

# *Research on the Causes of Bullwhip Effect in Supply Chain Management and Its Mitigation Countermeasures*

Aijing Feng<sup>1,2,\*</sup>

<sup>1</sup>*School of Business, Shandong Normal University, Jinan, 250014, China*

<sup>2</sup>*Meigu School, Shandong Normal University, Jinan, 250014, China*

*\*Corresponding author*

**Keywords:** Bullwhip benefit; supply chain; demand information; information sharing

**Abstract:** Bullwhip effect in supply chain widely exists in supply chain, which is a phenomenon of demand variation and amplification in supply chain and an image expression of demand information distortion in supply chain. Specifically, the bullwhip effect refers to the fact that when the information flow in the supply chain is transmitted from the end customer to the original supplier, the information is distorted and gradually enlarged due to the inability to effectively share the information, which leads to more and more fluctuations in demand information. Bullwhip effect increases the inventory cost and transportation cost of each subject in the supply chain, which greatly affects the operation level of the supply chain, and even has a serious impact on the economy of the whole country. It has also attracted the attention of many scholars for many years, so alleviating the problem of bullwhip effect is a necessary prerequisite for enterprises to operate normally, provide high-quality products or services and effectively enhance the competitiveness of the supply chain. This paper first expounds the bullwhip effect in the supply chain, and on this basis, deeply analyzes the causes of the bullwhip effect, and puts forward corresponding mitigation countermeasures, so as to reduce the variability of demand in the supply chain, alleviate the bullwhip effect, improve the competitiveness level of the supply chain, and enhance the operational efficiency of the supply chain, so that the main bodies in the supply chain can achieve multi-win.

## 1. Introduction

The market environment has changed from supplier-led to customer-led, and the market environment has changed greatly, thus the idea of supply chain management has arisen [1]. In order to cope with the gradual improvement of market competitiveness of East Asian enterprises such as Japan, European and American enterprises put forward supply chain management [2]. The development of information technology is also promoting the development of supply chain management [3]. As we all know, uncoordinated production and marketing, worthless activities and bullwhip effect are common problems in supply chain management [4].

The phenomenon of demand heresy amplification in supply chain is "whip Effect." Bullwhip effect means that when the information flow in the supply chain is transmitted from the end consumer to the original supplier, the information is distorted and gradually enlarged because the information

cannot be effectively realized, resulting in the fluctuation of demand information expanding upstream along the supply chain. Because its wave shape is like oxtail, it is called bullwhip effect [5]. In short, the three key words of bullwhip effect are demand information, information transmission and step-by-step amplification [6, 7].

When information is transmitted from downstream to upstream in the supply chain, the demand information is distorted, and each subject in the supply chain will have higher inventory to cope with this demand change, which will lead to the increase of production cost, tight cash flow and operating cost, which is not conducive to the long-term survival, sustainable development and the promotion of core competitiveness of enterprises [8-10].

Therefore, it is one of the key factors to explore the causes of bullwhip effect and put forward mitigation countermeasures to ensure the efficient operation of supply chain management, improve the service level and enhance the core competitiveness of enterprises.

## **2. Cause analysis of bullwhip effect**

### **2.1 Demand forecasting**

There is a problem of layer-by-layer correction in demand forecasting in supply chain. Specifically, each subject in the supply chain will take the order data of downstream enterprises as their own reference for market forecast, and at the same time, consider the uncertain factors and modify the forecast value to some extent. When the information is transmitted to the upstream of the supply chain, multi-layer forecast correction appears, and it gradually deviates from the accurate market demand information. When the information finally reaches the most upstream supplier, it is very different from the original demand information, which inevitably produces the bullwhip effect.

### **2.2 Bulk order**

For the sake of inventory safety and the best economic scale, enterprises usually choose to order in bulk. Even if the market demand increases, because of the safety stock, enterprises will not order from suppliers immediately, but will order from suppliers in batches when the stock is close to the lower limit. Because of this, the order quantity of each subject in the supply chain is usually greater than the actual sales volume, which is also one of the causes of the "bullwhip effect".

### **2.3 Fluctuations in prices**

The price of goods will fluctuate due to factors such as price discount, wholesale discount and season. Based on this, in order to reduce the cost of raw materials and improve the net profit, enterprises are often willing to purchase in large quantities in advance, which in turn leads to the purchase volume far exceeding their actual demand. In the end, each subject in the supply chain has an inventory level that exceeds their actual demand, further aggravating the "bullwhip effect".

