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# How to manage the bullwhip effect in the supply chain :

A case study on Chinese Haier Group

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## **Abstract**

This thesis intended to increase the understanding of bullwhip effect in electrical appliance industry in the Chinese market. In the supply chain management, the bullwhip effect is a phenomenon can never be ignored. The bullwhip effect has being defined as information distortion when orders move form downstream enterprises to the supplier (Lee et al 1997b). The distortion information was amplified step by step, and finally propagates to the enterprise marketing, logistics, manufacture and other fields. The existence of the bullwhip effect weakens the ability to add value and competitiveness of the supply chain. Hence, enterprises must collaborate and jointly mitigate the bullwhip effect to reach groups coexist.

This work focus on the electrical appliance industry in China, and based on the successful experience of the case company, Haier Group, to formulate recommendations. Firstly, this research analysis the four causes of the bullwhip effect: demand forecast, price fluctuations, order quantity and short game (Lee et al 1997a). After analyze these causes, this study begins to identify the impacts which the bullwhip effect bring to the members of supply chains. The most obvious impacts can be defined as inaccurate forecasting, inadequate customer service and high inventory cost. Next, the paper evaluate the measures of Haier implement to dampen the bullwhip effect. Information sharing, the key point to solve the problem has been use in Haier. In addition to this, the Just in Time (JIT) strategy which include JIT purchase, JIT delivery and JIT distribution is another important measure for Haier to achieve the goal of mitigate the bullwhip effect. Overall Every Control and Clear (OEC) management was created by Haier Group and aims to improve the supply chain management, is another countermeasure to deal with the bullwhip effect. Besides, the inventory management also have an important role in gaining the control of bullwhip effect.

In summary, the successful experience on dampening the bullwhip effect of Haier can shine a light for electrical appliance industry in China on solving the similar problem. Information sharing is always the key point to mitigate the bullwhip effect, and related instructions should build to remove the barriers of sharing information.



|  |    |
|--|----|
| <b>1. Introduction</b> .....   | 1  |
| <b>1.1 Background</b> .....  | 1  |
| <b>1.2 Research Focus</b> .....  | 2  |
| <b>1.3 Overall Research Aim and Individual Research Objectives</b> .....                 | 4  |
| <b>1.4 Outline Structures</b> .....  | 6  |
| <b>2. Review of Related Literature</b> .....   | 8  |
| <b>2.1. Introduction</b> .....   | 8  |
| <b>2.2. Methodology of Literature Review</b> .....                                       | 8  |
| <b>2.3 Introductions of bullwhip effect</b> .....  | 8  |
| <b>2.4 Theoretical Framework</b> .....   | 10 |
| <b>2.5 Findings of the Bullwhip Effect</b> .....   | 11 |
| <b>2.5.1 The impacts of bullwhip effect</b> .....  | 11 |
| <b>2.5.2 Counter-measures of the bullwhip effect</b> .....                               | 12 |
| <b>2.5.2.1 Avoiding Multiple Updates</b> .....   | 12 |
| <b>2.5.2.2 Break Order Batches</b> .....   | 13 |
| <b>2.5.2.3 Stabilize Prices</b> .....  | 13 |
| <b>2.5.2.4 Eliminate Gaming in Shortage</b> .....  | 13 |
| <b>2.6 Summarize:</b> .....  | 13 |
| <b>3. Research Methods</b> .....   | 16 |
| <b>3.1 Introduction</b> .....  | 16 |
| <b>3.2 Research strategy</b> .....   | 16 |
| <b>3.3 Data collection</b> .....   | 18 |
| <b>3.4 Framework for Data Analysis</b> .....   | 19 |
| <b>3.5 Limitations and Potential Problems</b> .....                                      | 21 |
| <b>3.5.1 There are lots of data need to be collected and used for the research</b> ..... | 21 |
| <b>3.5.2 Case study cannot answer a large numbers of relevant questions</b> .....        | 21 |
| <b>3.6 Reliability and Validity</b> .....  | 22 |
| <b>4. Findings</b> .....   | 24 |
| <b>4.1 The Background of Haier</b> .....   | 24 |
| <b>4.2 Results from Research</b> .....   | 26 |
| <b>4.2.1 Evaluation of Sales Department</b> .....  | 26 |

|         |   |    |
|---------|---|----|
| 4.2.1.1 | Background of Sales Department .....                                  | 26 |
| 4.2.1.2 | How the Bullwhip Effect Happens.....                                  | 28 |
| 4.2.1.4 | Causes of the Bullwhip Effect .....                                   | 30 |
| 4.2.1.5 | Measures for the Bullwhip Effect .....                                | 31 |
| 4.2.1.6 | Significant Problem and Solution in Reality.....                      | 32 |
| 4.2.2   | Evaluation of Purchase Department .....                               | 34 |
| 4.2.2.1 | Background of Purchase Department .....                               | 34 |
| 4.2.2.2 | Impacts of the Bullwhip Effect.....                                   | 35 |
| 4.2.2.3 | Causes of the Bullwhip Effect .....                                   | 35 |
| 4.2.2.4 | Measures for the Bullwhip Effect .....                                | 37 |
| 4.2.2.5 | Significant Problem and Solution in Reality.....                      | 38 |
| 4.3     | Summarize .....   | 39 |
| 5.      | Analysis .....  | 42 |
| 5.1     | Introduction .....  | 42 |
| 5.2     | The causes of bullwhip effect.....                                    | 42 |
| 5.2.1   | Demand signaling .....  | 43 |
| 5.2.2   | Price fluctuation .....   | 44 |
| 5.2.3   | Order Batching.....   | 45 |
| 5.2.4   | Shortage Game .....   | 46 |
| 5.3     | The impacts of bullwhip effect in electrical appliance industry ..... | 46 |
| 5.4     | Measures to Mitigate the Bullwhip Effect.....                         | 48 |
| 5.4.1   | Information Sharing .....   | 48 |
| 5.4.2   | Just In Time (JIT) .....  | 49 |
| 5.4.2.1 | Just In Time Purchase .....   | 49 |
| 5.4.2.2 | Just In Time Delivery .....   | 50 |
| 5.4.2.3 | Just In Time Distribution .....                                       | 50 |
| 5.4.3   | OEC Management.....   | 51 |
| 5.4.4   | Inventory Management.....   | 51 |
| 6.      | Conclusion.....   | 53 |
| 6.1     | Introduction .....  | 53 |
| 6.2     | Research Objective: Summary of Findings and Conclusion.....           | 53 |
| 6.2.1   | Research Objective 1: Causes of Bullwhip Effect and Its Impacts.....  | 53 |
| 6.2.2   | Objective 2: Measures To Mitigate the Bullwhip Effect .....           | 54 |
| 6.3     | Recommendations .....   | 55 |
| 6.4     | Self- Reflection.....   | 56 |
| 6.5     | Contribution & Suggestion for Further Research .....                  | 56 |
| 7.      | References: .....   | 58 |

**Appendixes:**..... 60

## **1. Introduction**

There is no doubt that no matter what era it is, people are always pursuit of increasingly interests. As time changes, firms have to think about saving more cost to achieve better financial performances instead of simply increasing sales performances than before, recently. Therefore, the importance of building supply chain with high performance while reducing cost has found by more and more firms, currently. Meanwhile, the problems that often show up inside of supply chain and also bring negative impacts for firms are also become increasingly significant. The bullwhip effect, as one of such problem which could not be ignored.

Supply chain is not only a net involving various participators, it is also a value-added chain which aims to bring more benefits to companies with lower cost. Improve the entire supply chain value-added and enhance the competitiveness of the supply chain become the common goal of each nodes enterprise. An efficient supply chain management cannot only help to creating a suitable supply chain, but also bring corporation the competitive advantages. Somehow, no matter how perfect the supply chain management system is, there is still exist a wide variety of difficulties, which could be identified as inaccurate forecasts make it difficult to meet the customers' demand, the opaque information lead to unstable supply, the lack of supply, the unbalance between production and transportation, the high level of inventory and so on. There are so many reasons can cause these problems, one of the main reasons is the bullwhip effect. This phenomenon in the supply chain management is been defined as the variance of orders may be larger than that of sales, and the distortion tends to increase step by step (Lee et al.1997).

### **1.1 Background**

As the description by Lee et al. (1997), the bullwhip effect happens in many companies. The most famous case which happened in Procter & Gamble (P&G) and Hewlett-Packard (HP) provide good understandings of the bullwhip effect. This information distortion was first pointed out by Forrester (1958) in his system dynamics, and he also pointed that the way to tackle is reducing delays in the supply chain (Hussain and Drake, 2011). The most famous "Beer Distribution Game" was reported by Sterman (1989) as an evidence of the bullwhip effect, in this game, players are divide into four groups and each group represent brewer, distributor,

wholesaler and retailer. The four players can only make inventory decisions by the orders from neighboring player, they cannot exchange information with other members. The result of the game show that demand information distortion in supply chain internal transfer due to the asymmetry of information between each node enterprises in the chain in order to maximize their own interests.

The bullwhip effect could easy cause a set of risks gradually, from downstream to upstream, it will affect the operation of the whole supply chain, increase the inventory and waste of resources. Therefore, study the bullwhip effect and eliminate its negative impacts on the supply chain has an important significance. There have different insights on how to mitigating the bullwhip effect according to different researchers. Forrester (1961) hold the view of that the bullwhip effect can be mitigated through modification in behavioral practice, Sterman (1989) have the insight of modification in individual education can help to mitigate the bullwhip effect. While according to Lee et al. (1997), there are four major causes of bullwhip effect: 1. Demand forecast updating, 2. Order batching, 3. Price fluctuation, and 4. Rationing and shortage game. Lee et al. (1997) also suggest attacking the institutional and inter-organization infrastructure and related processes can make for companies to control the bullwhip effect.

Recently, due to the electronic appliance industry of China has significant achievement, the future development of it has attracts increasingly more attentions. That is why this study focuses on electrical appliance industry in China. Electrical appliance industry is one of the fastest growing and the most competitive industries in China, if its supply chain can be managed efficiently, there is no doubt it will make a huge contribution to Chinese market. For such reason, a good performance firm in this area which also full of experiences on dealing with the bullwhip effect are necessary to selected for this study. Haier Electronic Group, as the best and successful firm of this field in China which also has long history and rich experiences in such area is a fairly suitable example for this research. Thus, this study connects related literatures to the actual example of Hair, and explore how Hair do to dampening the bullwhip effect.

## **1.2 Research Focus**

The bullwhip effect is actually exist in supply chain system for reasons and could not disappear even in a rationality lab way. Although there are many counter measures of

bullwhip effect, there is no key to open all lock. Based on different situation, it is better to take different measures. ZARA, the Spanish organization has 650 clothing stores serve around 50 different countries; strict control of its supply chain plays an even greater role in its success (Emerald Strategic Direction 2002). The key point of ZARA's supply chain management is accurate strict control and nearly completes control; make the circulation speed and efficiency of the entire supply chain reach the highest. The order model of ZARA also helps to mitigate the bullwhip effect. ZARA store to take purchase twice a week and the stores will make orders based on existing sales and demands. This would ensure that each order to meet demands in the next few days, order quantity is not great. Through a small amount of order for many times can basically eliminate the adverse impact of order batching, and effectively reduce the bullwhip effect to some extent.

The bullwhip effect can also occur in electrical appliance industry. Unlike other supply chain, the electrical appliance industry supply chain has its own characteristics: firstly, electrical appliance manufacturers have little upstream suppliers. For most large electrical appliances manufacturing enterprises in China, their upstream suppliers are supply raw materials such as steel, copper, aluminum, etc. Secondly, there are many types of products in the supply chain. Electrical appliances are a necessity in people's daily life; it has a considerable number of types, such as: refrigerators, washing machines, air-conditioning, televisions, microwave, etc., and it also includes the home, kitchen, and communications in all aspects of people's daily lives. Thirdly, diversification of the supply chain downstream distributors. China's electrical appliance sales including electrical specialty stores, department stores, household electric appliance chain, brand monopoly, etc. This situation makes the flow of Chinese electrical appliance downstream supply chain complexity. Fourthly, the electrical appliance supply chain subject to seasonal changes significantly. As the two main products of the home appliance industry, refrigerators and air conditioning supply chain is affected by seasonality greatly, from a clear sales season and off-season. Since China joined the World Trade Organization (WTO), Chinese electrical appliance industry became the manufacturing center of world electrical appliance industry. Although Chinese electrical appliance industry has an advantage in the manufacturing cost, but it also have a high transaction cost. The high transaction cost not only weaken the profit margin of this industry, but also affects the increase of

Chinese electrical appliance industry's operate efficiency and its competition in a large part.

A major focus of this research will concentrate on the management of bullwhip effect in electrical appliance industry, it also include reasons causes the bullwhip effect; the impacts of bullwhip effect, and what measures can help to manage this effect. Furthermore, in order to increase the understanding of bullwhip effect in electrical appliance industry in the Chinese market, two main steps need to be tackled: the first one is no doubt the review of related literatures, and second is a case study about Haier Group Company.

### **1.3 Overall Research Aim and Individual Research Objectives**

The overall aim of this research is to increase the understanding of the bullwhip effect and help to minimize the impacts of it in electrical appliance industry in Chinese market. In order to achieve this target, it is necessary to gain an insight on what is the bullwhip effect, what causes the bullwhip effect, and what measures can take to dampening the bullwhip effect. It is a little difficult to say which measure is more efficient, according to different situation, even the same measure can cause different effect. This paper is focused on Chinese market, so the collection of empirical data is come from Chinese company--The Haier Group, which has a great development since Zhang Ruimin became Haier's CEO and adapted a series new strategies, it has become the largest electrical appliance brand in China. Because of the successful experiences, Haier Group also become the best example to follow for other electrical appliance firms. Haier, as one of the best electronic appliance industry firm both in China and the world with rich history and experiences which could be seen as one of the most representative in China of such area.

