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Strategic Fit in Supply Chain Management: A Coordination Perspective

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1. Introduction

A supply chain (SC) consists of all companies involved in the procurement, production, distribution and delivery of a product to a customer. Because different economic entities participate in the SC, it is significantly more complicated to manage than a single organization. Decision making in SCs is difficult due to differences between the objective functions of different SC members. Locally optimal decisions made by individual members are not necessarily optimal for the SC as a whole. In today's market, competition between individual companies is being supplemented and supplanted by rivalries between SCs. Obtaining a larger market share means winning the competition. When a SC is not able to satisfy customer's needs, its market share will be lost to competitors. Supply Chain Management (SCM) as a field of study intends to organize, coordinate and control the activities toward the ultimate goal of winning this competition.

One of the critical issues in the SCM is the consistency between "what the supply chain performs" and "what the customer expects". The survival of supply chains in a competitive business environment depends on the consistency between "Customer expectation" and "SC performance", which forms the concept of "Strategic Fit". To examine the concept of strategic fit, we first describe its elements in detail. There are two main elements that constitute strategic fit: (1) the customer's expectation, which is the main building block of the "competitive strategy" of a SC and (2) the SC's performance, which is associated with the "SC strategy" in responding to the established competitive strategy.

The customer's expectation is defined by the target customers that the company intends to serve. A company's "competitive strategy" is its basic method of satisfying more of the customer's expectations than its competitors. Indeed, the competitive strategy of a company includes its target customers and their specific needs, such as the product type, orders, information, special services, and so on. Porter (1979) introduces the following five competitive forces that shape the strategy: bargaining power of buyers, threats of new entrants, bargaining power of suppliers, threats of substitute products or services, and rivalry among existing competitors. The strongest competitive force can be considered as the basis for the strategy formulation (Porter, 2008). Based on Porter's model, the competitive advantage of a company can be based on product differentiation or lower prices (Porter, 1985). Porter's generic competitive strategies model (Porter, 1980) introduces three main competitive strategies, including product differentiation, cost leadership and focus (market segmentation). Applying the appropriate strategy depends on the targeted market scope

(broad or narrow) and the customer's expectations (lower cost or product differentiation). According to Porter's generic competitive strategies model, if the customers are cost-conscious or price-sensitive and the company targets a broad industry market, then cost leadership is the right strategy. In cost leadership, the company sets out to become the lowest cost producer in its industry using solutions like economies of scale, preferential access to raw materials, economical distribution channels, proprietary technology, and so on. If the company targets a broad industry market and the customers expect products with unique characteristics, then the product differentiation strategy will be appropriate. Differentiation involves offering a product that is perceived throughout the industry as unique. The uniqueness of a product or service may be associated with the special features of the product, including innovative technology, unique design, size and shape. When the company competes in a focused market segment with a narrow scope, it can exploit from both differentiation and cost leadership strategies in the targeted segment, which is called a focus strategy.

Although the customer expectation is the basis for defining the competitive strategy, it is obvious that the business environment (including, customers, suppliers, competitors, and governmental regulatory agencies) plays a key role in defining a company's competitive strategy. Defining the competitive strategy of an organization requires identifying or predicting the behavior of its customers, suppliers, and competitors. However, if there is little information about the business environment, then the predictability is impaired and the environmental uncertainties increase. Because the strategy is concerned with the future, the strategy planning process always faces some degree of uncertainty. The first step in formulating the competitive strategy is known as identifying the sources of uncertainties. Four sources of uncertainties are identified for an independent company: (1) Demand structure, (2) Supply structure, (3) Competitors, and (4) Externalities (Wernerfelt and Karnani, 1987). A recent study has identified three sources of uncertainties in SC: demand, supply, and process uncertainties (Peidro et al., 2009).

In addition, the defined competitive strategy can move the company toward business environments with low or high degrees of environmental uncertainty. It all depends on "how the company intends to compete." Although the uncertainties make the future more ambiguous, higher levels of uncertainty also provide some opportunities (alongside the risks) for the company (Courtney et al., 1997).

Environmental uncertainties for various businesses differ in kind as well as in degree. Four levels of uncertainty are distinguished for business environments: (1) A clear enough future, (2) Alternative futures, (3) A range of futures, and (4) True ambiguity. Suitable strategies for each level of uncertainty have been presented in the literature (Courtney et al., 1997).

So far, we have discussed the relation between the customer expectations, business environment uncertainties, and competitive strategy. Based on these topics, it follows that the competitive strategy chosen by a SC depends on how much uncertainty the SC faces. Now, we will discuss the required activities and decisions within the SC supplementing the chosen competitive strategy. Indeed, by setting its competitive strategy, the company decides to compete in a business environment with specific types and degrees of uncertainties. Success in this environment requires an appropriate match between the SC strategy and the uncertainties.

There is a close relationship between customer's expectations and "customer satisfaction". If the company meets the customer's expectations more accurately and better than its competitors, it will have satisfied customers. "SC performance" reflects the SC's ability to

provide the product or service to the customers that satisfies them. The nature of operations within the SC, including procurements of raw material, manufacturing, transportation, and delivery of goods (i.e., SC performance) forms the "Supply Chain Strategy (SCS)". Because the SC includes all stages in fulfilling a customer request, the SCS includes all activities and decisions associated with the flow of goods and information across the SC. The SCS is about planning and decision making about questions such as network design, sourcing, purchasing, manufacturing, pricing, inventory decisions, transportation, new product development programs, marketing, advertisement, finance, and customer relationship management programs. Chopra and Meindl (2001) introduce the logistical and cross-functional drivers representing the SCS as the facilities, inventory, transportation, information, sourcing, and pricing. The first three drivers are the logistical, and the last three are the cross-functional drivers. Supplementing the above categories, another classification proposes five areas of decision making in SC: production, inventory, location, transportation, and information (Hugos, 2003). A SCS may rely on responsiveness or efficiency (Chopra and Meindl, 2001; Hugos, 2003). Because responsiveness and efficiency are the two ends of a spectrum, the SC manager must resolve the trade-off between responsiveness and efficiency in each of the above categories. Table 1 illustrates the responsiveness-efficiency trade-offs in the five SC drivers according to Hugo.

