Mitsubishi Electric's Measures for Environment-Conscious Products

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1. Introduction

To reduce the environmental load of products, Mitsubishi Electric has done the following: (1) developed technology for assessing products, and introduced it to the company's management system, (2) developed a Factor X indicator for comprehensively quantifying and improving the environmental performance of products, and (3) ranked products based on Factor X as an evaluation indicator ("Eco-Products" or "Hyper Eco-Products"). We have been implementing basic measures for the environmentally friendly design of products, and are now entering a new phase toward "Environmental Vision 2021."

2. Product Assessment

2.1 Concept of "Design for Environment"

In December 1999, Mitsubishi Electric formulated its "Policy Related with the Definition and Idea of Design for Environment" that takes into account the idea of designing for the environment, as shown in Figure 1.

As shown, the principles are to consider all stages of the product life cycle, including the manufacturing process, disposal process, and recycling process, and for the company and external suppliers and vendors to cooperate to reduce the total environmental load. The three points described below are called the "MET perspective." "M" for Material means effective use of resources; "E" for Energy means efficient use of energy; and "T" for Toxicity means reduce use of substances potentially harmful to the environment. These perspectives are emphasized in order to reduce the environmental load associated with products and production.

2.2 Product assessment regulation

We established the "Product Assessment Regulation" in October 2001 in response to the enforcement of the "Basic Law for Establishing a Recycling-Based Society" in April 2001. Product assessment means assessing the environmental impact of the production and use of products, before production begins. If the assessment shows that the environmental impact of a product is found to be greater than that of the conventional model, the product is returned to the design phase for modification to reduce the environmental load. If the environmental load of a product is too high, the product will not be produced. By incorporating this product assessment in the production phase, Mitsubishi Electric is working to reduce the environmental load.

2.3 Product assessment procedure

The product assessment procedure is as follows:

(1) Product assessment is conducted in the product

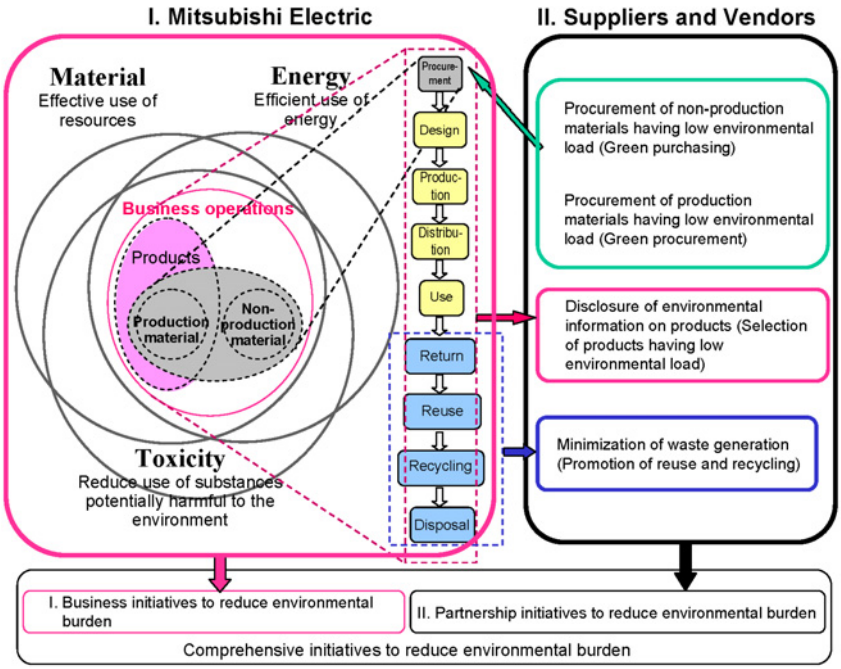

Fig. 1 Concept of Mitsubishi's design for environment

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development and design phase.
(2) Baseline products are selected.
(3) Products are assessed individually for the respective assessment items.
(4) The total score is assessed in accordance with the individual assessment.
(5) The necessity of measures such as design change is determined (total judgment).
(6) Assessment records are stored.

