

Analysis of Supply Chain Information Value and Comparative Study of Information Transmission Mode Based on Participants

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ABSTRACT: In the paper, related research results of domestic and foreign scholars about supply chain information, client demand satisfaction and cost reduction are reviewed in the perspective of SCM. Information value in supply chain is analyzed. Supply chain information collection mode, rarely related in the study, is classified: independent information collection by manufacturer, information collection and delivery to manufacturer by distributor and information collection by the third party service provider. Advantages and disadvantages are analyzed on the basis with certain reference value.

KEYWORD: Supply chain; Value of information; Transmission mode

1 INTRODUCTION

Supply chain management refers to all processes of maximizing supply chain operation with the minimal cost from procurement to satisfaction of final clients. Supply chain is a functional network chain structure model connecting suppliers, manufacturers, distributors, retailers and final users into a whole around core enterprises through control by information flow, logistics and capital flow, including raw material procurement, intermediate products and final products production, and product delivery to customers through sales network [1]. It is logistics chain, information chain and capital chain connecting suppliers to users on one hand, it also belongs to a value-added chain on the other hand. Value of materials can be increased on supply chain due to processing, packaging, transportation and other processes, thereby bringing income to related enterprises. One of essences in supply chain management theory is coordination among members in the supply chain. The best supply chain performance and beneficial competitive advantages can be obtained through close coordination and collaboration among members on the supply chain. Effective information transmission is key factor to coordinate supply chain network (SCN). Dispatching, delivery or manufacturing information can be distributed to related mechanisms in actual operation aiming at JTT production process in production link, or continuous replenishment program (CRP) and rapid response process in retail link. Therefore, coordination and operation of the

supply chain are established on the basis of enterprise high-quality information transmission and sharing on all nodes. Supply contracts and information sharing have become key factors of enterprise production plan and inventory control decision-making of members on the supply chain [2].

Since Forrester's Research found that demand information is fluctuated and amplified in the process of transmission from downstream part to upstream part, the aspect is further analyzed and studied in a lot of literature. Steman's Beer Distribution Game vividly reveals that incapable communication of information is an important reason for amplifying orders and inventory of node enterprises. Production fluctuations are caused by fluctuation and amplification phenomena of orders and inventory, thereby leading to uneven production capacity, production capacity shortage or surplus, production cost increase and inventory maintenance cost. Total cost of the entire supply chain is increased. Long response cycle of the whole supply chain can be caused due to delay of order information transmission time and advancement on logistics. Lee [3] deeply studied the phenomenon, which is defined as Bullwhip Effect, and he further analyzed cause of bullwhip effect. Many researchers [4-5] continued to explore how to weaken and eliminate bullwhip effect through in-depth study of bullwhip effect. Timely and effective information is achieved, and it one of methods for effectively weakening bullwhip effect, which are proposed by many scholars.

2 ANALYSIS OF SUPPLY CHAIN INFORMATION VALUE

Timely access and immediate transmission of information are foundations for realizing supply chain management. Uncertainty of the whole supply chain can be lowered, and supply chain efficiency can be improved through effective information transmission. Value can be fully embodied through highly sharing information in the supply chain. Related studies mainly focus on bullwhip effect. Lee et al. [6-7] studied value of information sharing through one two-stage supply chain model. Study indicates that inventory levels and stock costs of manufacturer can be effectively lowered by distributors and whole-sellers through information sharing. Sharing of customer demand information is one of main strategies for eliminating bullwhip effect. Huang [8] further proved that distributors and whole-sellers can effectively lower inventory and replenishment quantity by information sharing through a four-stage supply chain model, and manufacturer can reduce replenishment. Yu [9] found that pareto improvement of the whole supply chain can be caused with improvement of information sharing level aiming at different forms of information sharing through analyzing a two-stage supply distributed supply chain, and manufacturers can reduce inventory levels and save cost especially. Cachon[10] discovers that supply chain using information sharing strategy is averagely lowered by 2.2% compared with supply chain using traditional information strategy through sharing research on demand and inventory information, and the lowering degree can be up to 12.1%.

Domestic scholar-Hou Shiwang [11] considers a two-stage serial supply chain and models of a manufacturer and retailers. Simulation analysis discovers that demand correlation coefficient, demand fluctuation size, supply advance period, inventory cost, stock loss cost, etc. are factors affecting supply chain information sharing, wherein demand correlation coefficient and demand fluctuation size have the greatest influence, the former can save inventory cost by 60%. Jing Huaiming studies inventory information sharing of a two-stage supply and found that supply chain service level has been significantly improved, the stability has been strengthened, improvement degree of supply chain value depends on plan service level as well as the value between variance and mean value under the condition of different demands.