### **2.4 Shortage game**

When there is an imbalance between production and sales of products in short supply, manufacturers will implement quota rationing in proportion, and sellers will exaggerate their order demand to avoid shortage. This exaggerated order demand will make the cost of supply chain higher and disrupt the original normal plan of supply chain. And when demand decreases, orders will decrease. This shortage game makes demand information more distorted and intensifies the "bullwhip effect".

## **2.5 Supply chain collaboration is low.**

The main bodies in the supply chain have poor cooperation and low degree of cooperation. On the one hand, the degree of information sharing and information exchange among the subjects is limited, and at the same time, the receiver and sender of information have different coding and decoding methods and abilities, and the lack of professional knowledge leads to the distortion and asymmetry of information in the transmission process; On the other hand, some subjects are worried that their confidential information will be leaked to their competitors, resulting in their own interests being damaged. This uncoordinated "internal friction" within the supply chain reduces the operational efficiency and competitiveness of the whole supply chain, which is also one of the reasons for the bullwhip effect. Under the background of global economic integration, all subjects in the supply chain should fully trust each other and strengthen cooperation to achieve "win-win".

## **3. Countermeasures to alleviate bullwhip effect**

To solve the bullwhip effect fundamentally, it is necessary to make the main bodies of the supply chain have the same and common goals, which is generally impossible. In practice, we can make full use of the incentive mechanism to achieve effective information sharing to a greater extent, so as to alleviate the bullwhip effect.

Based on the analysis of the causes of the bullwhip effect, it is considered that the bullwhip effect is related to the interests of all subjects in the supply chain, the attitude of all subjects in the supply chain to information sharing, the ability of information exchange and communication of all subjects in the supply chain, the attributes of the supply chain and other factors. Therefore, it is possible to alleviate the bullwhip effect from the above perspective.

### **3.1 Strengthen cooperation and realize information sharing through incentive mechanism.**

In the actual operation of supply chain management, the implementation of information sharing is more difficult. Only by establishing an incentive mechanism consistent with the goal of information sharing can we stimulate the initiative, autonomy and enthusiasm of all subjects in the supply chain to share information.

In the early stage of information sharing between suppliers and manufacturers, manufacturers can adopt price incentive mechanism to encourage suppliers to join in information sharing in order to obtain stable supply of raw materials. Adopting price incentive mechanism, on the one hand, it not only increases the cost of information sharing for suppliers, but also provides suppliers with certain price subsidies. On the other hand, the reduction of manufacturers' inventory costs and transaction costs guarantees their long-term and stable profits, so this strategy is feasible.

### **3.2 Reduce the fluctuation of demand information through information sharing**

Each subject in the supply chain should raise the awareness of cooperation, actively strengthen cooperation and exchange with upstream and downstream enterprises, and ensure that the information in each link in the supply chain can be transparently shared and exchanged with other links. The main contents of information sharing are inventory information, order information, product information, marketing information, logistics information, etc. Information sharing can effectively reduce the problem of layer-by-layer revision of demand forecast in supply chain, so that the information reaching the most upstream supplier is not much different from the original demand information, effectively avoiding the problem of distortion of demand information and reducing the fluctuation of demand information in the transmission process.

### **3.3 Reduce price fluctuation**

In order to avoid the phenomenon of large-scale hoarding of goods by the demand side, the supplier should adopt the strategy of "low price every day" to reduce price fluctuation so as to generate more stable and real demand.

### **3.4 Shortage avoidance game**

Customers can be classified into key customers, important customers and general customers according to their importance. Give different levels of satisfaction to different levels of customers' order requirements.

When the supply exceeds the demand, ensure that the supply of key customers is sufficient, the supply of important customers is satisfied, and the supply of general customers is satisfied as much as possible, instead of simply implementing quota rationing in proportion, so that the supply chain can reduce a lot of losses. In addition, appropriate punishment measures can be taken for customers' return behaviour, so as to avoid the behaviour of customer shortage game.

### **3.5 Reduce the circulation links in the supply chain**

Obviously, the more circulation links in the supply chain, the more time and cost it takes for products to reach the final consumers from the initial manufacturers, and the greater the bullwhip effect. Reducing the circulation links in the supply chain can shorten the chain length of the supply chain, shorten the distance between suppliers and consumers, reduce the distortion and amplification times and degrees of demand information, and make the demand information obtained by the main bodies of the supply chain more accurate.

### **3.6 Shorten lead time**

Generally speaking, the shorter the order lead time, the more accurate the forecast. Specifically, Stalk and Hout concluded that if the lead time is shortened by 50%, the prediction error will also be reduced by 50% [9]. Due to the uncertainty of the lead time, downstream enterprises will have a big error in demand forecasting. Therefore, the shorter the lead time, the faster the main body in the supply chain will respond and adjust to the market, and the bullwhip effect will be weakened.

