PROPOSAL ABOUT NEW CONCEPT OF VALUE
— PART 1: SOCIAL VALUE

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ABSTRACT

A new value concept for the total value assessment is proposed, in which value, as it changes with time, is expressed in area, on the basis of the conventional equation of VE CONCEPT. Recycling ratios at the time of scrap are also introduced.

INTRODUCTION

In the 21st century, we will be confronted with a task of achieving two widely different goals, that is, preservation of global environment including resources and energy saving) and search for profitability, which are contradictory from the conventional corporate viewpoint. Just making efforts is not enough. If we fail to achieve these goals, tomorrow will not come. the reason why we projected our theme on such a big screen is that we think that VE is a very effective means to achieve these goals. However, during the process of solving each problem involved, we will meet difficulties which we cannot deal with under the conventional sectional view of value. Therefore, we have been searching for a new value concept for the next generation, and have created a model equation of the new value concept using transportation (automobiles) as an example.

NEED TO CHANGE CURRENT EQUATION OF VALUE CONCEPT
— MOTIVE FOR PREPARING THIS PAPER

Needs in VE activities — problems in implementing VE Job Plan. Current value concept is expressed in the following equation:

$$V = F/C \qquad (1)$$

Cost (C) has been defined as life cycle cost since Mr. Miles originated the value concept. However, life cycle cost is difficult to define in reality, and, in some cases, the cost is assessed even on the basis of variable expenses in manufacturing products. For functions (F), the objectives of VE activities are use functions and esteem functions, but the scope of use functions is difficult to define, and so, in most cases, value is assessed only on the basis of conspicuous use functions. To solve this problem, the equation of value concept has been more often discussed than before among VE engineers. The mainstream approach to the problem is by focusing attention on F in equation (1) and increasing the number of function items to be assessed, or on C in equation (1). This approach is expressed by either of the following equations:

$$V=(F1+F2+F3++F_n)/C \text{ or } (2)\ V=F/(C1+C2++C_n)$$

In this equation, costs and functions are variables relative to each other. Also, costs and variables vary with time and locations. On this point, there is still room for improvement. Therefore, value should be expressed as the function of functional and cost elements, each including time elements.

Needs in functions

Among the various classifications of value, use values and esteem values have been considered as the objects of VE activities. Along with changes in social circumstances, the scope of functions to assess has changed significantly. In providing products and service, producers must take many items into consideration. major items that must be considered in view of contemporary trend are:

Use functions:

— Basic functions indispensable to products and service

Satisfaction:

— Customer satisfaction (Contribution to promotion of sales of products and service)

— Reliability (It is a long time ago that people accepted low quality because of low price. Recently people by reliable products, even if they are somewhat expensive.)

— Manufacturer satisfaction (Maintenance and expansion of employment, motives for improvement)

— Environment satisfaction (Reduce nuisances to society, such as noise, exhaust heat, bulkiness, disturbance to environmental beauty.)

Easiness in service

— Easiness in maintenance after production, including logistics. Effective use of resources

— Low running costs

— High recyclability

People have become more and more interested in these items, and people have come to take them into consideration in assessing competitiveness of products. These are values, and, at the same time, functions. In this sense, the conventional assessment of value on the basis of use functions often misleads us. Therefore, it is time for us to review the conventional value concept.

Needs in cost

According to research institute reports on products which consume energy when used, such as automobiles, the ratio of running costs, which customers have to pay after purchase, exceeds the ratio of initial costs, and, moreover, the running cost ratio has been increasing every year. This shows that we should assess the true value of products from the customer's viewpoints by the entire life cycle cost including running costs. According to VE theory, running costs should be counted as part of life cycle cost in assessing the value of products, but this, in reality, has been neglected. Furthermore, scrapping expenses nowadays are so large that public organizations pay these expenses with our taxes. Unfortunately, scrapping expenses are included in the assessment of neither the product cost nor the life cycle cost.

Needs in Social Concerns

Regarding energy consumption for automobiles, required amount of energy at each stage of material, production, and maintenance after consumers obtain the vehicles is overwhelmingly large. In view of resources saving and environmental preservation, it is necessary for both producers and consumers to assess how much energy is consumed for each purpose: on producer's side, the assessment is required as sales tactics and image strategy, and, on the consumer's side, as the duty for those who live on the earth. Therefore, considering these needs, we realize the necessity to extend VE concept as shown in the chart on the following page. The VE concept has been known for a long time, but has not been fully reflected in the equations.

