

ESTABLISHMENT OF A VALUE EVALUATION METHOD FOR COMPACT CAMERAS AND ITS APPLICATION TO BUSINESS MANAGEMENT

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Kazuhiro Uehara is a manager at Cost Engineering Department 21 of the Cost Engineering Headquarters at Canon Inc. Tokyo, Japan. He is in charge of cost engineering for cameras, one of Canon's many products which range from business machines such as copiers and printers to cameras. To provide customers with products at reasonable prices, the CE headquarters evaluates the costs of Canon products at various stages, that is, planning, development, and production. The CE headquarters has continued its efforts to achieve targeted costs by using the Value Engineering Method. As part of these VE activities, Mr. Uehara pursues cost reduction, and also studies what consumers value most by studying mainly camera products, one of the most popular consumer products.

ABSTRACT

This study introduces an evaluation formula to quantitatively evaluate function F of products by combining human feeling, one of the important factors in determining customer satisfaction, and the various functions of that product by using the basic VE formula: $V = F/C$. In addition, this study introduces an evaluation method of value V based on the relationship between sales quantity and price.

This study, then, presents a VE management system using this evaluation method for business management as one of various management supporting systems.

INTRODUCTION

Today, camera models are available from various camera manufacturers. These manufacturers are comparable in terms of expertise and their products do not differ greatly in their basic functions. Therefore, consumers find it difficult to distinguish between one model and another.

Under such circumstances, the most important challenge facing manufacturers trying to introduce hit items to the market is how to determine which factors will ensure customer satisfaction.

The VE basic formula, V (value) = F (function) / C (cost), is very easy to understand conceptually. However, it is difficult to actually apply it to business management.

Let us cite a simple example. In a market flooded with so many competitive products, it is difficult to analyze in specific numerical values which products satisfy customers because such analysis must take numerous factors into consideration. One, therefore, tends to end up concluding that products that sell in large quantities or generate a great deal of profit are likely to enjoy high customers satisfaction.

This study is characterized by the fact that it combines methods presented in various fields with unique ideas and presents a combined systematic evaluation method. This study also uses data on compact cameras to show how such a method can be used in actual business management.

OVERVIEW OF THIS STUDY

This study consists of two steps (see Fig. 1).

In the first step, we set up the following evaluation method by focusing on a compact camera as an example:

- 1) Setting up a formula to objectively and quantitatively evaluate function F , the numerator in $V = F/C$, by multiple regression
- 2) Expressing consumer feeling, one of the most important factors in determining consumer purchase decisions and adding it in a digitized form to the above evaluation formula
- 3) Setting up a formula to evaluate "value V "

based on the relationship between function F and the sales quantity.

- 4) Setting up a method for setting prices and for simulating the number of units to be sold, based on the above formulae.

In the next step, a procedure for using the evaluation method obtained in the first step in business management is introduced.

- 1) Setting a value V that meets the aims of product planning in the planning and development stages
- 2) Weighting function F by using time-series data obtained in the first step
- 3) Cost C's allocation to the elements of a production cost based on the relationship between value V and function F.

