

On the System Dynamics of the Logistic Risk of Marketing Channels

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Abstract—Logistics runs through the entire process of an enterprise's production and management. Logistics, as an enterprise's "the third profit source", is an effective management tools for companies to obtain and maintain a competitive advantage, the management of logistics risk of marketing channels is a critical part of the risk management of channels. The paper introduces the logistics risk types, and from the systematic view, analyses the connotation of the logistics system of marketing channels, and factors influencing the logistics risk of marketing channels are indicated. On this base, a systematic dynamics model for the logistics risk of marketing channels is constructed, and the simulated results is obtained by Vensim PLE. The results show that it is essential for logistics risk management in marketing channel to control suppliers', manufacturers' and distributors' own possible risks and decrease the outflow rate.

Index Terms—system dynamics, logistic risk, marketing channels

I. INTRODUCTION

In logistics system of marketing channels, the internal and external defects of the system may lead to hazards, which make it difficult to achieve the best security status of efficiency, quality, cost and time. This is the logistics risk defined in this paper.

Logistics system for a enterprise or a society is very important. There are many uncertain factors causing risks in the logistics system. Like the logistics service provider, it is so difficult to choose correct provider that brings out logistics service quality risks, so reference [1] proposed an improved FCM algorithm to segment logistics service providers in order to achieve customer segmentation properly. Information is also the key factor influencing the logistics effect, and reference [2] proposed a dynamic risk management model for the information security management in IC manufacturing industry, that model had been successfully applied to guide the information security management practices in IC manufacturing companies, and offers a comprehensive and practical solution. Reference [3] also proposed that logistics tasks heavily depended on reliable shipment and accurate tracking information, so it investigated how RFID technology was implemented and adopted in

Taiwan's logistics industry, many companies in Taiwan had accepted and utilized this technology.

Logistics system of marketing channels, from the perspective of the normal channel logistics operation practice, includes the risks of personnel, logistics, facilities / equipment, management and information.

Based on the principle of best satisfaction of customer needs and the reasonable sharing of cost, the logistics in corporate marketing channels, by different parties to bear, can be divided into a proprietary logistics and corporate outsourcing logistics (also called "the third party logistics") which are shown in Figure 1.

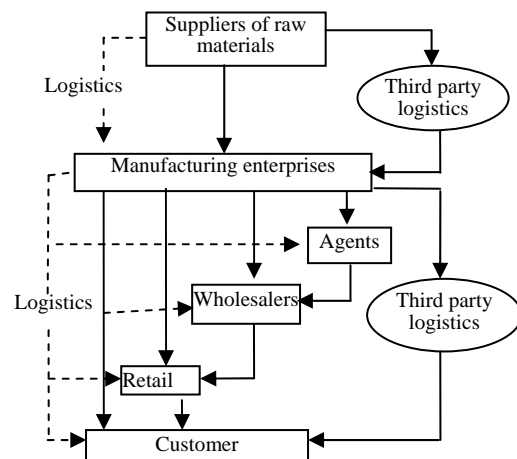


Figure 1. Schematic of Marketing Channels for Logistics Operators

Based on this perspective, the types of logistics risk of marketing channels can be discussed from the following two aspects.

A. Self-logistics risk of Marketing Channels

Self-logistics is that the logistic functions of a manufacturing enterprise are operated by the enterprise itself, not by a third party logistic service provider. The possible risks in self-logistics include:

Risk of loss of good: The possible reasons that cause this risk include the transportation line selected, transportation vehicles chose, transportation staff or

emergency events in the transportation process. It may also be caused by the nonfeasance of the transportation bearer. Due to the limited resource that an enterprise has, not all the logistic processes are operated by this enterprise and sometime they rely on outsourcing. According to the requirement of JIT, delay distribution may lead to great economic losses for shipping enterprises.

Risk of cargo delay: The possible reasons that cause this risk include the transportation line selected, transportation vehicles chose, transportation staff or emergency events in the transportation process. It may also be caused by the nonfeasance of the transportation bearer. Due to the limited resource that an enterprise has, not all the logistic processes are operated by this enterprise and sometime they rely on outsourcing. According to the requirement of JIT, delay distribution may lead to great economic losses for shipping enterprises.