The research objectives of this paper are as follow:

1. Identify the causes and impacts of the bullwhip effect in electrical appliance industry.
2. Evaluate critically the Chinese Haier Group's measures to mitigate the bullwhip effect.

3. Formulate recommendations to the electrical appliance industry in China on dampening the bullwhip effect.

Since the article is mainly aim at research the bullwhip effects in Haier Group Company's supply chain and how does the firm deal with it. Combining with existing theories about the bullwhip effect, this research will finally find scientific measures for the bullwhip effect. Therefore, it is extremely important for the research to identify the reasons which cause the bullwhip effect happens as the first step. In order to do that, the first objective of the research is finding these set of elements. Furthermore, considering about such amount of characteristics different from others for electrical appliance industry, this kind of specially conditions which could hardly to be ignored are still need to be explored in this article. After finding out the core origins, the secondary elements which could affect the bullwhip effect are also fairly significant for the whole picture. That is why they are the elements that need to be considered by this article. Hereafter, the measures which could mitigate the bullwhip effect will be the main mission. Thus, the article then will focus on finding the solution to reduce the negative impacts of bullwhip effect. Since it is a research for the Haier Group Company, the article would also need to find out the measures that Haier takes to deal with the bullwhip effect. There is no doubt that combine the practice with theory is the best way to prove it. Forasmuch, one of the most important objective of the article is analyzing measures which the firm takes to reduce the bullwhip effect and trying to find the combinations with theories from other researches. Thereby, the merit of the bullwhip effect's measures of Haier would be explored and concluded at the end of the article. Meanwhile, in the last, the recommendations of supply chain management measures for dealing with the bullwhip effect would also been showed. Moreover, the Haier Group would also been introduced as a successful example for the other firms which managing the familiar supply chains as Haier Group's.

Among these purposes, the objective 1 and 2 are the main themes the article trying to focus on. They could be seen as the core missions for the whole research. While the objective 3 is about the distribution both for readers of the research and related companies. It also could be seen as the supporting objective of the article. Somehow, it is fairly necessary to highlight for readers that, do not ever view these research objectives as separate. Contrary, all of them are interlinked. Despite the purposes are

written as separately, they are still come from the same goal which is find out the desirable bullwhip effect measures of Haier Group according to the analyze and theories. Thence, they are actually linked as a progressive relationship and all surrounding with the bullwhip effect issue in realistic environment.

#### **1.4 Outline Structures**

##### Chapter 1. Introduction

This chapter provides most of background information and basic acknowledge of SCM and the bullwhip effect also with the importance of this concept. At the same time, since the research is focus on electrical appliance industry of China, the chapter also introduces some background in this field. Afterward, the purpose and research objectives of this research are listed in this chapter with explanations of reasons why the purpose and objectives are chose by this research.

##### Chapter 2. Issues and review of related literature

In this chapter, some existing useful literatures and also theories which related to the research objectives of this article will be reviewed. Most of the literatures are focus on why the bullwhip effect happens and how to deal with it. At the end of this chapter, there is also a discussion with using of qualitative method about these literatures which is fairly necessary for the following parts of the research.

##### Chapter 3. Research method

This chapter selects the research strategy, data collection and also data analyze method. Depends on the research objectives and nature of the research, the case study is choose as research strategy and the internet interview is choose as data collection method. Meanwhile, the data analyze framework is also settled in this chapter. In the end, the limitation and potential risk of choosing these methods are also show up.

##### Chapter 4. Finding

This chapter provides the background information of the case company through using secondary data form websites and Annual Report. Further, the details of interviewing two managers from sales department and purchase department of the company are showed, also. The interviews are mainly based on three key questions which are how

the orders come from, what impacts and cause of the bullwhip effect are and what countermeasures the company pursuit for the bullwhip effect.

#### Chapter 5. Analysis

In this chapter, the analysis through comparing the relationship between literatures, theories in chapter 2 and the finding results from chapter 4 shows up. The analysis is mainly discusses the cause of the bullwhip effect and also the measurement should pursuit for dealing with it. It provide a clear insight on research objectives of this research study.

#### Chapter 6. Conclusion

This chapter concludes the final observations research objectives which related key points of the research. Moreover, the self-reflection and limitation of the whole research are also provided at the end of this chapter

#### Chapter 7. Reference

This chapter includes all references used for achieving the research.

## **2. Review of Related Literature**

### **2.1. Introduction**

There is no doubt that no matter what kind of the firm is, the supply chain management system is indispensable. According to the definition from J. Aitken (1998), the supply chain is:” A network of connected and interdependent organizations mutually and cooperatively working together to control, manage and improve the flow of materials and information from suppliers to end users.” It is always one of the most important and necessary part of the firm. A perfect supply chain system could not only reduce the costs and wastes of recourse in many aspects, but also bring more values for the firm in lots of areas.

### **2.2. Methodology of Literature Review**

Considering about the natures both of the study and research strategies, since most of questions are about why the bullwhip effect happens and how to deal with it, the literature review is mainly used the qualitative method for researching. Most of the data was gathered from the previous study. In order to have a deeper insight on the supply chain management and relevant fields, the course literature of supply chain management and other literature suggested by the tutor were carried out. The study of this subject cannot go on without the review of related literature, different literatures were reviewed which include Lee et al.(1997a b), Sucky(2009), Agrawal et al.(2007), Croson and Donohue (2006), Hussain and Drake (2011), Dejonckheera et al.(2002). The reason for choose these literatures is because of their relevance to this study, and all these literatures were chosen from scientific database of academic publications and journals from the internet. The literatures were helped in identifying different methods that could be used identify the cause of bullwhip effect, the impact of the bullwhip effect and formulate recommendations to dampening the bullwhip effect.

### **2.3 Introductions of bullwhip effect**

According to Lee et al. (1997b) there is a phenomenon that the variance of orders may be larger than that of sales, and the distortion tends to increase as one moves upstream which is called bullwhip effect. It is a distortion in the sharing of information from downstream to upstream in the whole supply chain system; the effects can propagates the enterprise’s marketing, logistic and manufacture. Despite There are lots of factors

which could affect the efficiency of supply chain, like organization structure, channel of information, geographical distribution, industry characteristics etc., the bullwhip effect is still one of the most deep-rooted influence factor for the whole system. You cannot find another such kind of element like the bullwhip effect which could affect all parts of the whole supply chain system. No matter what kind of industry the firm are, what place does the firm in or how hard does the firm try by its own, the processes inside of the firm from producing plan to all kind of inventory must be all influenced by the bullwhip effect and hard to avoid. That is why the bullwhip effect is one of the most deep-rooted influence factor.

As firms recognize the importance of the supply chain management, how to manage the bullwhip effect in the supply chain becomes a significant and common problem. When people are trying to manage this effect, the first objective of all should be clarifying what causes the bullwhip effect. In order to achieve that, Forrester (1958) as the man who defined the concept of bullwhip effect at the first time, has pointed out the cause of this effect which is due to system dynamics. Moreover, he has also proposed the way to tackle this effect's negative impacts which is reducing delays of productions in the supply chain (Hussain and Drake, 2011). After developing for years, the concept has become increasingly comprehensive than before. According to the summarized by Lee et al.(1997ab), there are four major causes of the bullwhip effect: 1. Demand forecast updating, 2. Order batching, 3. Price fluctuation, and 4. Rationing and shortage gaming. These causes could not only make negative impacts of increasing enterprise operating costs for the whole supply chain from upstream to downstream, but also lead to overreaction when facing the changes in the markets. Wherefore, the authors built a set of solutions for the causes above to reduce influences of the bullwhip effect as their contributions, which are 1. Avoid multiple demand forecast updates, 2. Break order batches, 3. Stabilize prices and 4. Eliminate gaming in shortage. While Agrawal et al. (2007) has argued that the longer lead-time of products are the mainly reason of bullwhip effects. Since the longer the lead-time is, the more uncertainty of forecasting for demands in the future are, so that the quantity of orders will become more changeable. For those reasons, it is fairly significant to reduce the bullwhip effect by making inventory policies end to some extent lead-times are suitable. What is more, sharing the relevant information across various stage of supply chain are also helpful. Nowadays, the bullwhip effect is becoming the focus of supply chain management

because of its huge impact. In order to help firms reducing their bullwhip effect by analyzing and measuring step by step, Sucky (2009) has divide resent research on the bullwhip effect into six general categories: I . Quantification of the bullwhip effect, II . Analyze and identify the cause of the bullwhip effect, III. Observing the bullwhip effect in some industries, IV . Addressing methods for reduce the bullwhip effect, V . Simulating the system behavior, VI. Experimental validation of the bullwhip effect. In the next section of the chapter for this study, the mission will mainly focus on what the impacts of the bullwhip effect are and how to address methods for mitigating the bullwhip effect based on the four causes of the bullwhip effect which has mentioned above.

## **2.4 Theoretical Framework**

### **Product push vs. Demand pull**

Generally speaking, the traditional product push and demand pull can be seen as two different systems to manufacture and assemble the products. Bonney M et al (1999) point that the different information resource distinguish two different systems which are push and pull. The push means to anticipate the demands and take action based on it, while pull means to take action depends on the markets demands. Product push and demand pull are often seen as the two opposites.

### **Just in time (JIT)**

Just in time (JIT) is based on the idea that do not make any action if possible until there is real a need (Christopher, 2011). JIT is a theory based on Pull system, and the Just In Time system is helpful to manufacturing firms for increasing global competitiveness through a set of measurements. The measurements which involved in JIT are inventory reduction, quick setups and orders, quality of source, supplier networks, teamwork and participation, continues improvement ( Bonney et al., 1999).

### **Vendor Managed Inventory (VMI)**

Vendor managed Inventory (VMI) is aim to shift the costs and responsibilities for supplying components on a just-in-time basis to supply firms (Fields, 2006). This concept of VMI is always introduced in researches as a supply chain management and

inventory management method in which the supplier has taken the responsibility for making decisions to the timing and amounts of inventory replenishment (Southard and Swenseth, 2008). The main advantage of using VMI is increasing the customer service levels through higher participating members' performance while decreasing the costs (Waller et al. 1999, cited in Southard and Swenseth, 2008).

### Overall Every Control and Clear (OEC) management

Overall Every Control and Clear (OEC) management has been explained by Wang Yinmin, the human resource management director of Haier: "O stands for Overall, E stands for Everyone, Everything, and Every day, C stands for Control and Clear. OEC means that every employee has to accomplish the target work every day. The aim of the OEC management- control system is that overall control everything that everyone employee finishes on his or her job every day with a 1% increase over what was done the previous day." (Lin 2005). The OEC management is centered on the final market, have a clear ultimate goal for the market. Based on the fickle market, the OEC management can put forward different measures, and improve the work constantly.

## **2.5 Findings of the Bullwhip Effect**

### **2.5.1 The impacts of bullwhip effect**

The bullwhip effect is occurred during the information sharing from downstream to upstream. The worse the information sharing between suppliers and customers does, the bigger influences caused by the bullwhip effect will be. Once the market demand from the end users in supply chain increase, the production capacity of the entire supply chain increase. Meanwhile, as the reason of production usually is more than the increase of the market true demand, the upper place does the producer in the more production will be made. Finally, the beyond part backlog as inventory in the different nodes of the supply chain, and those backlog will become a huge amount of waste which cost a lot for all of members of the supply chain system. Vice versa on the situation of demand decreasing, once the demand slowdown or negative growth, a lot of capital and products will be a backlog in inventory form, the whole supply chain might fall in a poor cash flow situation. This seriously affect the good functioning of the supply chain, even lead to business failures, especially the small businesses which in the end of the supply chain. Despite some of large firms might survive from this situation, the lost both for tangible

and intangible assets will also fairly huge. Hussain and Drake (2011) have summed the impacts of the bullwhip effect up in three aspects, which are:

- Inaccurate forecasting which may cause periods of low capacity utilization or periods of having no enough capacity
- Inadequate customer service
- High inventory costs

In terms of the speed of response of the market, the bullwhip effect show that the more in the back end of the supply chain, the slower the response speed of the enterprise is. As a result, when the market demand increases, suppliers are often unable to support manufacturers; while market demand is slowdown, the suppliers often continue to overproduction, which resulting in overstock.

## **2.5.2 Counter-measures of the bullwhip effect**

According to the theories above-mentioned, it is easily to see that the bullwhip effect could initiates a huge impacts on the supply chain management. For this reason, finding out the counter-measures of it would provide a fairly significant meaning for the research. Lee et al. (1997a b) puts forward on the solutions from four aspects based on the four causes: avoid multiple demand forecast updates, break order batches, stabilize prices and eliminate gaming in shortage.

### **2.5.2.1 Avoiding Multiple Updates**

The first cause lead to the bullwhip effect includes no visibility of end demands, multiple forecasts and long lead time; therefore, reducing lead-time, accessing sell-through data and information on inventory status, and only single control of replenishment can be good solutions to this issue. Longer lead-time can cause the uncertainty in the forecasting of future demands increase and consequently the variability of order quantity increases (Agrawal et al., 2007). Hence, improving operation process, shorten the lead time and reducing the order quantity can be efficient to reduce the bullwhip effect. Lead time shortened, demand volatility is relatively reduced. Another efficient way is inventory information, Croson (2006) asserts inventory information can help upstream of supply chain better anticipate and prepare

for swing in inventory needs downstream and achieving the target to dampen the bullwhip effect.

**2.5.2.2 Break Order Batches**

Batch ordering often lead to bullwhip effect, which has serious implications for the whole supply chain (Hussain and Drake, 2011). Random or correlated ordering, high order cost and full truck load (FTL) economics are the main reasons cause the bullwhip effect. Thus, discount on assorted truckload, consolidation by third party logistics and regular delivery appointment are solutions to the bullwhip effect. Smaller batch sizes, synchronized batch sizes can also be seemed as a good way.

