

Key Questions in Multi-Echelon Supply Chain Management

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Abstract— Supply chain management is one of the essential business functions for a business entity to operate and sustain specially in the globalized business environment these days. Managers responsible for supply chain management should be aware of its importance and able to address the right problems relevant in their organization. As in other management endeavors, successful supply chain management usually starts with identifying the key questions which lead to the underlying issues in their supply chain. In this paper, we consider business players in various positions of a multi-echelon supply chain. Depending on their roles in the supply chain, those players probably have different interests, goals, issues, and questions to be asked. We observe the general relationships between the business players in a multi-echelon supply chain and suggest the key questions to be addressed for efficient supply chain management.

Keywords— Supply chain management; supply contract

I. INTRODUCTION

As its name implies, a supply chain consists of several operations played by different entities. Typical entities playing supply chain operations include seller, producer, and supplier. Each player makes several decisions to perform their roles efficiently. Since the decision usually has impact not only the player who makes it but also other players in the supply chain, management of the supply chain inevitably involves many complicated problems. Understanding how the entire supply chain operates is very important to avoid making myopic decision making which only considers a part of the supply chain and/or short-term effects of the decisions. In this paper, we discuss the fundamental issues in end-to-end supply chain management and end up with key questions which can be countered by typical players in a multi-echelon supply chain.

II. CUSTOMER SERVICE LEVEL

A. What matters is speed!

It is the era of speed. By taking express train in Seoul, the capitol of Korea, you can get to Busan, the second largest city in Korea located 417km south of Seoul, in about two hours by express train. By hitting on the four-way expressway road, you can reach anywhere in the country in half a day. Transportation is not the only arear where speed matters these days. The world's highest level of high-speed Internet penetration in Korea makes it easy and quick to access the information you want at any time.

A well-developed transportation and communication network provide various convenient services to people's daily life. A typical example is a courier service. In the past, it took several days to send and receive parcels and had to go to the

post office in person. Now, any item is delivered to your home within a few days after ordering. It is also very convenient to make an order itself. All you have to do is search the Internet for the product you want to purchase and enter information such as delivery address. In the past, you had to go to the store to find the items you liked, which took much time. Buying things has become so convenient and quick.

When the environment changes, people change too. In the era of speed people get impatient. Those letters that used to take days to send and receive are now almost disappeared. Some people miss the warmth of the handwritten letters, but they are too slow to survive these days. Almost all courier companies promote next-day or even same-day delivery. Shipping tracking is now an essential feature of any online shopping mall. Your order should arrive at least the next day and you should be able to see where it is and what time it is expected to be delivered. Providing these kinds of services are very essential in most businesses to win and survive competitions. Otherwise, customers will turn away. The customer is king. That's true. No matter how good a product is, what is the use if customers do not find it attractive? The seller must satisfy the customer's needs.

One of the virtues customers expect from service providers is speed. "The product is not bad, but the delivery was too late." A customer comment like this has as bad a negative impact as one saying "There is a problem with the product." In order to satisfy customers, i.e. to increase the level of customer service, it is necessary to reduce the time it takes for delivery. If the customer service level is high, customers will purchase the product in the future, and the reputation will improve, which will attract more customers. On the other hand, the longer the delivery time, the lower the level of service perceived by customers. If he/she receives a late delivery, the customer will never order again, and your reputation will suffer. This is where the seller's concerns begin. As soon as receiving orders, the seller wants to have no problems with shipping. To do so, the seller must always have the product they have got an order for. However, is this possible?

B. Stock is necessary but expensive!

In general, sellers always have a certain level of inventory. Inventory is a set of products stored in advance for sale in future. If we have a lot of inventory, we can ship the product immediately when the customer places an order. In other words, the level of customer service will increase. On the other hand, if inventory is low or the seller is out of stock, there may be not enough products to ship when a customer

places an order. In this case, the customer service level decreases.

