A New Sustainable-Growth Industrial Production System

By Nagata Katsuya

Why is a new concept of industrial production needed now?

In the great current of the times, in which local environmental pollution by industry developed into pollution of the living environment in cities and then escalated into global environmental contamination, the limit of nature's cleaning power has come to be widely recognized, together with the finiteness of natural resources. The problem of waste is a social problem which has close connections with both and is very close to our everyday lives. The seriousness of the problem has been recognized, and there is strong demand for a basic solution. This is more or less common to all industrialized countries, and all such countries are aiming to structure sustainable-growth societies through nationwide endeavors.

As society becomes affluent, people's sense of values changes—the value of the tangible declines in relative terms, while the value of the environment rises. The amount of waste increases, whereas the capacity to dispose of it cannot keep pace. This is a paradox incidental to affluent society. The purpose of structuring a sustainable-growth society is to radically settle this paradox.

In such a situation, a new concept is being demanded in industrial production. One example of such a new concept is 'product responsibility,' referred to in a law concerning a recycling economy and waste disposal enacted in Germany in 1994. Product responsibility encompasses three-tier responsibility—responsibility for designing a recyclable product, responsibility for collecting used and life-expired products and responsibility for recycling and/or disposing of them. It requires the manufacturer to produce and distributor to sell products that impose little burden on the environment. The law is based on a broad viewpoint that covers not only production and distribution but also recycling and disposal after use.

This concept can be considered for a production system where social veins are connected with social arteries. Its materialization will lead not only to innovations in disposal and recycling technologies, but also to changes in the social system, and should cause a paradigm shift in the production-consumption system, a shift which will, in turn, lead to a change in the industrial structure and the creation of new industries. It will provide a valuable lesson to the developing countries which will have to produce environmentally friendly goods when they progress industrially hereafter.

Recent developments regarding life-expired products

In Japan, there has recently been a flurry of developments relating to used and life-expired products. Regarding consumer goods in general, which are the subjects of discussion here, the government has clarified a basic policy course regarding household electrical appliances and automobiles.

The volume of four representative household electrical appliances—refrigerators, washers, TV sets and air conditioners—dumped annually in Japan is estimated at 600,000 tons, and local governments now have the responsibility for disposing of about 40% of them, including those brought in by dealers.

Manufacturers are required to design these household electrical appliances in a way that facilitates recycling, and also required to cooperate with local governments in disposal and recycling. Now, they are required to step up their recycling endeavors. At a meeting in June 1997 of a government council on production, selling and recycling, composed of representatives of producers, distributors, recycling businesses and consumers, the structuring of a new system was proposed as a "Japan model" under which producers would assume responsibility for recycling, and consumers would pay the cost of recycling whenever they dumped a used product. This system is basically intended to shift the recycling route for used household electrical appliances from local governments to manufacturers and integrate the environmental cost

Table 1: Numerical targets* for recycling and curbs on use of harmful substances

Target year	2002 and beyond	2015 and beyond
Used motor vehicles (weight)	Recycling rate: 85% or over	Recycling rate: 95% or over
Recycling target for new models (weight)	Possibility of recycling: 90% or over	
Disposal by landfill (volume)**	Three-fifths or less of 1996 level	One-fifth or less of 1996 level
Target year	By the end of 2000	By the end of 2005
Use of lead (weight)***	50% or less of 1996 level	one-third or less of 1996 level

*For the time being, the numerical targets concern passenger cars of 1,500 to 2,000 cc, and the numerical targets for other sizes and types of motor vehicles including motorcycles should be inferred from them.
**The volume of shredder dust that will be generated from the same degree of disposal as in 1996 is assumed to be 1.
***The weight of lead used in 1996, not including the lead in batteries, is assumed to be 2000 kilograms.

in the private sector, which will include the social "veins." At present, a legislative study is underway for the purpose of quickly structuring the system. In the meantime, major household electrical appliance manufacturers have set up departments in their organizations to perform recycling.

The number of automobiles owned in Japan at present is about 70 million, and about 5 million of them are scrapped every year. Generally, automobiles that have reached the end of their useful lives are brought by car dealers to wreckers and shredders where they are disassembled and crushed, and about 75% of the total weight is recycled as reusable parts, steel and nonferrous metal scrap. The remainder, which amounts to 700,000 to 800,000 tons a year, is buried in the ground as shredder dust. The amount illegally dumped, however, is estimated at about a 10,000-vehicle equivalent per year.