**2.5.2.3 Stabilize Prices**

The high-low pricing, delivery and purchase asynchronized can causes the fluctuating prices, this is another main cause of the bullwhip effect. To reduce the frequency and the level of wholesale price, discounting is the simplest way to control the bullwhip effect (Lee et al., 1997a). It includes developing appropriate pricing strategies to encourage retailers so that reduce the advance purchase behavior. Although take the discount strategy can increase the sales of enterprises in a short time, in the long run, it do more harm than good.

**2.5.2.4 Eliminate Gaming in Shortage**

The causes of shortage game are proportional rationing, ignorance of supply conditions and unrestricted order and free return policy. When trying to solve this, allocate based on past sales, shared capacity and supply information, flexibility limited over time and capacity reservation are the most efficient ways. Dejonckheera et al. (2002) recognize an order-up-to policy is optimal in the sense that it minimizes the expected holding and shortage costs. Generally, trust and good relations of the various stages in supply chains can reduce duplication of effort and reduce transaction costs, while leading a reduction in the bullwhip effect.

**2.6 Summarize:**

Table 1 Causes and solutions of the bullwhip effect

| Causes of bullwhip effect | Contributing factors | Solutions |
|---------------------------|----------------------|-----------|
|---------------------------|----------------------|-----------|

|                                 |   |   |
|---------------------------------|---|---|
| Demand forecast bullwhip effect | <ul style="list-style-type: none"> <li>● No visibility of end demand</li> <li>● Multiple forecasts</li> <li>● Long lead-time</li> </ul>   | <ul style="list-style-type: none"> <li>● Access sell-thru or POS data</li> <li>● Single control or replenishment</li> <li>● Lead-time reduction</li> </ul>  |
| Order batching                  | <ul style="list-style-type: none"> <li>● High order cost</li> <li>● FTL economics</li> <li>● Random or correlated ordering</li> </ul>   | <ul style="list-style-type: none"> <li>● EDI&amp;CAO</li> <li>● Discount on assorted truckload, consolidation by 3<sup>rd</sup> party logistics</li> <li>● Regular delivery appointment</li> </ul>  |
| Price fluctuation               | <ul style="list-style-type: none"> <li>● High-low pricing</li> <li>● Delivery &amp; purchase asynchronized</li> </ul>   | <ul style="list-style-type: none"> <li>● EDLP</li> <li>● Special purchase contract</li> </ul>   |
| Rationing and shortage gaming   | <ul style="list-style-type: none"> <li>● Proportional rationing scheme</li> <li>● Ignorance of supply conditions</li> <li>● Unrestricted orders &amp; free return policy</li> </ul> | <ul style="list-style-type: none"> <li>● Allocate based on past sales</li> <li>● Shared capacity &amp; supply information</li> <li>● Flexibility limited over time; capacity reservation</li> </ul> |

(Source: Lee et al 1997b)

Table 2 Impacts of the bullwhip effect

| The impacts of bullwhip effect |                             |                      |
|--------------------------------|-----------------------------|----------------------|
| Inaccurate forecasting         | Inadequate customer service | High Inventory costs |

(Source: Hussain and Drake 2011)

According to Lee et al (1997a b), the major causes of the bullwhip effect and solutions to each cause can be clearly identified, which form the foundation of this study. The three impacts pointed out by Hussain and Drake (2011) also provides guidelines to find out the impacts of the bullwhip effect in appliance electrical industry. The bullwhip effect is not solely a result of operational complication (Croson and Donohue, 2006). Human behavior and operation complication can cause bullwhip effect in different degree no matter how careful you are. This study shows the main causes of the bullwhip effect, the impacts of it and what should be done in order to mitigate the effect. According to different causes of bullwhip effect, we can take corresponding measures, but sharing information can always be the key solution. There is one thing which needs

to be highlighted that while the above strategy can weaken the bullwhip effect negative impacts of the supply chain in a certain extent, nevertheless, due to the bullwhip effect's causes is related to their systems, completely eliminating this effect is impossible. As long as the enterprises in the supply chain efforts toward the right direction, they must be able to mitigate the impacts of the bullwhip effect and benefit from it while in the fierce market competition. This paper analyzes the impacts of the bullwhip effect in supply chain operations, indicating that its harm to the enterprise, a brief analysis of its causes, and measures to solve the "bullwhip effect". Finally, to quantify the harm brought about by the bullwhip effect, it will play an active role in future development of supply chain strategic alliance.

### **3. Research Methods**

#### **3.1 Introduction**

In last section, related literatures have shown the main issues about the bullwhip effect, includes what is the bullwhip effect, what causes it and how the bullwhip effect influences the supply chain. But how the electrical appliance industry gain the capabilities to manage the bullwhip effect and achieve more efficient supply chain management (SCM), ought to be based on research. Consider with the three inter-related objectives of this research:

1. Identify the causes and impacts of the bullwhip effect in electrical appliance industry.
2. Evaluate critically the Chinese Haier Group's measures to mitigate the bullwhip effect.
3. Formulate recommendations to the electrical appliance industry in China on dampening the bullwhip effect.

A large number of research works need to do. As the center of this research is on the electrical appliance industry in Chinese market, the study and analysis of empirical data on how Haier Group, one of the most representative companies in China, manage the bullwhip effect can make an important contribution. Objective 1 was addressed in the literature review section, which part gives a clear state of the bullwhip effect. The objective 2 and 3 need further explore through the collection and analysis of empirical data, and the empirical work of data collection is based on case study. While Chinese market has its own characteristics from other countries, only comparing and connecting the theories with the realistic of China can make the research bring us a fuller understanding of the issues surrounding the bullwhip effect. The objective 3 is based on how many useful knowledge you get from previous study, so that the suitable recommendations can be formulate.

#### **3.2 Research strategy**

How to choose an appropriate research strategy? It depends on both the research's nature and the research strategy's characteristic. In this research, objective 2 set out to

“evaluate critically the Chinese Haier Group’s measures to mitigate the bullwhip effect’, it means the empirical data of Haier Group need to be collected and analyzed. In general, this research is mixed quantitative with qualitative research, thus the quantitative research is aim to answers the how questions, while the qualitative research is to answer why questions (Biggam, 2008). This research not only need to explore the sale amount of Haier’s production, the turnover of Haier Group, it also need to evaluate Haier Group’s measures to mitigate the bullwhip effect and why. After find out the nature of this research, the next step is to choose a suitable research strategy. But what research can adapt and why is it suitable?

From Biggam.J (2008), there are numerous research strategies we can choose. Experimental research is often implement experiment to test whether the previous hypothesis which formulate by the researcher is right or not, and the main purpose of the experiments is to establish a causal relationship between the variables. So the characteristic of experimental research is obviously not appropriate to this research. Action research, is also unappropriated to this research, because it is often begin with particular questions in surrounding environment and the researcher more often than not is familiar with this environment. The characteristic of this research is that the research always involved another participate besides the researcher. Historical research is also fail to address this research’s aim. Historical research use the historical data, in accordance with development of history to study the past events. Survey-based research maybe is one of the most popular research strategies, since the survey-based research is not limited to the observation of the study object directly, it can obtain large material indirectly. While this research is based on Haier Group, it have a definite study object, so the survey-based research is also not suitable. Case study, another popular research is only focus on one individual unit or part of an individual unit, case study researcher needs to find the study object’s characteristics. Through this approach, researcher can study the organization in-depth, and obtain the information they need. After a summary and comparison, case study is the appropriate research strategy to implement the empirical research due to its characteristic and the nature of this research.

After chosen the adopted research strategy, it is important to ensure how to implement this approach. In this research, case study has been divided into three stages. The first stage is advanced preparation, this stage need us to collect information about Haier

Group and confirm the centralization of study. Such as there are lots of nodes in the supply chain of Haier, we have to choose the most representative like purchase and sale department. There are high variety of production in Haier, we cannot calculate all of them, and then we can choose refrigerator, washing machine, air condition and personal computer. What's more, we also have to collect information about the upstream and downstream with Haier.

The second stage is aimed at implement the research on Haier's supply chain management (SCM). While the bullwhip effect is a manifestation which can seemed as the multiple steps in the chain can cause considerably distorted in demand signals (Christopher. M, 2011). So it is rather important to evaluate what measures Haier have taken to manage the distortion in demand signals, so called the bullwhip effect. The information which needed from stage one and stage two can collect from Internet, like Haier's official website and its financial statement.

In the third stage, personal interview can be conducted to collect the empirical data. The purchase and sale are the two core departments of one group, the two managers of purchase department and sales department in Haier will share their personal experiences with us through the interviews. The interview can focus on the difference impacts of bullwhip effect in different link in the supply chain, and also different measures to manage the bullwhip effect according to different impacts. These information may not provide a lot of data, but it can help to obtain the news of the company, strategies, planning and objectives. In order to ensure the reliability and validity, the three stages needs to combine step by step, absence of any step may causes the unreliability or invalidity.

### **3.3 Data collection**

The research of how to manage the bullwhip effect is based on a case study on Haier Group in China, which is a good example in managing the bullwhip effect in order to achieve more efficient supply chain management. While implement a case study on Haier Group which is located in China, and it is difficult for the researcher to conduct the interview face to face, during this situation the best way to solve this problem is internet interview. This research is not aimed at contributing to the increase of the whole operation of Haier, there is no need to explore all processes of this firm, and

obviously it is a huge work. The purchase and sale department is the focus of this interview, since they are also the core links in the supply chain and the most representative to reflect the bullwhip effect. Relatively, managers are the decision maker of one apartment, they decide the strategies and objectives. So the manager of Haier computer department and minister of Haier's supply chain have been interviewed, they can not only tell about what are the impacts of bullwhip effect in each process, but also tell what are their measures to manage this effect. Additionally, they also can tell their own views and what problems have been encountered with managing the bullwhip effect.

In this study, Mr Fang, the sales manager of Haier computer department and minister of Haier's supply chain Mr Li have been interviewed. According to different function and position, different questions have been asked. Such as for Mr Fang, the manager of Haier computer department, the questions of what is the main source of your orders, will the order of the year effected by seasons, is there any regular patterns of this impacts, and what are the impacts of bullwhip effect in your department etc. While for Mr Li, the minister of Haier's supply chain, the interview questions are focused on what are the purchasing processes, what does the purchasing plans mainly in accordance with, and the same questions as what are the impacts of bullwhip effect in your department.

Through the internet interview, the qualitative data can be obtained, these data can help understanding Haier's strategy more intuitive, and of course can help to meet the objective 3, formulate recommendations to electrical appliance industry in China. To achieve the target, questions must arranged beforehand. Secondary data is another method of collecting the research data used in this research, it can also help to provide a fuller understanding of Haier's operation on supply chain management (SCM).

### **3.4 Framework for Data Analysis**

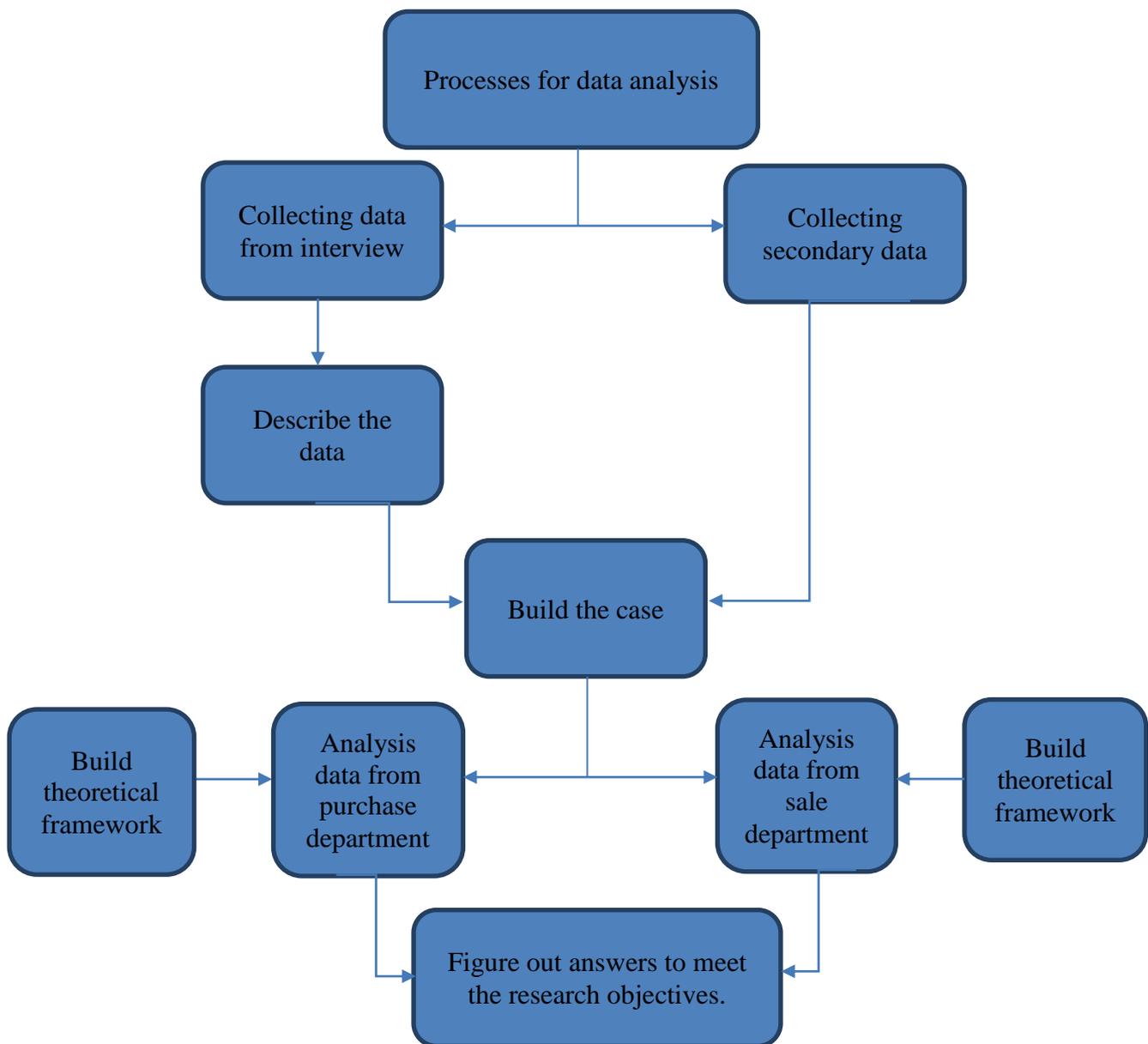
This section is aimed at give a clear statement on how to analysis data after collecting interview data and secondary data. In order to meet the research objectives through interviews, the better way is to divide the interviews data into two types in accordance with the different theme. Definitely, the themes can be describe as purchase and sales, the different themes can reflect the different impacts of the bullwhip effect and after

analysis the different data, different conclusions can be drawn on how to manage the bullwhip effect.