Decision making area	Definition	Meaning of efficiency in this area	Meaning of responsiveness in this area
Production	Capacity of factories and warehouses across the SC to make and store the products respectively	No excess capacity	Creating a lot of excess capacity
Inventory	All goods held by the manufacturers, distributors, and retailers throughout the SC	Cost of inventory should be kept as low as possible by holding low amounts of inventories	Holding large amounts of inventory
Location	Geographical sites of SC facilities	Centralizing activities in fewer locations to gain economies of scale	Decentralizing activities in many locations close to customers and suppliers for fast responses
Transportation	Movement of goods between different facilities in SC	Slow and low cost modes of transportation	Fast and costly modes of transportation
Information	Connections among the various activities and stages in the SC	Short term: Collect less information about fewer activities Long term: collect and share informative data generated by the other four drivers	Collecting and sharing accurate and timely data generated by the operations of the other four drivers

Table 1. The five SC drivers and the responsiveness-efficiency trade-off

Generally speaking, efficiency in performing a task means that the costs are as low as reasonably possible. In a strategy based on efficiency throughout the SC, the customers

receive low prices. On the other hand, they cannot always quickly and easily obtain their desired product.

In contrast, in a SC strategy based on responsiveness, the customers receive high availability of products, low lead times, and highly innovative products. However, the customers cannot expect such low prices. In this case, the customers can obtain the desired product more quickly and easily but at higher costs.

Alignment between competitive and SC strategies, known as "strategic fit," can be achieved by adjustments between the SC drivers and environmental uncertainties. The strategic fit is known to be the most important issue associated with the SCM in competitive environments (Hogus 2003, Chopra and Meindl, 2006). Achieving strategic fit is difficult from both the theoretical and practical points of view. Although many prior researchers have studied ways to achieve strategic fit, it still requires more practical solutions. The previous studies have focused on explaining various aspects of the concept of strategic fit, but their models are limited to the problem as they are defined from the macro-strategic perspective.

In this chapter, we discuss how strategic fit can be achieved by coordinated decision making on some decision variables throughout the SC. This chapter, supplementing previous studies, provides a more practical solution for aligning the strategies throughout the SC based on the concept of coordination. Coordination plays a unique and central role in SC management. Hugo (2003) has defined the SCM as the "coordination of production, inventory, location, and transportation among the participants in a supply chain to achieve the best mix of responsiveness and efficiency for the market being served". In the traditional decision making process, each SC member makes its authorized decisions individually. Each SC member aims to maximize its own profit regardless of the other participants. Nevertheless, most of its decisions affect the other members. For example a retailer's decision on the order size affects the production batch size, setup costs and inventory holding costs of the producer. Therefore, we can conclude that the individual optimization of decision variables in the SC results in a local optimization that is not necessarily globally optimal. To address these deficiencies, coordination models have been developed by field researchers. A coordination model in a SC can be defined as an operational plan that aligns the decisions of different SC members toward the globally optimal decision. Coordination mechanisms have an operational plan for finding the globally optimal decisions. If the SC has a decentralized structure, i.e., if independent economic entities participate in the SC, then the globally optimal solution is not always acceptable to all SC participants. Although the globally optimal decisions increase the total SC profitability, they often decrease the profits of some members in the decentralized SC structure. An economic entity accepts a decision if its profit increases by accepting the decision. For example, consider the case in which making a decision increases the total profit (the sum of all SC members' profits) of a two-stage SC (including one retailer and one manufacturer) by $100; now, if the retailer's profit increases by $110 while the manufacturer loses $10, then the manufacturer refuses to implement the decision. In such cases, it is necessary to establish an incentive scheme to induce the lost member to accept and implement the globally optimal decisions. By establishing the incentive scheme, the surplus is shared between members fairly to ensure their participation. If a decision variable X is under the authority of one SC member but affects other members' profitability, then coordinated decision making on the decision variable X increases the overall SC profit. However, applying the coordinated value of the decision variable X decreases the profit of the decision maker. Therefore, coordinated decision making requires appropriate incentive schemes to convince the members to

participate. Return policies, discount models, pricing schemes, and delays in payments are some of the incentive schemes in the field of SC coordination. In this chapter, we demonstrate that strategic fit can be achieved in a SC through coordinated decision making.

2. Literature review

Fisher (1997) has introduced a structure for determining the right supply chain strategy. According to Fisher's model, the SC strategy is established based on the product type (Fisher, 1997). For functional products, where demand is predictable and stable over time, an efficient supply chain is suitable, while for innovative products where the product lifecycle is short and demand is unpredictable, a responsive supply chain is more appropriate. Fisher's model considers the differences between the products as the main factor in establishing the right SC strategy. Because the product type affects the uncertainties from the customers' side, Fisher's model considers the demand uncertainties as the only effective parameter in establishing the SC strategy. The demand for functional products is mainly predictable, while innovative products have an unpredictable demand. The uncertain demand for innovative products can creates high and frequent shortages in satisfying the customers' demand. The average stock-out rate for functional products is 1% to 2% while this rate is 10% to 40% for innovative products (Fisher, 1997). Based on Fisher's model, there are two main strategies to manage the supply chain: efficiency and responsiveness. The primary purpose of an efficient supply chain is to provide the lowest price to the customers, while a market-responsive SC aims to respond quickly to the customers' demand. Suppose that efficiency is the right strategy for a SC; what must its members do to create an efficient SC? Based on Fisher's model, in this case the manufacturer should maintain a high utilization rate, the inventory should be minimized throughout the SC, and the suppliers should be selected based on their cost and quality. In contrast, to create a market-responsive SC, the manufacturer should deploy excess capacity, a high level of inventory should be held throughout the SC, and the suppliers should be selected based on their flexibility, speed, and quality.

Subsequently, Lee (2002) introduced a framework for establishing a strategy based on supply and demand uncertainties. In Lee's model, in addition to the demand uncertainty, the supply uncertainty has been taken into account. Like the customer demand, the supply process may include uncertainties. If the supply process is well established, it is called a "stable" supply process. The stable supply process has characteristics including high numbers of supply sources, reliable suppliers, dependable lead times, few break downs, and high flexibility. Compared with the stable supply process, if the supply process is in the early development phase, it is called an "evolving" supply process. The evolving supply process has characteristics including limited supply sources, unreliable suppliers, variable lead times, vulnerability to breakdowns, and inflexibility. Although the product type often affects the supply uncertainty in addition to the demand uncertainty, this is not always the case. The product type always defines the demand uncertainty, but it is possible for a product with low demand uncertainty to have higher supply uncertainty. In other words, functional or innovative products can have certain or uncertain supply processes. Therefore, there are four possible combinations of supply-demand uncertainties in Lee's model: functional product-low supply uncertainty, functional product-high supply uncertainty, innovative product-low supply uncertainty, and innovative product-high supply uncertainty. Lee's model provides a framework to establish the appropriate SC strategy for

each of these combinations. Lee's model, supplementing Fisher's model, introduces four strategies based on the product type and supply uncertainties for the SC. Table 2 shows Lee's model. As shown in table 2, Lee's model encapsulates the uncertainties as the demand and supply uncertainties and introduces four strategies to manage a SC: efficiency, risk-hedging, responsiveness, and agile strategies.

