Chapter-1

Introduction
1. Introduction

1.1 Supply chain coordination – Basics and concepts

Contemporary and future market has already competed business organization to shift the strategic focus from competitiveness among units to competitiveness among concerned supply chains. Market globalization, product diversity and technological breakthroughs that stimulate independent companies to collaborate in a supply chain to compete with other supply chains. Practitioners, academics, and consultants have extolled the importance of coordination and its promise for significant inter-organizational gains. Within a supply chain setting, coordination involves two or more independent companies working together to jointly achieve greater success than can be attained in isolation.

Traditionally, companies have operated in environments characterized by inadequate information (Patnayakuni et al., 2006). The placing of periodic orders has been the primary information-sharing mechanism. Supply chain choices, for example production and inventory decisions, have been made based on local information at the site of activity. This has led to operational inefficiencies in the form of excess inventories, increased operational costs and additional coordination costs (Li and Wang, 2007).

Recent developments in the information technology area enable firms to increase the degree of interaction with their trading partners and establish tighter coordination of their supply chain activities. Due to improved information availability, integration has become an alternative for supply chain parties. Companies are increasingly striving towards supply chain management (SCM), which can be defined as the coordination of the traditional business functions and the tactics deployed across these business functions (Mentzer et al., 2001). Again supply chain managers are recognizing the need to eliminate supply chain inefficiencies, and align the decisions and their execution more closely between the trading partners in order to achieve balance between supply and demand (Simchi-Levi et al., 2003; Fisher et al., 1994).

A typical supply chain (SC) consists of different functions: logistics, inventory, purchasing and procurement, production planning, intra-and inter-organizational relationships and performance measures (Arshinder et al., 2008). SCs are generally
complex with activities spread over multiple functions or organizations over lengthy time horizons. The dynamic structure of a supply chain poses many interesting challenges for effective system coordination. Supply chain members cannot compete as independent members. As per value chain framework a product received by the end customer has passed through a number of entities adding to the value addition of the product before its consumption. To improve the overall performance of supply chain, the members of supply chain are expected to behave as a part of a unified system and coordinate with each other (Arshinder et al., 2008). Thus “coordination” comes into focus. The primary reasons for coordination are that departments and work groups are interdependent in terms of sharing information and resources to perform their respective activities efficiently and effectively. They could be sequentially interdependent or reciprocally interdependent.

Supply chain has evolved from the era when issues related to materials flow (Forrester, 1961) was introduced, which later on become part of SCM. SC has evolved very rapidly since 1990s showing an exponential growth in papers in different journals of interest to academics and practitioners (Burgess et al., 2006). Although there is sufficient literature, the definition of supply chain coordination is still imprecise. The most commonly accepted definition in the literature of “coordination” is “the act of managing dependencies between entities and the joint effort of entities working together towards mutually defined goals” (Malone and Crowston, 1994). Supply chain coordination mechanisms are needed to change the behaviour of individual partners in the supply chain to improve supply chain performance (Li and Wang, 2007; Dyer and Singh, 1998). According to Simaputang et al. (2002) coordination is a necessary prerequisite to achieve the mutual of goal of supply chain as a whole as well as those of the participating units, given the nature of interdependence between these units. Coordinated upstream and downstream integration in the supply chain can improve and differentiate supply chain performance (Frohlich and Westbrook, 2001). Different coordination models have been proposed considering isolated activities or different functions of supply chain. There is no unique perspective on coordination, but the lack of coordination can be easily articulated through a variety of surrogate measures. The consequences of lack of coordination are inaccurate forecasts, low capacity utilization,
excessive inventory, inadequate customer service, inventory turns, inventory costs, time to market, order fulfillment response, quality, customer focus and customer satisfaction (Ramdas and Spekman, 2000). Fisher et al. (1994) has cited a study of the US food industry, which estimated that poor coordination among SC partners was wasting $30 billion annually. The mismatch between supply and demand results in a rise in the costs of stock out, markdown, expediting, transshipment, advertising and sales preparation, excess inventory (Horvath, 2001), obsolescence, and disposal (Fisher et al., 1994).