In summary, information sharing can effectively reduce fluctuation amplification phenomenon in the process that end-consumption demand information is transmitted upwards along the supply chain. Therefore, node members on the supply chain can arrange scientific and rational production operation and inventory distribution plan according to shared

information. Logistics quantity and flowing direction can be controlled through information transmission of all nodes in the supply chain, thereby directly reducing supply chain operation cost and making prominent contribution in the aspects of vendor managed inventory (VMI), effective customer response (ECR), quick response (QR), etc. However, previous studies are rarely related to discussion of information transmission and obtaining mode in supply chain. On the basis, influence of different information obtaining modes on total cost of supply chain can be explored in the paper respectively in the aspects of manufacturer independent acquisition of market information, seller collection of information and supply to manufacturer, information collection and transfer to manufacturer by a third party (TP), etc. Quantitative analysis is conducted in order to provide basis for effective and rational coordination.

3 INFORMATION TRANSMISSION MODE

In the paper, a typical two-stage supply chain is proposed. The supply chain is only composed of one producer and one distributor. Manufacturer is responsible for manufacturing products, and the distributor is responsible for selling products. Information acquisition in supply chain: manufacturer (M), distributor (D) and third-party (TP) can form three typical modes of obtaining information in supply chain according to different participants: independent market information acquisition by producer (CM mode); information collection and supply to manufacturer by seller (CDM mode) as well as information collection and transfer to manufacturer by a third party (TP). Concrete model can be described next respectively aiming at various information acquisition modes.

3.1 *Manufacturer is responsible for information collection.*

Manufacturer is responsible for the information collection mode that the manufacturer itself is responsible for collecting market information from customers and timely sharing the information to downstream distributor. Distributor determines the order quantity according to own stock holdings and market demand information. The information can be transmitted to manufacturer. The manufacturer can arrange production plan and control inventory accordingly. Concrete process is shown in figure 1.

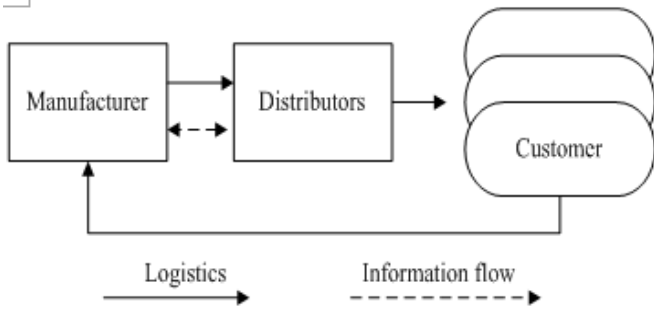


Figure 1. CM information transfer mode

3.2 Information Collection by Distributor

The so-called information collection mode by distributor refers that the distributor stores collected market information and inventory information in own database system, and the information is shared with manufacturers in real time, thereby quickly and easily realizing information transmission, and assisting manufacturer in decision-making control. Concrete flow is shown in figure 2.

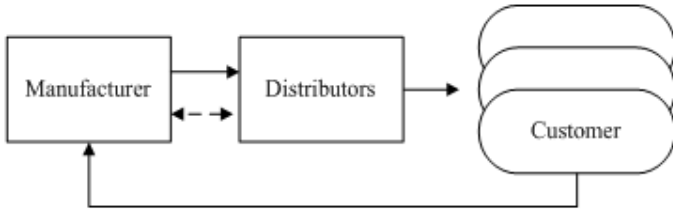


Figure 2. CDM information transfer mode

3.3 Information Collection by Third Party

Information collection mode by third party refers to a service mode that enterprises collect and store information except partner enterprises in the supply chain, enterprises on the whole supply chain can be served. It is required that specific information is provided for users according to specific requirements within specific time section. Concrete flow is shown in figure 3.

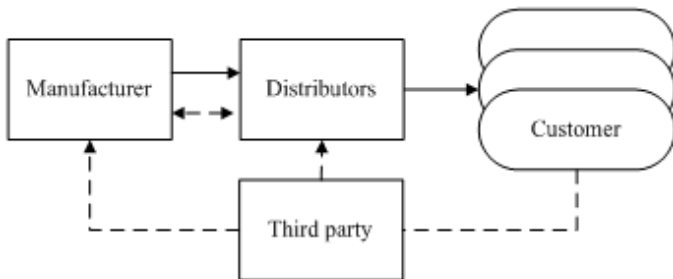


Figure 3. CTPM information transfer mode

4 ANALYSIS OF THREE INFORMATION COLLECTION MODES

The following definitions are made in the paper for modeling needs: p is retail price, w is whole-

sale price given by manufacturer to distributor, c_0 is unit cost of manufacturer, c is unit product distribution cost of distributor, c_i refers to information collection cost of unit product under i information collection mode. π_i^j refers to profit obtained by party i under j information collection mode. It is assumed that manufacturer production capacity is not limited by resources on the market without complete competition. Market demand can be timely met. It is set that product demand is linear function of price in order to maintain generality: $Q = a - bp$, wherein Q is market demand, and a , and b are greater than 0.