Risk of wrong goods delivered: That goods are sent wrongly is often because the enterprise information system failure, or because staff are careless for their jobs. That goods are sent wrongly is often because the enterprise information system failure, or because staff are careless for their jobs. Modern logistics need to rely on modern information technology in order to ensure the effective operation of system. The important role of the information is as following: shortened time from receiving orders to deliver goods; inventory amount; improve handling and transportation efficiency; improve order processing precision; prevent errors of delivery and distribution; regulating the demand and supply. If the logistics information system does not work well, it may increase the risks of distribution delay, wrong distribution and wrong shipping goods.

B. The Outsourcing Risk of Marketing Channels Logistics

Mentioned as reference [4][5][6][7][8][9], the outsourcing risks of marketing channels logistics will be divided into the four types as the following:

The environmental risk of outsourcing logistics: This risk mainly refers to the industry environment and enterprise environment. Due to the imperfect logistics industry and the immature logistics market, it is difficult to select the appropriate external logistics service providers for enterprises. However, most enterprises are lack of knowledge of outsourcing logistics, and their purposes are different from the external logistics service providers, these will easily lead to the conflict of understanding. Meanwhile, the internal operation processes will be affected by the outsourcing logistics, it even needs to be integrated again, which may cause the internal conflicts.

Control risk of outsourcing logistics: The self-logistics is a part of internal operation processes for enterprise, under the model, enterprises directly face to the customers and are convenient to communicate with customers. The external logistics service providers are an uncontrolled outsourcing, without the chance of communicating with customers directly for enterprises

will result in the overreliance on these external professional logistics companies in logistics service, even in other aspects. Thus, once enterprises cannot select the appropriate logistics service providers because of ineffective evaluation system, it is not only the logistics service will be affected, but also the corporation image and market share will be damaged. Moreover, cooperation is difficult to establish and maintain the trust mechanism which will endanger the cooperation relationship and lead the logistics out of control.

Information risk of outsourcing logistics: Information asymmetry in market is the primary factor to cause the risk of outsourcing logistics. It is impossible to grasp fully information of suppliers, so it is difficult to make the selection and monitoring decisions. Next, for outsourcing logistics, a lot of information need to be shared with service providers, and a lot of information is also provide by logistics service providers, which will bring the issue of information security. That is to say, the expansion of scope of information transfer and the logistics service providers' disloyalty will result in the loss of information resources of enterprises, core technology and business secrets. It is even likely to be imitated and caught up by competitors and makes the enterprises lose their advantage of resources and core competitiveness.

Risk of outsourcing cost: This risk is caused by the two following aspect: on the one hand, it is related to the service level of the service providers. It will reduce the cost risk if the logistics service providers offer high quality and low cost service compared to enterprises. Conversely, the enterprises choose low effective logistics providers because of lack of correct judgment, which will result in the cost risk of outsourcing logistics. On the other hand, this cost risk comes from the increasing of conversion management cost. The conversion cost means that, the enterprises being able to assume the logistics function transfer the logistics to the outsourcing logistics service providers, this will result in the increasing of management cost which includes monitoring costs, coordination costs and integration costs.

Goods loss risk of outsourcing logistic: For outsourcing logistics, such as risks of loss of goods, delay of goods and wrong goods delivery also exist, these risks can be regarded as the goods loss risk of outsourcing logistics.

II. PROPOSED METHODS

The systematic is an important feature of logistics activities, and its systematic structure and function is composed of a variety of subsystems which have complex relationships among various subsystems. At the same time, logistics plan is uncertainty. Logistics activities include transportation plan, storage plan, loading and unloading plan, distribution plan and equipment operation, and these activities are changeable in the process of logistics, so the dynamic is their characters. The dynamic from the change of time and space is the feature of system dynamics, so using the method to analyze the marketing channel logistics will

help managers estimate the dynamic change of the logistics system in time, take measures to enhance the positive impacts of various internal and external factors on logistics operation and reduce the negative impacts of them, which would make the channel logistics play a better efficiency to achieve the goals of marketing channel management.

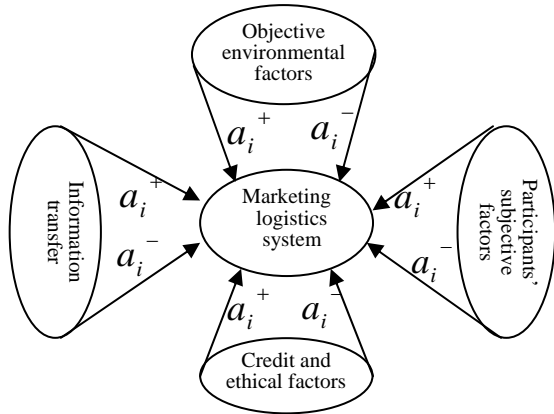


Figure 2. Risk Factors Impacts on Marketing Channel Logistics

Further understanding (seeing Figure 2), if the storage is set to the first state of controlled dynamic system, in this state, the factors may be considered as following:

