

# Consumer Incentives Toward Construction of Supply Chain for Inverse Manufacturing

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## Abstract

*This paper presents the concept of the closed-loop supply chain we call Inverse Supply Chain which adds the reverse system to the past supply chain. The life cycle management for consumer products is very difficult, and the cooperation of consumers is indispensable to build the society oriented to recycling of resources. In this paper, the various incentives to the consumer actions contributed to the improvement of QCD control in recycling was discussed. As a system that incentives are given to the consumers, we propose Green Mileage System.*

## 1. Introduction

While the environmental issues such as exhaustion of resources and shortage of final treatment facilities are becoming evident, various efforts and researches regarding reverse logistics are being made to realize recycling society<sup>[1]</sup>. Conventional supply chain management (SCM) has dealt with supplying products to consumers, but in the future, the closed-loop supply chain system should be built to recycle resources from consumers to the artery industries through the vein type industries. The System Modeling WG of the Committee for the Inverse Manufacturing Forum aims at establishing the structure of the supply chain for resource recycling, and is studying what could be the future supply chain with considerations on consumer behavior and vein-industry roles.

This paper presents the concept of inverse supply chain system and the study on the incentives for consumer participation that will play very important role in realizing the system. The various incentives to the consumer

actions such as “informing disposal timing of a end-of-life product” and “disassembly of an end-of-life product on the consumer site according to the disassembly manual” contributed to the improvement on QCD control in recycling are discussed in this paper. As a system that incentives are given to the consumers, we propose “Green Mileage System” which adds the point to environmental activity of a consumer and gives the privilege according to the accumulated point.

## 2. Inverse supply chain

Inverse Supply Chain is a type of supply chain for recycling resources. The chain includes, as shown in Figure 1, the conventional artery type supply system that supplies products from manufacturers to consumers, but also includes the system for supplying end-of-life products and parts from consumers to reuse/recycling companies, further includes the system for supplying reused parts and recycled materials from reuse/recycling companies to manufacturers. As outlined in Table 1, to establish the

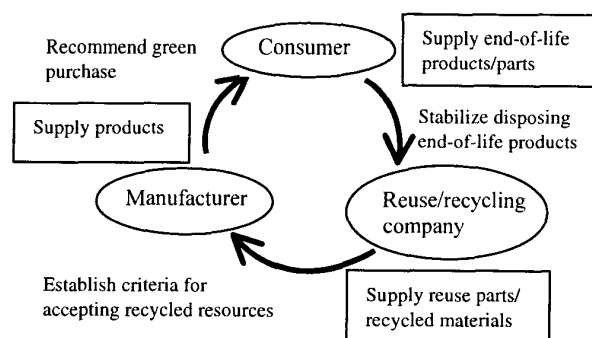


Figure 1 Inverse supply chain system concept

**Table 1 Inverse supply chain essential**

|                              |   |
|------------------------------|---|
| Basic concept                | <ul style="list-style-type: none"> <li>• Business model that addresses resources cycle</li> </ul>   |
| Production/<br>Sales methods | <ul style="list-style-type: none"> <li>• Production planning assumes reuse parts/recycled materials</li> <li>• Adjust supply/demand for reuse parts/recycled materials</li> <li>• Sales method making product life cycle management easier</li> <li>• Utilize used parts for repairing products</li> </ul>  |
| Inventory                    | <ul style="list-style-type: none"> <li>• Eliminate unnecessary stocks of maintenance parts for older models after model change</li> </ul>   |
| Profit                       | <ul style="list-style-type: none"> <li>• Gain profit out of services provided</li> </ul>  |
| Cost reduction               | <ul style="list-style-type: none"> <li>• Reduction of manufacturing cost by using reuse parts</li> </ul>  |
| Transactions with suppliers  | <ul style="list-style-type: none"> <li>• Manufacturers supply products to consumers</li> <li>• Consumers supply end-of-life products to reuse/recycling companies</li> <li>• Reuse/recycling companies supply reuse parts/recycled materials to manufacturers</li> <li>• Stabilized disposal timing and quantity of end-of-life products</li> <li>• Establishing quality criteria for accepting reuse parts/recycled materials</li> </ul> |