NEW VE CONCEPT MODEL

Objectives

Firstly, in assessing product value, value concept should be extended from the conventional sectional one to a two-dimensional area by considering value as a function of time, and dealing with the value of product from its birth to scrapping. Secondly, achievements in customer satisfaction with resources and energy saving, as well as use functions, should be assessed by considering the elements of satisfaction, social effects, and reliability (reliability and maintainability) in addition to basic functions of products. Values regarding energy saving are hereafter mentioned as "social values." This new value concept enables us to assess product value from a viewpoint near to that of consumers, and to assess achievements in social needs as well. However, the costs required at the stage of product planning, concept making and production — initial costs from the viewpoint of consumers — are not dealt with in this paper since these costs have been studied and discussed many times in the past. Thirdly, product value should be provided with continuity beyond life cycle by assessing product value remaining at the time of scrapping using recycling ratio.

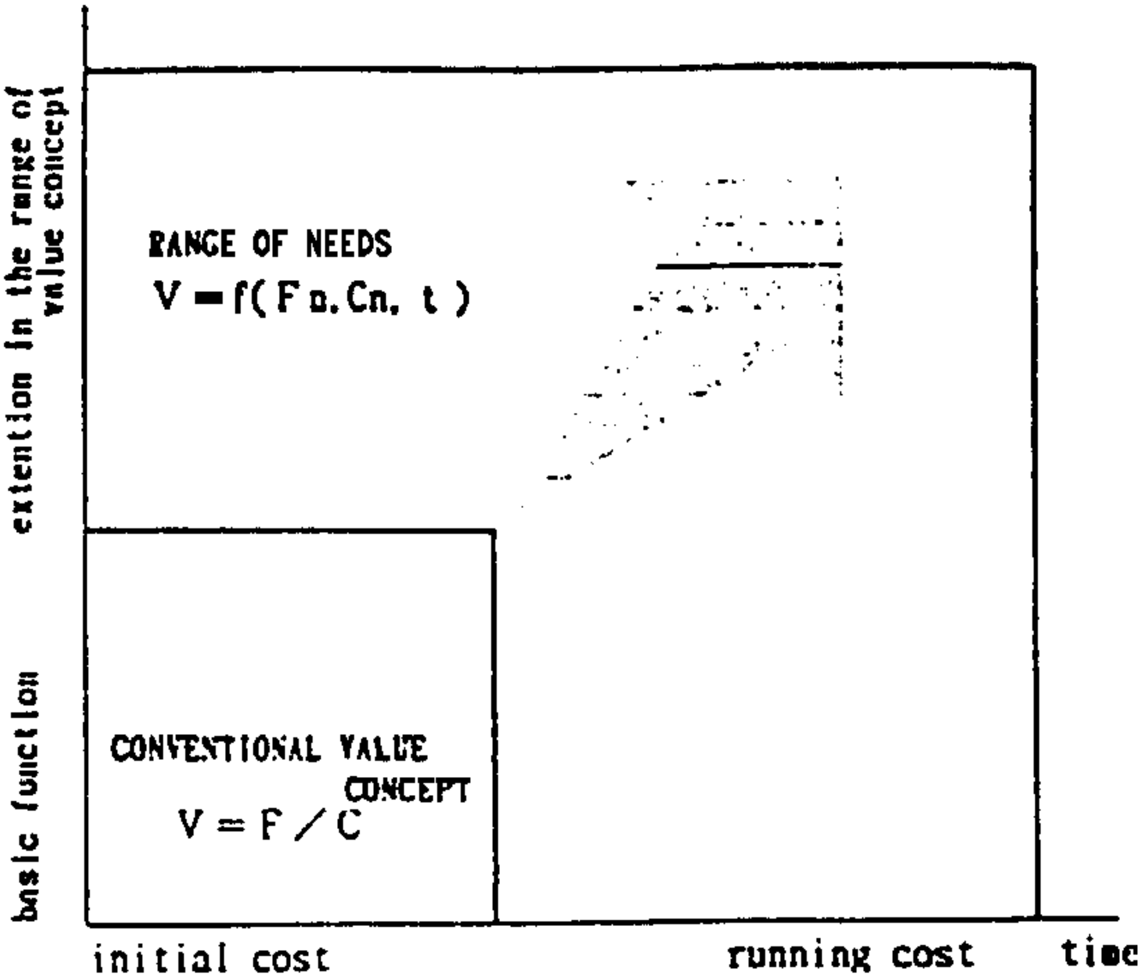


Fig. 1 Range Required for VE Concept

Equation of New VE Concept

Need to assess product value with respect to many value elements mentioned, other than use value, is urgent, but, in this paper, attention is focused on social values.

