STUDY OF INFORMATION SHARING PLATFORM IN ECO-SUPPLY CHAIN

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Abstract: Based on the importance of effective information sharing in ecological supply chain, we build a logical model of information sharing platform in eco-supply chain. After that, we expound the information sharing mechanism and the ecological supply chain information interaction of the platform. At the same time, in order to realize the ecological effects in the ecological supply chain, we put forward the ecological detection algorithms of information shared and the logistics optimization algorithms of vehicle route arrangement.

1 INTRODUCTION

It is easy to produce the "bullwhip effect" of demand enlargement, because the enterprises are unable to realize effective information sharing in the supply chain. However, this increases the production, supply, inventory management and marketing risk of the upstream suppliers, and even causes the chaos of production, supply and marketing in the ecological supply chain.

In addition, the demand information's enlargement makes the production of the products on the entire supply chain be increased exponentially from the ecological perspective. The production of the mass products is necessarily to consume large amounts of water, coal, electricity and raw materials, etc (Wensheng, 2010). As a result, a lot of gas pollutants would be discharged to the environment. The production process not only wastes resources but also causes environment damage. But, the tenet of ecological supply chain is to make the consumption of resources and the negative effects of the ecological environment to the minimum. Thus, effective information sharing is very important in the ecological supply, and so, it is necessary to research the information sharing platform in ecological supply chain from the perspective of information process.

2 STUDY OF INFORMATION SHARING PLATFORM IN ECO-SUPPLY CHAIN

As is mentioned above, information sharing in ecological supply chain has very important significance. So it is necessary for us to study how to realize information sharing in the ecological supply chain. In our general view, there are two kinds of information participants in ecological supply chain. One is the information providers. The other is the information demanders. The realization mechanism of sharing information is as shown in Figure 1.
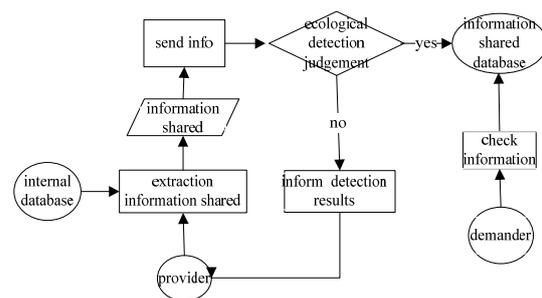

Figure 1: Realization mechanism of information sharing in ecological supply chain.

2.1 The Construction of Information Sharing Platform in Ecological Supply Chain

In fact, the information providers in the ecological supply chain include supplier, producers, sellers, logistics providers, government agencies. Meanwhile, each provider is also a demander. Therefore, for many participants, we should consider to build an information sharing platform in ecological supply chain to realize the above way of information sharing.

Enterprises in supply chain set up information platform to share information cooperate. The construction of information sharing platform is invested by each member enterprise in the supply chain. At the same time, the government department is responsible for coordination, supervision and control. The information sharing platform in ecological supply chain follows Figure 2.
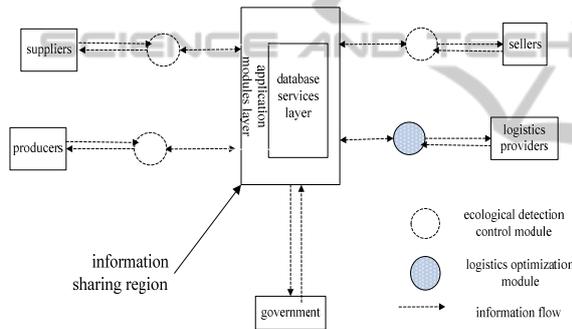

Figure 2: Information sharing platform in ecological supply chain.

2.2 The Illustration of Information Sharing Platform in Ecological Supply Chain

The participants of the platform are suppliers, producers, sellers (retailers and distributors collectively), logistics providers, and government departments. With customer's products as the core, they form a net chain structure, in which the suppliers are mainly responsible for raw material purchase, the producers are responsible for the product production and manufacturing, sellers are responsible for product sales, logistics providers are in charge of the whole supply chain transportation. They have formed upstream and downstream relations which is shown in the below Figure 3. Each participant is given certain privileges and provided an interface to get into the platform. The platform is made of four layers. They are customer layer,

control layer, application layer, and the database service layer. The customer layer provides each node enterprises an interface for registration. The control layer comprises some modules including logistics optimization and ecological detection modules. The application layer manages the shared information. While the database service layer provides data support for the operation of whole platform. The whole platform is based on the Internet. So, the participants can obtain and send relevant information after they login in the platform.