a_1^+ : Positive impact factors of objective environmental factors

a_1^- : Negative impact factors of objective environmental factors

b_1^+ : Positive impact factors of information transfer factors

b_1^- : Negative impact factors of information transfer factors

c_1^+ : Positive impact factors of Participants' subjective factors

c_1^- : Negative impact factors of Participants' subjective factors

d_1^+ : Positive impact factors of credit and ethical factors

d_1^- : Negative impact factors of credit and ethical factors

The taken measures and the obtained results in the first state will be the second state of the controlled dynamic system. If the second state is the transportation, the effective assessment data of the second state is as following:

a_2^+ : Positive impact factors of objective environmental factors

a_2^- : Negative impact factors of objective environmental factors

b_2^+ : Positive impact factors of information transfer factors

b_2^- : Negative impact factors of information transfer factors

c_2^+ : Positive impact factors of Participants' subjective factors

c_2^- : Negative impact factors of Participants' subjective factors

d_2^+ : Positive impact factors of credit and ethical factors

d_2^- : Negative impact factors of credit and ethical factors

If the risk factors of marketing channel logistics are controlled well, the results will be obtained as following:

$$a_2^+ > a_1^+, a_2^- < a_1^-, b_2^+ > b_1^+, b_2^- < b_1^-, c_2^+ > c_1^+, c_2^- < c_1^-, d_2^+ > d_1^+, d_2^- < d_1^-.$$

Therefore, in a long-term view of system, there would be $a_i^+ > a_{i-1}^+, a_i^- < a_{i-1}^-$. Thus, when the task of marketing channel logistics is nearly finished, the negative factors affecting the system are close to zero,

namely $a_n^- \rightarrow 0$ (n is the final link or the final function in the marketing channel logistics). The analysis will be beneficial to manage and control risk of marketing channel logistics

III. RESEARCH METHOD

The system dynamics is to establish a system dynamics model to reflect the structural relationships among variables in system, and dynamically simulate the process of system or some subsystems. The fundamental purpose of the establishment of a system dynamics model is to solve the problem existing in the system, deepen understanding of the relationship between feedback structure and dynamic behavior within the system, so that system behavior can be improved. [10]

Because of the nature of dynamic and feedback of marketing channel logistics, with the continuous improvement of internal and external complexity of logistics system network, the establishment of this system dynamics model for marketing channel logistics will play a great role on risk decision of marketing channel logistics.

A. Factors Analysis of Logistics System

It is the first step to define the contained elements of marketing channel logistics when analyzing the logistics risks. A system must exchange matters and information with surrounding environment, when defining the boundary of system, distinguishing the internal elements and external elements is necessary.

The system of marketing channel logistics, as a complex and large system, involves in multiple departments and links, and the interaction of outside world is also multi-level, and influenced by the factors of economy, market, social environment and resource distribution. Therefore, according to the composition of members and risk types of marketing channel logistics, elements of this system include suppliers, manufacturers, distributors, customers and logistics industry environmental factors out of marketing channel system. Logistics risks from suppliers, manufacturers and distributors are mainly referred to the quality of logistics operations, goods loss quantity, goods loss rate, risk control strength of enterprises, order loss quantity and impact on enterprise credit. When the logistics industry environment is unstable and immature, logistics risk will be great, and the quality of logistics operations will be affected, which would increase the logistics risk for enterprises in the marketing channel; a variety of increased risks will bring the negative impact on the enterprise credit; the decline of the enterprise credit will lead to orders reduced, which will increase the risks of enterprises; increased risks will encourage enterprises to adopt control measures. Suppliers, manufacturers and distributors will reduce risks through their own internal logistics risk control management. Thus, the boundary of this system is defined.

B. Drawing of causal diagram

Causal diagram shows the logic relations among different factors of the system. However, causal diagram only reflects the general aspects of the feedback structure of a system and does not tell the difference of various variables. Thus, it is necessary to draw the process diagram to display the variables properties. By using system dynamic software Vensim_PLE, the risk causal diagram of channel logistics is plotted, as shown in Fig. 3.

