Inverse Manufacturing: from products to services

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Manufacturing is an activity for enriching the quality of human life by supplying various kinds of artifacts which provide us with more services than nature. However, with the increase of human activity, as a by-product of manufacturing, our natural environment is being degraded or polluted. These phenomena come mainly from too much consumption of energy and natural resources, and the disposal of waste. The probable effect of manufacturing activity today may be too much for the natural preserving capacity of the earth to absorb. If we can reduce the volume of industrial production, the problem may be solved. But, it is fundamentally difficult to reduce our industrial activity in spite of the natural human desire to attain a high quality of life. Therefore, the feasible solution should seek to keep the quality and volume of industrial activity while reducing the environmental burden of manufacturing. Towards this aim, we propose a concept of inverse manufacturing, where physical substances are re-used as much as possible, while the services or functions of products are maintained appropriately.

To cope with the above issue, it is effective not only to consider the product design and manufacturing preparation concurrently, but also to design the total product life cycle as a whole from product planning, and through product design and manufacturing, to product usage, maintenance and re-use/recycling/disposal. A comprehensive strategy for product maintenance and improvement during product usage should be established, and all life cycle processes should be controlled. With such an approach, re-use/cycling activities can be rationalized. The whole product life cycle can be made visible and controllable. We call this approach Inverse

Manufacturing by stressing the controllability of re-use/recycling processes, where close cycles of manufacturing activity are preplanned and controlled. Inverse manufacturing is practically implemented today in maintenance-centered products such as aircrafts or heavy industrial machinery. This concept can be extended into commodity products, such as household appliances or personal computers, etc.

Inverse manufacturing can be the basis not only for the change of product life cycle into a closed cycle, but also for an innovative paradigm shift of industrial structure. Traditionally, manufacturing companies supply physical products to fulfil customer's demands. Once physical products are in customer's hands, they are used, and finally they are disposed. But, the real demands of customers are not to possess physical products, but to receive appropriate services from products. In this sense, the new role of the manufacturing industry can be defined as a supplying industry, where manufacturing companies maintain the total product operating environment, and customers only buy services in such an environment. This type of service environment is common in some industry areas, for example, in telephone and communication. Copy machines are another example. People rarely buy copy machines, but they just lease machines and pay for services. However, due to several technical, social, economical and political reasons, this new style of manufacturing is not totally popular for automobiles or electronic appliances. If this style is accepted by society, the environmental issues concerning manufacturing will be greatly reduced, because the environmental burden can be controlled explicitly and independently with the services for customers. Thus we re-define the manufacturing industry as a service industry.

It is now almost obvious that the service industry concept based on inverse manufacturing will be a definite solution for our environmental problems caused by manufacturing. In addition to social, economical and political problems, there are many technical problems, such as, product life cycle modeling and management, deterioration modeling, re-use/recycling processes, monitoring of operations etc. Further research is desired for such problems.