$$VT = \sum_{n=1}^{4} AnVn = \sum_{n=1}^{4} \int_0^T An(Fn/Cn)\,tdt \quad ---(3)$$ F1

$$V1 = \int_0^T (V0-At)dt \quad ----(4)$$ F2

$$V2 = f(V) = \int_0^T (V-0.01*t)dt$$ F3

$$V3 = f(V) = \int_0^T Vdt \quad ----(7)$$ F4

$$V4 = f(V) = \int_0^T Vdt \quad ----(8)$$ F5

$$V1 = \int_0^T (V0-At)dt = V0*T-(V0-R/T)*T*T/2 = 0.50$$ F6

$$V2 = \int_0^T (V-0.01*t)dt = V*T-0.01*T*T/2 = 10.5 \text{ years}$$ F7

$$V3 = \int_0^T Vdt = 0.999*10 \fallingdotseq 10 \text{ years}$$ F8

$$V4 = \int_0^T Vdt = (0.5/1.0)*10 = 5.0 \text{ years}$$ F9

Total value index:

(Refer to formula **F1** in formula listing) (3)

Use value:
An= Weighting ratio for each value
V0=F0/C0:Initial value (conventional value)
V1=F1/V1:Use value
R=Recycling ratio

T=Product life cycle (years)

Social values:
V2=F2/V2:Operational value element
V3=F3/V3:Reliability value element
V4=F4/V4:Function utilization value element