Each node enterprise should share information which has been detected by ecological detection module to this platform except the government departments and logistics providers. The ecological detection modules are used to detect whether the information shared to the platform conforms to the ecological requirements. Each ecological detection module includes some different detection algorithms. The enterprises in the same role correspond to the same ecological detection module, while enterprises in different roles correspond to different ecological detection module, because the information shared by them need to detect different kinds of ecological indices. For example, the detection control module of producers is more concerned about the recycling and utilization rate of waste, the utilization rate of raw materials and so on. But the detection control module of suppliers is more concerned about the recycling and utilization rate of purchasing materials.
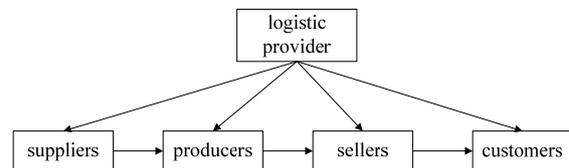

Figure 3: The upstream and downstream relations in the supply chain.

2.3 Information Interaction in Ecological Supply Chain Information Sharing Platform

The information shared in ecological supply chain not only includes the information of the traditional supply chain, but also the ecological information of each enterprise and the government's eco-policy information. The convenient, timely, accurate information interaction among enterprises in ecological supply chain improves each other's operation efficiency. Information interaction among enterprises in ecological supply chain is as follows.

2.3.1 The Information Interaction of Government

The information shared among government department and other node enterprises consists of related environmental protection laws and regulations, environmental protection policy and environmental protection practice achievement of the enterprises. The government will provide the latest environment evaluation indices standard to the platform at any time, such as energy utilization rate index, equipment and material utilization rate index, recycling index of waste, etc. Meanwhile, the government departments share ecological information of other enterprises from the platform, such as the amount of waste recycling, the utilization rate of energy, emissions intensity of waste gas, etc. This behavior is necessary for the enterprise and government to understand the present reverse logistics in supply chain promptly. So, they can identify problems timely and modulate the operation procedure in ecological supply chain to promote waste recycling utilization effectively.

2.3.2 The Information Interaction of Suppliers

The information flow of suppliers mainly includes information that suppliers share with other node enterprises. The suppliers provide materials demand and supply information for logistics providers. The suppliers provide quality, order of producers, order implementation, products and technology improvement information for producers. The suppliers provide various ecological indices information for supply chain platform. Meanwhile, suppliers obtain from the platform producers' demand, inventory, production planning information, etc. They also receive feedback information of its ecological information. Then they adjust their production ways of products to accord with ecological requirements according to the feedback information timely. So, they can control ecological level of the whole supply chain from the source.

2.3.3 The Information Interaction of Producers

Producers have a direct link with suppliers, sellers, logistics service providers from. Producers provide the material information needed by the future production cycle, real-time updating inventory information and production planning information for the suppliers. To ensure the enterprises of the supply chain develop coordinately, producers are also required to share the new product's development information with the suppliers, which includes new craft, new technology and new material information. The producers share sellers with the product，order and order executive information. They also share the goods supply information with the logistics providers. At last, they send out kinds of ecological indices information to ecological supply chain platform. Meanwhile, the producers can obtain information shared form other node enterprises in the platform. After receiving the feedback information, the producers adjust their production ways of products to conform to ecological manufacturing, such as craft, design, packaging, etc.

2.3.4 The Information Interaction of Sellers

Aiming at reducing supply chain cost and preventing upstream enterprise from overstocking products, sellers should share theirs inventory information with suppliers, so that the suppliers can organize flexible production, especially when the uncertainty brought by demand fluctuation and occasional glitches in production and transportation is evitable , sharing the inventory information is particularly important. At the same time, sellers would also share logistics demand information. Just like other role of member enterprises, the sellers also share kinds of ecological indices information to ecological supply chain platform and receive information from the platform. Based on the feedback information from the platform, the sellers try their best to achieve ecological marketing standard.