Multiple benefits originate from effective SCC. Some of these include elimination of excess inventory, shortening of lead times, increased sales, improved customer service, efficient product developments efforts, low manufacturing costs, increased flexibility to cope up with high demand uncertainty, increased customer retention, and revenue enhancements (Fisher et al. 1994; Lee et al., 1997). Coordination is thus perceived as a prerequisite to integrate operations of SC entities to achieve common goals, which are nothing but the goals the SC as a whole.

Supply chain (SC) coordination is a productive initiative to manage the complex SC activities with the help of coordination mechanisms like contracts, information sharing, information technology, joint decision-making, etc. (Arshinder et al., 2007b). In supply chain context coordination can be achieved with joint decision making on all processes of supply chain like procurement, production, distribution and warehousing and economic allocation of the requirement of resources among supply chain members.

Coordination is nothing but a prerequisite of operational integration of supply chain entities to achieve some common goals. Simaputang et al. (2002 & 2004) have also elaborated extensively on utility of coordination in supply chain.

Typically, organizations complement each other in any supply chain. Interdependencies may enhance such complementarities. Coordination could also be a source of competitive advantage. Supply chain Coordination (SCC) can also be perceived as a mechanism to cope up with the uncertainty. The lack of coordination may result in poor performance of supply chain. The mismatch between supply and demand results in a rise in the costs of stock out, markdown, expediting, transshipment, advertising and sale preparation, excess inventory, obsolescence, and disposal (Fisher et al., 1994). According to Lee et al. (1997) the current policies may quickly become outdated.
because they are created mainly to suit local company to earn local benefits and not the coordinated supply chain, which results in demand amplification.

Supply chain coordination may be explained as a progressive process of consolidation of the relationship between supply chain partners. The process may be shown as an integration continuum in Figure 1.1 (Spekman et al., 1998) with four stages. The model indicates how a supplier may be developed into a partner. In the first stage, the relationship is based on price negotiations and may be treated as an adversarial relationship. In the ‘cooperation stage’, long-term contracts are established, and the number of suppliers is actively reduced. Subsequently in ‘coordination’, information linkages enable wider and more exchange of routine information. In most supply chains, all the key supplier relationships have achieved the cooperation or coordination stages in their integration efforts. However, ‘collaboration’ is an extreme form of integration at various levels of supply chain process and activities.

Figure 1.1: Stage of supply chain integration (Source: Spekman et al., 1998)

![Stage of supply chain integration](image)

According to Malone’s definition (Malone, 1994), the first step of coordination is integration of external information to coordinate exchange of information among companies. The second step of coordination is collaboration with Supply chain partners to jointly coordinate information and material flows. The third and ultimate step of coordination is optimal coordination capturing cost benefit issues of the supply chain partner. The steps of supply chain coordination are shown in Figure 1.2.

Lee (2000) proffers three dimensions of supply chain integration as shown in Table 1.1. The first dimension is ‘information integration’, when demand information, inventory status, capacity plans, production schedules, promotion plans, demand forecasts, and shipment schedules are shared. The ‘coordination’ dimension in the framework results in redeployment of decision rights, work, and resources to the optimal-positioned
supply chain member. The final dimension, ‘organisational linkages’, includes channels of communication, common performance measures and incentives.

**Figure 1.2:** Steps in supply chain coordination (Source: Malone, 1994)

The focus of coordination may be on operational or organizational supply chain linkages as shown in Figure 1.3. The mutuality of coordination requires sharing responsibility in achieving better performance. This can be achieved in two ways: by adding complementary (how chain members collectively increase value) or coherency (creating common understanding). Coordination may focus on organizational linkages, and sharing benefits and risks. This type of coordination is needed to reward or penalize decision makers according to how their actions support reaching common targets. Coordinating collective learning means spreading knowledge and capabilities across organizational borders, targeting those capabilities that implement logistics improvement initiatives (Simatupang et al., 2002).
Table 1.1: Dimensions of supply chain Integration (Source: Lee, 2000)