Image of Total Value Vt

Image of Total Value Vt

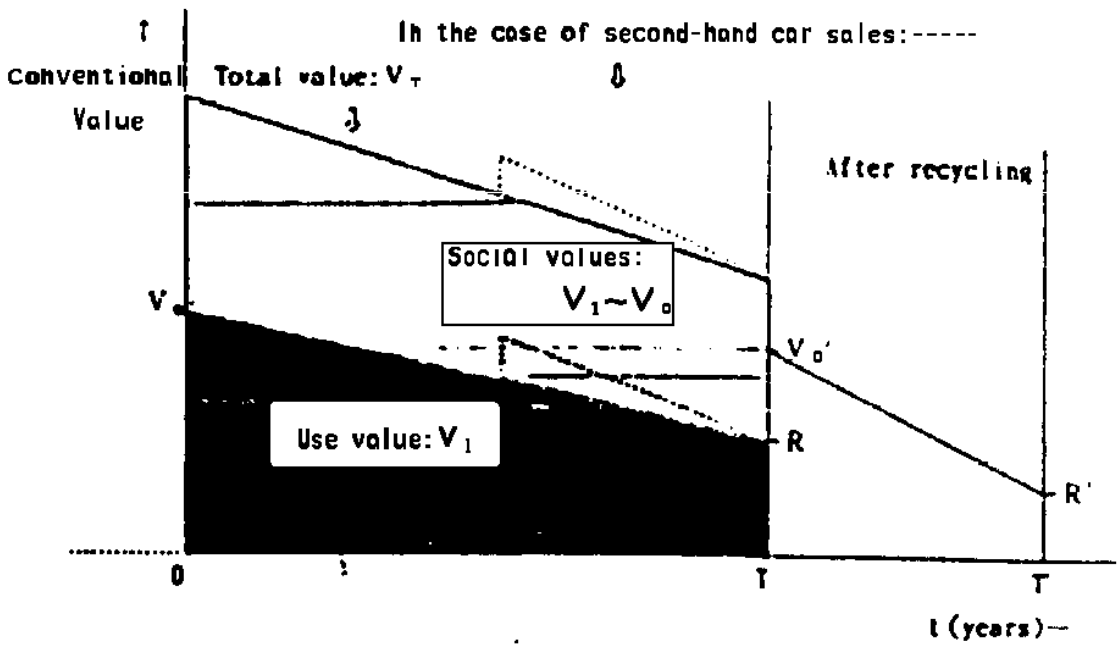


Fig. 2 Total Value Index: V_T

STRUCTURE OF MODEL EQUATION

Concept of Model Equation

Use value, fundamental to products, is expressed by the area defined by the value index at the stage of sales (conventional value), the recycling ratio (substitute for value remaining at the stage of scrapping), and life cycle period. Similarly, social value, new value elements introduced to indicate social needs, are expressed by the area of time-dependent values integrated for each value element. Because each element has different base, value standard is provided for each value element to determine relative value with respect to the value standard. Moreover, value elements differ in contribution to value, and thus weight ratio is provided for each value element in accordance with energy consumption, though there may be different ways to determine the ratios. Energy consumption is used as a scale of weight in this paper because our main target is resources and energy saving.

Finally, use value and social values are added to calculate total value index. Value of recycled products is assessed in a similar way, which is not shown here.

Use value

Use value V1 is calculated by initial value and recycling ratio:

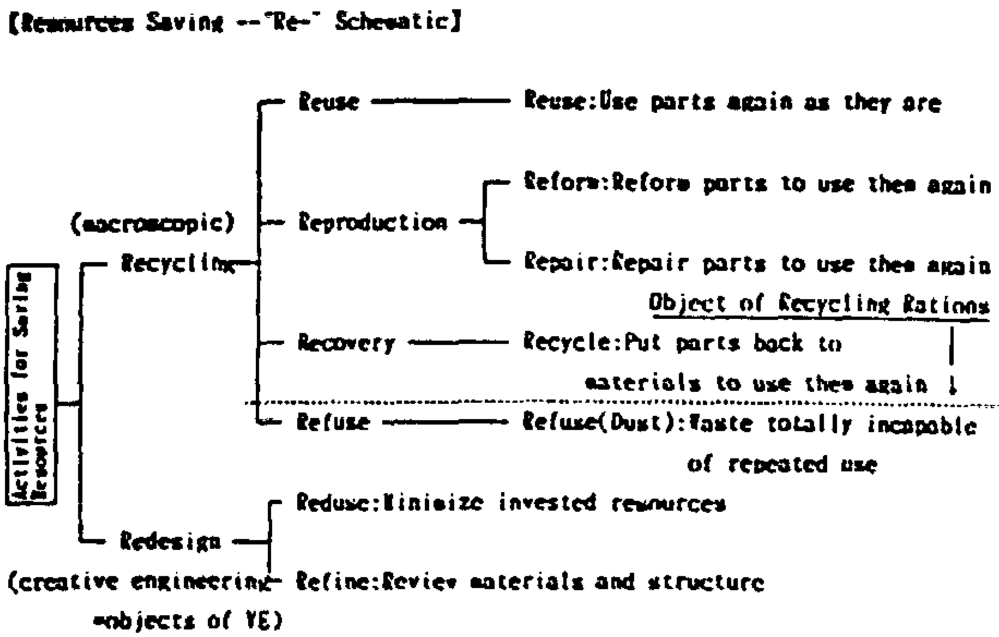
(Refer to formula **F2** in formula listing) (4)

Where A: Depreciation rate A = (V0-R)/T

Initial Value V0 = F0/C0

Professor Takehara, Wako University, gave a special lecture on the elements of recycling ratio at the 25th VE session. In his lecture, object of recycling is divided into four "re-" categories, as mention in the next paragraph, by easiness in recycling. The rest, which we have no other way but to discard, is also classified into "re-" categories. Recycling ratios, macroscopic coefficients, are provided to be used in assessment, considering utilization of resources in recycling and energy required in using resources again. Reasonableness in using the recycling ratios is generally explained as: the recycling ratios, consisting of three elements (reuse, reproduction, and recovery), are calculated by ratios of energy required in producing the equivalent products again as well as by weight ratios for these elements. The ratios of energy for the three elements are shown in the schematic in Table 1 below. In cases where all parts can be reused, recycling ratio is 0.9. In cases where 50wt% of all parts can be reproduced, the recycling ratio is 0.63.