2.3.5 The Information Interaction of Logistics Providers

The information flow is composed by the information the logistics providers send to the platform and prepare to share with other members of eco-supply chain, such as the optimal route schemes, logistics route, vehicles information, etc. The logistics providers are the important link in the entire eco-supply chain, because the logistics providers are responsible for the material, product transportation and the feedback of order information of the entire supply chain. If it is necessary, the logistics providers will keep certain inventory for the producers. At last, Logistics providers also share kinds of ecological indices information to ecological supply chain platform.

3 THE ALGORITHM RESEARCH OF INFORMATION SHARING PLATFORM IN ECOLOGICAL SUPPLY CHAIN

The ecological detection modules comprise some different ecological detection algorithms and the logistics optimization module consists of some route optimization algorithms in the platform. The platform can maintain its ecological characteristics because of these modules that play a control function. In the following, we choose two algorithms of these modules to explain the control process.

3.1 Logistics Optimization Algorithm of Vehicle Route Arrangement

Ecological supply chain means that we would take advanced logistics technology to reduce environment pollution and resources consumption caused by logistics and that we should make the processes of logistics activities and environmental protection coordinate and unified in promoting the development of economy, under the guidance of the sustainable development concept (Hock, 1999). After the ecological supply chain information sharing platform is established, logistics providers can make a comprehensive consideration of logistics service request in the supply chain. Then, they could find the optimal logistics arrangement strategy to minimize the logistics cost and reduce the environment damage caused by logistics process by means of the logistics optimization module.

3.1.1 Algorithm Statement

The optimization problems of logistics distribution vehicle route are called Vehicle Routing Problem, which is called VPR for short abroad. The classical Vehicle Routing Problem (VRP) involves a set of delivery customers to be serviced by a homogeneous fleet of vehicles housed at a central depot. The objective of the problem is to develop a set of vehicle routes originating and terminating at the depot such that all customers are serviced, the demands of the customers assigned to each route do not exceed the capacity of the vehicle that services the route, and the total distance traveled by all vehicles is minimized (Jun and Yaohuang, 2001). In this paper we consider an easy optimization algorithm with constraints of vehicle capacity, the distance between each two demanders and the demanders' goods weight in the logistics

optimization module.

3.1.2 Description and Flow Charts of the Algorithm

With the delivery of directly round trip used by all demanders as the initial feasible arrangements, the algorithm is designed to find the two demanders of the largest savings:

① connecting the two demanders when their total freight volumes are no more than the volumes of the vehicle's load carrying ability; adding the demander of the largest savings ,when connecting with the former two demanders, to the line until the total amounts of the freights in the line equal or surpass the limit of the vehicle load, then adding the final demander when the sum of its demand and the previously total freight volumes surpasses the limit of the vehicle. The line generated through the method above ensures that the freight volumes provided for the demanders just equal the vehicles' full load.

② connecting the two demanders when their total freight volumes is equal to the volumes of the vehicle's load carrying ability;

③ connecting the two demanders when their total freight volumes surpass the volumes of the vehicle's load carrying ability, which ensures the vehicle fully loaded. Then the remaining demanders and the distributing vectors are organized into a new distribution route planning; the results of the solution by adopting the above method repeatedly until all the possible demanders are connected completely will be the optimal solution.

The flowchart of optimization algorithm in vehicle routing is as shown in the following Figure 4.

3.1.3 Algorithm Examples

As the following, the table 1 gives the shipments of each logistics demander and the table 2 gives the distance between logistics provider and demanders. Here, we assume the capacity of the vehicles is 1. LP-- logistics provider, D — demanders.

Table 1: Shipments of each logistics demander.

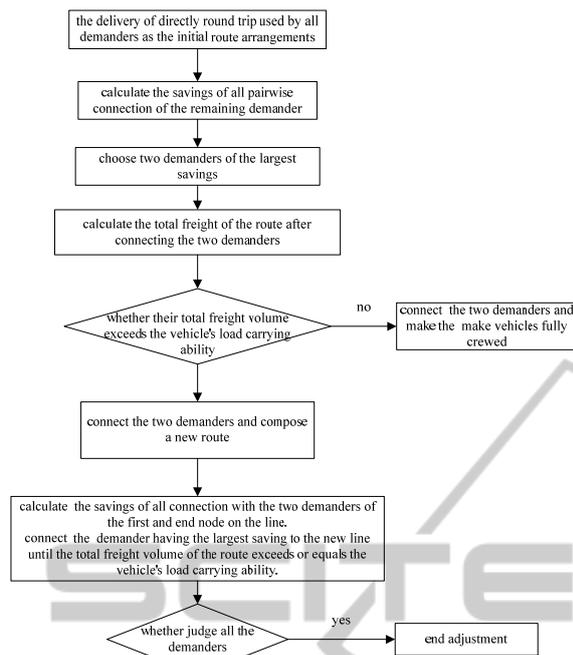| LP	1	2	3	4	5	6	7	8
freight	0.3	0.35	0.3	0.2	0.6	0.3	0.5	0.4