### **3.7 Establish a strategic partnership**

By establishing strategic partnership, the subjects in the supply chain trust each other and share information, so that the supply and demand in each stage of the supply chain can be well matched and the costs of both parties can be reduced. For example, if the supplier trusts the retailer's orders and forecasts, the supplier can omit the forecasting link. At the same time, if the retailer trusts the quality and quantity of the supplier, the retailer can omit the inspection and testing link when receiving the goods. Generally speaking, the trust of each subject in the supply chain and good strategic partnership can reduce duplication of work, reduce the cost in the whole supply chain and reduce the adverse effects caused by bullwhip effect.

## **4. Conclusion**

There are many reasons for the bullwhip effect, but the fundamental reason is that the information in the supply chain cannot be effectively shared. Bullwhip effect exists widely in supply chain. At present, we can only weaken and alleviate bullwhip effect, but we can't eradicate it. The mitigation

measures proposed in this paper can reduce the variability of demand in the supply chain, alleviate the bullwhip effect, improve the competitiveness of the supply chain, improve the operational efficiency of the supply chain, and make the main bodies in the supply chain achieve "win-win" in many ways.

How to realize effective information sharing in actual operation is a fundamental measure to alleviate the bullwhip effect, and it is also a major challenge and an important research topic to improve the operation efficiency of supply chain. At present, neural network and intelligent decision-making machine have been applied to solve the bullwhip effect, and I believe that the bullwhip effect can be alleviated to a greater extent in the near future.

For enterprises in the supply chain, they should and must clearly realize the importance of information sharing, and then under the stimulation of incentive mechanism, they should be willing to share information, actively realize information sharing and establish strategic partnerships with their own upstream and downstream enterprises to ensure the sustainable development of enterprises themselves and the whole supply chain.

## Acknowledgement

This was funded by the College Student Innovation Project of Shandong Province (Item Number: S202210445071).

## References

- [1] Shen Houcai, Tao Qing, Chen Yubo. *Supply chain management theory and method*. *China management science*, 2000 (01): 1-9. doi: 10.16381/j.cnki.issn1003-207x. 2000.01.001.
- [2] Chen Yuan. *Cause Analysis of Bullwhip Effect in Supply Chain and Its Solution*. *Management and Technology of Small and Medium-sized Enterprises (next issue)*, 2021(11):149-151.
- [3] Zhai Yuanyuan, Zhang Shuo. *Analysis on the effectiveness of information sharing to alleviate the "bullwhip effect" in the supply chain*. *China Storage and Transportation*, 2021 (10): 119-120. DOI: 10.16301/j.cnki.cn12-1204/f.2021.10.001.100010000001
- [4] Qiao Ziyu. *Analysis of the causes and solutions of "Bullwhip Effect" in supply chain*. *Modern Commerce*, 2018 (01): 132-133. DOI: 10.14097/j.cnki.5392/2018.01.059.
- [5] Ma Zujun, Dai Ying, Wu Zhenye. *Using information sharing to suppress bullwhip effect in supply chain*. *Journal of Southwest Jiaotong University*, 2003(02):204-207.
- [6] Da Qingli, Zhang Qin, Shen Houcai. *Research on Bullwhip Effect in Supply Chain*. *Journal of management sciences in china*, 2003(03):86-93.
- [7] Fu Ye, Zheng Shaolian. *"Bullwhip Effect" in Supply Chain-Analysis of Causes and Countermeasures*. *Journal of industrial engineering and engineering management*, 2002(01):82-83.
- [8] Shao Xiaofeng, Ji Jianhua, Huang Peiqing. *Analysis of Bullwhip Effect in Supply Chain*. *Journal of Donghua University (Natural Science Edition)*, 2001(04):119-124.
- [9] Gu Qiao. *Bullwhip effect in supply chain and its mitigation countermeasures*. *Journal of Wuhan University of Automobile Technology*, 1999(04):73-77.
- [10] Stalk G, Hout T M. *Competing against time: how time-based competition is reshaping global markets*. New York: Free Press. 1990. 43.
- [11] Wu Yuechen, Liu Bo, Fan Lihua. *Study on the origin and inhibition method of cattle whip effect in supply chain*. *China Storage and Transportation*, 2022, No. 267(12): 138-139.DOI:10.16301/j.cnki.cn12-1204/f. 2022.12. 097.