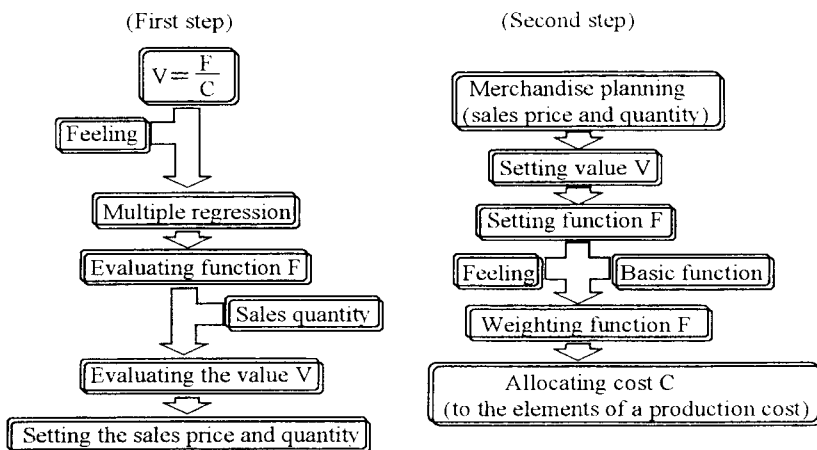


Fig.1 Procedure of this study

EVALUATION METHOD OF FUNCTION F

The basic concept of VE according to the formula $V = F/C$ involves reducing cost C and increasing function F, thus increasing value V so as to obtain greater customer satisfaction and generate profits. C in this formula $V = F/C$ represents either manufacturing cost or sales price, which is expressed in numerical values. Therefore, it is relatively easy to evaluate. F is generally evaluated digitally by, for example, multiple regression. However, in the case of consumer products such as cameras, it is not easy in practice to obtain convincing results because such products are widely available on the market and are for the most part indistinguishable in terms of both specifications and performance. We assume that human feeling may be one of the key factors in determining a consumer's choice of product. As a result, we decided to study the evaluation method of F by taking human feeling into account.

1. Converting feeling into numerical values

What do consumers focus on, when they select a camera at a shop? What are the differences between cameras that sell well and those that do not? Consumers naturally pay attention to the specifications and prices indicated in catalogs. In

addition to these factors, their individual feeling that a product is "groovy" or "neat" seems to us to play an even more important role in the selection a product. We, therefore, attempted to convert such human feelings into numerical values. Here is how this was done. (see Fig. 2).

(1) Monitor survey

To determine what users are really conscious of, a monitor survey was conducted as described below.

- 1) Several compact camera models made by several manufacturers and survey sheets were provided to monitors.
- 2) On the survey sheets, monitors commented on what they liked or disliked and gave reasons for their opinions of each model.

(2) Data analysis

From the survey results, we obtained the numbers of comments such as "Like" and "Dislike" to know which aspects of each camera monitors noticed, then analyzed the reasons for their comments. Finally, we obtained a value that represents consumer feeling by combining the degree of attention and degree of favorable reception.

