

## THE SYSTEMATIC COST MANAGEMENT AIMING FOR CUSTOMER SATISFACTION

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Yoshinari Nagoya is a mechanical design engineer and a certified value specialist. He was the former Manager of Value Engineering Center of Tochigi Operation, Refrigeration & Air-conditioning Division of Hitachi Ltd. and he also was former Vice President of SJVE's Tokyo Chapter. He holds a Bachelor of Engineering from Shinshu University. At Hitachi he invented in 1980, an epoch-making refrigerator that has set a standard refrigeration system of nowadays. In 1994, his invention received "The Governor's Award of Tochigi Prefecture". In 1991, Hitachi's Tochigi Operation received "Miles Supreme Award" from SJVE in which his created VE system named "Spiral-VEC" was commended. He presented his VE papers on Marketing VE in 1990 and on Target Costing in 1998 at SAVE International Annual Conference.

### ABSTRACT

We first set the Product Improvement Value for a product to be developed by customer needs quantitatively: It is the total target value of product development activities strategically.

We then develop the product speedily using cost-effective activities and management, attaining the target value by integrating and systematizing, various activities.

This paper describes a systematic method of cost management for product development.

### INTRODUCTION

In a business environment where competition is borderless and the global environment is often one of bitter controversy, the ultimate goal is to develop products that will not only meet the customers' needs directly but also satisfy environmental requirements.

In order to accomplish this goal, we emphasize the following: reinforced activities in the primary stage of product development, total cost evaluation of life cycle costs, concentration and systematization of activities, with vectors aligned and to attain the stated aims, etc.

Various attempts have been made using conventional methods of Target Costing and concept VE, but many problems are materialized: high costs due to design incorporating redundant functions originating from loss of customer needs quantitatively, unattractive product planning, production unattractive utilizing insufficient

integration and systematization of cost-reducing activities.

The author and his colleagues developed a product development VE system named "Spiral VEC (Spiral Value Engineering for Customers)": This system aims to first evaluate the developing product by customer needs quantitatively as the total target value of product development activities. And the author has actually applied the method. <sup>(2)</sup> <sup>(3)</sup>

This paper describes a cost management method improved over Spiral VEC, a method that presents a new scheme of customer needs quantitatively and allows the related divisions and persons to execute Target Costing and VE systematically, aiming at rapid product development.

### GOAL IN PRODUCT DEVELOPMENT

The author has experienced many problems in the development of household electric appliances: The major goals are summarized in Table 1.

As shown in the table, major goals and problems are:

1. Product development system which makes us second to none in developing products which attract customers and vary from products of other competitive companies.
2. System of cost management and VE activities effective to attain high targets of profit and costs.
3. Product development system which covers every step from product planning to service after sale consistently.

To achieve these aims, the author started to develop a "Systematic Method of Cost Management Oriented for Customer Satisfaction" from the viewpoints of customer satisfaction, systematized activities,

information centralized and open to public, speed and concurrency, so that the person in charge can work positively to attain the target.

Table 1. Major Goals in Product Development

Goal	Key Improvement
1. Leading industry in developing products which vary from those of other companies.	<ul style="list-style-type: none"> <li>• Predicting changes in product environment.</li> <li>• Predicting changes in customer needs.</li> <li>• Presenting original ideas for products</li> <li>• Setting targets for strategic product strategy.</li> <li>• Not copying products made by other companies.</li> </ul>
2. Products which customers would await with expectation.	
3. Meeting target costs by avoiding inaccurate evaluation of plans and concepts.	• Management of transition of development stages which do not allow advancing to a next stage if the target cost has not been attained.
4. Fulfillment of VE ideas.	<ul style="list-style-type: none"> <li>• Execution management system which is intensive and systematic with definite objectives.</li> <li>• Centralized management of VE information.</li> </ul>
5. More comprehensive VE ideas.	
6. Publicity raising customers' expectations.	• Intensive publicity on principal functions of products.
7. Service adding to customers' feeling of satisfaction through use.	<ul style="list-style-type: none"> <li>• Providing rapid, cordial services.</li> <li>• Checking management of development by studying users' satisfaction.</li> </ul>

**CONCEPT OF CUSTOMER SATISFACTION**

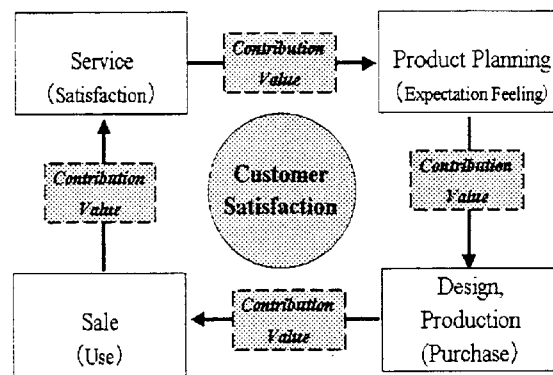
To develop products attractive to customers, let us discuss Customer Satisfaction viewed from the customer side.