The seller cannot necessarily have a lot of inventory just to increase the level of customer service. Because inventory is money. Again, inventory is a product that is bought from a producer in advance for sale to a customer in the future. It takes a lot of money to hold a lot of inventory, and this money is only recovered when the stock is sold. In addition, if he has a lot of inventory which has not been sold eventually, the seller suffers a huge loss. Therefore, from the seller's point of view, the smaller the inventory is, the more profit he gets. However, as we mentioned earlier, low inventory means lower customer service levels. The seller cannot simply keep inventory low. In the end, inventory is a necessary evil that sellers want to avoid but cannot.

C. Forecasting is always wrong!

If the seller cannot live without it at all, what is the appropriate level of inventory? The appropriate inventory level depends on the customer's order volume. For selling products with high customer orders, the seller probably needs to have a lot of inventory. For products with low customer orders, a small amount of inventory would be enough. What if the seller knew in advance how many customers would order? Of course, the seller only needs to have just enough inventory for the customers' order. This will increase the level of customer service while eliminating unnecessary inventory. But how does the seller know when and how much customers place orders?

Wouldn't it be great if the seller could know exactly what's going to happen in the future? If you know it is going to rain tomorrow, you would not be disappointed without an umbrella. What if you knew in advance whether the stock market will rise or fall tomorrow? Just thinking about it makes us happy. Many people are interested in what will happen in the future and want to know in advance. One of the things that seller is interested in and wants to know in advance is customer demand. Products that are in high demand, that is, products that will sell a lot, need to be stocked in advance to prevent them from being sold out due to lack of products. Conversely, low-demand products require lower inventory levels to reduce losses from unsold inventory.

No one can predict tomorrow's stock price in advance. But anyone interested in stocks often makes predictions. The stock price will go up today then come down tomorrow, it will rise until this month then the trend will break next month, it will stay down until the end of this year then it will turn up from next year, etc. There are several ways to make this prediction. A predictor can use experience, make predictions by considering various factors related to stock prices, or predict future stock prices by statistically analyzing past stock price data.

These various techniques are also used by sellers to predict customer demand. A seller can predict which product will sell how much and when from past sales experience. Sales department employees who deal directly with customers and take orders are particularly good at making these predictions. In addition, it is possible to predict future demand by analyzing historical sales data using various statistical techniques. For example, if sales volume has been continuously increasing in the past, it would be reasonable to

predict that demand will increase in the future. In addition, it can be predicted that the demand for products in the summer of this year will also increase if the products sold a lot in the summer in July and August every year.

Demand forecasts are made in order to adjust inventory levels in line with projected future sales, but in most cases the actual demand will be different from the forecast. For example, a product that is predicted to receive 100 orders may sell only 90, or it may have 110 orders and not fulfill 10 orders. It rarely happens that the exact 100 orders come in as predicted. It is just as stock prices rarely exactly match predictions. If so, why do we make false predictions anyway? Here are key questions regarding demand forecasting:

- What are the appropriate forecasting techniques?
- How can we measure the accuracy or level of error of prediction?

III. PRODUCTION PLAN AND EXECUTION

A. Plans change!

The seller is supplied from the wholesaler or directly produces the products it sells. The wholesaler again is supplied the product from the producer (if the seller directly produces the product, it does not go through the wholesaler because the seller is the producer). It takes a certain amount of time for a producer to produce a product. The seller must request the production of the product in advance in consideration of this time so that the product can be supplied at the desired time. When the seller receives the customer's order and requests the producer to produce the product, the delivery is delayed by the production time. After all, the seller has to predict the customer's order in advance and request the supply of the product from the producer before receiving the customer's order.

Although the seller's demand forecast information plays an important role when establishing a production plan, the demand forecast does not necessarily become a production plan. Producers also have their own circumstances to consider. An example is production capacity. In order to produce products, resources such as production facilities and labor are required, which are bound to have limitations. That is, the maximum amount that can be produced during a certain period is limited. If the demand forecast is higher than this limited production capacity, it will have to be planned to start production early. For example, if the demand forecast for June is 500 pieces and the monthly production capacity is 300 pieces, it is impossible to produce all 500 pieces in June. The producer needs to make a plan to produce 200 pieces in May in advance.