Table. I "Re-" Schematic



Provided that the weight ratios for each element are A, B, C, and D respectively, the recycling ratio (R) is determined by the following equation:

$$R = 0.9 \sim A \{ 0.6 \sim B \{ 0.4 \sim C \quad \text{---(5)}$$

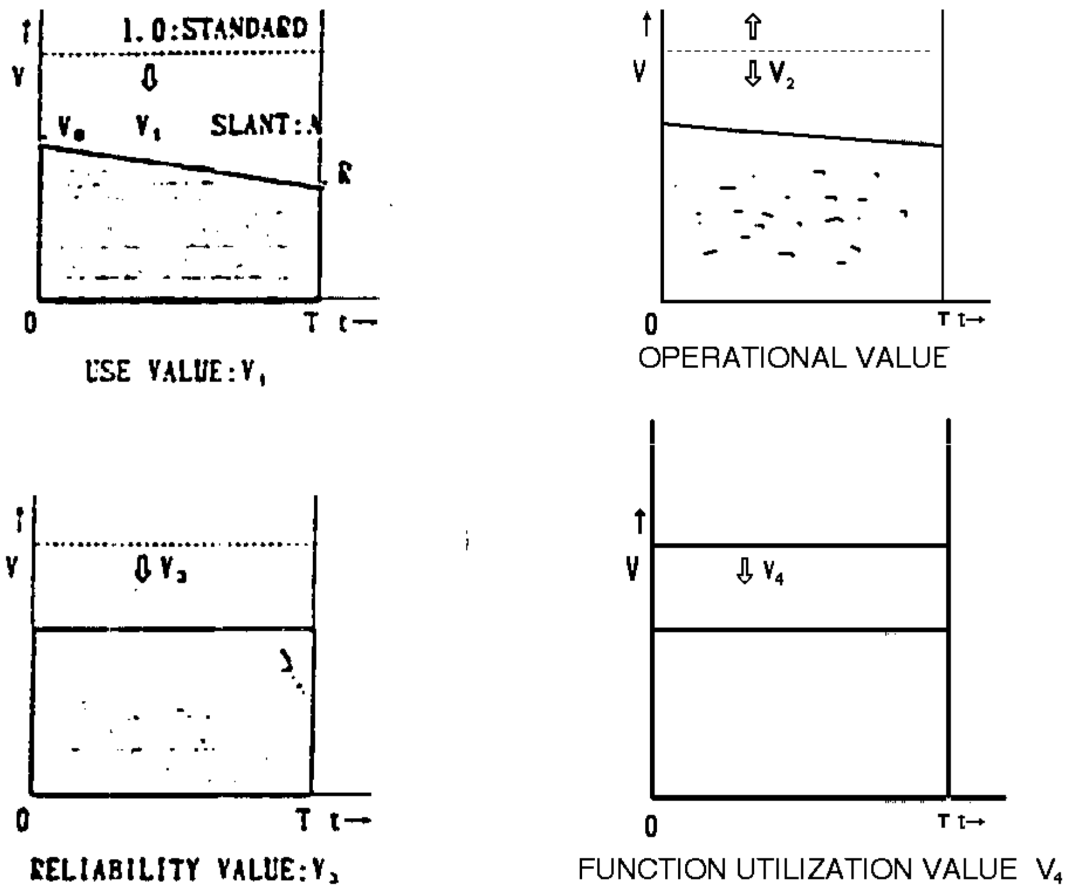


Fig. 3 VALUE ELEMENTS(V_1 ~ V_4)

Social Value

For each value element selected on the basis of environment preservation, each value element is weighted to calculate total value in accordance with energy consumption over vehicle life cycle:

Weighting for value in = 0.15 Only at initial stage producing materials and vehicles.

Weighting for operation- = 0.70 During life cycle value Weighting for reliability = 0.10 During life cycle value Weighting for function = 0.05 During life cycle utilization value
Total = 1.00

Weighting Ratios for Social Elements

Operational Value Element

According to reports on energy consumption in auto industry, energy required in operating vehicles accounts for the majority of total energy consumption, though figures are slightly different from one report to another. In essence, reducing operational energy is much more effective on a global scale than improving recycling ratios. Let us look into the elements related to operational energy. The amount of energy consumption is reduced by reducing mileage, but this is not what products are meant for. In this paper, elements controllable on the producer's side are focused on. Levels of energy consumption under the conditions of average use of cars and running performance (statistical values in the industry) in Japan is set at 1 (the same as the conventional value index) as the standard for value assessment equation (6). Energy consumption is dependent on fuel economy improves by 10%, value index (V) goes up to 1.1. Time axis needs to be calibrated considering fuel economy being affected by friction, etc.