It can be considered that user's feel "satisfied" through a circular process consisting of four steps parenthesized in Fig. 1.(2)(3)

- ① Expectation: Consumer with a desire for such and such a product looks for a desired product with expectation.
- ② Purchase: He finds a product satisfying his expectation and purchases it.
- ③ Use: He uses the product.
- ④ Satisfaction: He feels satisfied with the product, which leads him to further expectation.

To make a product that delivers customer satisfaction, it is important to divide and relate as follows:

$$\text{Customer Satisfaction} = \text{Expectation at the time of purchase} + \text{Feeling of satisfaction through use}$$



( ) : View from the customer side  
 Contribution Value : The improvement value of the product specifications which meets user's expectations

Figure 1. Concept of Spiral VEC

CONCEPT OF SPIRAL VEC

Spiral VEC relates the four stages of "Expectation" and "Satisfaction" on the user side to the four stages on the maker side shown in Fig. 1 to increase Customer Satisfaction at each stage consistently. It also aims to run the cycle of the four stages for continuous development.

The four stages on the maker side are as follows:

**(1) Stage of product planning**

Find out what the user wants, and convert the idea to design quality, considering how each product function can be improved, it is important to do as follows:

- Investigate expectations (needs) of users for products.
- Obtain the Evaluation Factors of expectations and emphasis rate of Evaluation Factors.
- Study important Evaluation Factors.
- Think ideas of a product in relation to the important Evaluation Factors.
- Convert the ideas into design quality and find how much product functions could be improved.

You obtain the "Contribution Value"  $C_i$  from Equation (1). The Contribution Value indicates how much the improvement of product functions would contribute to the expectation of users, considering customer needs.

$$\sum C_i = \sum E_i \times \sum T_i \quad (1)$$

$E_i$  : Emphasis rate of individual Evaluation Factor

$T_i$  : Improvement of individual design quality  
= Design target value / current value

You obtain the Product Improvement Value  $V$  from the Contribution Values  $\sum C_i$  and Life Cycle Cost Coefficient  $LC$ .

Product Improvement Value  $V$  :

$$V = \frac{\sum C_i}{LC} \quad (2)$$

$LC = LC1$  of developing product /  $LC0$  of present similar product

First, set up the Product Improvement Value strategically so that you can win against other companies. To get this value, examine a product plan from the product concepts covering the product specifications, life cycle costs (mainly selling price), profit and when to start selling; then obtain approval from the executive, and start development.

**(2) Stage of design and production**

Bring the product concepts into an actual design, assigning a target cost with Contribution Values reflected in individual functional components and parts in order to attain the target cost (permissible cost) which is equal to the selling price minus the target profit. Draw up a systematic "Total Target Development Diagram" of cost reducing measures to attain the purpose and practice Target Costing and VE activities beyond the border of organization.

**(3) Stage of sale**

In this stage, appeal to users' expectations, emphasizing the quality of the product developed. For this purpose, select the functional features having high Contribution Values as features of appeal to users, name the product for familiarity, and perform intensive publicity activities by effective means of mass media and demonstration. The end result should be that the product name will be widely known in a short time.

**(4) Service**

Provide users with clear operating instructions and information on services of maintenance and repair, thereby satisfying their expectations.

Find out what users like about the product to prepare for succeeding product development.

SYSTEMATIC PRODUCT DEVELOPMENT SYSTEM

Described here is how to proceed with the systematic product development system improved from Spiral VEC.

**1. Stage of product planning**

**[Step 1] Quantization of customer needs**

Figure. 2 shows how a product is developed by quantizing customer needs. The key point is creation of original ideas based on customer needs.