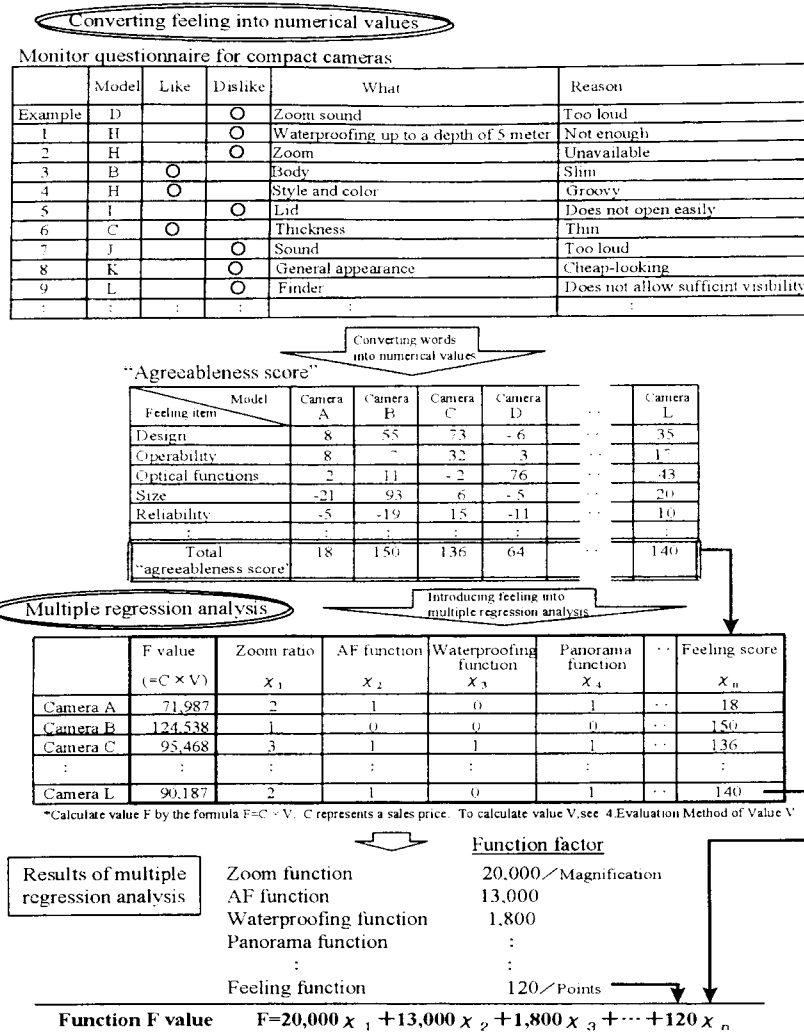


Fig.2 Conversion of feeling and a formula for evaluating function F

- 1) The total number of comments expressing "like" and "dislike" represents the number of comments given about a specific camera, that is, the degree (amount) of attention. The difference between the number of such comments, "Like" and "Dislike," represents the product's reputation (quality).
- 2) Determine the weight factor A of one "Like" comment and one "Dislike" comment by using the Delphi method.
- 3) As a formula of (quality × quantity), multiply (like + factor A × dislike) by (like - factor A × dislike).
- 4) A square of the number of samples is dimensionally effective. Therefore, determine the absolute value of that number, take its square root, and convert it into a numerical value. (If the value of the square

root is negative, remove the negative sign.)

“Agreeableness score” = $\pm \sqrt{((\text{like} + \text{factor A} \times \text{dislike}) \times (\text{like} - \text{factor A} \times \text{dislike}))}$

- 5) Prepare a scorecard of “agreeableness” for each camera model, in terms of each factor, that is, design, operability, size, etc.
2. Formula for evaluating function F by multiple regression analysis

Common knowledge in the camera industry holds that the price range of compact cameras is determined mainly by the zoom ratio. We conducted multiple regression analysis by adding feeling scores obtained by the method introduced in section 3.1 to elements listed as basic functions in the catalog including zooming, autofocus,

panoraming, and waterproofing. to introduce an evaluation formula for function F. (See Fig. 2.)

We take a compact camera as an example. To obtain function F value, the zoom ratio is multiplied by a function factor of 20,000 when a zoom function is provided. Similarly, a function factor of 13,000 is applied for the autofocus function and a function factor of 1,800 is applied for the waterproofing. Furthermore, the feeling score is multiplied by a function factor of 120. Thus, by obtaining function F, quantitative evaluation becomes possible.

METHOD FOR EVALUATING VALUE V

Quantitative evaluation of function F is thus possible. Now, we would like to discuss what value V represents.

When different cameras have the same functions, and there is difference in sales price, the lower priced model has a higher V value. Therefore, we would like to examine the relationship between the sales price and the sales quantity under the condition that value F is fixed.

We can estimate how many more cameras will sell when value V is higher, if the camera's functions remain the same. If we know the answer to this question, we can determine what should be value V by reverse reasoning.

When cameras with different functions sell at prices matching their respective functions and they have equal V values, we can imagine that they will sell in equal quantities and that value V for users will affect the number of units to be sold. This means that, with this method, we can judge that, if they sell for prices that match their respective functions and are equal in value V for users, cheap-looking and stylish cameras will sell in equal quantities, and that they will have the same V value if they sell in equal quantities. Customer value V should have such significance.

However, it is not easy to analyze cases in which cameras have different functions with different sales prices. Therefore, we first fixed the functions and confined the variables to prices alone. If an identical camera with equal functions sells on the market at half a price (that is, with double V), will the sales quantity double? Or will this quantity triple or quadruple? If we know the answer to this question, we should be able to determine the price on the basis of the number of units sold and value V, which is the inverse of the price.

Taking a compact camera as an example, we have introduced a formula from the viewpoint described below to make confirm the above concept.