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Exchanges</th>
<th>How</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information integration</td>
<td>Information, knowledge</td>
<td>Information sharing; collaborative planning, forecasting and replenishment</td>
</tr>
<tr>
<td>Coordination and resource sharing</td>
<td>Decisions, work</td>
<td>Decision delegation, work realignment, outsourcing</td>
</tr>
<tr>
<td>Organisational relationship linkage</td>
<td>Accountability, risks/costs/gain</td>
<td>Extended communication and performance measures, incentive realignment</td>
</tr>
</tbody>
</table>

The terms like integration, collaboration, cooperation and coordination are complementary to each other and when used in the context of SC can easily be considered as a part of SCC. This assumption can be followed without any loss of generality as the elements like integration (combining to an integral whole), collaboration (working jointly) and cooperation (joint operation) are the elements (or may be forms) of coordination (Arshinder et al., 2008).

Figure 1.3: Modes of coordination (Source: Simatupang et al., 2002)

<table>
<thead>
<tr>
<th>Mutuality of coordination</th>
<th>Complementarity</th>
<th>Coherency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focus of Coordination</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operational linkages</td>
<td>Physical Flow Coordination</td>
<td>Information Sharing</td>
</tr>
<tr>
<td></td>
<td>Object: products, services or logistics processes</td>
<td>Object: information</td>
</tr>
<tr>
<td>Organisational linkages</td>
<td>Incentive Alignment</td>
<td>Collective Learning</td>
</tr>
<tr>
<td></td>
<td>Object: benefits and risks</td>
<td>Object: knowledge and capability</td>
</tr>
</tbody>
</table>

Various coordination schemes have been developed to capture all possible managerial scenarios. Quantity discount models have been proposed for supply chains with multi-period inventory systems in which upstream parties mitigate the overstocking risk of
downstream parties by proposing a discount (Weng, 1995). Research reports in recent past, cover variations of discount model as per the policies formulated under different situations. These include quantity discounts under demand disruption (Qi et al., 2004), discount policies under demand and production cost disruptions (Xiao and Qi, 2008; Xiao et al., 2008), discount models under uncertain demand (Li and Liu, 2006), quantity discounts considering retailers’ expectations on the basis of their partial information (Karabat and Sayin, 2008), and model for scheduling of discounts (Shin and Benton, 2007). In coordination schemes for revenue sharing contract, the supplier initially charges the buyer a low wholesale price at the beginning of a period and the buyer shares a fraction of the revenue generated from the sales at the end of the period (Cachon and Lariviere, 2000; Giannoccaro and Pontrandolfo, 2004; Cachon and Lariviere, 2005; Chauhan and Proth, 2005; Koulamas, 2006). Buyback is another scheme of coordination between buyer and seller, mostly applicable in downstream side of a supply chain. Under this scheme the buyer is allowed to return any leftover units to the supplier at the end of the period at a fraction of purchase price (Pasternack, 1985; Padmanabhan and Png, 1997; Emmons and Gilbert, 1998). Quick response is a SCC scheme which attempts to reduce the lead time by better demand information (Iyer and Bergen, 1997).

Various collaborative tools emerged in the mid-1990s as potential enablers of supply chain integration (Stank et al., 1999). These tools aim to optimize coordination process, with an ultimate goal of enabling a truly integrated supply chain. Some of the strongly advocated collaborations were proposed in mid-1990s under the banner of concepts such as Vendor Managed Inventory (VMI), Collaborative Forecasting Planning and Replenishment (CPFR), and Continuous Replenishment (CR). It is widely accepted that creating a seamless, synchronized supply chain leads to increased responsiveness and lower inventory costs.

1.2 Supply chain coordination studies

Zimmer (2002) considered order and delivery decisions in a just-in-time environment, with one supplier and one producer. The target of the study was to find a coordination mechanism to improve decentralized decision-making. The model-based study revealed that the supply chain’s total costs are higher in a decentralized decision making situation
without coordination than in a centralized system. After adding a coordination mechanism with information sharing and incentives, the decentralized system performance improved and went up to the same level as that of a centralized one. This result indicates that in supply chains with decentralized decision-making, the correct use of coordination mechanisms enables optimal supply chain performance.