The acceptance/rejection decision (total judgment) is first made by the design division, then by a division providing an objective evaluation, and finally by the plant manager. A baseline product is selected for comparing how the environmental load of products has been reduced relative to the baseline product. The baseline products are selected from Mitsubishi's products of 1990 corresponding to the current products. When targets of environmental load reduction are determined for phase-based achievements over the medium and long term, the same baseline product is used for a series of development phases. Otherwise, assessment of a product in each development phase based on a previous model as the baseline product is permitted, providing the policy of "better than the previous model" is followed.

Table 1 shows the individual assessment items.

Table 1 Individual assessment items of product assessment

Assessment item	Main targets of assessment
1) Weight reduction	Reduction of the amount of materials to be finally discarded by downsizing and/or reducing the weight of products
2) Service life	Reduction of the amount of materials to be finally discarded by extending the lifespan of products by improving durability, using upgradeable design, and/or improving the repair system
3) Resource reuse	Reduction of the amount of materials to be finally discarded by recycling metals and resin materials
4) Reusability	Reduction of the amount of materials to be finally discarded by reusing parts, etc.
5) Product crushing	Easier crushing procedure
6) Ease of dismantling/separation of materials	Easier dismantling and separation for reuse, recycling, and disposal processing
7) Recovery/transport	Easier recovery and transportation of products by waste disposers
8) Product safety and environmental friendliness	Prohibition, reduction, or safety measures for harmful, toxic, or dangerous substances
9) Product packaging	Reduction in the volume of packaging, reuse and recycling of packaging material
10) Energy conservation	Reduction of energy consumption and reduced use of consumable materials
11) Information disclosure	Disclosure of information for reuse, recycling, and disposal
12) Manufacturing process	Reduced emissions of harmful/toxic substances from the manufacturing process and energy saving and reduction of waste associated with manufacturing
13) Distribution	Reduction of environmental load by improving and increasing the efficiency of distribution systems
14) LCA	Establishing a guideline for product development to reduce environmental load by clearly identifying the environmental load indicators of the respective phases of raw material arrangement, product manufacturing, transportation, usage, and disposal

3. Method of Assessing the Environmental Performance of Products

We have developed a unique "Factor X" indicator to assess the degree of improvement achieved in reducing the environmental load of a product.

3.1 General concept of Factor X

The "X" is a variable to indicate the multiples (i.e. multiple number) of the value of "environmental efficiency" of a product at a time against the value of the "environmental efficiency" of the baseline product at the baseline time. The factor is expressed by:

Factor = Environmental efficiency of the product under assessment/Environmental efficiency of the baseline product

This equation was announced officially in the "Guideline" published by the Japan Environmental Management Association for Industry in 2004 [(1)].

Performance factor = Performance of new product/Performance of old product

Environmental load factor = (Degree of environmental load reduction) – 1 = Environmental load of old product/Environmental load of new product

If the above expressions are true, then the following expressions are also true for the factor:

Factor = Environmental efficiency of new product/Environmental efficiency of old product

= Degree of performance improvement/Degree of environmental load reduction

= Performance factor × Environmental load factor

The expressions indicate that the factor assesses not only the degree of environmental load reduction but also the degree of improvement in product/service performance. In short, it is reasonable to use Factor X to measure the degree of improvement in environmental performance of products.

3.2 Mitsubishi Electric's Factor X

Mitsubishi Electric's Factor X is unique in that the calculation follows the "MET" perspective mentioned above (Reference 1).

(1) The expression "Factor X = Performance factor × Environmental load factor" does not represent the factor value by means of a single item; it indicates clearly the contribution of both environmental load reduction and performance improvement to the value of the factor.
(2) The environmental load factor integrates the degrees of reductions of all environmental load reduction items into a single value. Multiple environmental load reduction items are classified on the basis of the MET perspective, and the degree of reduction of each perspective is numerically expressed as (the square root of the sum of the

squares of multiple reduction degrees of individual items), and finally integrated into a single value by vector synthesis of M, E, and T indicators.

(3) The performance factor adds up the degree of improvement in the performance of basic functions and product service life. If multiple basic functions are to be assessed, the degrees of improvement in the performance are integrated into a single value by calculating the arithmetic mean. Basic functions are defined for the types of products.