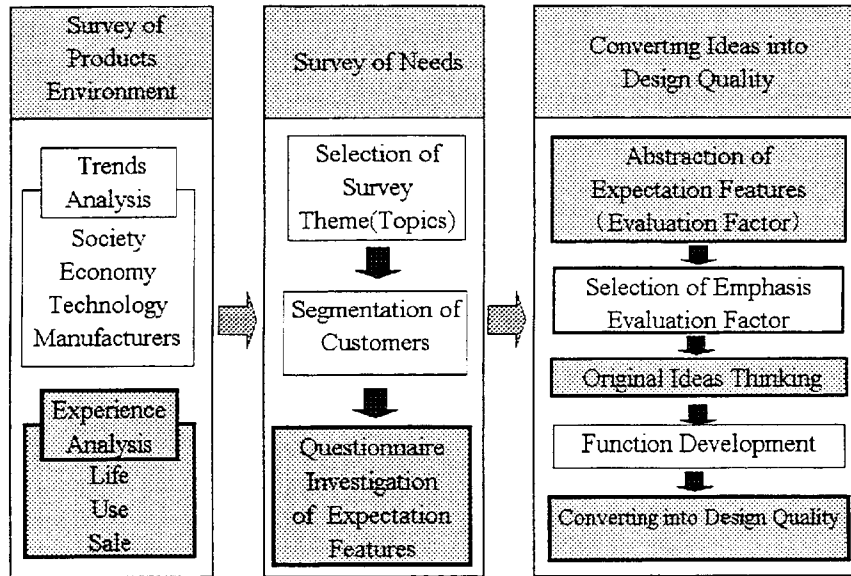


Figure 2. Production Process from Customer Needs

**(1) Survey of product environment**

Analyze trends in society, economy, quality and industry, which could affect the future of products, and try to predict to future trends.

Accumulate user profiles such as the lives, experiences of using existing products, and add in the selling experience of dealers to help anticipate expectation of users for new products.

**(2) Survey of customer needs**

From the data of surveys of product environment, select items for investigation.

Segment customers and address expected users on what features they expect, and how many of them express expectation on each specific feature, i.e. frequency of expectation, in addition to features they desire.

**(3) Abstraction of customer expectation features (Evaluation Factor)**

A product developed simply to realize the expectation features of high frequency of expectation will not necessarily be so attractive as to distinguish your company from others.

Therefore, you find the essential character of expectation features (called Evaluation Factor) by the KJ Method (Kawakita Jiro Method) or Evaluation Factor Analysis Method. For vector alignment of participants and obtaining original ideas, discussion and analysis by using the KJ Method is recommended.

Table 2 shows, as an example, the Evaluation Factors obtained for a refrigerator:

Table 2. Example of Refrigerator Evaluation Factors

Evaluation Factor		Description
Primary functions	Refrigeration	High performance in refrigeration
	Preservation	High performance in preservation of foods
Secondary functions	Economy	Low running costs
	Operation	Easy to operate and adjust
	Safety	Safe for people
	Maintenance	Easy to maintain
	Installation	Easy to install and move
	Comfort	No discomfort such as noise or vibration
Additional functions	Design	Beautiful and tasteful
	Expansion	Appropriate modification possible
		E.g. ice maker

Analyze the degree of correlation between the expectation features and Evaluation Factors to obtain the emphasis rate of Evaluation Factors.

Put the expectation features along the vertical axis in order of frequency and divide them into three groups, a, b and c, in decreasing order of frequency: and put the Evaluation Factors along the horizontal axis and divide them in three groups, A, B and C, in order of correlation with the expectation features.

Assign a number to each combination of (a, b, c) and (A, B, C), for example, 5 to a-A, 1 to c-C, where 5 is the largest number. Assign to each expectation feature a number representing the degree of correlation with each Evaluation Factor. Sum up the numbers for each Evaluation Factor and divide the sum by the total calculated for all Evaluation Factors to obtain emphasis rate and order.

Quantization made in this manner allows keeping a graph of changes of emphasis rate of Evaluation Factor from year to year, facilitating prediction of future trends.

Select an important Evaluation Factor whose emphasis rate is likely to rise in the future, and develop original ideas to satisfy this Evaluation Factor. Include the data from product environment survey and expectation features of customers, and evaluate.

Study whether the target Contribution Value is satisfied using the evaluated ideas, gather the ideas which can be realized in the product within the target Contribution Value, and select the candidate product functions.

#### (4) Converting ideas into design quality

Develop and convert the product candidate functions selected to design quality improvement items. Set the Quality Improvement Value  $T_i$  in the time series graph of quality values, and predict the time the product can be put on the market for the first time.