Simatupang et al. (2004) present a case study on how coordination mechanisms are carried out in practice, compared to theory. In their investigation on a fashion firm, they found that there was lack of shared vision and end-to-end supply chain planning and execution that impeded the adoption of coordination mechanisms.

Sahin and Robinson (2005) studied the impact of five different information-sharing levels and physical flow coordination levels in a make-to-order supply chain. Under full coordination, one decision maker coordinates replenishments of the manufacturer, transportation provider, and vendor to obtain an efficient replenishment schedule. The other extreme is the traditional replenishment process with no information sharing except orders. Their simulation study indicates that costs are reduced to an average by 47 per cent by shifting from a traditional to a fully integrated system, and that the cost savings are particularly due to the improved coordination of decisions. Information sharing without decision-making coordination clearly has less impact on costs.

Xu and Beamon (2006) present a process for selecting a coordination mechanism. The selection was primarily based on environmental factors, which include interdependencies between organizations, uncertainty, and information technology. The features of a desired coordination mechanism are described using resource-sharing structure, considering level of control, sharing risk and decision style as the attributes. Then possible mechanisms to meet these features are listed. In the example given in the article, selection is carried out on market pricing, quick response, supplier-managed inventory (SMI) and strategic alliances. A coordination mechanism reflecting the desired features is selected as the most appropriate mechanism for SCC.

Arshinder et al. (2008) show the classification of literature on SC coordination on the basis of the following issues: 1. Roles of coordination in SC and its various models, 2. Coordination across different functions (logistics, inventory, forecasting, and product

1.3 Purpose and objective of the research

In the last two decades, both academicians as well as practitioners have been showing keen interest on both research and application of various factors of supply chain management. Globalization of market, increased competition, sinking gap between products in terms of quality and performance are compelling the academicians and practitioners to rethink about how to manage relevant business operations more efficiently and effectively.

Since, scope for improvement within an organization is decreasing; the academicians and practitioners are looking for newer alternatives of integrating the business activities beyond the organization’s boundary. More specifically, they are trying to align and coordinate the business processes and activities of the channel members to improve the overall performance of the supply chain.

The literature shows the existence and use of various coordination schemes to capture varied organizational and environmental scenarios. These supply chain coordination schemes include quantity discount, quantity flexibility, revenue sharing, advance discount booking, vendor managed inventory, quick response, sales rebate, collaborative planning forecasting and replenishment etc. Each of these schemes has its uniqueness intension of meeting the needs of market environment, associated risks and challenges, demand for certain infrastructural factors and organizational climate for its implementation, associated costs and benefits etc. The supply chain manager is supposed to select an appropriate SCCS for a given SC environment. Moreover, SC manager has to manage and maintain the selected SCCS. This justifies the fact that there is a need for capturing relevant issues within a framework which will help decision maker take a meaningful decision in selecting SCCS. A research project has been formulated with this background for achieving the following objective as selection of SCCS in a given SC environment.
1.4 Organization of the thesis

This research project selection of most appropriate supply chain coordination schemes in given environment. This research project consists of six chapters.

Chapter 1 includes the basic concepts and the role of supply chain coordination. Also various studies related to supply chain coordination were carried out were included.

Chapter 2 includes the contemporary research on supply chain coordination. The current scenario of Indian supply chain management and coordination is described in this chapter. A systematic literature survey has been carried out to explore the influencing factors relevant to SCCS selection. Also a literature survey has been carried on classification of different SCCSs and subsequently a classification scheme of SCCS has been proposed at the end of this chapter.

Chapter 3 consists of empirical studies on the importance of influencing factors and importance or applicability of different SCCS in Indian context.

Chapter 4 covers the analysis of the interrelationship of factors selected in the previous chapter. DEMATEL supported by MMDE is used to analyze the interrelationship and develop Impact Relationship Map.

Chapter 5 includes the application of DEMATEL based ANP (DANP) as multi-criteria decision making tool to prioritize the different SCCS alternatives.

Chapter 6 includes summary and conclusion.