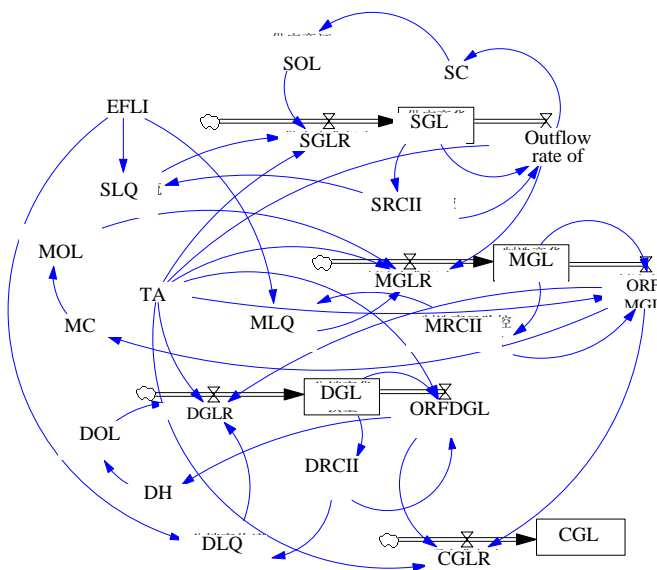


Figure 3. Marketing Channel Logistics Risk Causal Diagram

SOL-Supplier's order loss
EFLI-Environment of logistics industry

SC-Supplier's credit
SGL-Supplier's goods loss
SGLR-Supplier's goods loss rate
ORFSGL-Outflow rate of Supplier's goods loss
SLQ-Supplier's logistics quality
SRCII-Supplier's risk control intensity index
MOL-Manufacturer's order loss
MGLR-Manufacturer's goods loss rate
MGL-Manufacturer's goods loss
ORFMGL-Outflow rate of manufacturer's goods loss
MLQ-Manufacture's logistic quality
MRCII-Manufacturer's risk control intensity index
MC-Manufacturer's credit
DGL-Distributor's goods loss
DGLR-Distributor's goods loss rate
ORFDGL-Outflow rate of distributor's goods loss
DRCII-Distributor's risk control intensity index
DH-Distributor's honor
DLQ-Distributor's logistics quality
CGLR-Costumer's goods loss rate
CGL-Costumer's goods loss

As far as the logistics system of marketing channel is concerned, the logistic quality is affected by the environment of logistics industry and the risk control intensity of the enterprise. Logistics quality obviously affects goods loss rate, which determines goods loss quantity. Goods loss quantity influences risk control intensity, which in turn affects outflow rate of goods loss and logistics quality.

IV. RESULTS AND DISCUSSION

The process diagram drew based on causal analysis only shows the logic relationships of various system factors and does not reveal the system structure quantitatively. Therefore, it is necessary to construct the system dynamics equations on the practical basis to simulate the system dynamic behaviors. Based on the practical experience, according to Fig. 3, the system dynamic equations are constructed below.

- (1)FINAL TIME = 100, Units: Month (The final time for the simulation) ;
- (2)INITIAL TIME = 0, Units: Month (The initial time for the simulation) ;
- (3)SAVEPER = TIME STEP, Units: Month (The frequency with which output is stored) ;
- (4)TIME STEP = 1, Units: Month (The time step for the simulation) ;
- (5)Supplier's credit = EXP (-outflow of supplier's goods loss), unit: dimensionless;
- (6)Supplier's logistics quality = Supplier's risk control intensity index* logistics industry environment, Units: dimensionless;
- (7)Supplier's order loss = (1-supplier's credit)*100, Units: piece;
- (8)Outflow rate of supplier's goods loss= (1-supplier's risk control intensity index)*supplier's goods loss/adjustment time, Units: piece/month;

(9)Supplier's goods loss rate = (supplier's order loss+100*(1-supplier's logistics quality))/adjustment time, Units: piece/month;

(10)Supplier's goods loss = INTEG (+supplier's goods loss rate -outflow rate of supplier's goods loss, 0), Units: piece;

(11)Supplier's risk control intensity index=1-EXP (-supplier's goods loss/100), Units: dimensionless;

(12)Distributor's credit = EXP (-outflow rate of distributor's goods loss) , Units: dimensionless;

(13)Distributor's logistics quality=distributor's risk control intensity index* logistics industry environment, Units: dimensionless;

(14)Distributor's order loss= (1-distributor's credit)*100, Units: piece ;

(15)Outflow rate of distributor's goods loss= (1-distributor's risk control intensity index)*distributor's goods loss/adjustment time, Units: piece/month;