Raising Customer Satisfaction also raises the Contribution Value  $\Sigma C_i$ . Therefore, strive to improve the Quality Improvement Value until the target Contribution Value described in the following paragraph is reached.

#### 【Step 2】 Planning product concept

Determine the concept of a product to be developed from product strategy, considering the Product Improvement Value  $V$  of equation (3) and the life cycle of the product. Set a temporary target Contribution Value and study the life cycle cost coefficient  $LC$  to determine the concept.

Take year-by-year changes in the life cycle cost as a basis, and take the target Contribution Value into consideration in order to set the initial selling price at a reasonable level.

Empirically, it is desirable that Product Improvement Value  $V \approx 2$  and Contribution Value  $\Sigma E_i \approx 2$  to make a hot-selling product. This may necessitate full model change, but once the Contribution Value is determined, the product concept is determined.

When  $V \approx 2$ , the quality Improvement Value rises and therefore new technologies must be developed. In most such cases, the costs will rise, so the costs must be greatly reduced to attain the target costs. Find a way of staying within the target costs in concept VE before starting development and proposing the product plan. If you advance to design VE and pre-production VE without attaining the aim, flexibility in changing design will be reduced and target costs exceeded. Do not advance to the next stage if you are over budget.

Development project activities using cooperation between related divisions are essential for success in product development of high difficulty. This means coordinating engineering activities among the following: sales, survey laboratories, quality development, product planning, design, VE center (project secretariat), materials, production, service and, in addition, outside dealers.

In order to coordinate and proceed with development speedily, activity vector alignment is needed. For this purpose, define target values for individual participants, supply all relevant information to them, and allow them to develop activities systematically: they should then be eager to attain their goals. A tool prepared for this purpose is the "Total Target Development Diagram" shown in Fig. 3. You can visualize the activities arranged systematically using this tool.

## 2. Stage of design and production

### 【Step 3】 Stage of design and production

In this stage, you will emphasize the design quality and competitive cost so that customers feel satisfied. You can specify the activities obtained by concept VE in the "Total Target Development Diagram" shown in Fig. 3.

For target costing and VE activities, you can use the "Practical Target Costing with 3-Stage VE Program" which the author presented at the 1998 SAVE INTERNATIONAL ANNUAL CONFERENCE.<sup>(4)</sup>

The "Total Target Development Diagram" is explained below. Fig. 3 explains it schematically, a very large diagram of wall size. The diagram should indicate the Product Improvement Value, improvement of product functions, product design, target costs, and ways of reducing costs individually for various fields quantitatively, in an easily understandable manner.

It is named the "Total Target Development Diagram": selling price, individual Contribution Values and cost reducing measures developed as target values are linked systematically.