Distributors are only responsible for sales under CM information acquisition mode, and profits obtained by the distributors are shown as follows:

$$\pi_D^{CM} = Q \cdot (p - w - c) \quad (1)$$

$Q = Q(p)$, therefore the conditions for maximizing distributor profit is $\partial \pi_D^{CM} / \partial p = 0$,

$$p^{CM} = (a + bw + bc) / 2b \quad (2)$$

Manufacturer can independently collect market information under CM mode. It is set that unit product information collection cost is c_M , therefore the profit can be expressed as follows:

$$\pi_M^{CM} = Q \cdot (w - c_0 - c_M) \quad (3)$$

Since whole-sale price w is influence factor of sales Q , π_M^{CM} corresponds to w for obtaining partial derivability, $\partial \pi_M^{CM} / \partial w = 0$ is made, and the follows can be obtained:

$$w^{CM} = [a + b(c_0 + c_M - c)] / 2b \quad (4)$$

It can be added into formula (2), and the follows can be obtained:

$$p^{CM} = [3a + b(c_0 + c_M + c)] / 4b \quad (5)$$

Formulas (4) and (5) are added into formulas (1) and (3), and total profit of supply chain under CM mode can be obtained as follows:

$$\pi_{D+M}^{CM} = 3[a - b(c_0 + c + c_M)]^2 / 16b. \quad (6)$$

w^{CDM} , p^{CDM} , π_{D+M}^{CDM} and w^{CTPM} , p^{CTPM} and π_{D+M}^{CTPM} can be obtained, which is similar to the above method. Concrete condition is shown in table 1:

Table 1. Prices-Profits in Different Modes

Transmission Mode	Optimal value		
	w	p	π_{D+H}
CM	$\frac{a+b(c_0+c_H-c)}{2b}$	$\frac{3a+b(c_0+c_H+c)}{4b}$	$\frac{3[a-b(c_0+c_H+c)]^2}{16b}$
CDM	$\frac{a+b(2c_0+c_0-c_H-c)}{2b}$	$\frac{3a+b(c_0+c_{DM}+c)}{4b}$	$\frac{3[a-b(c_0+c_{DM}+c)]^2}{16b}$
CTPM	$\frac{a+b(c_0+c_{TP}-c)}{2b}$	$\frac{3a+b(c_0+c_{TP}+c)}{4b}$	$\frac{3[a-b(c_0+c_{TP}+c)]^2}{16b}$

5 CONCLUSION

In general, core competence of the manufacturer lies in producing satisfied products in line with customer demand with low cost advantage. Its market information is mainly obtained from two parts: one is order quantity of distributor, and the other is information obtained by own market investigation. 'Bullwhip effect', information distortion and time delay risks are available. Unit product information collection has larger cost, thereby leading to too high product wholesales price, improving sales price, reducing demand, and lowering supply chain profit. aiming at distributor, When the product is sold, Consumer preferences as well as market supply and demand can be comprehended. In addition, own inventory condition can be comprehended accurately. Therefore, manufacturer can be obtain more accurate market information easily through effective incentives on distributor. Comparatively, distributor information transmission has obvious advantages. Information collection has lower cost as a professional third-party enterprise due to advantages in terms of professionalism, organizational structure, etc. Of course, there are asymmetric information and moral risk hazard. Effective restraints are demanded for ensuring accuracy of provided information. However, information transmission mode of the third party is beneficial for integrating and utilizing resources. Professional advantages of the third party can be converted into increase of overall profits of the supply chain.

In the paper, three information collection modes of CM, CDM and CTPM are constructed on the basis of analyzing information value of supply chain aiming at information collection mode. Preliminary theoretical basis is provided for information obtaining mode of enterprise. Of course, the model

and the reasoning of the paper are established on the basis of certain assumptions. If industry supply chain is located in the initial establishment stage at present, establishment of strategic partnerships with members of the supply chain is one of the effective means to obtain information. It is recommended that CM and CDM modes should be adopted. However, if markets of some industries are highly mature, such as automobile, mobile phones and other industries, mode of the third party should be adopted as the best choice.

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