As in the case of household electrical appliances, automakers are required to pay attention to recycling when they design their cars. However, because there are fears that illegal dumping and disposal in an improper manner will increase as a result of the increase in the cost of disposal and recycling, there are strong demands for further promotion of recycling and proper disposal.

In May 1997, the Ministry of International Trade and Industry announced the "Used Car Recycling Initiative," a comprehensive policy package about the recycling of vehicles that have reached the end of their lives. It projects a target for a recycling ratio and a target for restricting the use of harmful substances, and contains requirements for formulation and announcement of action programs by the industries concerned, introduction of a "manifest" system to prevent illegal dumping of used cars and the establishment of a center for exchange of information about motor vehicle recycling among the parties concerned.

The targets for the recycling ratio and the limit on the use of lead (excepting lead in batteries) are shown in Table 1. The recycling ratio target is about the same as those being studied by EU and European countries, including Germany.

Ways to implement the new concept for production and expectations

The following are approaches that manufacturers must take to make the products proposed above:

● ***Ensuring that value remains after product life expiry***

Manufacturers have to design their products so that the products will still have value after use and recycling. To be specific, expensive materials should be kept, as should reusable parts, and manufacturers should use the same materials and parts for the same kind of products.

● ***Structuring an "eco-production system," which uses recycled products and parts***

Manufacturers should structure a system that enables them to reuse parts and materials without the need to first reduce them to raw material. Products made using such a production system will 'grow' throughout generations (to be explained later) and will impose little burden on the environment.

● ***Structuring a new production/consumption system***

Under an ecologically harmonious production system, new industries, such as a parts rebuilding and regeneration industry and a material regeneration industry, will come into being. On the producer side, the production system will be transformed to one that allows reuse of parts and materials after only minimal processing. This is a revolutionary change in concept. The old thinking that production of goods starts with raw materials has been scrapped. Used materials that must be reduced to raw material and waste that is useless as a result of mixing will be taken care of by conventional basic materials industries, such as the steel, nonferrous metal and cement industries. Such feedstock recycling, including the use of such material as a reducing agent in a blast furnace, will occupy an intermediate position between the recycling of materials, parts and products mainly by assemblers and final disposal of non-reusable waste.

● ***Meeting the demand for product functions and servicing***

Another significant trend in consumer attitudes is the growing emphasis on product serviceability. Consumers do not recognize any value in a product that lacks symbolic meaning or aesthetic appeal. They buy such a product only for its practical function. 'Pay-Per-View TV' is a typical example. A system that satisfies the above demand is one that fits in with the new consumer trend. A used product ends its life as far as its function is concerned, but its component parts do not.

● ***Basics in recycling: quantity, quality, technology, and use***

From the viewpoint of quantity, quality, technology and use, which are the basics in recycling, there are at present problems with rebuilt parts. However, use is of paramount importance. Technologies for regeneration and reuse will progress if they are needed. As regards use, however, a strong determination on the part of manufacturers to structure a production system that enables recycling is of critical importance.

● ***Second thoughts on conventional production systems***

Up until the present, basic materials industries have imported raw materials in large quantities at a time to ensure optimum efficiency through economies of scale. However, this system generated a great amount of industrial waste. Moreover, the operation of domestic mines has created a situation where it costs a great deal of money even today to make good the aftermath of digging and extraction. Such a production system is a relic of the age of a dearth of goods, when increasing the production of materials was a supreme imperative. In industrialized countries, there is a

strong probability that industries based on such a system will be phased out eventually. In designing a recycling system, reducing material consumption is an important component. As a result, the significance of used-material collection is tending to decline. Such industries, however, will be assigned a new role as waste feedstock-recycling plants.

● *Current difficulties in parts recycling*

Since many products now in use were not designed with eventual recycling in mind, it is difficult to disassemble and reuse them as parts. Therefore, recycling (including disassembly) will have its greatest difficulty in the period immediately ahead. With the spread of products designed to ensure easy recycling, however, reuse will become easier. Therefore, there is at present a favorable business climate for the growth of a parts rebuilding and reuse industry.