To understand the different impacts of different processes in supply chain, different questions may be asked to the two managers, while they have different consideration focus in the supply chain.

The Figure 1 can give an intuitive expression on the approach which can adopted to analysis data form case study.

Figure 1: The processes of data analysis for Haier Group case study



(Source: Own construction)

The first step in this processes is sorting data according to different themes. Then, the next step is to describe theses data, this was not just describing what the questions and the answers are, these description needs to find out what the questions and answers reflect, and to seize the key point. The next step is to build the case, by using both primary and secondary data. And then, analysis data through build theoretical framework and figure out answers are quite important, therefore they can connect the actual to the theoretical which has mentioned in literature review. To figure out answers for meeting the research objectives have to consider the insights in literature review and in accordance with the case study on Haier Group.

### **3.5 Limitations and Potential Problems**

There is never a statement about research can be done flawlessly, more or less limitations were existed. To this research, which related to implement a case study on Haier Group in China, limitations cannot be avoided.

First and the most important of all, the limitation of using a case study as research strategy is been pointed out. Although case study has been recognized as one of the best strategy of research, it still has some weakness which cannot be denied. Since the nature of this research should be considered at the first place, it is easily to understand the limitations of case study itself could hard to avoid in this paper. Thus, it is also one of the significant part that we should discuss in this chapter.

As Bathmaker & Harnett (2010) pointed out, there are several limitation of the case study which also compliance with this research.

#### **3.5.1 There are lots of data need to be collected and used for the research**

Due to the nature of the case study, such kind of research could not just aim at theories. Instead, it should focus on the combination between theory and the case. Thus, a lot of data, not only about the company itself, but also the research questions inside of the company should be collected and used for the research. However, according to Bathmaker & Harnett (2010), these works would takes much time of research. Moreover, such many of data and information inside of the articles might make readers confuse about the emphasis of the research.

#### **3.5.2 Case study cannot answer a large numbers of relevant questions**

As Bathmaker & Harnett (2010) explained, a case study cannot focus on many questions during one research. Since there are lots of data work need to do which mentioned above, the research can hardly to focus on many questions. Furthermore, because case study should pay attention on few point of the company, the research could only defined as focusing on several questions about relevant researches. Therefore, it is easily to understand that an article which use the method of case study could only answer a few questions but not too much about their research area. In addition to such situation, this article might has some weakness about the research for question from relevant area.

### **3.6 Reliability and Validity**

The survey of the research should be reliable and valid. In our research, the literature review and interviews are seen as parts of scientific methods which used to achieve the objectives of this research. The reliability and validity of these parts are fairly important for the research since they will lead to the reliability and validity of analysis and conclusion in this research.

As the data collection and research strategy which mentioned above, the research is aim at only one company which avoid some risks of external validity. Further, most of the data and comments used in this research are from the managers of Haier Group and also rich of experiences in relevant areas which guarantee the reliability and validity of the research to some extent. On the other hand, since the data collected from person which might involve the errors of subject and participants. These errors might bring negative impacts of reliability and validity to the research.

In order to reduce these errors while achieving reliability and validity of the research, the questions which set for the interviews are all related to this research for reliability and also use comparability questions for the internal validity which could reflect different aspects through asking same questions to people with different perspectives from their answers. In this way, the external reliability and validity of this research could be obtained.

There are also some literature which used to support the research. In order to guarantee the reliability and validity of this part, it is follow with a scientific process which includes introduction, methodology, result and discussion. Moreover, there are also

some acknowledge which provide for the readers to gain validity. The literature we chosen are all have been published and confirmed which posted on webs. Overall, the internal validity of the research is not compromised following with those methods above to gain reliable result.

## **4. Findings**

In this chapter of findings, the results of the case study will be described, it will discuss the main measures that Haier Group has been taken to mitigate the bullwhip effect. It is of great importance to evaluate how Haier Group's to take measures to mitigate the bullwhip effect in order to formulate recommendations to the electrical appliance industry in china on dampening the bullwhip effect. In this section, there are three key elements which could identified as, what the main source of the orders are; what are the impacts of the bullwhip effect to the firm and the countermeasures for this problem. This research focus on two departments of Hair Group: Sales and purchasing department. Despite these two sectors cannot represent the whole supply chain, both them play important roles in the supply chain. Description were based on the information and data from persons whom being interviewed in this case.

In following sections, the case of Hair Group will be presented, and in the next chapter, the case will be analyzed and discussed related to the literatures mentioned above to establish key points. The transcripts of the interviews with sales manager and purchase manager can be found in Appendix.

### **4.1 The Background of Haier**

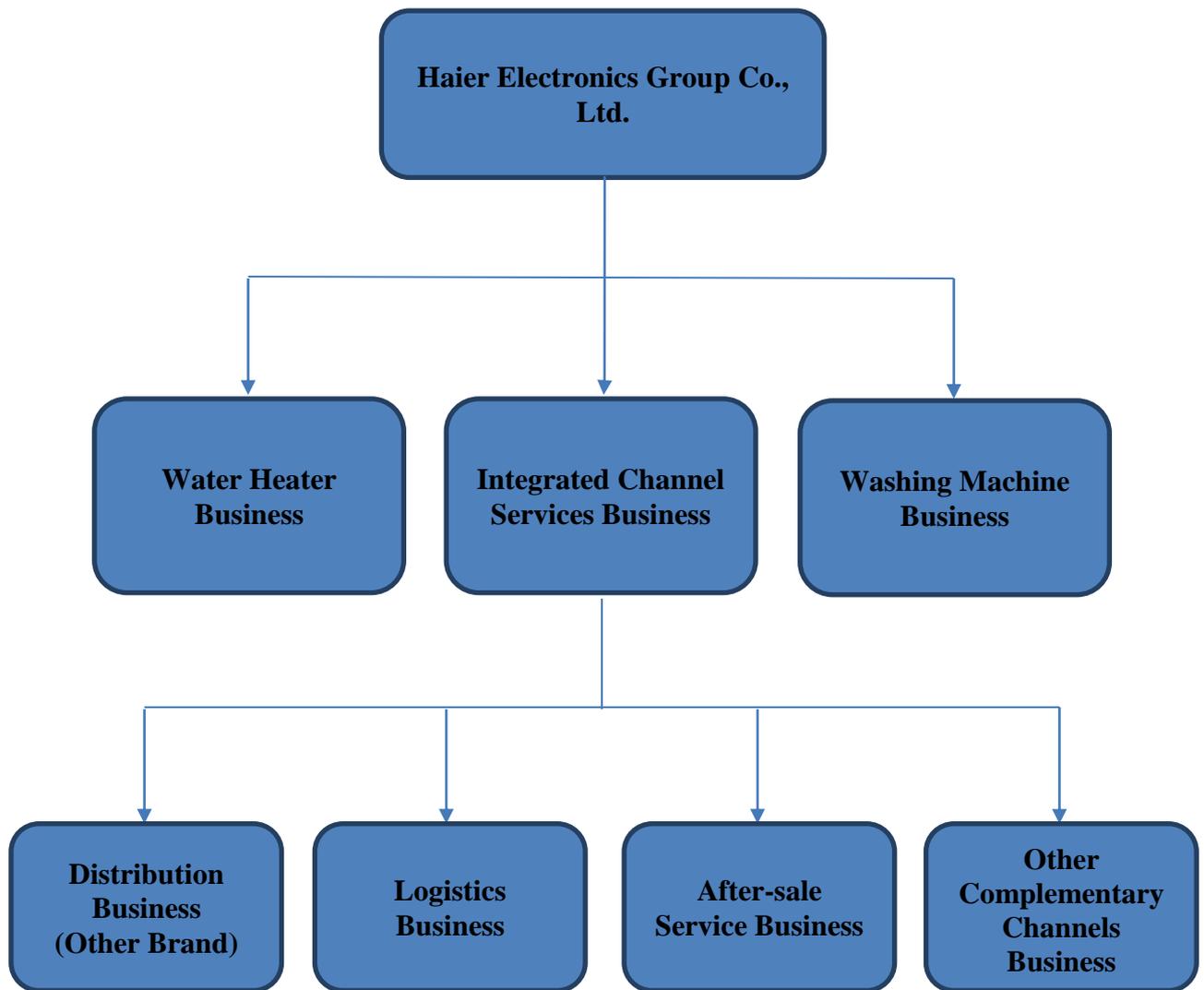
Haier Group is a Chinese multinational firm which famous since its consumer electronics and home appliances products in the world. As one of the most famous brands of China, the firm's headquarter is located in Qingdao city, Shandong province, China. There is no doubt that it is one of the best white producer both in China and the world which was been founded as Qingdao Refrigerator Co. in 1984 at the outset. Haier Electronic Group Company, Ltd. is a subsidiary of Haier Group. The Company and its subsidiaries (the "Group") are committed to the research, development, manufacture and sale of washing machines and water heaters in China under the brand name of "Haier". In addition, the Group is also responsible for the integrated channel services business for some other home appliance products of both "Haier" and "non-Haier" brands such as refrigerators, televisions and air-conditioners which substantially broadening its sources of revenue and driving its profit growth. Nowadays, the products which made by Haier are sold in over 100 countries.

Haier Group was on the verge of bankruptcy, in the very beginning. Nevertheless, after 28 years of entrepreneurial innovation, it finally becomes the world's largest manufacturer of household appliances. At the year of 2011, Haier brand got the largest market share in white goods of the world, with 7.8 percent. In 2013, Haier's global turnover achieved 175.1 billion Chinese Yuan, and have more than 85,000 employees in 17 countries, Haier's users are around the world in more than 100 countries and regions. Global management consulting firm in Boston announced the "2012 Annual Global Top 50 Most Innovative Companies" list, Haier ranked eighth, with Apple, Google and other brands into the top ten, it is the only enterprises of China into this range.

The turning point of Haier's success is when Zhang Ruimin became Haier's CEO. In order to adapt to the development and change of the epoch, Haier has implemented brands strategy, diversification strategy, international strategy, global brand strategy and network strategy also (Haier Group, [http://www.haier.net/cn/about\\_haier/strategy/](http://www.haier.net/cn/about_haier/strategy/)). Nowadays, Haier Group not only become the world's first brand of white goods, it also set an example of Chinese electrical appliance industry on how to manage the supply chain efficiently. It has the best supply chain system of China both in managing and equipment areas. Learning about the methods which Haier used for managing their supply chain system combining with scientific theories could help other similar companies in China a lot to improve the skills for dealing with problems of their own supply chain systems.

According to the diagram showed below, it is clear to see the business composition of Haier Electronic Group. The diagram shows there are three parts of businesses in the firm which are water heater business, washing machine business and integrated channel service business. In these businesses, the water heater business and washing machine business include every process from research, creation and development to manufacture, sales and others. While the integrated channel service business only aim to finish the processes of logistics, after-sale service and other complementary channels for other products that made by Haier Group. Distribution business for products of the firm without "Haier" brand is also involved in this business part.

Figure 2: Simplified Business Structure of Haier Group



*(Source: Haier Group Annual Report 2011, P3)*

## **4.2 Results from Research**

### **4.2.1 Evaluation of Sales Department**

The sales department of Haier Group as one of the most important members of the firm and also the department which get the clearest understanding of their markets. Since the department has the most clearly cognition about their market situations, it is also the starting points of the bullwhip effect in the firm. That is reason why it should be evaluated for this article.

#### **4.2.1.1 Background of Sales Department**

According to the manager of sales department in Haier, since the huge demands of products and the size of the firm, there is no possible to provide products to the end users around the world, directly. Therefore, most of the customers that the firm faces to are the distributors all over the world which could touch with the end users directly. While, since there are also some towns and villages that has small demands and hardly to build distributors locally, minority of county tally providers which might indirect face to the market of end users also exist.

Due to this situation, the customers of the firm which are also the direct distributors for the end users could get a quite well understanding about the markets and also easily to make the forecasts for future demands from end users precisely.

As people knows, the demands of productions form markets are always changing, sometimes there are still regularity. Through the introduction from the manager of sales department, generally, the orders from customers will fluctuate with the seasons. For example, as the sales manager pointed out, due to influence by the change of temperature, the demand of air conditions of the markets are always get higher in every summer than any other seasons, While, the refrigerators are also needed more by markets during summer and other festivals since parties for those times' requirements. Moreover, the orders of personal computers will get higher in summer and winter vacations for students. After these regular increases, the orders will get lower for a while and returned to normal, gradually.