Strategy	Demand uncertainty	Supply uncertainty
Efficient	Low	Low
Risk-Hedging	Low	High
Responsive	High	Low
Agile	High	High

Table 2. Supply chain strategies based on Lee's model (Lee, 2002)

The efficiency strategy denotes lowering costs as much as possible by eliminating non-value added activities and exploiting economies of scale, high utilization rate, cost-effective transportation, etc. In the risk-hedging strategy, members share and pool the resources to create alternative supply sources and reduce the supply uncertainty risks. The responsiveness strategy is associated with quick responses to the uncertain customer demand. According to Lee's model, when both demand and supply are uncertain, then the agile strategy is appropriate. Agility means responding quickly to the uncertain customer demand while sharing and pooling the sources to evade the supply uncertainty. Indeed, the agile strategy can be viewed as a combination of the risk-hedging and responsiveness strategies (Lee, 2002).

Agility is defined as "using market knowledge to create more value and profit in a rapidly changing market" (Naylor et al., 1999). In contrast, lean thinking is about eliminating all waste throughout the system, including cost and time wastes (Womack and Jones, 1994). Essentially, the agile strategy is implemented where demand is volatile, and the lean strategy is suitable when demand is stable. The agile or lean strategies considered in isolation do not necessarily result in the best strategy (Mason-jones et al., 2000). Agility and leanness can be combined within one supply chain to meet customer demand, which is called "Leagility" (Naylor et al., 1999). Leagility is defined as the combination of lean and agile strategies within a supply chain by determining a decoupling point. The decoupling point defines where the chain must be agile and where it must be lean. Members of the SC upstream of the decoupling point should focus on leanness, while the downstream members should be agile. Figure 1 demonstrates the leagile strategy in a simple SC.

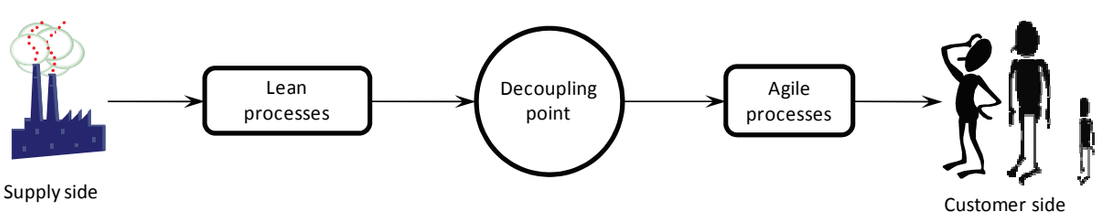

Fig. 1. Leagile strategy (Naylor et al., 1999) and decoupling point in a generic SC structure

According to the basic leagile strategy, by determining the decoupling point, the downstream members must focus on agility while the upstream members must focus on leanness. Because the abilities of members may conflict with their imposed roles (lean or agile), it seems that the basic leagile strategy may fail to achieve the maximum SC profit.
Chopra and Meindl, (2006) consider two main strategies for the SC (efficiency and responsiveness) and introduce a three-step procedure for achieving strategic fit. In the first step, competitive strategy of the SC is established, and as a result, the uncertainty level that SC must face is measured. In the next step, the SC strategy is recognized, and in the last step, the competitive and supply chain strategies are matched to the strategic fit zone (see Figure 2). Chopra and Meindl, (2006) show that there is a direct relation between the competitive strategy and the supply chain strategy in achieving strategic fit, i.e., whenever the competitive strategy targets market segments with higher uncertainties, the supply chain strategy must be shifted toward responsiveness. Figure 2 shows the direct relation between competitive and supply chain strategies in achieving strategic fit. As shown in Figure 2, when increasing the uncertainties, the SC strategy must also increase its responsiveness to avoid the harmful effects of high uncertainty on the customer service level. If the SC intends to focus on efficiency in a highly turbulent business environment, then customers will be lost due to the low service level, low product availability, long lead times, and low responsiveness. The uncertainty causes the overall SC service level to decrease. In an uncertain environment, if the SC does not make any efforts to maintain its service on a reasonable level, then the service level decreases, and the customers abandon it in favor of its more responsive competitors. In contrast, in a certain business environment, all things are predictable, and therefore the customers need low prices in addition to the presumed high responsiveness. Here the competition is based on cost efficiency. In other words, in a certain environment, the responsiveness level of the chain is not damaged and can be fixed at a reasonable level. In this situation, all the competitors can provide the customers with the desired level of responsiveness; therefore, the challenge is to provide them with low prices.

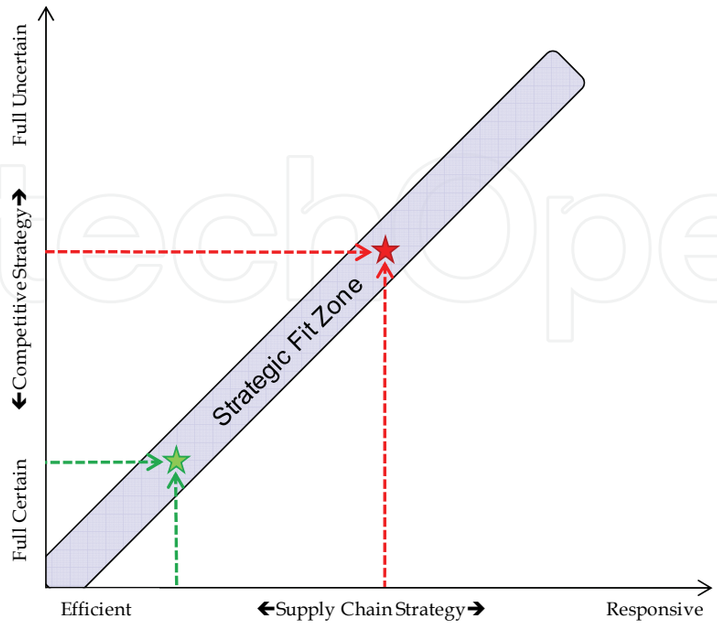

Fig. 2. Strategic Fit zone (Chopra and Meindl, 2006)

In achieving the strategic fit, it is important to know that the desired level of responsiveness can be achieved by assigning different levels of responsiveness to each SC member. If one member has the ability to provide a desired level of responsiveness at a reasonable cost, then it allows other members to be more cost-efficient. Indeed, we can assign different roles to the different members. In contrast to the leagile strategy, the roles of individual members in achieving a given level of responsiveness are not fixed. Each member's role depends on its ability. One critical issue, which is the main concern of this chapter, is that "each SC member uses its potential ability if and only if using the ability creates benefit to itself in addition to the others". Therefore if a costly role is assigned to one member, that member must be compensated and acknowledged by other members to guarantee its participation.