inverse supply chain, manufacturers have to evoke the demand for reuse parts/recycle materials, and define quality criteria for accepting them first. Also, disposing or putting out the end-of-life products by consumer for recycling needs to be more stable in terms of quantity and time to improve the quality, cost, and delivery (QCD) in the vein system<sup>[2]</sup>. To improve the QCD in recycling, two approaches are shown in the bold-lined boxes in Table 2. One approach is the effort made by manufacturers to solve the problem without asking consumers for their cooperation. This approach is the transition from the product selling business to the lease/rental business, which will make managing the product life cycle easier (lease/rental society). The other approach is based on the

conventional sales but which gives consumers incentives to elicit their positive cooperation toward resources recycling (green mileage system). Since it is not practical to assume that all the household consumer products can be supplied through lease or rental business, this paper concentrates and details on the green mileage system.

### 3. Planning to build the inverse supply chain

#### 3.1. Consumer incentives

As shown in Table 2, cooperation from consumer is indispensable for establishing the time and quantity of

**Table 2 Effect of social circumstance changes on QCD control in recycling**

| Social circumstance changes                | At present        | Present+regulations (deposit regulation, etc) | Present+regulations +information infrastructure  | Green mileage system  | Lease/rental society  |
|--|-------------------|---|--|---|---|
| Changes regarding the end-of-life products | Sell and transfer | Collection quantity increases                 | <ul style="list-style-type: none"> <li>• Product information disclosure</li> <li>• Historical data on the use of products</li> </ul> | <ul style="list-style-type: none"> <li>• Introduction of consumer incentive</li> <li>• Establishing the time and quantity for disposal</li> </ul> | <ul style="list-style-type: none"> <li>• Maintaining the quality (keeping product quality during use)</li> <li>• Establishing the time and quantity for disposal</li> </ul> |
| Q  | Difficult         | Difficult                                     | Relatively difficult   | Relatively easy   | Easy  |
| C  | Difficult         | Relatively difficult                          | Relatively difficult   | Relatively easy   | Easy  |
| D  | Difficult         | Relatively difficult                          | Relatively difficult   | Relatively easy   | Easy  |

disposal and for planning easier maintenance of product which helps reduce the cost for collection and disassembling products. Enhancing consumers' awareness for their participation and morale will be advantageous as consumers will play a part in the system. To build up such a system, it would be necessary to give consumers incentive which will be described as follows.

- An incentive to inform of the time for disposing (making reservation) end-of-life product
- Manufacturer to propose information for upgrading a product
- An incentive for consumers to suggest improvements for an environmentally conscious product.
- Buy-back price to be determined according to the way the product has been used
- An incentive for consumers to disassemble products at their places according to the manual for disassembling
- An incentive for bringing end-of-life products to the appointed collection sites

### 3.2. Green mileage system

Through the discussions on the consumer incentives for building the Inverse Supply Chain described above, the Green Mileage System has been proposed to promote recycling by giving green mileage points to consumers for their environmental activities. The consumers will get privileges in accordance with the points. The basic ideas, management structure, and mileage points of this system as discussed are described as follows with the system concept diagram in Figure 2.

#### a) Basic concept

- Incentives for the consumer environmental activities
- Stable disposal of end-of-life products to reuse/recycling companies
- Stable supply of reuse parts/recycled materials from reuse/recycling companies
- Promote utilization of reuse parts/recycled material by manufacturers

#### b) Operation structure

- Participation by consumers, manufacturers (including shops), and reuse/recycling companies
- Integrated management of information by Green Mileage Center
- Information on green points are provided for consumers through Green Mileage Center
- Manufacturers issue purchase orders for the reuse parts/recycled material to reuse/recycling companies based on the production planning
- Supply reuse parts / recycled materials to manufacturers from reuse/recycling companies

#### c) Examples of green points

• Consumer has informed of the date to dispose end-of-life product to Green Mileage Center and made reservation

• Consumer made a suggestion to manufacturer for environmental improvement

• Less degradation in an end-of-life product (well maintained)

• Consumer has disassembled a product for disposal according to the disassembly manual