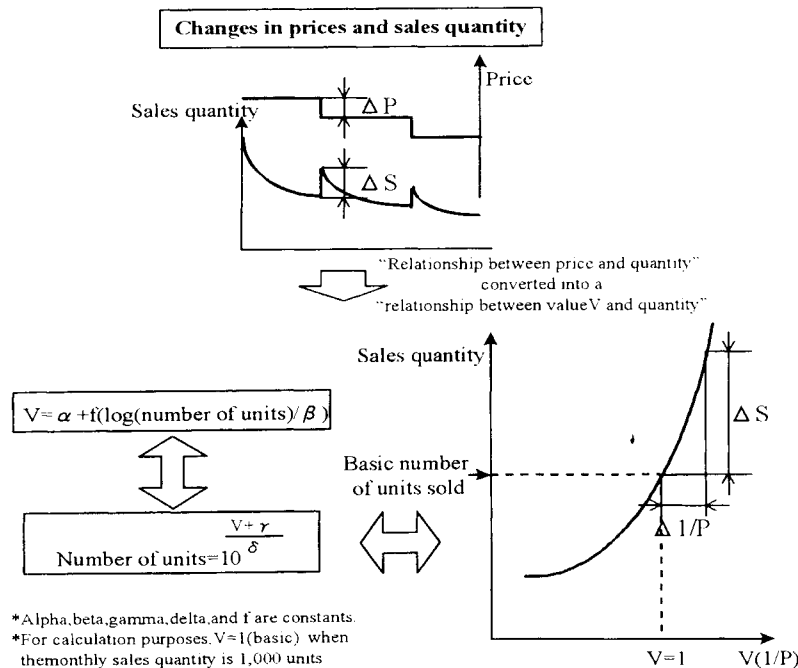


Fig.3 Relational formula of the value and sales quantity derived from the relationship between the sales price and sales quantity

If a product is cheaper, it generally tends to sell more. We know also that over time a new product's sales quantity tends to decrease. In order to minimize this decrease, that is, maintain the sales quantity, sales prices are often reduced. As shown in Fig. 3, from the relationship between this reduced price, delta "P", and the incremental quantity realized by price reduction, delta "S", we can obtain an approximate relational formula for price and sales quantity.

In the case of compact cameras, a general relational formula is obtained as indicated in Fig. 3. Plotting this formula allows us to easily see that the sales quantity increases very rapidly as value V increases.

ESTIMATED SALES PRICE AND QUANTITY BASED ON FUNCTION F AND VALUE V

By combining the evaluation formula for value F, which includes a feeling element and the evaluation formula for value V based on the relationship between value V and the sales quantity, when we fix either price C, value V or the sales quantity, we can theoretically determine value V or price C based on the relational formula $V = F/C$.

The simulation described below is therefore possible. An example with compact cameras is shown in Fig. 4.

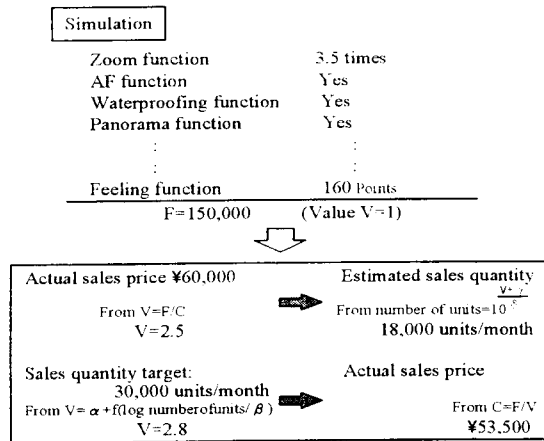


Fig. 4 Prices and sales quantity as assumed based on function F and value V

If a new product is equipped with a zoom ratio of 3.5X, a feeling score (agreeableness score) of 160 points, and an autofocus function, value F becomes 150,000. This value means that V = 1, that is, if 1,000 units are to be sold per month,

each unit should sell for 150,000 yen. If this camera is actually sold for 60,000 yen, value V will be 2.5 according to the relational formula of $V = F/C$. Consequently, the sales quantity obtained from the relational formula for value V and sales quantity should be 18,000 units.