(16)Distributor's goods loss rate= (distributor's order loss + outflow rate of manufacturer's goods loss+100*(1-distributor's logistics quality))/adjustment time, Units: piece/month;

(17)Distributor's goods loss= INTEG (+distributor's goods loss rate - outflow rate of distributor's goods loss, 0), Units: piece;

(18)Distributor's risk control intensity index=1-EXP (-distributor's goods loss/100), Units: dimensionless;

(19)Manufacturer's credit =EXP (-outflow rate of manufacturer's goods loss), Units: dimensionless;

(20)Manufacturer's logistics quality=manufacturer's risk control intensity index* logistics industry environment, Units: dimensionless;

(21)Manufacturer's order loss= (1-manufacturer's credit)*100, Units: piece;

(22)Outflow rate of manufacturer's goods loss= (1-Outflow rate of manufacturer's goods loss)*manufacturer's goods loss/adjustment time, Units: piece/month;

(23)Manufacturer's goods loss rate= (outflow rate supplier's goods loss + manufacturer's order loss + (1-Manufacturer's logistics quality)*100)/ adjustment time, Units: piece/month;

(24)Manufacturer's goods loss = INTEG (+ Manufacturer's goods loss rate - Outflow rate of manufacturer's goods loss,0), Units: piece;

(25)Outflow rate of manufacturer's goods loss =1-EXP (-Manufacturer's goods loss /100), Units: dimensionless;

(26)Logistics industry environment =0.5, Units: dimensionless;

(27)Adjustment time=1, Units: month;

(28)Customer's goods loss rate= (outflow rate of distributor's goods loss+ outflow rate of manufacture's goods loss)/ adjustment time, Units: piece/month;

(29)Customer's goods loss = INTEG (Customer's goods loss rate, 0), Units: piece.

By using Vensim_PLE, simulation results of above equation have been obtained. Following are manufacturer's various status simulation results, demonstrating the system internal characteristics from different aspects. The results show that with the increase

of goods loss (Fig. 4), manufacturer increase the risk control intensity index (Fig. 5) and enhance logistics quality (Fig. 6), maintain the system at its optimal status. Due to the time delay of taken measures, manufacturer's goods loss rate increases (Fig. 7). But with time, due to the increase of control intensity index, goods loss rate decreases and finally approaches a stable status, which leads to the changes of outflow rate of goods loss correspondingly, reaching at zero eventually.



