by Wal-Mart and many other big box retailers. Oil companies often use technology to manage the gasoline inventories at the service stations that they supply (Wikipedia, 2010e).
11. *Outsourcing*: Purchasing, also called procurement is the process by which companies acquire raw materials, components, products, services, or other resources from supplier to execute their operations. Sourcing is the entire set of business processes required to purchase goods and services. For any supply chain function, the most significant decision is whether to outsource the function or perform it in-house. Outsourcing results in the supply chain function being performed by a third party (Chopra *et al.*, 2009). Looking beyond mere outsource and sister concerns, collaboration across organizational boundaries increases market responsiveness and revenue while driving down costs of operations and maximum customer satisfaction (Sahay and Gupta, 2007).
12. *Collaborative Planning*: Collaborative planning covers the synchronization of decision rights, logistics, and new product development. When adopted, the parties jointly determine who is better positioned to either control the activity or determine the necessity for continued joint efforts. Soroor *et al.* (2009) also mentioned collaborative planning is one of the enabler for flow coordination mechanisms (are designed to manage product and information flows) in supply chains.

Often the manufacturer can better plan the production process and determine the retailer's order quantity, if supplied with information on consumer demand. The efficiency gains realized by a more efficient production process and a more accurate order quantity are typically split between the parties via the wholesale price. In such cases,

the retailer will delegate the inventory decision rights to the manufacturer. Collaborative planning, forecasting, and replenishment enables supply chain partners to share historical data and develop plans to manufacture and distribute a product (Blanchard, 2007).

Coordination of new product development activities requires tight organizational links, open communications, and trust between the parties. This consumes time and resources.

Third-Party Logistics (3PL): Due to increased competition markets make enterprises more concerned in getting good results. To achieve this goal companies have to focus on achieve core competencies or processes. Activities that can be performed by partners are outsourced in different ways, varying from a simple and volatile commercial supply to a long term partnership. Logistic is a process that has a strong role in manufacturing enterprises and mainly to those in dynamic competitive environments. The growth of logistics process outsourcing has led business to a new class of logistic service providers called third-party logistics (3PL). According to Qureshi *et al.* (2007), the outsourcing of logistical functions to third-party service providers has become an increasingly powerful trend in modern multinational companies.

Online Security: Securing information transmission along the supply chain is necessary to prevent disclosing sensitive information due to intrusion, system misuse, privilege abuses, tampering, and fraud by rivals in the marketplace as the information that communicates with its supply chain partners is one of the most important assets within an organization (Kolluru and Meredith, 2001). Lewis (1999) mentioned that leakage of information can pose a threat to supply chain members and so companies need to protect the sensitive information through different means, such as the creation of "firewalls" and signing non-disclosure agreements to earn the right to use the information from SCM partners. Wal-Mart and Procter and Gamble have signed a confidentiality agreement to appreciate the value of confidentiality in their alliance. This indicates that appropriate security arrangements between senders and receivers cannot be ignored and are possible.

2.3 Performance

Performance of an enterprise is often measured as a ratio of output to input. The outputs constitute the products of the enterprise and the inputs are the resources used by the enterprise. Rise in global competition has compelled the firms to increase performance standards in many dimensions such as quality, cost, productivity, product introduction time and smooth-flowing operations (Hitt *et al.*, 2001). It is noteworthy that quality is important for both efficiency and responsiveness (Vachon *et al.*, 2009). Quality is determined by the extent to which a product or service successfully serves the purpose of the user during usage (Phusavat and Kanchana, 2008). Customers require products and services of a given quality to be delivered by,

or be available by, a given time, and to be at a price that reflects value for money. These are the needs of customers. An organization will survive only if it creates and retains satisfied customers and this can only be achieved if the products or services meet customer needs and expectations. In context of product quality, reliability of the product and its service during the use is the utmost important factor for measuring product quality (Sahay *et al.*, 2006). Responsiveness is defined as the ability of a supply chain to respond rapidly to the changes in demand, both in terms of volume and mix of products (Christopher, 2000; Holweg, 2005). The responsiveness of a supply chain describes how quickly it responds to customer (*i.e.* the rate of communication). It includes the delivery of product in right quantity, of right quality and at right time. The "supply chain lead time" is the time spent by the supply chain to process the raw materials to obtain the final products and to deliver them to the customer. It includes supplier lead time, manufacturing lead time, distribution lead time, and logistics lead time for transport of raw materials and semi-finished/finished goods (Bhagwat and Sharma, 2007). More importantly, lead time can play a major role in achieving competitive advantages through quick response to customer requirement (Ye and Xu, 2010). And as such it is an important performance measure and source of competitive advantage, it directly interacts with customer service in determining effectiveness of supply chain. According to Chan (2003), the profit of an enterprise is directly affected by the cost of its operations. Total cost is a sum of all its complex attributes such as distribution cost, manufacturing cost, inventory cost, raw material cost, etc. Distribution cost includes the transportation and handling cost, safety stock cost and duty. Manufacturing cost includes labor, maintenance and re-works cost. Inventory cost includes the work-in process and finished goods inventories.