On the contrary, if we want to sell 30,000 units per month, this means that value V will be 2.8 according to the relational formula for value V and the sales quantity indicated in Fig. 3. It follows then from the relational formula of $C = F/V$ that the actual sales price should be 53,500 yen.

HOW TO USE THE RESULTS OF THIS STUDY IN BUSINESS MANAGEMENT

Before introducing new products to the market, manufacturers go through various steps, including development and production. If the importance of "0 Look VE" is stressed in general VE activities, various activities will be very important in the planning stage to ensure that consumers will be very satisfied with the new products. Next, we would like to explain how this theory can be used to identify a sense of values, so that they can be reflected in product planning during the planning stage where neither merchandise prototypes, nor specifications are fixed. Furthermore, we would like to propose this procedure as a systematic evaluation method. If this method is applied to a specific merchandise strategy, the steps described below may be followed (Fig. 5).

- (1) Setting a V value that matches product planning needs

First, let us assume that we have set a sales price range and a sales quantity for a new product, Camera I, in the planning stage. At this stage, however, the camera's specifications are not fixed.

Here, let us assume that we have a plan to sell this new model, Camera I, at twice the rate of a current good seller Camera L, keeping both sales prices at the same level. Because the sales price of Camera L was 45,000 yen and its monthly sales quantity was 30,000 units, we would have to sell 60,000 units of Camera I at 45,000 yen.

According to this plan, we would like to determine value V required for Camera I. If value V of Camera L is 2.8, according to the formula given in Fig. 3, the required value V for Camera I will be 3.2.

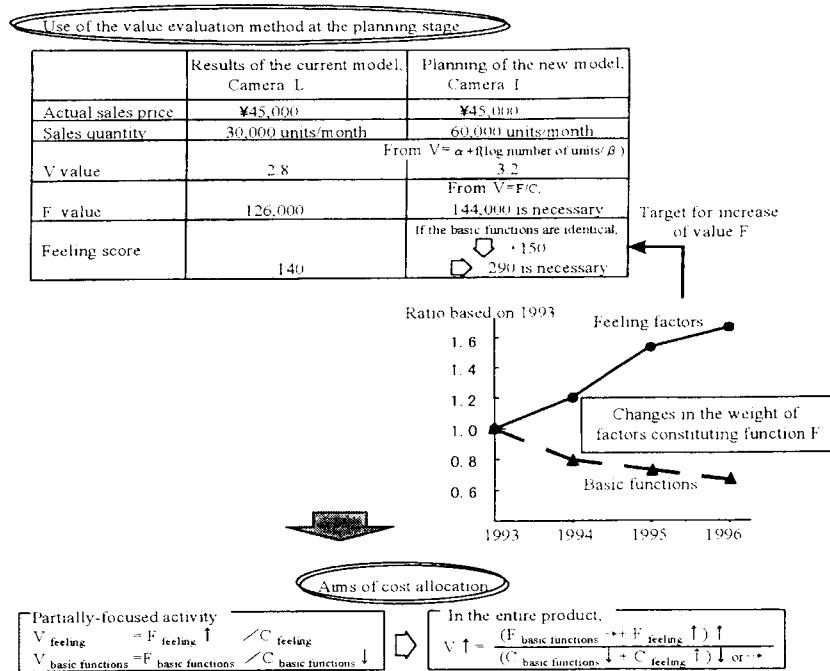


Fig.5 How to use evaluations in business management

(2) Setting function F to satisfy value V

Since value V and sales price of Camera I have been fixed, function F required for Camera I can be calculated by using the formula $V = F/C$. In this case, Camera I requires a function F value of 144,000, while the function F of Camera L was 126,000.

The elements constituting function value F are zoom ratio, availability of autofocus, availability of a panorama function, and human feeling. For Camera I, therefore, we should determine which elements should be stressed in an attempt to increase function value F.

One thing to consider here is the fact that the evaluation formula for function value F changes constantly. In the case of a camera, for example, the first time an autofocusing was added to a camera, the availability of such a function greatly affected the evaluation formula for function F. However, after this function had become very popular, the effect on the evaluation formula became less. Thus, by comparing the evaluation formulae obtained in a time series by multiple regression, we can see changes in the weight of each factor in the evaluation formulae (Fig. 5).