According to the description by sales manager of the firm, except those regularity changes which caused by the market, the firm could also influence the order changing through prices decreasing in some traditional festivals of China to gain more sales volume which will attracts end users and increase orders. While, as time changes, there has some special days been created by people in China in recently years which brings more chances of selling for the firm. Therefore the price decreasing during those days will also attract much more orders than before. At last, at the beginning of a new production enter to the markets, there are many measures would took by the firm for attracting end users. During that time, the orders for such production could also increase for a while.

After those increasing in special times, the orders from customers of the firm will go lower than normal, and gradually return to a stable volume, finally.

#### **4.2.1.2 How the Bullwhip Effect Happens**

Through the evaluation of sales department manager in Haier Group. There are following three main reasons which will cause the bullwhip effect in the sales department.

First of all, through the sales manager's introduction, since the firm will take measures for helping new productions enter to expecting markets, in the life beginning of the new production, the helping measures will stimulate the demands. At the same time, due to customers of the firm hard to gain enough experiences of real demands for the new productions so that make forecasts which depend on the unreal situation in optimistic. Thus, the orders during these times are always higher than realistic which must cause the bullwhip effect.

Secondly, in order to safeguard the benefits of the firm, most of the customers have to accept the protection policies for products which have annual or quarterly contract volume requirements that created by the firm. Wherefore, in order to achieve the requirements of the firm, the customers need to order amount of productions which will not be sold at the end. According to that situation, some orders of the productions could not reflect the real demands of the markets directly. Somehow, since the manufactures could not understand the real demands of markets, the forecasts made by them are mostly depends on the orders from customers. The orders which have disability to reflect the real demands are easily to misleading the manufactures to make a wrong forecasts in optimistic way. Accordingly, the bullwhip effect shows up.

In addition, the sales manager also pointed out, when the festivals come, the firm will take special measures for promoting selling which will attract more people buying productions. Depends on the situation at those times, both of the customers and the firm are hard to make the forecasts for the future in a sensible way. This is also a fairly significant reason which cause the bullwhip effect.

For such reasons above, the bullwhip effect shows up in the whole supply chain and brings a lot of impacts for the firm, negatively.

#### **4.2.1.3 Impacts of the Bullwhip Effect**

According to the manager of sales department in Haier, the impacts of bullwhip effect are mainly reflect in three parts for the firm which are cost increasing, risk of inventory and endangers to life cycles management of productions.

At first, the bullwhip effect is easily to cause the non-cooperating between the manufactures in upstream and customers in downstream which will finally increase the cost of producing, transporting and some other factors. Even worse, the sales of products would also have a negative impact due to the non-cooperation situation.

Because of the members from upstream to downstream in one supply chain could not to get the real demands information from markets at the same time, the forecasts and selling plans for the markets which made by customers and the firms are different and have time gaps. Hence, once the bullwhip effect happens in the supply chain, despite there are certain amount of inventory of the production which hold by the manufactures in the upstream, it will hard to meet the demands of customers of the firm which in the downstream of the supply chain. Due to that situation, the manufactures will certainly held an optimistic perspectives of demands and make larger forecasts of the productions than before. For the purpose of meeting demands of customers to catch up selling chances, the manufactures must increase their speed of producing, transportation and just in case, more inventory will also hold by the manufactures than before which inevitable to increase the costs for this business process. Further, the sales performance would also become worse since downstream members of the supply chain could not get required products in time while holding unnecessary invents which hard to sale.

At the same time, as the sales manager introduced, the bullwhip effect could heighten the risk of holding unnecessary inventory of the production easily. Since the nature of the bullwhip effect, the information of demanding from the customers could not reflect the real demands and requirements of the end users. Most of time, the bullwhip effect brings more demands of the productions to the firm than reality which cause the forecasts with more optimistic aspect than it should be. In order to fulfill the demands of customers in any time, the manufactures of the firm have to hold larger inventory which usually over the real needs. Somehow, after the busy season of selling, it is hard to solve

such many inventory without any loss. Therefore, the risk of inventory would absolutely get higher while reducing the income and increase the cost.

Similarly, when the off-season of productions' selling, the demands from customers will lower than markets which cause the pessimistic forecasts both customers and the firm. Thus, the producing, transportation and inventory and other processes will all decreased by the firm. Which misleading the firm hardly to meet the real needs from markets and easily to reduce capability of the firm for catching up new selling chances until the next busy season.

Last but not least, the sales manager also believe the bullwhip effect is fairly harmful for the life cycle management of products. Since the nature of the bullwhip effect, it must cause a huge fluctuation in the demand information at the upstream of supply chain which must misleading the firm hardly to catch up the selling chances, even lose the markets share that owned before. Meanwhile, since the information form the markets could not knew by the firm in time, it is hard for the firm to make changes and improvements of the products in time for meeting the requirements that expected by the markets. Both of these problems could reduce the selling volume and income, increase the cost while higher the challenging for lifecycle management and also easily to shorten the lifecycle of the productions.

#### **4.2.1.4 Causes of the Bullwhip Effect**

Investigating the reasons which cause the bullwhip effect in Haier Group, the manager of sales department in the firm believes the following problems inside of the firm could be seen as the mainly reasons.

First of all, the firm does not get the clearly demand analysis about what the markets really need. Since there is no possible to let the firm get exact demand information from the market directly, instead, most of the markets' reflections which the firm could get are from the customers. Therefore, it is harder to make an extremely precise analysis about the market demands.

Secondly, as the sales manager pointed out, the evaluation system of sales performance for sales employees is not comprehensive enough which does not consider the inventory part in. As sales department of the firm, the sales performance would be seen as the

most significant factor for evaluating their staffs so that other factors are easily ignored to some extent. Thus, there is no doubt that the sales staff would hard to consider about any other factors during working. In order to catch up every sales chances, sales staff would order more unnecessarily inventory for in case which must cause the bullwhip effect in the upstream of the supply chain.

Moreover, in some cases, the sales plan of productions are not only depend on the forecasts which analyzed in scientific way. Instead, sometimes managers inside of the firm could change plans only based on their own optimistic or pessimistic perspectives which are fairly subjective. Thence, the subjectively sales plan could also easily to cause the bullwhip effect.

Last but not least, through the sales manager's introduction, the short of data collection and exchange system which access to the terminal stores directly is also one of the most significant problem. Because of the weakness in this area, the firm is hard to get the accurate and true information from the markets. The demands which expected by end users are also could not be known and fulfilled by the firm in time. Thus, the firm could not get to know the situation of the real markets and also the demands of end users. Instead, customers could mislead the firm about what situation of the real market in a fairly easy way. It is seriously endangers for the firm which cause the bullwhip effect

#### **4.2.1.5 Measures for the Bullwhip Effect**

As the opinion of the sales manager in Haier Group, for dealing with the bullwhip effect, the firm should get clearly about what creations the markets need and what improvements the end users expect for. It is fairly important to be highlight that productions are made for the end users but not distributors of the firm. If the firm aims to lead the markets in now and the future, collecting information from the markets and end users directly is necessary and also effective.

Then, the forecasts of productions should not only made in a scientific way, but also fairly detail which involve demands of every model in every terminal store. In this way, the forecasts would be more objective and clearly which avoid potential unnecessary inventory and other costs while reducing the risk of the bullwhip effect.

Further, the sales manager also believes building a supply chain with flexibility by the firm is also necessary for dealing with the bullwhip effect. Since a flexible supply chain will extremely improve the cooperation between members from upstream to downstream through trust building and information sharing, it could not only shorten lead time but also reduce the unnecessary inventory so that decrease the risk of the bullwhip effect. According to the annual report of Haier Group in 2011, the company has integrated many logistics companies in 2010, with 1 year's adjustment, the firm has already able to build flexible supply chain. Besides, in order to build flexible supply chain, the firm has also make a close relationship with 5 biggest suppliers of it.

At last, according to the sales manager, the firm should also make a strict management and controlling procedures system about the purchasing, selling and inventory both for manufactures in upstream and customers in downstream of the firm. Therefore, the unnecessary inventory and demands information which easily to mislead every members inside of the supply chain to make unrealistic forecasts and selling plans would avoid to some extent while reducing the risk of the bullwhip effect.

In those ways, the bullwhip effect would be reduced in the whole supply chain. Meanwhile, the unnecessary inventory and cost could also be avoided both by the firm and its cooperators.

#### **4.2.1.6 Significant Problem and Solution in Reality**

According to the introduction which provided by the sales manager of Haier Group, despite the comprehensive measurements have been made already, there are still some problems showed up during the sales department dealing with the bullwhip effect in realistic.

One of the most significant problem which found by the sales manager is the surge order during new productions enter to markets. Most of time, when a new productions enter to market, the order of this model would be zoomed and surge fairly quickly in a short-term. That is because, generally, the new productions are expected in optimistic way by both of the firm and customers. For the reason to gain the best sales goal and avoid the risk of stock shortage, customers will order more productions than real needs. Due to that, the firm will make more optimistic forecast, get more order and inventory

which misleading by wrong demands. Thus, after the short-term of surge in order, the firm will finally find there are many inventory losses show up.

For avoiding this problem, the firm has make a set of measures. Before implementing, the firm will make a comprehensive markets entering plan aim for the new production within every necessary details including which areas, channels and terminal stores the product will go, clearly.

Then, at the beginning of entering, the sales data of every model from every terminal stores will collected and analyzed once a day. Based on these data, the forecast of the production will be analyzed through considering various factors. During this process, the individual aspects without supporting by scientific analysis will be avoided for decreasing the amplified order.

Another problem pointed out by the sales manager is also caused by individual decisions. Since both of managers inside of the firm and its customers are easily to make forecast decisions of the productions just depends on their self-intuitions, and most of these forecasts will become the main causes of the bullwhip effect directly.

In order to reduce this irrational decisions, the forecasts are planned by a system with fairly strict procedures. The firm will make the detailed forecasts follow with rolling order in 13 weeks, 4 weeks, and T+2 weeks for every production for reducing individual aspects.

In addition, the firm has also align the interests of the firm and employees to create a win-win management culture. The firm established an assessment mechanism which assess the performance of staffs link with the execute situation of orders to ensure the interest both for the firm and staffs. Because of this assessment, every staff inside of the department should consider about more factors but not just the sales performance. This measurement let the staffs of the department cannot just focus on their own short-term sales performance, instead, they would focus more on the whole performance of the order which increase more benefits both for the staffs themselves and the firm. That opinion is also argue by the annual report of Haier Group in 2011.

In the opinion of sales manager of Haier Group, despite the bullwhip effect could not be eliminated absolutely in the sales department. Through using the existing measurements,

such as the comprehensive forecast system for productions, assessment linked with orders for staffs and also necessary alarm for wrong forecast, the bullwhip effect could be controlled in a reasonable level.

#### **4.2.2 Evaluation of Purchase Department**

As a purchase department, it belongs to the upstream of the firm which is the one could face to the manufactures and other suppliers in the upstream directly. In order to get a clear understanding about the situation of members in the upstream of the supply chain, purchase department is the key role which could hard to ignore. For this reason, this article made the evaluation about the purchase department of Haier Group through interviewing the purchase manager of the firm.

##### **4.2.2.1 Background of Purchase Department**

Through interviewing the purchase manager form Haier Group, just as the situation of sales department, the purchase forecasts of productions are planned rely on customer guide, which means customers demand-driven purchase orders or reserve order. For this reason, there are two mainly resource decide the purchase order of the firm which are the forecast based on data form sales department and productions' promoting strategic which planned to achieve strategic goals for the firm. In order to make a rationally purchase forecasts, despite achieving strategic goal is fairly important for future development of the firm, the sales order is still seen as the main resource while strategic plans is seen as secondary resource during purchase forecasts' planning.

According to the interview of purchase manager in Haier Group, since the sales situation are fluctuate with the seasons, the purchase orders are also follow with this rule. Due to the firm has enough sales experiences in Chinese market, most of the busy-seasons which include Chinese New Year, other traditional festivals and also some new celebrations recently created by people in China could be forecasted for a long time. In order to handle such many works during these terms, generally, the purchase forecasting and planning which are one of the most significant process of supply chain plans would finished in 30 days before the busy-seasons. After the busy-season, the orders of purchase would decreased obviously which is also forecasted by the purchase

department. Wherefore, the accurate forecasts and plans would also be done before end of the busy-season.

#### **4.2.2.2 Impacts of the Bullwhip Effect**

Although the purchase department of the firm performance good in forecasting process, the bullwhip effect still happens inside of the department. Through the introduction of purchase manager of the firm, except the misleading and risks increasing, there are three mainly negative impacts which caused by the bullwhip effect.

Overstock could be seen as the first significant impact in the department. As the purchase manager described, since the fact of changes and information gaps between every members inside of the supply chain, as one of the member in upstream, no matter how accurate the purchase forecasts is, the misleading by the bullwhip effect will still happens during implementing. Thence, the unnecessary inventory will finally show up. Moreover, since the nature of the bullwhip effect, productions with unnecessary inventory will together with pessimistic expects by almost every members of the supply chain and therefore become increasingly hard to sale than any others. Contrarily, the good-sales productions will always obtain optimistic expects and short of inventory.

Further, another impact is non-cooperating inside of the supply chain. Since the bullwhip effect is easily to break the original plans that every members inside of the supply chain followed with. Once the plans have no lead effective for business processes, the whole supply chain could hardly adjust to cooperate in a coordination way. Thus, if the situation continues, the confusions of operating must show up in the supply chain.

Last but not least, according to the purchase manager, the costs and losses will increase in a high level. Due to those two impacts above, not only the cost of inventory, transaction and managerial will increased pretty high, but also raising losses of incomes through mismatching the business chances. These problems will reduce the financial performance both of the firm and other supply chain members which should be took in a seriously way.