It is very important to check the production performance to ensure that the production is carried out according to the plan. This is because, as in most cases of demand forecasting, there are often differences between planning and execution. The cause of the differences is mainly that the somethings happen which are not expected during planning. Examples of such unexpected things include production equipment breakdown and extended production time. If there is such a discrepancy between the plan and the actual performance, the plan will be modified so that the product can be delivered to the seller as originally planned. In addition, if demand forecast changes or

an emergency order occurs, the production plan will be changed.

- What should be considered when establishing a production plan?
- When and how much is it efficient to produce the ordered quantity?

B. *Let's live together!*

In order to produce a product according to the plan, there must be enough resources for production, such as materials, equipment, and manpower. If resources are insufficient, planned production cannot be performed, resulting in delayed product supply, which ultimately leads to customer dissatisfaction with adverse impacts on seller and producer. Ensuring that the necessary resources are supplied in a timely manner is also an important part of supply chain management.

Among the resources required for production, materials are mostly supplied from outside. In order to produce its products, the producer purchases raw materials, parts, and semi-finished products from suppliers. As products become more complex and division of labor develops, the importance of linkages between producer and supplier is growing. The producer on the buying side wants to receive good quality materials at a low price and timely supply, and the supplier on the selling side wants to be able to sell a certain amount or more at a high price.

A conflict of interest between the two sides arises here. Buyers will prefer to buy only the quantity they need when they need it. This is because unnecessary inventory is eliminated if only the quantity used for production is purchased just at the time of production. However, on the side of the material supplier, such a timely supply is a difficult requirement to meet. In general, production is highly volatile because it is determined by customer demand. When the quantity of material orders suddenly increases, the supply side needs a lot of resources such as facilities and manpower, so there is a burden of securing a lot of these resources. On the other hand, if the quantity of orders decreases, the utilization of the secured resources is lowered, which is a loss to the supplier. In terms of price, the buying side wants to be supplied at a lower price, and the selling side wants to supply at a price that guarantees an appropriate profit. The price is the main criterion when a buyer selects a supplier, and it also induces price competition by deliberately selecting multiple suppliers. The more suppliers there are, the more intense the price competition gets and the greater the power of the buyer becomes. Conversely, for materials with fewer suppliers, the bargaining power of the supplier is greater than that of the buyer.

From a long-term perspective, it is desirable that the transaction be made in a way that benefits both the supplier and the buyer. Excessive price reduction worsens the business condition of the supplier, leading to deterioration of quality and delay in delivery, which adversely affects the buyer. This is why it is necessary to guarantee a reasonable profit to suppliers so that the buyer can receive a stable supply of high-quality products. Even if the supplier has the initiative, excessive price increases are highly likely to lead to a decrease in orders for suppliers. It is because buyers consider using alternative materials or seeking other suppliers. In the end, excessive price reduction(increase) may lead to an

improvement in the profit of the buyer(supplier) in the short term, but may lead to a decrease in overall business transactions between them in the long term.

- On what basis should the supplier be selected?
- What should be included in the supply contract?

IV. SUPPLY CHAIN MANAGEMENT

A. *See the forest rather than the trees!*

As mentioned earlier, before selling a product to a customer, various activities occur through several stages. The customer's order must be received, processed and shipped (sales). To do this, it is necessary to manage the right inventory in the right place and transport it to the place where it is needed (logistics). The manufacturer has to make a product with a plan reflecting the customer's order (production), and the necessary materials are procured from the supplier (purchase). This series of processes is called a supply chain, and since several companies are usually involved in this process, it is not easy to manage the supply chain from a centralized perspective. Companies tend to make decisions in the direction of maximizing their own profits, which leads to inefficiencies in the overall supply chain.