3. Achieving strategic fit

The proposed model for achieving strategic fit in SC is based on the Chopra and Meindl model and extends their model by providing more practical insights using the concept of coordination. According to the Chopra and Meindl model, as the SC establishes its competitive strategy against its competitors, the uncertainty level that it must face will become clear. Afterwards, there are two main steps to achieving strategic fit:

1. Establishing the supply chain strategy based on the implied uncertainties
2. Specifying the specific role of each SC member in achieving the established SC strategy.

In this chapter, by merging the concepts of SC coordination and strategic fit, the solutions for the both aforementioned problems are proposed.

3.1 SC competitive strategies and uncertainties

We consider a generic four-level SC including retailers, distributor, manufacturers, and suppliers. As the competitive strategy of the SC is defined, each member faces some uncertainty. Four main types of uncertainties are considered in this study: demand uncertainty, transportation time uncertainty, capacity uncertainty, and procurement time uncertainty. The four uncertainty types considered are the most common types of uncertainty in business environments. Table 3 shows the types of uncertainties, their definitions and their sources.

As shown in Table 3, the uncertainties considered include customer demand, transportation time, the reliability of the manufacturing process, and supplier lead times. There are several reasons for investigating these four uncertainties. First, these four uncertainty types are common uncertainties in the business environments that have been studied by the various researchers in the operations management field. Second, by investigating the above mentioned uncertainties, the pairwise relations between all SC members are considered, so the study covers all the SC relations from the customers' side to the suppliers' side. Third, by investigating this set of uncertainties, all the main sources of uncertainty, including customer demand, externalities, process, and supply, are taken into account.

3.2 Supply chain strategies

Supply chain strategies are associated with decisions made by the SC members. There are two viewpoints on categorizing SC strategies: (1) based on the decision domain and (2) based on the decision maker. SC drivers, introduced by Chopra and Meindl, (2001) categorize the SC strategies based on the decision domain into six classes: facilities,

Uncertainty	Definition	Source of uncertainty	Uncertainty affects the relation between …
Customers' demand rate	Retailers receive unpredictable levels of demand from the customers in each period.	Customer demand	Retailers-Customers
Transportation time	Various factors, such as weather conditions, customs clearance delays, and traffic congestion, cause the transportation time to be unpredictable.	Externalities	Distributor-Retailers And/or Manufacturers-Distributor
Reliability (on capacity)	Unpredictable constraints on the volume of production are caused by factors such as power cuts, machinery break down, workers strike, etc. These constraints prevent distributor orders being met on time.	Process	Manufacturers-Distributor
Supplier Lead times	Variable delays from the suppliers in delivery of raw materials to the manufacturers.	Supply	Suppliers-Manufacturers

Table 3. Four considered uncertainties types

inventory, transportation, information, sourcing, and pricing decisions. From the other point of view, strategies and decisions are implemented by the SC members. Therefore, it is possible to categorize SC strategies based on the decision makers instead of the decision domains. According to the generic model SC with four tiers, the SC strategies based on the decision makers are categorized into the four classes: supplier, manufacturer, distributor, and retailer.

To investigate the effect of each member's strategies and decisions on SC performance, it is more informative to categorize SC strategies based on decision makers instead of decision domains. By categorizing the areas of decision making based on the SC tiers (retailer, distributor, manufacturer, and supplier) we narrow down toward the strategies for coping with four types of uncertainties, each of which is associated with a specific tier of the SC.

In the next step, possible strategies must be defined for each member to deal with the corresponding uncertainties. Table 4 provides a structure for formulating the strategies for each SC member in facing these uncertainties.

As shown in Table 4, each SC tier has some options in coping with uncertainties. Some strategies cause the member to be more responsive, while other strategies cause the member to be more efficient. We do not claim that the suggested general strategies in Table 4 are the all possible strategies, but they are the most common and applicable strategies. It is possible to add more strategies based on the specific conditions of each SC into Table 4.

Some suggested strategies interact with each other. For example, consider the basic responsiveness strategies of a retailer. We designate quick response, high product availability, and high inventory level as the retailer's responsiveness strategies. Nevertheless, in most cases, a quick response strategy and high product availability are created through holding high inventory levels. Therefore, each retailer's responsiveness strategies influence other strategies.

Tier	Associated Uncertainty	Basic efficiency strategies	Basic responsiveness strategies
Supplier	Supplier Lead times	- Placing the main focus on low costs instead of low and fixed supply times - Supplying only fixed size batches - Investing in advanced systems and facilities as little as possible	- Providing short and fixed delivery times at higher cost - Ability to deliver various batch sizes quickly - High investment in advanced organizational systems and facilities
Manufacturer	Reliability (on capacity)	- Single facility located in a low cost area - Inflexibility on production process - Low levels of finished product inventory - Focusing on production of common products - Only in-house production at low cost - Low investment in production facilities	- Multiple facilities located near the markets - Investing in expediting production process - High level of finished product inventory - Focusing on production of innovative products - Outsourcing in emergency cases at higher costs - High investment in production facilities
Distributor	Transportation time	- Slow and cheap modes of transportation - Low levels of inventory in the warehouses - Limited number of central warehouses - Low-cost full truckload shipments - Fixed number of trucks	- Fast and expensive modes of transportation - High inventory levels in warehouses - Many warehouses near the markets - Higher-cost less than truckload quick shipments - Flexibility in the number and types of trucks
Retailer	Customers' demand rate	- Limited number of Central stores - Focus on providing low price to customers with a tolerable product availability rate - Low inventory levels	- Many stores in the vicinity of customers - Quick response to the customers' orders - High product availability - High inventory levels

Table 4. Strategies of SC members in facing the uncertainties

Furthermore, some strategies of different tiers of the SC interact with each other. In other words, to create a responsive (efficient) SC, it is not necessary to force all members to focus on responsiveness (efficiency) strategies. When a SC member implement a strategy based on responsiveness (respectively, efficiency), other members can make more efforts on efficiency (responsiveness) to satisfy the customers. In this situation, responsive members, by absorbing the uncertainties, create a definite environment for other members to be more

efficient. Here is one critical question: "Who is responsible for absorbing the uncertainties?" One might think that each member that encounters uncertainty is responsible for being more responsive (e.g., a distributor is responsible for transportation time uncertainties). Although this answer is feasible, it is not always the best answer. In the next section, using the "coordinated decision making" concept, we provide and discuss other possibly better solutions to this question.