#### **4.2.2.3 Causes of the Bullwhip Effect**

Seeking of the causes about the bullwhip effect, the purchase managers believe the following factors are the mainly reasons which could not ignored.

First of all is the fact of markets' changings. There is no doubt the markets are always changing and no one forecast their trends exactly. Hence, no matter how good the firm performance, this factor could hardly change and must bring both of many risks and challenges which including the bullwhip effect.

Then, the purchase manager also believes the lengthy supply chain is also the reason which causes and exacerbates the bullwhip effect. As a lengthy supply chain which includes many processes and members, it is easily to increase the problems of information gap and lead time. Moreover, the communication between each members inside of the supply chain would be much difficult while causing complicated relationships. In addition, varies processes would also longer lead time and gain more managerial cost. In that way, it not only cause the bullwhip effect, but also need more costs.

Another factor is the progressive exaggerated forecasts. Since there is no one inside of the supply chain want to lose selling chances while avoiding risks for achieving benefits, every member would expect more inventory of good-sale products and less of bad-sale one. Meanwhile, members whom at upper stream would demands more than downer one. In addition to the lengthy supply chain problem above, the demands would absolutely exaggerated and finally increase the impacts of bullwhip effect.

Besides, as the purchase manager introduced, the bullwhip effect shows up is also because the information network inside of the supply chain is not clear enough yet. In a supply chain, every members could hardly communicate with each other and easily to gain information gaps without a clearly information network. Due to this situation, the purchase department could plan their forecasts only based on the data provided by sales department without any other information which might different from the realistic. In this way, the bullwhip effect could only become more and more seriously.

At last, the factor of sales objective is also a cause of the bullwhip effect which hard to ignore. Sometimes the sales objective which made by sales department for gaining benefits for the firm could not reflect real demands from markets will misleading

purchase department to make wrong purchase and inventory forecasts which easy to cause the bullwhip effect.

#### **4.2.2.4 Measures for the Bullwhip Effect**

According to the interview, the solutions of dealing with the bullwhip effect are pointed out by the purchase manager of Haier Group very comprehensively with many different aspects.

Through the opinion of purchase manager, macroscopically, the value chain and supply chain should be as short as possible with fewer nodes which cause less deviation. Therefore, both of the information gaps and forecast exaggerations could be reduced while gaining better communications and decrease the impact of the bullwhip effect.

Before implementing, the purchase manager believes a detailed and comprehensive purchase forecast is fairly necessary. The purchase department expect to achieve minimum inventory or zero inventory in the premise of meet customers' needs. In order to achieve this goal, the data collected from sales department will be analyzed in a comprehensive way which need to consider about varies factors and the forecast will made following with the rule of 13 weeks rolling system as purchase process to shorten supply cycle. According to the explanation of purchase manager, a hypothesis is that this week set as T, through the analysis of sales plan, suppliers' product capabilities, lead time of purchase and existing sales data to inform the order plans from T+1 week to T+13 weeks to their suppliers in upstream. The process will implementing in rolling way and some deviations are allowed in the system. The implementing of the purchase plans carried out in serious way. The purchase plan for T week should be executed in 100% while the purchase plans from T+1 to T+6 weeks should be prepared and deviations under 20% are allowed. At the same time, the losses in last week of T week which cause by individual factors will be response and reparation by the person. In that way, the forecast would be more able to reflect the demands of realistic which reduce potential risks of the bullwhip effect.

As the introduction by the purchase manager, in implementing processes, Haier Group built an information network inside of the whole supply chain for information sharing. Hence, the data which collected from terminal stores directly and reflect the real demands of markets could be known by every members both in the upstream and

downstream of the supply chain. This measurement could decrease the information gaps between upstream and downstream and also provide a more reasonable sales data for every member of the supply chain to improve their forecasts. Thus, since the data flow become clearer, the bullwhip effect could reduce to some extent.

In order to improve the communication between each other, the firm held coordination meeting inside of the firm on every Tuesday which involve every department of the firm. During meeting, every department from upstream to downstream will discuss about which department response for firm's losses in last week and plan the macro forecasts together. Because the meeting in every week make chances for every department of the firm to communicate with each other face to face, many obstructs could avoided and the forecast could also be more comprehensive. Furthermore, the bullwhip effect could also be dealt by this measurement.

The modular supply is another measure which pursuit by the firm. It is an effective to decrease complexity of supplying while reducing supply cost and impacts of the bullwhip effect also.

Last but not least, according to the purchase manager, Haier Group make a chance for each of member in their supply chain system on platforms and molds sharing. Through these methods, not only the cooperators of the firm could gain more benefits, but also help the firm decreasing the complexity of controlling and managing processes. Further, the firm could built closer relationships with members inside of the supply chain which good for the firm to improve information sharing and control powers. Meanwhile, depend on such effects of this method, the bullwhip effect could also reduce inside of the whole supply chain system.

#### **4.2.2.5 Significant Problem and Solution in Reality**

According to the introduction of purchase manager of Haier Group, during the purchase department implementing measurements for the bullwhip effect in realistic, the most significant problem is the arguments between purchase department and sales department.

Since the sales department aim to sale a much productions as possible to achieve better financial performance for the firm. Besides, most of factors the sales department's evaluation involves are about sales record instead of others, such as inventory amount

and management costs. Due to this aspect, the sales department always decide to order more products than market needs for avoiding stock shortage. Somehow, this decision would lead to unnecessary inventory and increase potential risks of unmarketable and price reduction of the project which higher cost for the firm. On the other hand, the purchase department holds different aspect on this. As people know, the objective of the purchase department is saving costs of purchase, inventory and management cost to gain better financial performance for the firm. Thence, there is no doubt that inventory structure and management costs are the main factors that considered in evaluation of the purchase department. According to this aspect, the purchase department have to consider more about reducing inventory to avoid unnecessary while decreasing management costs or losing controls. This way of thinking is totally against the sales department's which must cause millions of arguments during them working together and hard to eliminate.

For solving this problem maximally, the in addition to some compromises and cooperation made by both of them, the sales department and purchase department must establish a cooperation system together to make arguments and set up responsibilities for every staff involved. In this way, once unreasonable losses occur, the firm is accountable to individual for protecting the benefits while gaining better financial performance for the firm.

Through interviewing, as the purchase manager's opinion, based on the nature of the firm and also existing OTS sales model, it is impossible to eliminate the bullwhip effect inside of Haier Group. What the firm could do is trying to improving management to prevent the bullwhip effect occurs and reduce its impacts during implementing.

### **4.3 Summarize**

According to the interviews for both sales manager and purchase manager of Haier Group above, the information which provide by them could summarize and show as the table below.

Table 3 The bullwhip effect in Haier

|                                    |
|------------------------------------|
| The bullwhip effect in Haier Group |
|------------------------------------|

|                                     | Downstream  | Sales Department   | Purchase Department   | Upstream   |
|-------------------------------------|---|--|---|--|
| Severity                            |   |  |   |  |
| Causes                              | N/A*  | <ul style="list-style-type: none"> <li>● Unclearly understanding of demands</li> <li>● Uncomprehensive performance appraisal of sales department</li> <li>● Short of data collection and exchange network</li> <li>● Impact of individual decisions</li> </ul>       | <ul style="list-style-type: none"> <li>● The fact of market changes</li> <li>● Lengthy supply chain</li> <li>● Progressively exaggerated forecasts</li> <li>● Uncomprehensive performance appraisal of sales department</li> <li>● Short of data collection and exchange network</li> </ul> | N/A  |
| Impacts                             | <ul style="list-style-type: none"> <li>● stock risk of retailers</li> </ul> | <ul style="list-style-type: none"> <li>● Non-cooperating which reduce sales</li> <li>● stock risk of retailers</li> <li>● Risk of life management of products</li> </ul>   | <ul style="list-style-type: none"> <li>● Non-cooperating</li> <li>● Overstock</li> <li>● Increase costs and losses</li> </ul>   | <ul style="list-style-type: none"> <li>● Overstock</li> <li>● Increase costs and losses</li> </ul> |
| Measures                            | N/A   | <ul style="list-style-type: none"> <li>● Meet demands</li> <li>● Built flexibility supply chain</li> <li>● Scientific forecast</li> <li>● Strict controlling system about the purchasing, selling and inventory in supply chain</li> </ul>                           | <ul style="list-style-type: none"> <li>● Reduce nodes in supply chain</li> <li>● T+13 forecast system</li> <li>● Use of ICT</li> <li>● Coordination meeting</li> <li>● Modular supply</li> <li>● Platforms and molds sharing</li> </ul>   | N/A  |
| Significant problems and treatments | N/A   | <ul style="list-style-type: none"> <li>● Surge in order of new products</li> <li>● Solution: data collection and forecasts</li> <li>● Individual decisions</li> <li>● Solution: T+13 forecast system</li> <li>● Align interests of the firm and employees</li> </ul> | <ul style="list-style-type: none"> <li>● Arguments between purchase department and sales department</li> <li>● Solution: Establish a cooperation system</li> <li>● Set up responsibilities</li> </ul>   | N/A  |

\* N/A: Not Available

(Source: Own structure)

Through this table, there are many different perspectives of between sales department and purchase of Haier Group. The sales manager believe the cause of bullwhip effect includes unclearly demand understanding and individual decisions. While the purchase manager thinks lengthy supply chain and exaggerated forecasts are main reasons of the bullwhip effect. In addition, the measurements which pursuit by these departments are different also. The measures taken by sales department are mostly in connection with markets demands and controlling to retailers, while purchase department pursuing measures are aim at coordinating the whole supply chain. What is more, the most

significant problems in sales department are caused by retailers from downstream and itself. Somehow, in the perspective from purchase manager, the arguments with sales department are the most significant problem in their department.

On the other hand, there are also many identical opinions and measurements in two department. During interviews, both of sales and purchase managers pointed out the uncomprehensive performance appraisal of sales department and short of data collection and exchange network are included in causes of the bullwhip effect. At the same time, the impacts of the bullwhip effect which described by these two managers are similar to each other. Further, both of them has introduced the T+13 forecast system as a measures for dealing with the bullwhip effect inside of the firm.

## **5. Analysis**

### **5.1 Introduction**

In this chapter, the research questions mentioned in previous chapter are trying to be achieved. This section will intend to provide analysis and discussion for causes of bullwhip effect, its impacts and the countermeasures to the bullwhip effect according to Haier Group. The research is focused on why the bullwhip effect appeared, the main causes, impacts of the bullwhip effect and countermeasures for it.

The general rule of ordering in appliance industry is first, retailers observe customers' needs, and then orders to wholesalers. In order to determine the quantity of orders from wholesalers, retailers must make a prediction of user needs. Generally speaking, retailers will forecast the customer's demands based on inventory movements of last cycle as well as the experience of next cycle, and order to wholesalers in accordance with this standard. Then, in the second phase of supply chain, according to retailers' orders, wholesalers will add their own judgments and then order to his supplier, the manufacturers. In the next stage, it is not possible of the manufacturer to start the production after the statistics of the exact number of orders, but to predict the number of orders in advance. Which can be seen, the manufacturer does not understand and cannot understand the data of consumer's actual demands in this supply chain. Therefore, the manufacturer can only carry out his forecast based on the orders of wholesalers. If the ordering from wholesalers and retailers has more pronounced volatility than the users' demands, the forecasting and inventory control problems of manufacturers is much more difficult than forecasting and inventory control problem of wholesalers and retailers. Increased volatility will force manufacturers to support more secure inventory than the wholesaler and retailer or maintain more inventory space, in order to achieve the same supply and service levels as wholesalers and retailers, thus the bullwhip effect is inevitable.

### **5.2 The causes of bullwhip effect**

According to lee et al. (1997a), Sterman's experiments of beer game can show that the bullwhip effect may causing by human behaviors, which include misconceptions about inventory and demand information. The bullwhip effect reflect the demands in the supply chain is not synchronous, and it reveals a common phenomenon in supply chain