Trends in compact cameras over the past few years indicate that, while the basic functions for taking photographs such as the zoom ratio or

autofocus function no longer play the most important role because almost all compact cameras available on the market have them, the feeling element is becoming more important. As a result, to increase the weight of function F of Camera I, in this case, we must improve design and size because cameras must now appeal to consumer feeling.

(3) Setting feeling scores that satisfy function F

Camera I, which requires a function F of 144,000 as opposed to a function F of 126,000 and a feeling score ("agreeableness" score) of 140 points of Camera L, which we obtained from the monitor survey, will require a feeling score of 290 points, which is the sum of the old score for Camera L and 150 points, if the zoom ratio, autofocus function, and other basic functions are assumed to be identical (Fig. 5). As a result, in order to sell twice as many of Camera I as many as of Camera L without changing the sales prices and basic functions of these two models (that is, improving the feeling score alone) a very high feeling score (double that of Camera L) will be required.

To realize the original product plan of the Camera I, we must achieve a feeling score of 290 points. In this case, we must create a prototype model that can obtain a feeling score of 290 points. With this model, we can conduct a

monitor survey as described in 3.1 under the same conditions. This procedure can then be repeated until a feeling score of 290 points is achieved.

(4) Cost allocation according to merchandise planning

Camera I, which has a feeling score of 290 points, will naturally cost more than the previous model, Camera L. In this case, applying the feeling portion only to $V = F/C$ surely increases function F, but cost C also rises. This is against the basic philosophy of VE. Therefore, any cost above that of Camera L, the previous model, should be minimized by reducing the cost of the functions that Camera I inherits from previous model in order to satisfy the feeling target. As a result, the sales price of the Camera I, as a whole, will match the target.

That is, with this method, we can increase value V of the product greatly by allocating clear-cut regions for the portion where function F is found to have value V and the portion where cost C is found to have value V (Fig. 5).

This is how the results of this study can be used in business management. In product planning, everyone is trying to create a better product at a lower cost. However, proceeding with the development without defining the targets for making a better planned product and the targets for reducing the cost will often end up with a product that is highly functional but expensive or a product that is inexpensive but unattractive.

However, by following the steps that we have outlined, we can clearly identify the targets of increased functionality and the cost targets, which makes it easier to evaluate various activities. Furthermore, since the VE concept is incorporated in all processes from planning to production, the use of this method will presumably make it possible to conduct consistent and logical VE activities.

SUMMARY

In this study, by combining various VE methods including how to fix the sales price, how to evaluate functions, how to evaluate a products' feeling, and many other VE methods which have been presented in reference documents and other sources, we propose a VE method that can be used effectively throughout the entire flow of processes from actual business planning to production. We then demonstrated the effectiveness of the method by introducing some examples.

This paper reports on the results of research conducted on cameras, and we think that this method can take any form depending on the product characteristics. In other words, the VE methods combined with basic theories are virtually limitless.

REFERENCES

- 1) Noboru Ishio: "Cost Management of Competitive Merchandise," Japan Management Association
- 2) Hideaki Shimizu: "A Target Cost Setting Technique based on Value Analysis Philosophy" A Collection of VE Research Papers, Vol. 12
- 3) Yoshihiro Watanabe: "Estimating Method for New Function Product Planning" A Collection of VE Research Papers, Vol. 17
- 4) Susumu Kamiya: "A Method of Value Evaluation reflecting Customer's Needs"
- 5) Research Material 11: "Setting Sale Prices in Merchandise Planning," Society of Japanese Value Engineering
- 6) "Adaptation of VE to Feeling Field." Research Report 1 on the 27th VE Congress
- 7) Hitoshi Ohmura: "Evaluation and Quantification," Japan Federation of Scientific Associations
- 8) Masayasu Tanaka: "Target Cost Management and Profit Engineering" Chuo Keizai Publishing