Figure 4. Dynamics of manufacturer's logistics goods loss

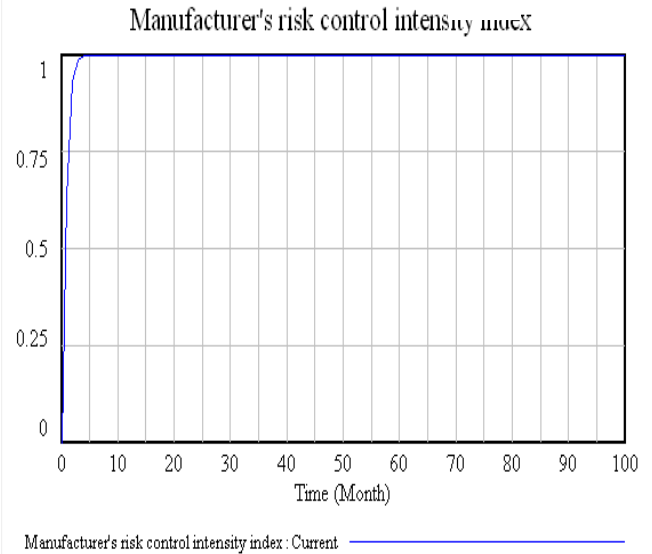


Figure 5. Dynamics of manufacturer's risk control intensity index

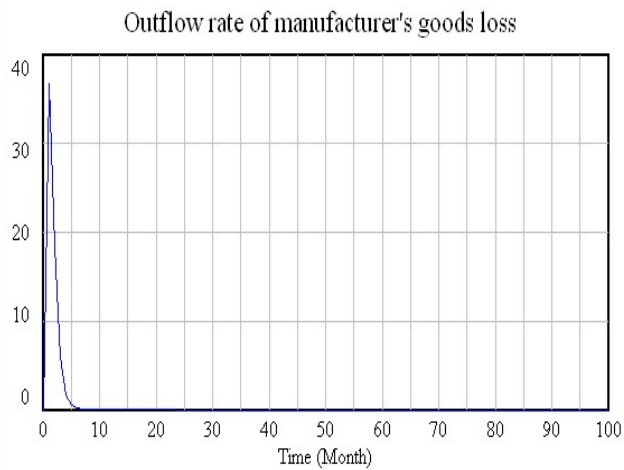


Figure 6. Dynamics of manufacturer's logistics quality



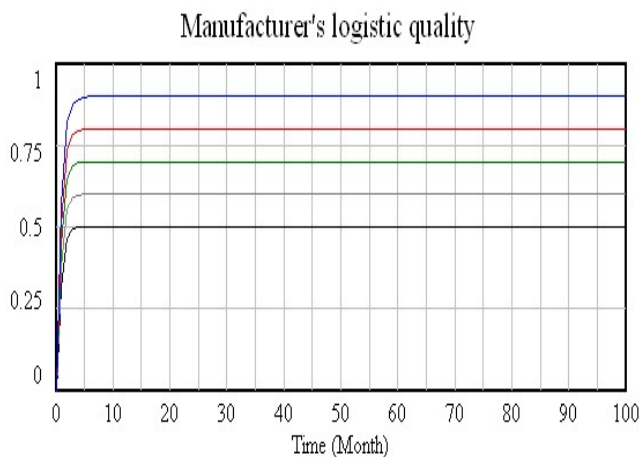
Manufacturer's goods loss rate : Current

Figure 7. Dynamics of manufacturer's goods loss rate



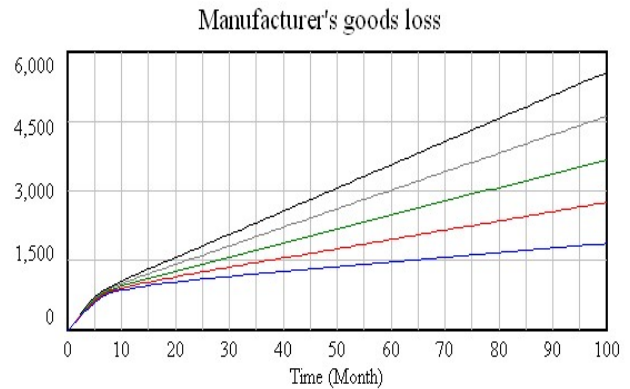
Outflow rate of manufacturer's goods loss : Current

Figure 8. Dynamics of outflow rate of manufacturer's goods loss



Manufacturer's logistic quality : Current 5
 Manufacturer's logistic quality : Current 4
 Manufacturer's logistic quality : Current 3
 Manufacturer's logistic quality : Current 2
 Manufacturer's logistic quality : Current
 Manufacturer's logistic quality : C:\Program Files\Wensim\Current

Figure 9. Dynamics of manufacturer's logistics quality under various industrial environments



Manufacturer's goods loss : Current 5
 Manufacturer's goods loss : Current 4
 Manufacturer's goods loss : Current 3
 Manufacturer's goods loss : Current 2
 Manufacturer's goods loss : Current
 Manufacturer's goods loss : C:\Program Files\Wensim\Current

Figure 10. Dynamics of outflow of manufacturer's goods loss under various industrial environments



Figure 11. Dynamics of manufacturer's goods loss rate under various industrial environments

Through simulating the internal structure of the system, it can be seen that in order to control the dynamics of logistics risk in the marketing channel, it is essential for supplier, manufacturer and distributor to control their own possible risks and decrease the outflow rate. By decreasing the risk loss and risk outflow, the enterprise's credit is kept and orders are placed, forming a virtuous cycle. Meanwhile, the environment of logistics industry is an external factor, which is difficult for an enterprise to control. Under different logistics industry environment, the cause and the loss of logistics risk are different. Generally (as shown in Figs. 9-11), as the industrial environment getting better, manufacturer's logistics quality increases, goods loss and outflow rate of goods loss decrease, thus lower the channel risk. Therefore, enterprise should not only hope the supports and improvements from government and commissions, but also correct their own behaviors, which will promote the industry to thrive in a virtuous cycle.

V. CONCLUSIONS

A complex marketing channel system determines the complexity of the logistics system, which brings its vulnerability and triggers a high-risk, and the high risk and vulnerability in practice will increase and be no less. So the paper introduced a good method for enterprise's managers to in a timely assess the positive impact of efforts to improve the logistics operation system and to reduce the negative impact by supervising the dynamic changes from suppliers, distributors, and governments, thus, the objectives of the marketing channel management would be easier achieved by the better play of the channels logistics efficiency.

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