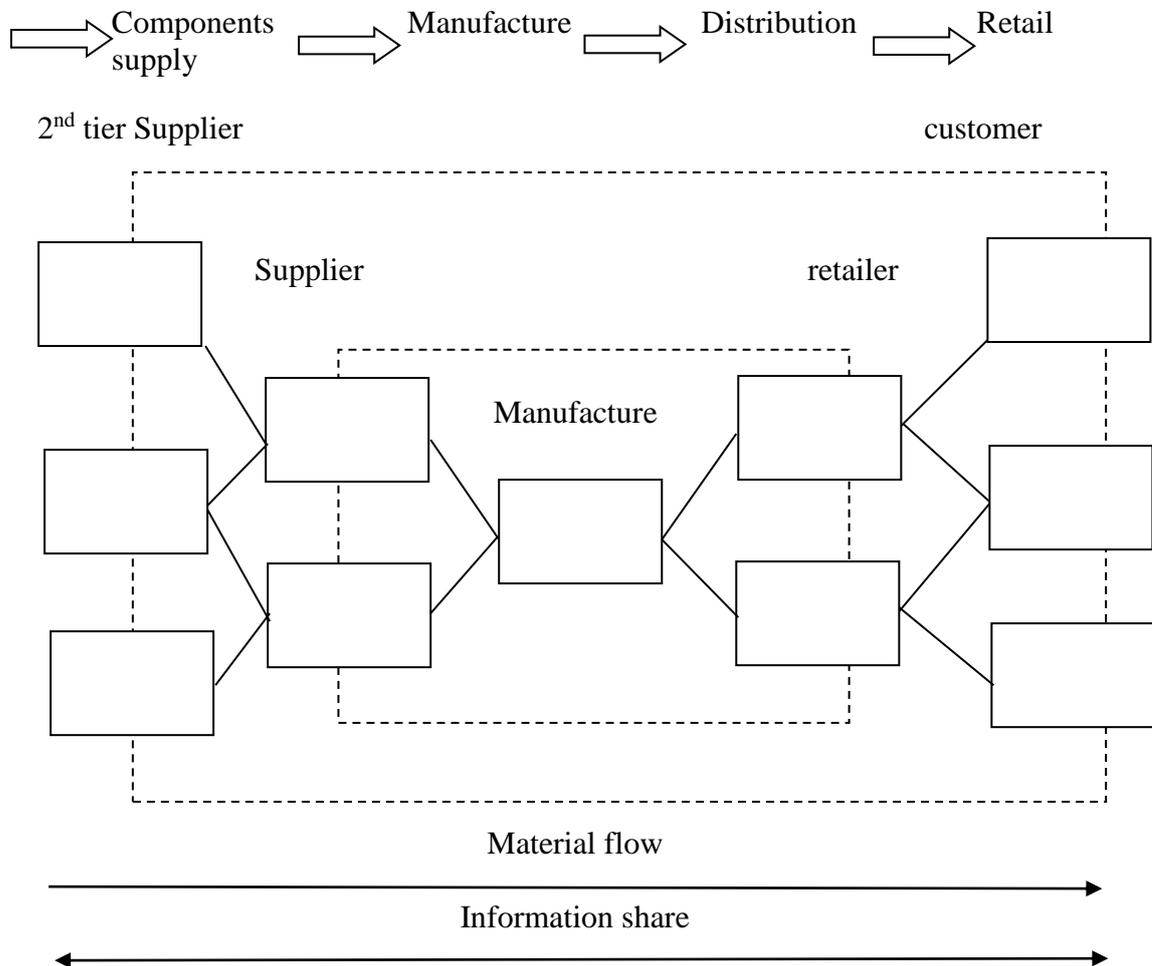
inventory management, what you see may not be true. As every known, the bullwhip effect is harmful to the supply chain management, it causes the production of wholesalers, retailers and manufacturers costs much higher than the actual demands of customer, and then resulting in product backlog, capital occupied and making the whole supply chain operations inefficient. With the increase of enterprise in the operation of supply chain, this effect is becoming increasingly obvious.

### **5.2.1 Demand signaling**

What causes the bullwhip effect? Through the interview of two manager of Haier Group, both of them hold the view of that the opacity of information is the main cause of bullwhip effect. And this is actually the most important reason, back to chapter 2 it has mentioned that the phenomenon that the variance of orders may be larger than that of sales, and the distortion tends to increase as one moves upstream. Lee et al. (1997a) argued the first of the four causes of bullwhip effect is demand signal processing which refers to no visibility of end demand, multiple forecasts and long lead time. The traditional system of manufacture is “push”, which means products are produced or assembled in batches in anticipation, and plays the role of “buffers” between the various functions and entities in the supply chain (Christopher 2011). Because the characteristics of electrical appliance industry in China market, manufactures cannot face the market and do not know the real demands of customers, the tasks of sales plan are not compatible with the reality, this is why manufactures often made wrong decisions. The retailer’s order do not represent customers’ real demands (Lee et al. 1997b). Traditional supply chain of electrical appliance industry consist of lots of links, which gain the risks of the bullwhip effect. Croson and Donohue (2006) believed that the causes of the bullwhip effect included operational and behavioral causes, the operational cause is pointed out by Lee et al. (1997a), while behavioral causes consist of stationary and known demand, and sharing dynamic inventory information. Thus, the longer the supply chain is, the greater the risks, and predict exaggerated progressively. In the traditional supply chain, each node enterprise always forecast their own demands based on their immediate downstream demands, in order to face the change of the marketing, they often adding a correction increment to the predicted value as their order quantity, this action produced inflated demand which also cause bullwhip effect. Otherwise, in order to prevent shortages, enterprises often setting safety stock and reorder point, the longer the advance orders, the greater volatility the market is, and then the less accurate

of demand forecasts, the more obvious manifestations of bullwhip effect. Figure 1 has showed the different links in the supply chain, information transfer between different links, the bullwhip effect is magnified layers.

Figure 3 Basic links in the supply chain of electrical appliance industry



(Source Own construction)

### 5.2.2 Price fluctuation

Products in electrical industry has another characteristic, the price is often affected by the season. In Haier Group, both sales and purchase departments were affected by season. In China market, national day, May Day, Chinese New Year and etc. are seemed as the best time to attract customers to buy their products, promotions will be adopted in order to increase sales. Lee et al. (1997b) argue that high-low pricing, delivery and purchase asynchronized causes fluctuating prices is another reason why the bullwhip effect appear. When the manufacturer's product price in supply chain has a random variation within a certain range, retailers tend to be expansion the orders when

the price is low, and reduce orders when it is high. In reality, vendors will adopt price discounts and other promotional strategies, which cause abnormal order or sales. This can resulting fluctuations in orders, and along the supply chain progressively larger from the downstream to the upstream. While face of price volatility, promotions and discounts, short supply, inflation, natural disasters, etc., retailers and distributors often taken the strategy of increase the inventory, and make the order quantity far greater than the actual demand. Upstream enterprises in the supply chain often use some promotional strategies, such as price discounts, quantity discounts, etc. If the inventory cost is less than the benefits gained from discounts, during the promotional period in order to obtain a large number of discounted goods, the downstream enterprises will give false statement about their sales amounts. Then sell the extra discounted goods in other marketing or postponed until after the end of sales promotion, some of these products are also resell to other retailer, this caused a great deal of uncertainty in demand. And for consumers, although they will change their purchasing in the price volatility period, this does not reflect the actual needs of consumers because they will delay or early part of their demands. This is why Price fluctuation causes the bullwhip effect.

### **5.2.3 Order Batching**

Batch ordering has serious implication for the supply chain which can results in the bullwhip effect (Hussain and Drake 2011). In the supply chain, each enterprise always taking the purchase cost and inventory costs into account when orders to the upstream firms, and would have a certain degree of control over inventory. Lee et al. (1997b) argue that high order cost, full truck load (FTL) economics and random or correlated ordering are the main reasons causes order batching. On the one hand, reducing the frequency of orders can reduce orders and purchase costs, therefore firms always orders to upstream after an interval period or accumulated to a certain extent, thus creating an order batching. According to Hussain and Drake (2011), large batch sizes can not only lead large fluctuation in inventory levels, but also amplifies the demand as it processes up a supply chain. On the other hand, it is difficult for firms to be replenished from its suppliers immediately after run out of inventory, so usually all enterprises will maintain a certain amount of safety stock in the delivery times while Economic Order Quantity (EOQ) has been adoption. The result is the forecast orders larger than the actual demand.

The longer lead-time can not only increase the uncertainty in the forecasting of the future demand, but also increase the variability of the order quantity (Agrawal et al. 2009). The longer the lead-time, the greater impacts on the timeliness of the information and the safety stock. Supplier in the supply chain form their own demand information based on receive orders, and send to their upstream ordering information, the result is order quantity much greater than the actual sales.

#### **5.2.4 Shortage Game**

Hussain and Drake (2011) said Forrester pointed out demand amplification is due to system dynamic. Shortage game is also another cause result the bullwhip effect. When there is a shortage of products, upstream suppliers are usually only partially meet the needs of downstream vendors ordering, or according to customer orders supply a certain proportion limitedly, in order to ensure the satisfaction of its customers' needs, the downstream vendors will deliberately exaggerated the market demand trying to make the exaggerated demands on upstream to offset cuts order quantity. Proportional rationing scheme, ignorance of supply conditions, unrestricted order and free return policy are all contribute to the shortage game's appearance (Lee et al. 1997b). When the short supply situation eased, the orders from downstream firms will suddenly drop, or even cancel. This shortage gaming will generate overreaction to downstream firms, result in upstream enterprises cannot distinguish how much of the growth is due to the increased of real market demand between these data, therefore cannot get the real information about the demands of product from downstream firms' orders. In addition, the supply of new products also have a great uncertainty, firstly consumers are more willing buy popular products without regard whether it is necessary; second, the new products have characteristics such as high price, short cycle and large fluctuations in demand. Once it happens, the order does not reflect the actual demands, this is so called the bullwhip effect.

#### **5.3 The impacts of bullwhip effect in electrical appliance industry**

After realizes the causes of bullwhip effect, what are the impacts of the bullwhip effect will be identified in this section. As previous chapters mentioned, the bullwhip effect is harmful to the supply chain and supply chain management. Demand amplification which caused by the bullwhip effect can result the information distortion. This information distortion make the upstream suppliers often need to maintain a higher

demand than its downstream inventory levels in order to cope with the uncertainty order of vendors. Thus artificially increasing the supply chain upstream suppliers' risks of production, supply, inventory management and marketing, rising inventory costs, product backlog, and weakening the competitiveness of enterprises. Hussain and Drake (2011) hold the view of that the impacts of the bullwhip effect includes inaccurate forecasting which can cause periods of low capacity utilization or periods of having no enough capacity, inadequate customer service and high inventory costs. For example, when manufacturers are faced with highly volatile demand information, it will bring many difficulties to their production arrangement, smooth production is difficult to achieve and resulting in the production ebbed and flowed and even meet shutdown state. The enterprise had to work overtime and rush production when the plant needed to meet the sudden increase in demand, through this the stability of product quality cannot get guarantee, and will also result in increased production costs, affect the overall competitiveness of the supply chain. When the manufacturer expansion of production scale in accordance with the distortion information, design the production capacity above the actual demand, the result is lower the production capacity utilization rate so resulting in waste investment and construction. In contrast, the phenomenon which logistics from upstream nodes to the downstream nodes progressively reduced as it processes up a supply chain will occurs, so that each node save a lot of unnecessary inventory. Such inventory is entirely caused by the interference of distortion information which operated in demand information transmitting process, do not play any role in buffering of requirements. On the one hand it backlog a significant of production capital, on the other hand with the changing of market demands it faced with the risk of obsolescence or retired.

The bullwhip effect increased the production costs. In order to meet the variable order arising from the bullwhip effect, manufacturers and their suppliers have to either expand production capacity, or increase inventory, Both of these approaches will increase the production cost of per unit of product. The bullwhip effect cause high inventory costs (Hussain and Drake 2011). Companies have to maintain a high inventory levels of raw materials or finished products in order to maintain a certain level of response and adapt to demand fluctuation, and this causes inventory costs increased. The bullwhip effect also increased transportation costs. Because of the bullwhip effect, transportation demand volatility changes over time, firms need to maintain the remaining capacity to

meet demands. As the number of home electrical appliance stores increased, transportation costs, inventory costs and warehousing maintain costs increase the enterprise's costs.

#### **5.4 Measures to Mitigate the Bullwhip Effect**

As one of the most famous brand of electrical appliance in China, Haier Group has undergone dramatic changes since it founded as Qingdao Refrigerator Co. in 1984 at the outset. Haier Group's rapid development, largely attribute to its advanced supply chain management system, Just In Time (JIT) strategy is a strong impetus to the efficient functioning of the Haier Group. In-depth research and analysis the use of JIT strategy, integrated information platform and supply chain management system of Haier Group, will help to further improve the management level of Chinese electrical appliance industry. The conversion of Haier's logistics management innovation is closely around the mode of production. The traditional system of manufacture is “push”, which is first to create a product and then sell to consumers, the products may not the most needed products to customers. In order to meet customer demands in the largest extent, the Haier Group is currently implementing the pull manufacture system, which is produce based on the demands. Set the orders as the driving force of business operations and the core business of all the work.

##### **5.4.1 Information Sharing**

In the supply chain which has a poor communication of demands, companies only receive the orders sent from its upstream node, and know nothing about final customers' demands. If the upstream enterprises can grasp the information of end-user, then they can timely and accurate understanding the product market, and filter out the interference information arising from the prediction of middle nodes, use final customer's needs as a basis to forecast demands. Weaken the information risk caused by the bullwhip effect. The information sharing among supply members has been highlights in the research of Lee et al. (1997b), they said sell-through data and information on inventory status are keys to gain control of the bullwhip effect. Haier Group applied the advanced information technology of modern logistics, and established a unique concept which is called one flow and three nets. The global supply chain resources net, global customer resources and computer information net which is created by Haier quicken the market response speed of the enterprise, to meet the individual needs of consumers. Haier

Group's one flow and three nets logistics system is an organic combination of the overall, Haier Group make the entire production plan in accordance with the orders to ensure the smooth operation of JIT production. In order to meet JIT procurement, JIT production and JIT delivery requirements, Haier Group build a one flow and three nets system within the scope of the entire group, and through computer information network keep a watchful eye on the demands for raw materials in the entire production process as well as market demands. Try to make demand data at a downstream site available to the upstream site is a remedy to avoid multiple demand forecast updates, one of the solutions to the bullwhip effect (Lee et al. 1997a). Through the one flow and three nets, Haier Group can have a better understanding of the customer needs and market demands, furthermore, Haier has decline the response time and the lead-time. As above mentioned, long lead-time can causes the uncertainty in the forecasting of future demand and the variability of the order quantity, thus, lead-time reduction can be seen as a countermeasure to mitigate the bullwhip effect. Lee et al. (1997b) argue that access sell-thru or POS data, single control of replenishment and lead-time reduction can contribute to help to solve the demand forecasting updating. The supply chain which set Haier as the core link, connect to suppliers and distributors played an important role, in the implementation of logistics management, shorten the lead time, reduce inventory, accelerate cash flow, and improve response capabilities to the market.

#### **5.4.2 Just In Time (JIT)**

Haier's CEO, Zhang Ruimin thought speed is the winning weapon in the Information age. Establishment of modern logistics for Haier is pick up speed, this speed means the fastest way to meet the customer's individual needs. In order to achieve this speed Haier Group applied the synchronous mode, as long as the moment of receiving the order, all departments and individuals related to orders must act in synchronization, synchronized process and synchronized delivery. In general, do three JIT.