3.3 Coordination in aligning strategies

As we have already discussed, alignment between competitive and SC strategies can be viewed as fitting between SC uncertainties and SC capabilities. According to Table 4, we suggest several generic strategies to cope with uncertainty. Finding the best strategy in each case requires economic analysis. Note that the best strategy in each case is context dependent. An applicable strategy that has the minimum cost is the best choice. There are two criterions in selecting the strategy: "applicability" and "minimum cost". Most of the strategies mentioned in Table 4 are not always totally applicable. For example, distributors are interested in "low-cost full truckload shipments", but when the customers' demand is uncertain, one of the coping strategies is "higher-cost less than truckload quick shipments" at higher costs. If applying this strategy does not offer reasonable gain to the distributor, it is not implemented. Therefore, this strategy is applicable if its implementation brings the distributor more profit.

Because responsiveness strategies are costly, none of the members is interested in being responsive. However, the strategic fit model reveals that in an uncertain environment it is vital that the SC strategy be planned based on responsiveness. Although the responsiveness of the SC does not require all SC members to be responsive, at least one member must be responsible for absorbing the uncertainties and creating the desired level of responsiveness. Coordinated decision making, along with incentive schemes, can resolves this problem. Depending to the types of uncertainties, as discussed above, the features of the coordination models and mechanisms to solve the efficiency-responsiveness trade-off will be different.

3.3.1 Customer's demand rate uncertainty

If the SC competitive strategy targets customers with highly uncertain demand, then to maintain the service level at a reasonable level, the SCS must involve responsiveness. In this situation, the quantity of orders received by the retailers is the uncertain parameter. In this situation, the size of orders for the next period can be estimated only up to some errors. Therefore, shortages may occur in the store. A shortage in the store causes the customers to look to buy the products from the competitors. Therefore, the competitive nature of the market creates a lost sales inventory system. Losing one customer harms the upstream members in addition to the retailer.

Holding more inventory on the part of the retailer is a common method of coping with demand uncertainty. To avoid losing customers, the retailer increases its inventory level at a cost. Holding more inventory as safety stocks at the retailer site decreases the probability of shortages and therefore prevents the loss of customers. By decreasing the shortages, the SC sales volume increases, so all the SC members benefit. The other side of the coin is the risk of excess inventory costs to the retailers.

When a retailer decides independently, only considering its own benefits and costs, increasing the SC sales volume has additional benefits for the other SC members. Therefore,

coordinated decision making is more beneficial for the whole SC. At the same time, increasing the retailer's inventory level causes a loss to the retailer with respect to its local optimum decision due to its excess inventory costs. Coordinated decision making is applicable if and only if the retailer receives a certain share of the extra benefits earned by other members.

In general, coordinated decision making about the downstream inventory level in the lost sales inventory systems with uncertain demand increases the retailer inventory (especially its safety stock). In the non-coordinated model, the retailer considers only its own costs in resolving the trade-off between overstocking and shortages, while in fact, losing the customers is costly for all the SC members. Since the cost of the shortage is more than the retailer's cost alone, coordinated decision making recommends decreasing the prevalence of costly shortages by having the retailers hold more inventory. Therefore, encouraging the retailer to hold more inventories will be economical for other members.

It is not rational for an economic entity like a retailer to increase its cost to benefit others. Other members must propose incentives to encourage the retailer to be committed to the coordinated decision about its inventory level. In this case, there is a decision variable (i.e., the retailer's inventory) under the authority of one SC member (i.e., the retailer) that affects other members' profitability through increasing the sales volume. Therefore, coordinated decision making on this variable, accompanied by an appropriate incentive scheme, can create more profit for all members. To convince the retailers, they can be offered incentive schemes, including discounts, profit sharing, pricing. Note that after applying the coordination model, the extra profit must be shared between members in such a way that all members' profits are greater than before applying it. In this way, the retailers accept the responsibility for absorbing uncertainties, and other members can operate in an efficient manner.

Another strategy for coping with demand uncertainty is for the distributor to provide shorter lead times. Because shortages occur due to exhaustion of the retailer stock and replenishing the retailer stock depends on the lead time (time between each retailer's placing an order and receiving the order) provided by the distributor, the shortages will be reduced if the distributor is able to provide shorter lead times. Hence, another strategy for facing the customer demand uncertainty is for the uncertainty to be passed through the retailer and absorbed by the distributor. In this case, instead of holding more inventory at the retailer's site, the retailers' inventory replenishing is expedited. In this new strategy, the distributor is responsible for absorbing the uncertainties. As in the case of the retailer, the distributor absorbing the uncertainties increases its costs. In the previous case, the retailers incurred more costs by increasing their inventory level, while in the current case, instead of the retailers, the distributor suffers more costs by shortening the lead times. Incentive schemes are needed to compensate the distributor for its excess costs and guarantee its acceptance.

Selecting between the two suggested strategies (increasing the retailer's inventory level versus shortening the distributor lead times) requires economic analysis. The strategy with the lower cost is selected as the responsiveness strategy against demand uncertainty. Note that the best strategy is context dependent and therefore may vary from one case to another.

3.3.2 Transportation time uncertainty

Transportation time uncertainty means a variance in the shipment time between an origin and a destination. There are several reasons for varying transportation time, including

weather conditions, clearance delay, terrorism. If the SC competitive strategy targets market areas that have the above conditions, then the transportation time will be uncertain. In this state, even given a fixed and known demand, the response to the customers will be disturbed due to irregular receipt of batches by the retailers. Therefore, transportation time uncertainty can significantly affect the SC's responsiveness. In turn, low responsiveness in the competitive market causes customer loss and degrades the SC's profitability. According to the strategic fit model, in the presence of increasing uncertainties, the SCS must maintain responsiveness.

The distributor's uncertain transportation time is considered as the supply time uncertainty from the retailer viewpoint. Previous studies have shown that increasing the lead time variance has more serious effects on SC performance than increasing lead time mean (Chaharsooghi and Heydari, 2010). Increasing the average lead time does not create an uncertain parameter, and therefore can be resolved at a certain cost by adjusting the inventory parameters. In contrast, increasing the lead time uncertainty raises the probability of under-stocking at the retailers' sites. Depending on whether the uncertainty in transportation is between manufacturers' sites and warehouses or between warehouses and the retailers' sites, the appropriate strategies will be different.