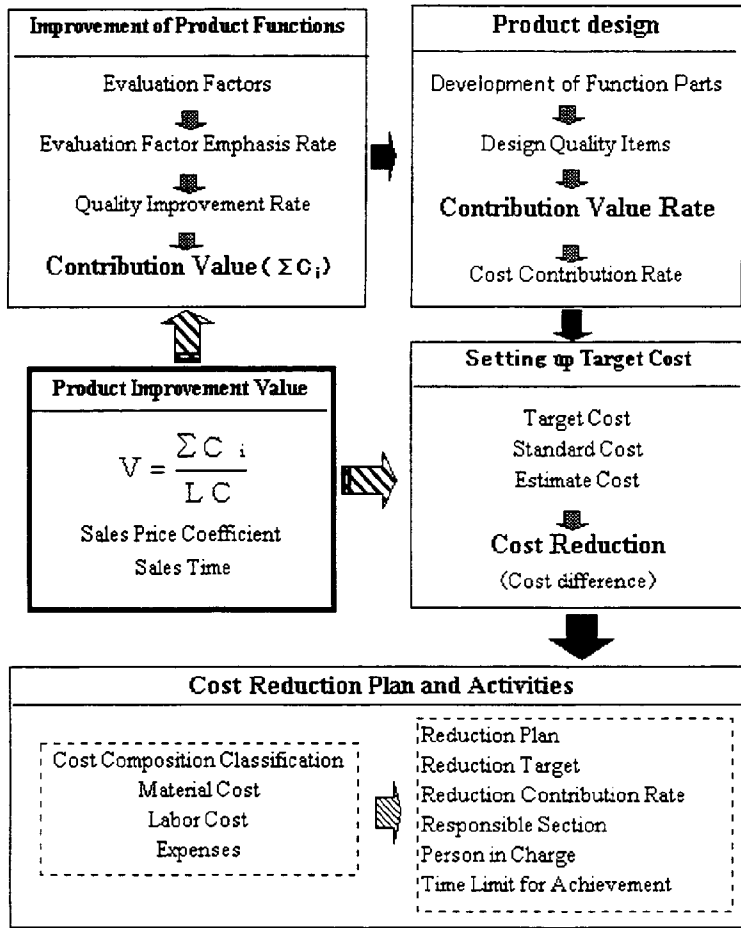


Figure 3. Concepts of Total Target Development Diagram

Let us look at assignment of target costs in concept VE using the weights of Contribution Values. The target cost  $C_{Ni}$  of individual functional unit  $F_{Ni}$  of a new product is,

$$C_{Ni} = f_{Ni} \times C_N \quad (3)$$

$f_{Ni}$  : Target cost contribution rate of individual functional unit  $F_{Ni}$

$C_N$  : Target production cost of new product

The estimated cost  $C_{Ei}$  of individual functional unit  $F_{Ni}$  is,

$$C_{Ei} = f_{Ei} \times C_E \quad (4)$$

$f_{Ei}$  : Estimated cost contribution rate of individual functional unit  $F_{Ni}$

$C_E$  : Estimated production cost of new product

The reference cost  $C_{Oi}$  of individual functional unit  $F_{Ni}$  is,

$$C_{Oi} = f_{Oi} \times C_O \quad (5)$$

$f_{Oi}$  : Reference cost contribution rate of individual functional unit  $F_{Ni}$

$C_O$  : Reference production cost of new product

The cost rise rate  $C_R$  of the reference cost due to functional improvement (with Contribution Value) can be given by equation (6).

$$C_R = \frac{C_O - C_E}{C_O} \quad (6)$$

Distribute any rises in cost by the Contribution Value contribution rate ( $C_{wi} = C_i / \sum C_i$ ).

The target cost contribution rate of individual functional unit  $F_{Ni}$  of new product, with the

Contribution Value reflected, can be obtained from equations (3)-(6) as equation (7).

$$f_{Ni} = \frac{f_{oi} + C_{wi} \cdot C_R}{\sum (f_{oi} + C_{wi} \cdot C_R)} \quad (7)$$

Use of this target cost contribution rate allows you to assign the target costs in proportion to the weights of Contribution Values. The target costs will be distributed logically to each functional improvement units, thereby stimulating design activities.

### 3. Stage of sale

#### [Step 4] Stage of sale

In this stage, you appeal to users to meet their expectations, emphasizing the quality of the product developed. For this purpose:

- (1) Select the product's functional improvement features that have high Contribution Values as the features to be highlighted for appeal to users, and name the product for familiarity. The name of the product should set it apart from those of other makers and it represents characteristics of the product simply. It should be included in product planning.
- (2) In the stage of product planning, utilize effective means of publicity, such as advertisement through mass media, catalogs and chances for product demonstration. Once the product is on the market, perform intensive publicity activities so that the product name will be widely known in the shortest possible time.
- (3) As for the product's functional improvement features, invite dealers' comments from their experience of selling the product and make appropriate improvements, keeping in mind the succeeding product development.

### 4. Stage of service

#### [Step 5] Stage of service

- (1) Provide users with clear operating instructions and services for maintenance and repair, thinking always of customer satisfaction.
- (2) Ask users what they think of the product and whether they feel satisfied with the product features of important Contribution Values, in order to prepare for the succeeding product development.

## CONCLUSION

The "Systematic Method of Cost Management Oriented for Customer Satisfaction" described above can be summarized as follows:

- (1) It is a systematic product development VE system designed for Customer Satisfaction in the four stages of product planning, design and production, selling and service, and use of Contribution Value which is Product Improvement Value aimed at meeting users' expectations.
- (2) All stages of development activities, from product planning to design and production, can be systematically developed by using the "Total Target Development Diagram" and Contribution Value. Therefore, management can be visualized, and efficient speedy development of product is possible.
- (3) Original ideas for product development should be obtained, since future products can be predicted from product environment surveys during the steps of developing product based on customer needs. Abstraction of data and high Product Improvement Value should be prioritized as product development objectives.

Use of this cost management method will allow you to create product concepts resulting in providing high Customer Satisfaction, and also to develop products with in target costs efficiently and speedily.

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