(Refer to formula **F3** in formula listing) (6)

(0.01: Calibration factor for fuel economy)

V= Average energy consumption for operating a vehicle in a year/energy consumption for operating an object vehicle in a year.

Calibration factor for affected fuel economy = 0.10/9 years 0.01 year (from experience

Standard (= 9.37) 106 kcal/year)
Assumption: Fuel economy = 8.5 Km/L

Average vehicle life = 9 years
Average mileage = 9,265 Km/year

The method for calculating V2 is expressed by equation (6). More important here is to understand how much value is improved by focusing attention on what and how to improve. Major assumed factors to improve fuel economy are design, operation, and environment (road, etc.). Regarding design factor, which can be improved independently of users, items to improve and effects are listed as follows:

Weight - 10% - Fuel economy - 8%
Transmission: From AT to MT - Fuel economy 10%
Aerodynamic drag - 10% - Fuel economy - 4% (at 100 km/Hr)

Reliability Value Element

Reliability of products under service is expressed by durability and maintainability of products. Durable products have long lives, and save resources. Products easy to maintain save energy in service. Therefore both value elements are useful as scales which meet social needs. Availability, which is commonly used in reliability engineering, is used here for calculating the reliability value element.

(Refer to formula **F4** in formula listing) (7)

V:Availability = MTBF/(MTBS+MTTR)
MTBF: Mean Time Between Failures
MTTR: Mean Time To Repair

Hence reliability value is improved by promoting simplification and standardization.

Function Utilization Value Element

This value is assessed on the basis of to what extent customers use functions provided for products. Objective of providing this value element is to save energy by eliminating unnecessary equipment. Information on functions which customers use should be obtained by market research in advance.

(Refer to formula **F5** in formula listing) (8)

V = Functions customers use / Functions provided

Total Value Index

Total value index is determined by summing the weighted use value (V1) and social values (V2 to V4).

Total value index VT = 11.15*vl+0.1*ve+0.05*V4 (9)

Weighting for use value is 1.15 because energy consumption required in production is included in use value. Assuming that the value index for each element is 1, VT is equal to 2.0 times the number of years set for life cycle.

Use

Since the equation for assessment is based on the amount of energy, approximate amount of energy saving is predicted by improvement in total value index. For example, improvement by "2" in the total value index approximately means 2*100,000 kcal in energy saving. Moreover, assessment of total value index is comparatively easy, and thus enables both producers and consumers to share the same tool for assessment of total value. For example, if fuel economy improves by slightly more than 20% with the assumption that the other values remain the same, the amount of energy saved is equivalent to that required to produce a brand-new vehicle.

EXAMPLE OF ASSESSMENT

Object

The value of our recent new model RV is assessed as an example on the assumption that its life cycle is 10 years. The results are shown below:

Use Value

Initial value: VO
Assumption VO = 0.80

Recycling ratio: R

Weighting distribution to each recycling element is 0.2 for reuse, 0.5 for reproduction, and 0.05 for recovery, and the rest is waste. Recycling ratio is calculated by substituting these values for corresponding values in equation (5):

R = 0.9*0.2+0.6*0.5_.04*0.05 = 0.50

Use value: V1

(Refer to formula **F6** in formula listing)

Social values

Operational value element: V2

Provided fuel economy of the object vehicle = 8.8 km/1, weight = 2.02 ton, from equation (6)

(Refer to formula **F7** in formula listing)

Reliability value element: V3

Statistical average values for MTBF and MTTR, instead of in-house data, are used in this calculation. From equation (7),

(Refer to formula **F8** in formula listing)

Function utilization value element: V4
Provided utilization ratio = 0.5. from equation (5)

(Refer to formula **F9** in formula listing)

Total value Index

From equation (9), total value index is calculated as follows:

VT = 1.15*V1+0.7*V2+0.1*V30.05*V4
= 1.15*6.5+0.7*10.5+.01*10+0.05*5.0
= 16.07 = 16.1 years

CHALLENGES IN THE FUTURE

Improvements of the value concept equation by adding other social values

Improvements of the model so that the use of the model industries as well.

Extension of applicability of the concept to the products at the stage after recycling.

AFTERWARDS

Admittedly, the value concept equation is not yet perfected, nor fully verified. Hopefully, this paper will motivate you to discuss "Extension of VE Applicable Range."

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