Figure 3 shows the two types of transportation time uncertainty, including manufacturers' site-warehouses and warehouses-retailers' site transportation time uncertainty. The warehouses are assumed to be under the authority of a distributor.

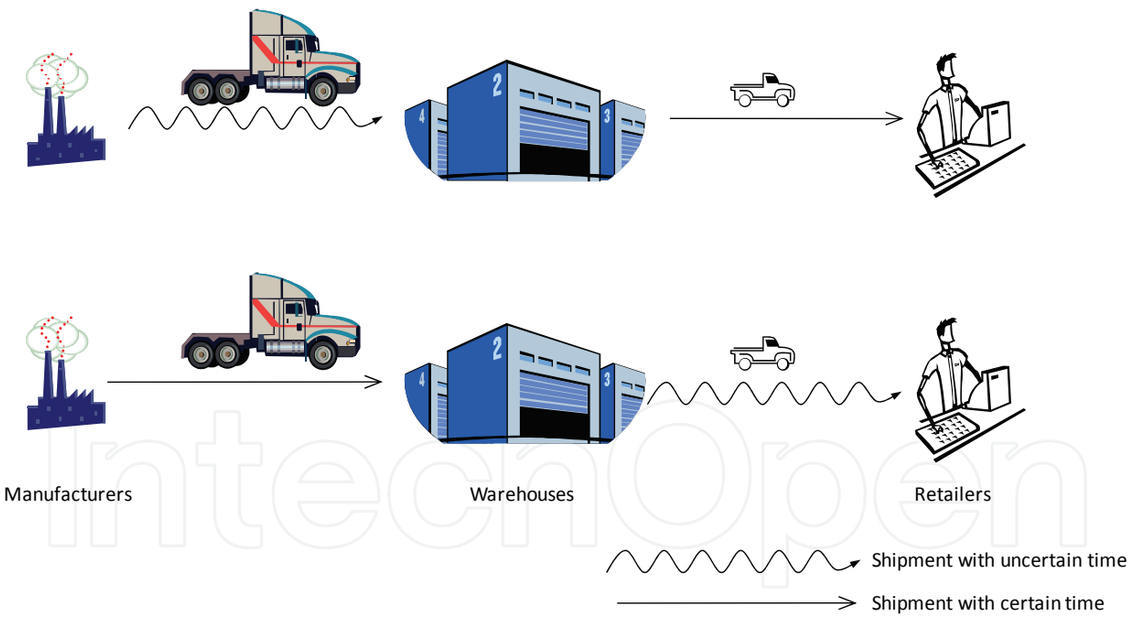

Fig. 3. Manufacturers' site-warehouses (top) versus warehouses –retailers' site (down) transportation time uncertainty

3.3.2.1 Manufacturers' site-warehouses transportation time uncertainty

There are two main strategies to prevent the decline of SC responsiveness in case of uncertain shipment times between the manufacturers' sites and the warehouses:

1. Use of more reliable transportation modes with higher costs and lower uncertainty (Note that these alternative modes are not always available)

2. Storage of a higher volume of product in warehouses
3. Combined solution

If expensive modes of transportation are used to deal with the uncertainty, then the distributor must pay more. Moreover, holding more inventory in the distributor warehouses causes investment depreciation and increasing inventory holding costs. By storing more inventory in the warehouses, the effect of late shipments is neutralized by shipping the retailers' orders from the stocks. In addition, a combination of these two strategies (using alternative transportation modes and holding more inventories in the warehouses) can be implemented to provide faster and more reliable transportation toward the retailers.

Apart from the selected strategy, decreasing the lead time uncertainty imposes some extra costs, but it can be seen as an investment (Bookbinder and Çakanyildirim, 1999; Ryu and Lee, 2003). Allowing the distributor to decide on one of the above strategies alone leads to a locally optimum solution. When the distributor selects the transportation mode, the main factor is the cost of each transportation mode. Therefore, the distributor selects a mode at a price as low as reasonably possible. If offering faster response times to the retailers imposes extra costs on the distributor, then the distributor will not choose this option. In this case, the distributor optimizing the transportation time based on its own costs affects the SC responsiveness level. Reducing the SC responsiveness (as a result of an inappropriate transportation strategy) also affects the profitability of all SC members. Because implementing each of the abovementioned strategies imposes costs on the distributor, when there are not adequate incentives the distributor does not change its mind toward coordinated decision making.

When the distributor is committed to the coordinated decisions, the transportation time is globally optimized and the maximum profit is achieved. At this stage, the earned profit is not shared between members fairly. The distributor, by implementing the expensive strategies, has provided these extra profits to the other SC members, while the other members do not pay much for them. To create a win-win situation, the extra benefits gained by the other members as a result of the distributor's coordinated decisions must be fairly shared. Otherwise, the distributor returns to its local decision, and the SC's responsiveness decreases, and all SC members incur losses. Selection between the three mentioned strategies to cope with the transportation uncertainties requires an economic analysis.

3.3.2.2 Warehouses –retailers' site transportation time uncertainty

Another transportation time uncertainty occurs when the retailer places an order to the distributor, the distributor has enough inventory in its warehouse, but the time between placing the retailer's order and receiving the order is uncertain. Reasons such as delay in order processing time, traffic congestion, and traffic restrictions in city can cause this type of uncertainty. In contrast with the manufacturer's site-warehouses transportation, which involves long paths, in this case the paths are mainly includes the urban and suburban streets. Two common strategies to face this type of transportation time uncertainty are as follows:

1. Flexible and quick transportation at higher costs, including:
   a. Using more trucks and re-routing
   b. Less than truckload quick shipments
   c. Network re-design with more nodes (warehouses) close to the retail centers
2. Holding more inventories by the retailers to decrease the probability of under-stocking due to delays.

In the first strategy, the distributor absorbs the uncertainties and allows the retailer to be more efficient. On the other hand, in the second strategy, the distributor passes on the uncertainties, and therefore, the retailer must respond to the lead time uncertainties by holding more inventories. For example, consider a retailer with its own warehouses with free capacity. In this situation, the retailer has the ability to hold more inventory and the second strategy is possible. Often, however, retailers are located in urban areas where this option is less feasible due to the lack of warehouse space and the high rental rate. Therefore, the choice between these two options is not so open, and there are some limitations that make only one option feasible. These limitations are present in all the strategies we have discussed in this chapter.

