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A Study on Factors Affecting the Degree of Bullwhip Effect and Inventory Cost to an Optimal Management Strategy for Information Sharing in Supply Chains

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Abstract: *To compete successfully in today's marketplace, it has become that success cannot rely solely on improving the efficiency of internal operations, and that collaboration with trading partners can build the foundation for a competitive advantage and substantially improve the bottom line. Companies need to efficiently manage the activities of design, manufacturing, distribution, service and recycling of their products, and services to their customers. The coordination and integration of these flows within and across companies are critical in effective supply chain management (SCM). In this paper, we define a two-stage supply chain model (a retailer and supplier). Based on results of simulations, we identify the factors*

Keywords: Supply Chain Management, Bullwhip Effect, Information sharing.

1 INTRODUCTION

Supply Chain Management deal with the management methods in World-Wide. For example, it is known as s uccess in DELL, Wal-Mart and so on. According to success auto-mobile industry in Japan, the company can be reduction cost by information exchange from phases of development to a close rate in many *keiretsu* companies.

In the auto-mobile industry of Japan, it is a group in the pr operties such as the system, and the subsidiary company succeeded in cost reduction by information exchange being performed frequently from phases of development to sales stage. We share management resources and information as one of the process in supply chain, and this is because, it is possible to reduce "waste" by optimizing the supply chain.

Based on the case study of the supply chain management, there are many theoretical studies in the bullwhip effect. Th e Supply Chain subjected to information distortion as demand information is processed and passed on from one part of the chain to another.

Information sharing among companies in a supply chain is regarded as an effective measure, the relations of WIN-WIN and the management strategy to relieve the Bullwhip Effect. In previous study, there are effective with the information sharing as measures to control Bullwhip Effect. However, it may be hard to do information sharing because there is not a clear standard and does not succeed in particular with the thing such as the profit allocation.

In this paper, we perform analysis about the effectiveness of the information sharing with the factor of inventory control. Moreover, using Excel Statistical software, we approach order policy and inventory cost with information sharing in management for decision making.

In Section2, we consider the study of Bullwhip Effect. We define the model for simulation in Section3.

In finally, we describe the inspection of information s haring with numerical analysis.

2 LITERATURE

The previous studies of Supply Chain Management co nsider two points. There are the cause and existence o f Bullwhip Effect, the reduction of Bullwhip Effect.

It was recognized that the inventory in the company played a role as the buffer which controlled uncertain demand conventionally. Therefore, it was thought that degree should be smaller than a change of the demand as for the change of the quantity of ordering of the company by holding extends stock.

In contrast, Forrester (1961) showed that width was rather bigger than a change of the demand to the company to the change of the quantity of ordering of the company using empirical evidence in American energy industry [3]. This phenomenon was called "Forrester phenomenon" using his name. These were pointed out in the TV production industry by Holt, Modigliani and Shelton (1968) and the auto-mobile industry by Blanchard (1983) [2], [4].

In a phenomenon to contradict it for such a previous way, Caplin (1985) [5] and Blinder (1986) [6] performed theoretical inspection and proved the existence. For example, it was considered that the model of the ordering (S, s) policy [5]. As a result, the fluctuation of the ordering by the retail proved the thing that was bigger than fluctuation of the demand when demand to retail was independent each other.

As an advanced study for Supply Chain became popular, it was cleared that the phenomenon occurred in an individual type of industry. This phenomenon was named "Bullwhip phenomenon" in American P&G Corporation.

In the cause study of Bullwhip phenomenon, we showed that the optimal stock quantities of the retail were

correlation to demand in a period, and Kahn (1987) [7] derived that raise Bullwhip phenomenon by a backlog in the excessive demand. Sterman (1989) [8] considered the cause of Bullwhip phenomenon using a production distribution game (i.e. beer game). This game noted that fluctuation of the ordering is appeared; one of the causes in Bullwhip phenomenon is an information distortion. There were four mains. That is the error in demand forecasting, failure of supplies and the device of leadtime, price fluctuation.

Chen et al. (1998)[11] considered the influence of the Bullwhip phenomenon using two forecasting models in the moving average and exponential smoothing method. Moreover, Cheung and Zhang (1999) [12] described the cancellation of the customer ordering with being a cause of Bullwhip phenomenon. It is because that the canceled demand is similar with dummy demand. The customer and the Supply Chain partner considered it what kind of factor damaged retail and an upstream (wholesale, maker and so on).

Therefore, Chen et al. (2000) examined the influence of the demand forecasting to become the factor to cause Bullwhip phenomenon in the Supply Chain model consisting of one stage (retail) or two stages (e.g.between retail and manufacturer) in [14].

3 MODEL

In this section, we define three information sharing m ethods: demand information, demand forecasting and or der information (See Fig.1, 2 and 3).

3.1 The method of Information Sharing

The models of study consist of three information sharing methods. First, DIS is to approach for ordering in Stage 2 using a data of demand in Stage 1. Second, FIS is to use moving average method in the order of Stage 2 based on the trend of demand. Third, OIS is to approach ordering using the data of order in Stage1.