A typical example of inefficiency in the supply chain is the bullwhip effect. Suppose a seller at one end of the supply chain predicts a customer demand of 100. Assume that the seller orders 110 from the producer with a 10% surplus (called safety stock) in case the customer's demand is higher than this forecast. The producer received 110 orders and planned to produce a total of 121 with a 10% surplus in consideration of the increase in future orders. If one material is needed to produce one part, the producer will make a purchase request for 121 materials to the supplier. If the supplier also produces an additional 10% spare in case the purchase volume increases in the future, about 133 materials will be produced. In the end, when 100 of customers' demand goes through the supply chain and reaches the supplier, it increases by about 33% to 133. This is called the bullwhip effect, as it is similar to raising and lowering the handle of the whip a little, and the wave gets bigger, and the tip of the whip goes up and down greatly. This whiplash effect creates excessive inventory in the supply chain, leading to inefficiency. As expected by the seller, even if customer demand increases by 10% more than expected, resulting in 110 pieces, producers and suppliers will have extra inventory. Moreover, when demand is less than expected, the excess inventory becomes larger, and the inefficiency of unnecessary inventory increases along the supply chain.

To prevent such inefficiencies, decisions must be made from the perspective of the entire supply chain. Above all, it is important to make the information necessary for decision-making available. In the example of the whiplash effect, if the producer knew that the seller had predicted the customer's demand as 100, he would not have made a production plan by adding an additional 10% margin to 110 orders, including the seller's safety stock.

- What are the adequate inventory levels throughout the supply chain?
- What information needs to be shared in the supply chain to increase efficiency?

B. What can you see!

Car drivers in these days use a lot of navigation devices. It is convenient to have a navigation system on dashboard. First of all, drivers do not have to worry about going to an unfamiliar destination. Even if the driver knows the route, he can still search on the navigation system to check if there is a faster route. In addition, smarter navigation systems have appeared these days that use real-time traffic information to guide you to your destination quickly, rather than on a nearby route. If you use such a navigation system, you can see at a glance information such as the route from the origin to the destination, traffic congesting, detours, and expected arrival time. It is very convenient. The driver can avoid the tedious waiting while getting stuck in the car. Even if there is a traffic jam, it is less frustrating because he now knows when he is expected to pass out the congesting area. He can answer his friend's call asking when he will arrive with an accurate estimated time of arrival. The waiting friends may be less frustrated too.

This is possible because information related to getting from where I am to my destination is visible using the navigation system. What if there is such a navigation system in the supply chain as well? It would be very convenient to have information about the supply chain at a glance. If there is information such as how many customer orders have been received, how much stock is in each warehouse, how much resources are secured for production, and when and how much material should be supplied from the supplier, the decision making becomes much easier. When a customer inquires about the delivery date of an ordered item, it is possible to respond when it will arrive. Of course, customer satisfaction will increase.

Providing such visibility is the purpose of supply chain management. Managers can easily obtain the information necessary for decision-making so that they can make quick decisions. This increases the agility of the company so that it can quickly adapt to the age of competition. It becomes possible to reduce inventory and shorten the delivery date of customer orders. Efficiency of the supply chain is an essential element for improving corporate competitiveness, especially for global companies with complex supply chains due to the internationalization of their sales networks and production bases.

V. CONCLUDING REMARKS

Each player in a supply chain takes part in a different role and utilizes information to perform their role successfully.

Those questions discussed in this paper help the players in a supply chain identify essential problems to be addressed and finally improve the efficiency of their supply chain. A seller tries to satisfy his customers by fulfill their orders in a timely manner. To improve the customer service level, the seller maintains inventory and conduct forecasting. Gathering and utilizing relevant information is essential for efficient inventory management and demand forecasting. Other players in a supply chain, such as producer and supplier, also need well-managed information to conduct their roles efficiently. These days the success of supply chain management relies more and more on utilizing information abundant in supply chain operations of sales, production, and procurement. Another key success factor in modern supply chain management is customer viewpoint. Regardless of their positions in a supply chain, every player shares the ultimate goal of supply chain management: serving the customers. Making every decision from customer viewpoint will eventually lead to customer satisfaction. Supply chain managers need to look at the questions they are addressing from customer's perspective to get effective solutions.

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