The distributor's use of flexible and quick transportation modes increases its cost. If the distributor's higher costs are not compensated, then the distributor refuses to implement this strategy. Implementing this strategy by the distributor in an uncertain environment makes the SC more responsive and, according to the strategic fit model, increases the profitability of the whole SC. It is more beneficial for all the SC members to convince the distributor to implement the strategy. The distributor, as an economic entity, implements the strategy that maximizes its own profitability. Determining parameters of the distributor's optimal transportation strategy requires the coordinated decision making. Coordinated decision making on a distributor transportation strategy must be followed by an adequate incentive scheme to guarantee a win-win situation.

Where the first strategy introduced is not applicable, the second alternative strategy can be applied to neutralize the transportation time uncertainty. When the retailers have enough storage space and the inventory holding costs are low, then the second strategy may be more profitable than the first strategy. In this situation, despite the retailers' irregular and delayed replenishments, the shortages are kept under control by holding more inventory in the retailers' sites. Received orders are filled from the retailers' stock. In this case, the retailers, by responding to the lead time uncertainty, allow the distributor to be more efficient. Using incentive schemes such as discounts and delays in payments can encourage the retailer to be committed to the coordinated decisions. Analytical models must be developed to determine the parameters of the coordination model and the relative incentive schemes.

3.3.3 Manufacturer's capacity uncertainty

One type of uncertainty that is often studied in the SC literature is the uncertainty associated with the production process. Most of the previous studies in this field consider the capacity constraints of the manufacturer. Uncertain constraints on production capacity where the manufacturer faces unpredictable capacity reduction (UCR), is the main concern of this section. A variety of reasons, such as random power cuts, machinery breakdowns, can cause the UCR in the manufacturers' site. Occurrences of UCR in successive periods disturb the product flow through the SC. This type of uncertainty mainly disturbs the relations between the manufacturers and distributor. The procurement process of the distributor can be seriously disordered due to the inability of manufacturer to satisfy the distributor's orders in a timely manner. The variance of the units per time unit during a certain period can be defined as a quantitative measure of the UCR. One or more manufacturers can experience UCR in their production lines simultaneously. If fluctuations in capacity occur in several manufacturers' sites concurrently, then their harmful effects will be reinforced.

As the capacity uncertainty is associated with the manufacturers, it is possible for each manufacturer to stop the propagation of uncertainty toward the downstream members by implementing the appropriate strategies. On the other hand, it is possible for each manufacturer to pass on the uncertainty by taking no action. In this situation, to maintain the SC responsiveness at a reasonable level, the downstream members (distributor or retailers) must neutralize the uncertainty. In other words, the customers should not sense the uncertainties; therefore, the imposed uncertainty must be neutralized either at the point of creation or by the downstream members. In this case, the manufacturers' sites are the points of creation, so the manufacturers, distributor, and retailers are possible options for neutralizing the uncertainty effect. Several strategies can be implemented facing this uncertainty to maintain the SC responsiveness at a reasonable level:

1. Founding additional manufacturing sites
2. Investment in excess capacity in the current manufacturers' sites
3. Outsourcing some part of the production process by the manufacturers
4. Holding more finished product at the manufacturers' sites
5. Holding more inventory in the distributor's sites
6. Holding more inventory in the retailers' sites

Depending on the uncertainty level and the SC conditions, one or more of the above options can be implemented. If the first four options are selected, then the uncertainty is neutralized at the point of creation by the manufacturer. If the last two options are selected, then the manufacturers pass on the uncertainty and the distributor or retailers have the responsibility of absorbing the uncertainties.

In the first strategy, increasing the numbers of manufacturers' sites can neutralize the impact of UCR. In this situation, if one site faces UCR, then other reserved manufacturing sites can compensate for the lack of capacity at the affected site by slightly increasing their production rates. The second strategy emphasizes providing more capacity to overcome the possible UCR occurrences. In this case, the utilization rate in the normal periods decrease, but in the UCR periods, the lower capacity is replaced by extra capacity. According to the third strategy, a part of the production line that experiences much of the UCR is outsourced to the third parties during the critical periods, often at higher costs. The fourth strategy neutralizes the impact of uncertainty by holding more finished goods at the manufacturers' sites. In this case, despite the output reduction in the production line at critical periods, the distributor's orders are met directly from the stock; therefore, the uncertainty propagation is stopped. Although implementing each of the first four strategies increases the SC responsiveness and the sales volume, it imposes more costs on the manufacturers. The manufacturers, by implementing the above strategies (at a cost), can increase the profitability of the whole SC. The manufacturers' participation depends on improving their profitability. Hence, to guarantee the manufacturers' participation, the other members should share the extra benefits resulting from the coordinated decision making with the manufacturers to create a win-win situation.

On the other hand, the distributor and retailers are responsible for implementing the fifth and sixth strategies, respectively. In implementing the fifth strategy, the manufacturer allows the uncertainty to pass and the distributor is responsible for absorbing the uncertainty. In this situation, the distributor receives its orders with an uncertain delay due to the UCR in the manufacturers' site, but the distributor meets the retailers' orders on time from its stock. In other words, the distributor absorbs the uncertainties by keeping more inventories and thus allows the manufacturer and retailers to operate efficiently.

If the sixth strategy is implemented, then both the manufacturer and distributor allow the uncertainty to pass downstream to the retail level. Because passing uncertainty on to customers causes serious damage to the SC's responsiveness level, the retailers must protect the customers from experiencing the uncertainty. In this case, the retailers meet the customers' orders on time from their own held inventory. The retailer's inventory serves as a buffer to absorb the uncertainty. In the fifth and sixth cases, the distributor and retailers incur more costs, respectively. The commitment of both the distributor and retailers to the coordinated strategy depends on their receiving sufficient incentives from the other SC members.
In the real world cases, mathematical modeling of each of the abovementioned six strategies is used to show which is most suitable for a particular application.