• Made a green purchase

• A consumer brought an end-of-life product to a collection site

• A consumer reported the maintenance/use history at the time of disposal

#### d) Privileges through accumulated green points

• Purchase new product at reduced price or get coupons

• Reduced fees for using public facilities

• Issue proof for environmentally minded activities

### 3.3. An example of green mileage system

In the example shown in Figure 2, the consumer has obtained green points through prior green purchases. He intends to recycle his personal computer and ask Green Mileage Center through telephone and Internet when is the best time to let out the product, and makes reservation for the date. The most suitable date to recycle the product is calculated and determined from the demand for the reuse parts/recycled materials based on manufacturer's production schedule, and from stock quantity of the end-of-life products in reuse/recycling companies. When the date is determined, at the consumer's house, he starts to disassemble his personal computer according to the disassembly manual that has come with the product at the time of purchase. This will save disposal expenses. In his actual disassembly work, he found difficult operations and he reports procedures and design change suggestions to improve disassembly work, and obtains due mileage points. The saved points will be informed through Internet or direct mail. His family decides to exchange the points with coupons for using public facilities.

## 4. Conclusions

To realize recycling society, it is indispensable to build a vein type Inverse Supply Chain System in addition to the conventional artery type supply chain system, also it is necessary to get consumers to participate with their enhanced environment awareness and cooperation to make better environment. This paper reports the concept of Inverse Supply Chain system, and proposes methods to

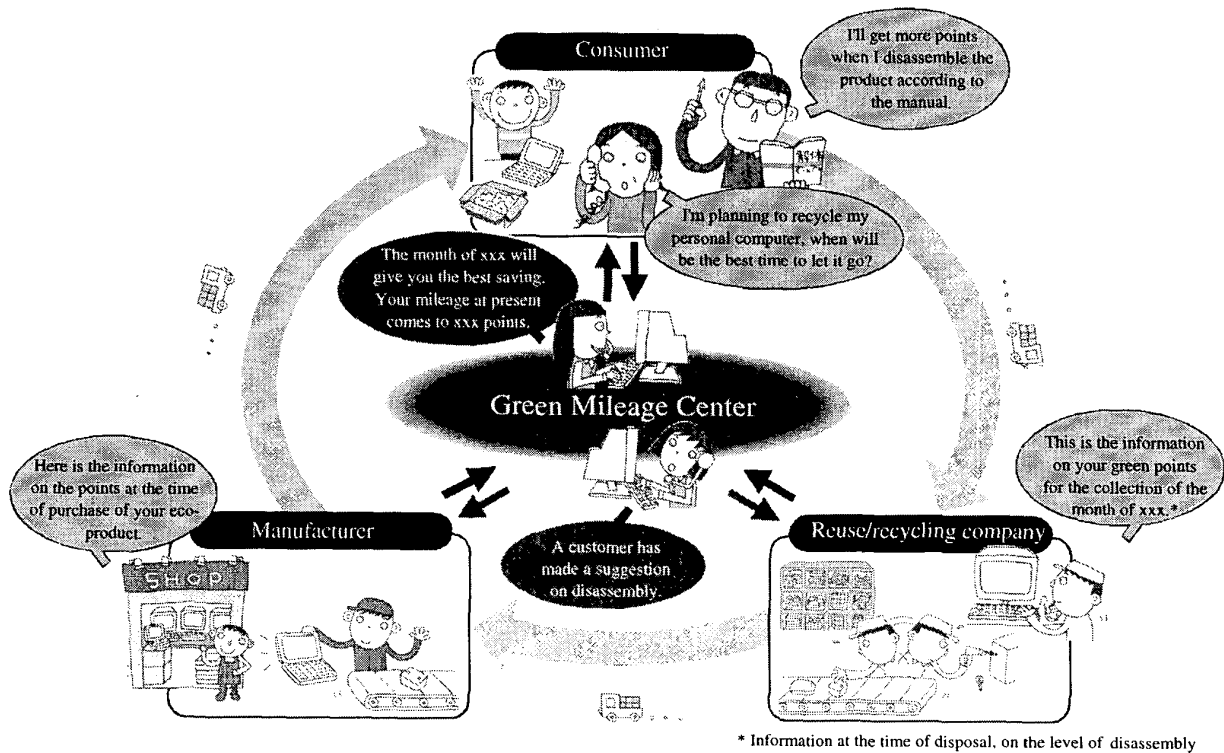


Figure 2 Green mileage system concept

make the concept concrete through the Green Mileage System that urges consumers to participate in the environmental activities. In future, to realize the inverse supply chain, it is necessary to study further on the artery/vein systems of physical distribution system, related laws and regulations, and environmental assessment.

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### References

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