Therefore, If Stage2 exists out of stock, approach for using the data of order in Stage1. If not, used for Stage 2 directly as a data of order in Stage1.

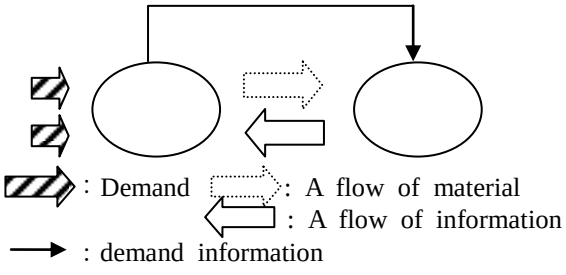

Fig1. DIS（Model 1）

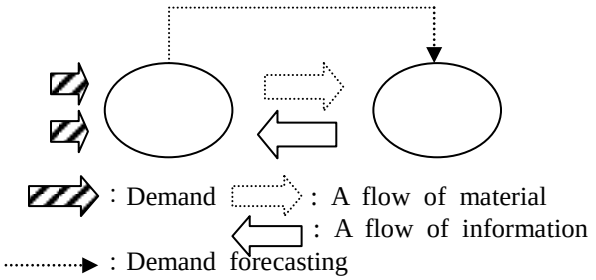

Fig2. FIS（Model 2）

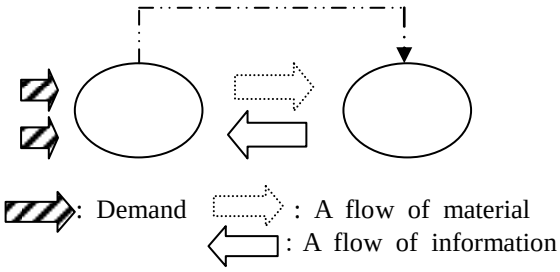

Fig3. OIS（Model 3）

3.2 Simulation

Using the model from Figure 1 to 3, we demonstrate simulation. The design of simulation is as follows.

Definition:

1. The simulation software use Microsoft Excel.
2. The number of trying simulation is fifty.
3. The data use average of simulation until fifty.

4 NUMERICAL ANALYSIS

In this section, we discuss inspection about the information sharing. At first, we inspect the Bullwhip Effect about three information sharing models.

In next sections, it considers the inventory cost and short age cost and inspects the elements of which inventory control are influenced by management strategy using the correlation.

Table1. The degree of phase1 until phase5

level / PA	phase1	phase2	phase3	phase4	phase5
MAP	3	5	10	15	20
LE	2	3	4	5	6
DA	55	60	65	70	75
DV	9	12	15	18	21
SS	1.65	1.76	1.89	2.05	2.33
OC	1	2	3	4	5

e.g) parameter stand for "PA", the moving average peri od stand for "MAP", the leadtime stand for "LE", the demand average stand for "DA", the demand variance stand for "DV", the safety stock stand for "SS", the o rdering cycle stand for "OC".

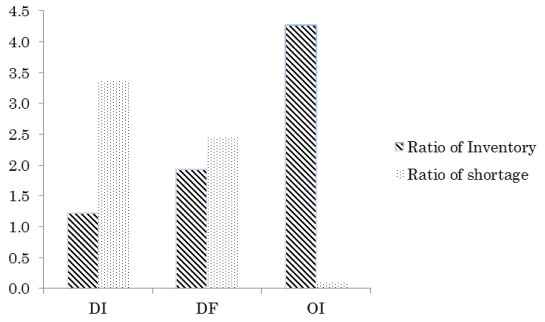

Fig4. Inspection of Information Sharing

4.1 Inspection of Bullwhip Effect

At first we discuss the inspection of the Bullwhip Effect. T he inspection method uses the value that divided standard d eviation of the quantity of ordering of Stage1 by standard d eviation of the quantity of ordering of Stage2. It understand s that an ordering information sharing is more effective to p rotect the degree of Bullwhip (See Fig.4).

4.2 Inspection of inventory and Shortage Cost

The inventory ratio consists of inventory cost ratio in Stage1 and Stage2. At first, the demand information sharing understands that the ratios out of stock increase. This can control the inventory to use information of the final demand for an ordering policy of Stage2, however, trend of the quantity of demand changes increases out of inventory cost. As the demand forecasts see the cost of the inventory and s hortage inventory, we can understand balance.

4.3 Inspection of management

We consider the amount of change from phase1 to phase2 in three information sharing models.

The case of demand information is to optimal the moving average period parameter in ratio of inventory, ratio of standard deviation and ratio of shortage. Moreover, in the case of demand forecast and ordering information, the ratio of inventory and standard deviation optimal the moving average period parameter and ordering cycle parameter, respectively.

Finally, the correlation describes the higher significant relation in demand information and demand forecast sharing.

5 CONCLUSION

In this study, we performed inspection of the information sharing from three models. When demand forecasting and ordering information sharing were the same tendencies and changed two factors.

It is understand that demand information sharing and demand forecasting should discuss about a strategy with the same tendency.

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