3.3.4 Suppliers' lead time uncertainty

Supplier lead time uncertainty can be defined as the unpredictable delays in delivery of raw material from the suppliers to the manufacturers. When a manufacturer places an order, the ordered batches will be delivered after an uncertain time period. Delays in procurement in the manufacturers' sites can cause the production line to shut down temporarily. In turn, shutting down the production line causes disturbances in the timely shipments to the distributor warehouses, damages the retailer's inventory system, and finally decreases the customer service level. We propose two simple strategies in the case of supplier lead time uncertainty:

1. Holding more volumes of raw materials at the manufacturers' sites
2. Shared Suppliers Between Manufacturers (SSBM)

If there is only one supplier and its lead time is uncertain, then there is no choice except to hold more raw materials at the manufacturers' sites to evade the production line downtime. Another option, especially in the case of high inventory holding costs, is multiple sourcing. In this case, to mitigate the risk of supplier delays, the structure of the SC is modified. Each manufacturer must have multiple sources of raw materials to avoid the risk of procurements delays. In the real world, however, the existence of multiple suppliers decreases the manufacturer's order volumes from each supplier. In this situation, the manufacturer is not a privileged customer for the suppliers. Therefore, despite contracting with multiple suppliers, delays frequently occur. On the other hand, contracting with only one supplier increases the probability of production line shutting down due to supply uncertainty. In addition, contracting with only one supplier also destroys the competitiveness between suppliers, which causes the supplier performance to decline over time. We propose the SSBM structure as an appropriate strategy. The SSBM structure is a supply strategy that is not subject to these problems. According to the SSBM strategy, each manufacturer has only one primary supplier, but in the case of delays from the primary supplier, its order can be supplied from one of the other manufacturers' primary suppliers. Figure 4 shows the SSBM structure. Because each manufacturer usually is located near its own supplier, receiving the orders from another supplier imposes more shipment costs in the SSBM structure, but the shortages will be decreased. The manufacturer is charged for the additional shipment costs. The SSBM structure has the following benefits:

1. Preserving the competitiveness between suppliers
2. Each manufacturer is a highly privileged customer of its supplier
3. Decreasing the risk of the production line shutting down
4. Smoothing the flow of materials throughout the SC

As in the previous cases, in this situation also one member (manufacturer) responds to the uncertainty at a cost. Other members should compensate the manufacturers to create a win-win situation. Coordinated decision making in supplying the raw materials with appropriate incentive schemes creates more benefits for all SC members.

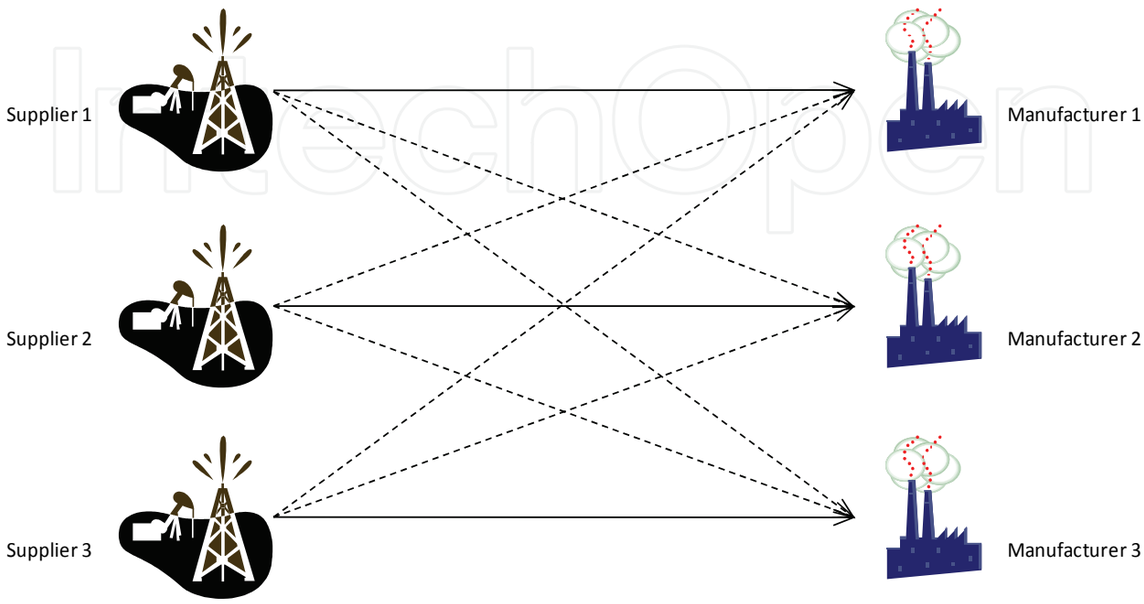

Fig. 4. Proposed SSBM structure

4. Conclusions

In this chapter, we have discussed the concept of strategic fit in supply chain management. We have seen that alignment between competitive and SC strategies can be achieved by coordinated decision making. Four major types of uncertainties that result from the chosen competitive strategy were investigated, including customer demand uncertainty, transportation time uncertainty, manufacturers' capacity uncertainty, and supplier lead time uncertainty. According to the strategic fit model, in highly turbulent environments with high level of uncertainty it is essential for the SC to focus on responsiveness to avoid losing customers. When the environment is uncertain, the responsiveness level of the SC decreases and the customers are attracted by the competitors. Therefore, the sales volume of the chain decreases, and all the SC members incur loses.

Appropriate strategies countering each type of uncertainty were examined. Depending on the member of the supply chain that encounters the uncertainty and the uncertainty type, the coping strategies have different characteristics. All of the strategies introduced in this chapter have some points of similarity:

1. All of the strategies require coordinated decision making
2. All of the strategies require an incentive scheme for the member who implements the strategy
3. Implementing each of the strategies means absorbing the uncertainty
4. Most of the uncertainties can be absorbed at the point of creation or with the assistance of downstream members.

In this way, we discussed the fact that achieving strategic fit requires coordinated decision making along with adequate incentive schemes. Incentive schemes guarantee the SC members' commitment to coordinated decisions. Finally, this chapter provides a conceptual framework for achieving better fit between strategies under various conditions. Developing the mathematical models is left as a topic for future study.

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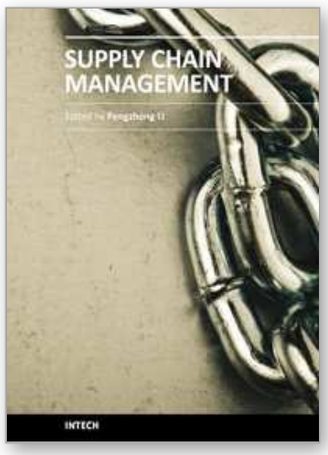

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The purpose of supply chain management is to make production system manage production process, improve customer satisfaction and reduce total work cost. With indubitable significance, supply chain management attracts extensive attention from businesses and academic scholars. Many important research findings and results had been achieved. Research work of supply chain management involves all activities and processes including planning, coordination, operation, control and optimization of the whole supply chain system. This book presents a collection of recent contributions of new methods and innovative ideas from the worldwide researchers. It is aimed at providing a helpful reference of new ideas, original results and practical experiences regarding this highly up-to-date field for researchers, scientists, engineers and students interested in supply chain management.

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