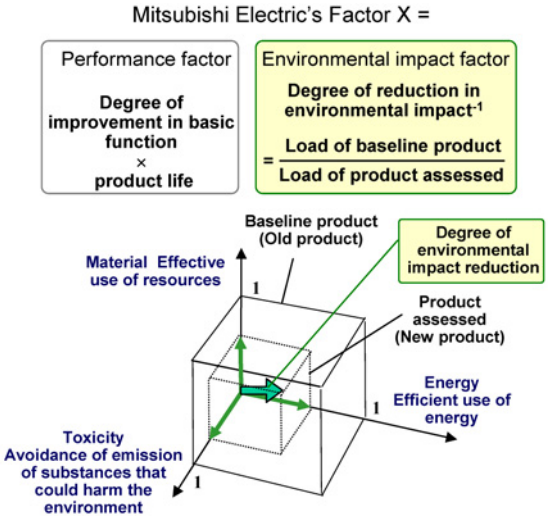

Fig. 2 Mitsubishi Electric's factor X

4. Ranks of Environment-conscious Products

Mitsubishi Electric established an "Environmental Plan" for the medium and long term starting in 1993 and has been working to reduce environmental load and promote environmental management. The Fourth Environmental Plan for fiscal 2004–2006 and the Fifth Environmental Plan for fiscal 2007–2009 included the establishment of the ranking of environmental products: "Product assessment," "Eco-Products," and "Hyper Eco-Products" (Fig. 3).

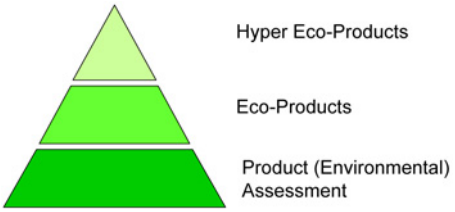

Fig. 3 Ranking of environment-friendly products

With Eco-Products and Hyper Eco-Products, Factor X is used as a quantitative indicator and a certification criterion (Table 2). The candidate groups of products for Eco-Products are selected and registered by respective business headquarters; they are considered as a parent population. The ratio of Eco-Products to the parental population is determined from the production output and weights and is defined as the "Eco product ratio." The target values of the environmental plan for the respective business headquarters and the whole of Mitsubishi Electric are determined in order to encourage the development and sale of Eco-Products. In fiscal 2007, 79 product groups were designated as "Design for Environment"; as a result, the Eco-Product ratio reached 82%.

Table 2 Definitions of eco-products and hyper eco-products

Definition of Eco-Products
1. "Environment-friendly products" satisfying any of the following items:
(1) Products satisfying predetermined quantitative criteria including degree of Factor improvement and social contribution (The standard values of respective product groups are to be defined by relevant business headquarters.)
(2) Products which have been recognized as the best products (top-runner products) in their class or received an environment-related award of excellence
2. "Environmentally effective products" whose use directly leads to environmental improvements
Definition of Hyper Eco-Products
1. Products certified by in-house certification procedure, employing a new concept or innovative technology that contributes to sustainability
2. Products which have obtained a Factor value of 2 or higher
3. Products which have received a prestigious environment-related award of excellence

5. Environmental Vision 2021 and Measures for Products

5.1 Completion of Eco-Product promotion

The target Eco-Product ratio in the Fifth Environmental Plan is 100% for mass-produced products, which are comparatively high in the development cycle and produced in large quantities. This means that the product design and manufacturing phases are continuously subject to environmental consideration for all the products. We believe that the basic target can be achieved within six years of the Fourth and Fifth Environmental Plan, and that promotion of Eco-Products will be completed simultaneously.

5.2 Future measures for products

The Environmental Vision 2021 aims to reduce CO_2 emissions from product use by 30% and the material input volume by 30% by the year 2021. With key environmental initiatives now incorporated in all our products, technological innovations are indispensable for achieving these targets. The measures for products taken in the past were incremental improvements made mainly by defining the environment-friendly performance in the form of indicators (visualization). We must continue to improve our efforts so that they will be important activities in the management of the company.

Reference:

(1) Takahashi T. et al.: Evaluation methods and Applications of Factor X Indicator for Realization of a Sustainable Society, 4th International Symposium on Environmentally Conscious Design and Inverse Manufacturing 3D-2-1F (2005)