Figure 4: The flowchart of optimization algorithm (Xuezhi and Gongyu, 2008).

Table 2: Distance between logistics provider and demanders.

	LP							
D1	9	D1						
D2	14	5	D2					
D3	21	12	7	D3				
D4	23	22	17	10	D4			
D5	32	31	26	27	25	D5		
D6	40	41	36	31	29	10	D6	
D7	50	49	44	37	31	18	8	D7
D8	52	51	46	39	29	20	10	10	D8

We take the delivery of directly round trip used by all demanders as the initial feasible arrangement. As a result, we need eight vehicles and the total transportation distance is 486. If the logistics optimization algorithm is used to optimize the transportation, the final route arrangement is like this: R1=(0 1 2 3 0); R2= (0 4 5 6 0); R3=(0 6 7 8 0).

Taking logistics optimization algorithm, we only need 3 vehicles for the distribution and the total transportation distance is 257.

3.2 Ecological Detection Algorithm of Sharing Information

As is mentioned above, the information shared to the platform from the enterprises in different roles should be detected by ecological detection module. In the following, we take a simple specific example to illustrate the ecological detection process.

3.2.1 Algorithm Statement

The ecological detection algorithms are designed to keep the platform ecological. And different kinds of information from different roles of the platform correspond to different ecological detection algorithms. Although the ecological detection algorithms are different, the design ideas of them are the same. The following algorithm is based on the customer order information shared by the sellers of the auto industry.

3.2.2 Description and Flow Charts of the Algorithm

The sellers register the platform through the platform's interface. After that they send out the information they want to share with other enterprises. Before the information goes into the platform, it must to be tested by the ecological detection module. The ecological detection module detects whether the customer order information shared complies with the ecological standard, referring to the latest policies issued by government. If it complies with the ecological indices it will go into the information sharing region of platform directly. If it does not conform to ecological indices, first, the ecological detection module will send the detection result to sellers and ask them to take some improvement measures; second, the module send the information to the information sharing region.

The flowchart of ecological detection algorithms about customer order information shared is as shown in the following Figure 5..

4 CONCLUSIONS

The information shared in the ecological supply chain not only involves the information shared in the traditional supply chain, but also ecological information. In order to realize the effective information transfer and sharing, we consider building ecological supply chain information sharing platform. Compared with the traditional supply chain information sharing platform, we add some control modules that contain some different algorithms, in order to guarantee the information shared ecological. Different roles in the platform send different kinds of information to the platform,
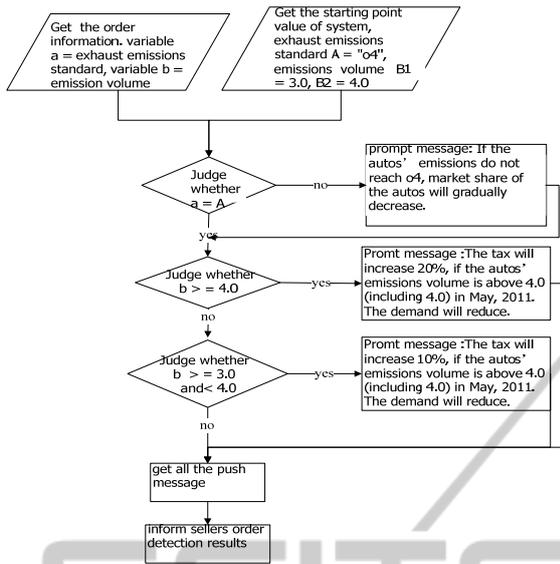
Figure 5: flowchart of ecological detection algorithms

all of which need to be detected. So, there should be a lot of algorithms. This needs our further study.

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