● *Cities—treasure houses of used parts*

In this age when material affluence has been attained and used resources in the form of products and parts are flooding cities and towns, it would not be surprising if a production system that reuses them was set up. The piles of waste scattered throughout cities in Japan could be called 'urban parts stockpiles,' from which large amounts of parts can be obtained through disassembly for reuse.

● *Structuring a recovery system problematic*

If reuse becomes economically feasible, there will be a strong incentive for collecting waste, but it will be difficult for regeneration to yield sufficient profit to cover the cost of collection too. In the case of such bulky products as household electrical appliances, it is not so easy, as in the case of PET bottles, to collect and store them at the dealer's premises. Instead, it would be more practical for dealers to collect them and take them to a depot. To establish and maintain such depots, assistance by local governments is necessary.

Signs of the birth of a new concept of production

Keeping the above points in mind, let's again consider a multiple recycling loop for industrial products. This consists of such factors as shown in Figure 1. In the arterial recycling route, not only in-plant recycling mentioned above but also intermanufacturer recycling has been conceived. An example of this, reported in the media, is the use by a household electrical appliance manufacturer of press chips generated at an automobile plant. As an example of interindustrial recycling, cement produced as blast furnace slag is produced in large amounts through cooperation between the steel industry and the ceramic industry, and there is also recycling at the regional level based on a waste exchange scheme. Recycling shops are also used for recycling products dumped as junk after use, in addition to such routes taken by consumers as garage sales and flea markets. Furthermore, there are plans to establish a product and parts recycling system. Such a system is classified into three stages—refurbishing, reconditioning and re-manufacturing—and is called an "eco-production system."

"Refurbishing" means collecting used products of good quality, bringing them to a service base, etc., changing some parts, cleaning up the products and reshipping them. "Reconditioning" means sorting used products by checking their condition and quality, sending the selected products to a regeneration plant, disassembling them to the necessary level, changing parts, assembling them again and shipping them. In both refurbishing and reconditioning, considerable portions of the collected products are reused. "Re-manufacturing" means taking out reusable parts from collected products and assembling new products using both recovered parts and new parts. This practice is becoming common in the production of personal computers and some office automation equipment.

Preparing for the eco-production era: NEC's disassembly of personal computers

Here, material recycling means recycling for reuse as material only. In addition, there is horizontal recycling, aimed at reversion of collected waste to the form of original parts, and vertical recycling, which uses waste to produce products of lower quality. Recycling of collected waste as a raw material is called feedstock recycling here. Returning waste metals to a refinery and monomer recycling of plastics are feedstock recycling. In addition, there is thermal recycling, which recovers energy.

Recycling of waste should be performed using the shortest possible loop in order to reduce the burden on the environment and optimize the economics of the process. This is exemplified by the rule of entropy. The production and consumption systems of this affluent age should be reexamined in the light of this rule. From this viewpoint, we may say that the time has come when the eco-production system consisting of refurbishing, reconditioning and re-manufacturing should be given a clear position in the overall flow of recycling. This industry is in the borderline area between arteries and veins and can be entered from both sides. It also has considerable growth potential.

Proposing the idea of a product that 'grows'

In order for resource recycling and environmental protection to progress hereafter, not only the development of related technologies but a change in people's perception will have great significance. In particular, product designers who occupy the decision-making position in resource recycling have an important role to perform.

Here we want to propose the concept of a product that 'grows.' A product that 'grows' is one based on the concept of 'sustainable development,' a slogan for global environmental protection. Products that we know and use today function and perform best when they are brand new, and begin to deteriorate after that. Manufacturers seek to make a profit by forcing the consumer to continuously purchase new replacement products. A product that 'grows' is so designed and produced that its performance gradually improves during its lifetime. The manufacturer charges a reasonably higher price for such a product, allowing for its improvement with use, and continues to make a profit. Production of such a product requires a clear vision of possible technological development in the future and designing from a long-range viewpoint. Such a product will be kind to the global environment and free from the vicious circle of price wars. The concept of a product that 'grows' has much in common with the concept of the said eco-production system. I will be pleased if this concept will serve as a hint to the development of new products in this materially mature society.

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Figure: The multiple recycling loop for industrial products and the eco-production system