##### **5.4.2.1 Just In Time Purchase**

Procurement is the most important part of logistics activities, in order to promote logistics reorganization, Haier has to together its procurement activities, scale operations and global procurement. Through B2B online purchases, online payment and online bidding which set enterprise resource planning (ERP) as background, and implementation of customer relationship management, Haier achieved information sharing, joint planning and joint development between internal and external suppliers.

All suppliers are receiving orders online, and query plan and inventory through the internet, to achieve replenishment in time and JIT procurement. To minimize the procurement cycle, so that the average of procurement cycle down from 10 days to three days.

#### **5.4.2.2 Just In Time Delivery**

Haier implemented JIT management in the internal distribution to reduce order quantities. According to Hussain and Drake (2011), balancing the order of the retailers, a longer order interval time and smaller batch sizes can reduce the bullwhip effect at supplier level. Distribution department play an important role in inventory costs reduction and manufacturing systems safeguard of logistics. After integration of delivery, logistics departments can assemble a batching of next day's production plan through ERP information system, meanwhile delivering in 4 hours, through this to achieve JIT delivery. On the one hand, bring the factory clean and bright, on the other hand reduce the inventory levels substantially.

#### **5.4.2.3 Just In Time Distribution**

Through the integration and restructuring of internal transport resources in Haier, building a transportation logistics division in accordance with the strategy of integration, coordination and control of transport operations, integration of social warehousing and transportation network resources, Haier Group established a nationwide network of distribution system which provide protection of logistics for the zero distance selling. At the same time, Haier collaborates with China Post, and opened up a new model of B2C sales. That is, as the volume of business gradually expand with the China Post, Haier Group's cooperation with the China Post has grown from a single product distribution penetration into Haier's distribution in chain.

Haier Group adopted JIT strategy in the supply chain management, and combine the JIT purchasing, JIT delivery and JIT distribution three aspects, which can reduce costs effectively and improve the efficiency, and meet market demands and consumer expectations continually. Through the JIT purchase, JIT delivery and JIT distribution, Haier Group can achieve the goal of zero overstock. At the same time reduce the procurement costs and inventory costs as much as possible in the production process of the Haier Group, help to improve the competitiveness of products. The successful implementation of JIT strategy in Haier Group, cannot do without Information Platform

and the effective functioning, through EDI and ERP system, firms can access to information on market demands effectively, and the information for consumer preferences, so that adjust the production plan in time. EDI and CAO are the countermeasures of high order cost which attributed to order batching, one of the main reasons of the bullwhip effect (Lee et al. 1997b). With these information, Haier Group can also obtain the contact with suppliers in time, sharing information, Provide components and raw materials organizational needed for the production, so that reduces the cost of procurement and inventory costs.

#### **5.4.3 OEC Management**

Overall Every Control and Clear (OEC) management is create by Haier Group, it refers to a full range of management for everything and everyone, every day. Each employees of Haier need to sum up the day job, contrast objectives to identify Problems, and take corrective measures in time. In order to avoid multiple demand forecast updates, Haier built the prediction system of rolling order in 13 weeks, 4 weeks, and T+2 weeks, analyze the sale and inventory of store, forecasts based on the same period and under the target, try to avoid inaccuracies caused by human factors. Through the OEC, everyone get involved, it greatly stimulated the vitality and creativity of employees. All aspects of service objectives can be clearly, and connected to each other, build a close relationship. The responsibilities can be define clearly, efficiency can be improved and it plays a very important role in the promotion of logistics reform.

#### **5.4.4 Inventory Management**

The traditional supply chain of electrical appliance industry has the characteristic of high inventory costs, and the high inventory cost is a symbol impact of the bullwhip effect. In order to reduce the inventory costs and achieve the goal of zero stock, Haier Group implied the unified management of warehouse, and use the computer system to manage inventory information. Haier Group established two international logistics centers, rational allocation of resources, reducing the extended and sluggish materials effectively and also reducing the warehouse area. Through Lee et al (1997b), Vendor Management Inventory (VMI) can be seen as the countermeasure of single control of replenishment, which helps to alleviate the bullwhip effect. In the process of VMI, in order to build a strategic partnership with supplier, Haier imply the consignment mode for those components of occupied large stock funds and long lead-time. According to the orders information which comes from the Haier Logistics online, supplier organize

the producing, supplying and then entering the Haier consignment warehouse in advance, the components re-apply for storage after use. This not only reduces the storage, transportation costs and management costs of sub-suppliers, but also guarantees the speed of response to market orders effectively, and maintained a zero inventory in carrying supplies. Haier's purchase costs can reached tens of billions each year, all procurement of goods is based on the order. In Haier Group, the warehouse is no longer a storage reservoir for supplies, instead, it is a flowing river, what flowing in the river are the necessary materials for production based on orders. Virtually eliminating the sluggish materials and the inventory.

Although Haier Group has a huge success in the supply chain management, there are still some defects cannot be ignored. In order to facilitate dispatch management, the transport business of "factory - Distribution Center" route has been giving to Haier's own trucks or large fleets which contracted to them, they do not consider about the scattered trucks, this causes the high transportation costs.

## **6. Conclusion**

### **6.1 Introduction**

The overall aim of this research is to advance the understanding of the bullwhip effect and help to minimize the impacts of it in electrical appliance industry in the Chinese market. The specific research objectives were:

4. Identify the causes and impacts of the bullwhip effect in electrical appliance industry.
5. Evaluate critically the Chinese Haier Group's measures to mitigate the bullwhip effect.
6. Formulate recommendations to the electrical appliance industry in China on dampening the bullwhip effect.

In this section, the research objectives above mentioned will revisit, and the summary and conclusion of the findings in this research will be offered. Recommendations for future study will be discussed in this chapter, furthermore, a reflection on this research is also include.

### **6.2 Research Objective: Summary of Findings and Conclusion**

#### **6.2.1 Research Objective 1: Causes of Bullwhip Effect and Its Impacts**

The main causes of bullwhip effect include: demand forecast updating, order batching, price fluctuation, rationing and shortage gaming as above mentioned. Downstream enterprises in supply chain will increase the quantity of orders to the upstream enterprises when they receive the signal that customers have a higher demand for the products. However, upstream firms make the prediction and decision only based on information from downstream, the control of inventory can affected by the distortion information inevitably, this distortion propagates in an amplified form from downstream to upstream. Economic Order Quantity (EOQ) may be the optimal ordering strategy to retailers while considerate about the factor of ordering cost, but it has a bad influence to the manufactures. In order to get the products as soon as possible or in full amount, the seller tends to increase the orders. Thus, the bullwhip effect appeared. When the

produce abilities cannot fulfill the potential demands, manufactures may rationing in accordance with retailers' orders. In order to get more quota, retailers will increase the orders which is higher than actual demands. While the demands come down, the orders come to the common levels. As a result of shortage gaming, the distortion information eventually lead to the bullwhip effect. Otherwise, the promotion and discount for large order leads to uncommon order and sale also cause the bullwhip effect.

The impacts of bullwhip effect to the enterprises are self-explanatory, sometimes it even has a serious influence. Because of the bad demand forecast, manufactures often pay the excessive material cost or shortage of raw material, extra manufacture cost, overtime cost, excessive inventory cost leaded by high inventory level and backlog of fund. The bullwhip effect made enterprises keep a higher inventory level than actual demands, which arisen the manage risks and weaken the firm's competitiveness. Meanwhile, it also lower the operation efficiency of the entire supply chain.

### **6.2.2 Objective 2: Measures To Mitigate the Bullwhip Effect**

As the most famous electrical appliance brand in China, Haier Group has a successful experience on how to mitigate the bullwhip effect. At first, information sharing was pointed out to solve this problem. While the bullwhip effect is caused by distortion information, information sharing between upstream and downstream enterprises have a quite important role to mitigate the bullwhip effect. For achieving this target, Haier build the one flow and three nets to share information among all participator in the supply chain. What is more, through this unique system, Haier can have a better understanding of the market and customers' demands, so that reduce the lead-time and quicker response time. The one flow and three nets can also help to meet the requirement of JIT purchase, JIT delivery and JIT distribution. These three JIT are another important measures of Haier to alleviate the bullwhip effect. Through the JIT purchase, the high material cost or raw material shortage can be improved, and the implementation of JIT delivery can smaller the batch size, while the JIT distribution provides protection of logistics for the zero distance selling. The EDI and ERP system are also adapted in order to access to information on market demands effectively. The Overall Every Control and Clear (OEC) management which created by Haier Group is also used to improve its own performance on the supply chain management. Vendor Management Inventory (VMI) is another important strategy of Haier to gain the control

of the bullwhip effect, the consignment mode which belongs to VMI has been applied to decrease the inventory level.

### **6.3 Recommendations**

Although there are various methods can help to mitigate the bullwhip effect, it is impossible to eliminate it completely. No matter what kind of measure has been taken to solve this problem, information sharing among supply chain members is always the key point, but it is quite difficult to carry out the information sharing in actual operation. How to fulfill the information sharing is of great significance in mitigating the bullwhip effect, through the case of Haier Group, the conclusion can be draw as follow:

Firstly, coordinate the benefits between supply chain members and build trust through each other. Only have the condition of trust can the enterprises in supply chain built the reliable cooperation and relationship. Coordinate the benefits of members, thus, the barriers of information sharing through different links in the supply chain can be removed.

Secondly, the techniques of information sharing. The transfer of information is the premise of information sharing, the implementation of EDI system, internet and e-commerce bring the convenience to transfer information. To the electrical appliance industry in China, built a suitable information platform can help to achieve information sharing, and reach the goal of mitigate the bullwhip effect. Generally speaking, built the suitable information platform can not only benefit the produce, delivery and distribution, but also benefit the data exchange and information sharing.

Thirdly, integrated the logistic system. In order to operate JIT strategies successfully, the electrical appliance firms in China have to establish a unified and efficient logistics system, the operation of logistics system should concentrate on the orders, and make the logistics plan based on the orders. Firms should find out the optimal scheme, reduce the material input and decrease the purchase, delivery costs.

Last but not least, information technique, hardware and innovation could not be one less. The success of Haier attribute to the integration of information technique, hardware and innovation. Since Haier Group has such a successful experience on how to mitigating the bullwhip effect, it is of great significance to other electrical appliance firms in China.

#### **6.4 Self- Reflection**

This research work have an unsuccessful beginning. At first, the main research questions were evaluating the impacts of the bullwhip effect in Haier Group's supply chain, and formulating recommendations to the Haier Group on dampening the bullwhip effect. However, the lack of data made it impossible to go on this study, while Haier Group really done well in solve this problem. As a result, the research questions have been redefined, the new research questions just as now been formulated.

After this research work, some advices can be given. First of all, have a deeper knowledge of the areas which interested you, it is important to do the right thing in the beginning. A deeper knowledge of interesting areas can help to find out the most suitable topics that interested you, and ensure you keep the right direction. Next, no matter what kind of methods been choose to do the research, they all needs carefully planning. In this study, case study has been chosen as the research strategy, before interviews of the case company, research questions and background data has been prepared.

Roughly, this research has achieved the overall aim of increase the understanding of the bullwhip effect in electrical appliance industry in China , and the research questions also been answered, there still exist limitations in this research work. Although Haier have successful experience on dampening the bullwhip effect, different firms have different situations, so the experience is inapplicability to all the electrical appliance industry in China. Another limitation is the research only interviewed two managers of Haier Group which may causes the risk on lack of reliabilities.

#### **6.5 Contribution & Suggestion for Further Research**

The study revealed the impacts of the bullwhip effect in electrical appliance industry and measures of Haier Group to mitigating such phenomenon, finally give some recommendations to electrical appliance industry in China to control the bullwhip effect. Some key observation were obtained based from the interviews of Haier. The bullwhip effect is very common in supply chain, there are also lots of researches about the impacts of the bullwhip effect and its countermeasures. However, there has little research about the electrical appliance industry, even/especially? in Chinese market. This study trying to fill this gap in accordance with related literatures, and relate to the

real situation of Chinese electrical appliance industry to come up with the most suitable recommendations.

As a suggestion for further research, the external relationships should be also studied. This research was focused on the internal relationships among different links in Haier Group, while the external connections between Haier with other suppliers are also need to study to achieve a deeper understanding of the bullwhip effect, and how to control the bullwhip effect in the cooperation of different companies. As an efficient supply chain management, every links in the supply chain should have a well performance and obtain the final excellent operation, try to dampening the bullwhip effect as much as possible.

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## **Appendixes:**

The interviews of Haier computer sell department manager Mr Fang and minister of Haier's supply chain director Mr Li were from october 8 to october 10.

Interview questions (for selling department)

What is the main source of your orders, stores, distributors or any others?

Will the order of the year effected by seasons? If it does, is there any regular patterns?

What do you think about the impacts of the bullwhip effect?

In your opinion, what is the main causes of the bullwhip effect?

What are your personal views on how to manage the bullwhip effect?

When your apartment tried to manage the bullwhip effect, what kinds of problems have you faced to, and how did you solved them?

Do you believe if the bullwhip effect could totally eliminate in your apartment?

Interview questions (for purchase department)

What are the purchasing process of your apartment?

What does your purchasing plans mainly in accordance with, the orders from selling apartments, depends on last season's data or any others?

Will the order of the year effected by seasons? If it does, is there any regular patterns?

What do you think about the impacts of the bullwhip effect for your purchasing?

In your opinion, what is the main reasons which could cause the bullwhip effect?

What are your personal view on how to manage the bullwhip effect?

When your apartment tried to manage the bullwhip effect, what kinds of problems have you faced to, and how did you solved them?

Do you believe if the bullwhip effect could totally disappeared in your apartment?