On the basis of above literature, main and sub factors for supply chain competitiveness are summarized in Table 1.

Table 1: Main and Sub Factors for Supply Chain Competitiveness

<i>Main Factors</i>	<i>Sub Factors</i>	<i>References</i>
Assets	1. IT Infrastructure Intranet/Extranet facility Bar coding Use of Electronic Data Interchange (EDI) Radio-frequency identification (RFID)	Stanley <i>et al.</i> (2009); Jha [*] kharia and Shankar (2004); Pandey and Garg (2009); Poon (2009); Lin <i>et al.</i> (2006); Tummala <i>et al.</i> (2006)
	2. Research and Development New product development capability Skilled employees Employee's training Adoption of latest technologies	Si <i>et al.</i> (2009); Singh <i>et. al</i> (2008); Ambastha and Momaya (2004); Charan <i>et al.</i> (2008); Singh <i>et al.</i> (2007a)

Main Factors	Sub Factors	References
	3. Automation Material handling Equipment	Chan (2003); Pandey and Garg (2009); Singh <i>et al.</i> (2007a)
	4. Plant Infrastructure Plant location Capability Availability of Suitable utilities Distributer network	Tracey and Tan (2001); Du (2007); Phusavat and Kanchana (2008)
Processes	1. Strategy development Product analysis Process analysis Market analysis Performance measurement system (PMS) Selection of appropriate SCM practices Vendor development Customer relationship management (CRM)	Laura <i>et al.</i> (2007); Singh <i>et al.</i> (2007a); Singh <i>et al.</i> (2008); Szu-Yuan Sun <i>et al.</i> (2009); Varma <i>et al.</i> (2008); Gunasekaran <i>et al.</i> (2004); Bhaskar and lallement (2010); Li <i>et al.</i> (2006); Mehrjerdi (2009)
	2. SC integration Risk and reward sharing Trust development in SC members Collaborative decision making and planning Partnership with dealer's, distributor's and retailer's	Arshinder <i>et al.</i> (2006); Lee (2000); Cachon <i>et al.</i> (2005); Disney and Towill (2003); Mehrjerdi (2009); Charan <i>et al.</i> (2008); Varma <i>et al.</i> (2008)
	3. Top management commitment Resource allocation (labor, machine, capacity, energy) Long term investment motives Employee's training and participation	Singh <i>et al.</i> (2007a); Singh <i>et al.</i> (2008); Si <i>et al.</i> (2009); Chan (2003); Kayakutlu and Buyukozkan (2010); Szu-Yuan Sun <i>et al.</i> (2009); Mehrjerdi (2009); Fantasy <i>et al.</i> (2009); Ganesan <i>et al.</i> (2005)
	4. Information Sharing Point of sales data Inventory Data Product quality data Product design and development data	Marek Pawlak <i>et al.</i> (2008); Francesca Michelino (2008); Arlbjron <i>et al.</i> (2006); Bhatnagar and Teo (2009); Groznik and Maslaric (2010)
Performance	1. Product quality Reliability Serviceability	Ambastha and Momaya (2004); Tracey and Tan (2001); Du (2007); Singh <i>et al.</i> (2007b); Phusavat and Kanchana (2008); Si <i>et al.</i> (2009); Vachon <i>et al.</i> (2009); Sahay <i>et al.</i> (2006)
	2. Responsiveness Reduced lead time On-time delivery Right quality Right quantity Transport optimization	Phusavat and Kanchana (2008); Si <i>et al.</i> (2009); Vachon <i>et al.</i> (2009); Ye and Xu (2010); Gunasekaran <i>et al.</i> (2004); Faisal <i>et al.</i> (2006)
	3. Cost Low cost Distribution cost Manufacturing cost Inventory cost	Ambastha and Momaya (2004); Lockamy and Smith (2000); Tracey and Tan (2001); Chan (2003); Halley and Beulie (2009); Phusavat and Kanchana (2008); Si <i>et al.</i> (2009); Vachon <i>et al.</i> (2009); Singh <i>et al.</i> (2007b)

3. CONCLUSION

Competitiveness of supply chains play very important role in survival of different members of value chain. Competitiveness cannot be judged based on certain business measures. For analysing competitiveness of supply chains, holistic approach consisting of factors from starting of product making to its final delivery up to end consumers, need to be considered. In this context, present study has tried to identify various factors affecting overall competitiveness of the supply chain. To develop a framework for analysing competitiveness of supply chain, these factors have been grouped into assets, process and performance. Main supply chain assets are IT infrastructure, research and development, automation, plant infrastructure. Important supply chain processes are strategy development, supply chain integration, top management commitment, information sharing, etc. Performance can be analysed in terms of product quality, responsiveness and cost. These factors can be further prioritised by AHP or TOPSIS etc. This study will help organisations to analyse their respective supply chain and to improve their respective performance.

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