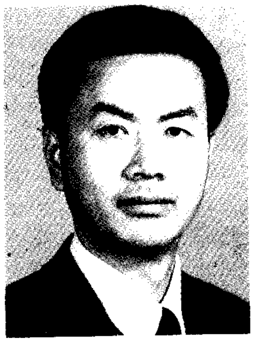
SUCCESSIVE CONTRACTIBLE METHOD IN FUNCTION ANALYSIS



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ABSTRACT

In this paper, we first give a new method in function analysis, which is called "Successive Contractible Method.". In this method, we divide the process of function analysis to three steps. By every step, we can find the improved objects of VE activity, finally we get the most important function objects that should be improved and gain better economic benefits.

INTRODUCTION

During value analysis (VA) one important part is the function analysis. The target of function analysis is to make clear for the target of products or executive project system; to identify and point out the unnecessary cost. In detail, through function analysis, one side we can find out the function for high cost, and the other side, find out the excessive function. As the characteristics of VE, we should find out the improving target function, not the spare parts of the products, only by this way, we can gain the benefit in the creation of a new project, to develop the creating power of mans' brain, not disturbed by the fact structure plan, and gain great success during VE.

FIRST

First, let us do function analysis on a product that has many spare parts. So we can do it in ABC analysis way. We divide all the spare parts into three categories, which can be noted by A, B and C, according to the law of Parieto contribution, the cost of A category is accounted for 80% of the total cost, but the accessory number of A category for 20%. Mark every spare parts in A category with x_1, x_2, . . . , x_n(here n is a positive integer). This is the first step of the Successive Contraction.

SECOND

In the second step, function definition is made and the function system diagram is drawn. Suppose that all functions number is m (m is a positive integer), all functions are noted as F_1, F_2, . . . , F_m. A function F; is taken arbitrarily. Consider the contribution to this function made by parts in category A "contributing to function F;" itself is a vague concept, so we can imply the method of subordination degree in fuzzy math..

According to its contribution to function F_j, spare part x_i(i= 1, 2, . . . , n) in category A is given, we can get the following formula, subordination degree collection of contribution to function F_j, $(a_{1j}/x_1)+(a_{2j}/x_2)+\ldots+(a_{nj}/x_n)$. Where a_{ij} is no more than one and no less than zero. The closer a_{ij} approaches to 1, the more spare part x_i contributes to function F_j. The closer a_{ij} approaches to 0, the less spare part x_i contributes to function F_j. $a_{ij}= 0$ means spare part x_i makes no contribution to function F_j. According to the method described above, function F_j corresponds to a vector $(a_{1j},a_{2j}, \ldots ,a_{nj})$. If every function is dealt with correspondingly, the following table can be drawn, see table 1.

TABLE 1

		ALL THE FUNCTIONS
		F_1 F_2 . . . F_m
The accessories in A Category	x_1	a_{11} a_{12} . . . a_{1m}
	x_2	a_{21} a_{22} . . . a_{2m}
	.	. . . . . .
	.	. . . . . .
	.	. . . . . .
	x_n	a_{n1} a_{n2} . . . a_{nm}

where total a_{ij} makes up a matrix, called contribution share matrix, which is noted as $A^*=(a_{ij})_{n,m}$. The vector $(a_{1j}, a_{2j}, \ldots, a_{nj})$ corresponds to function F_j is rightly the row vector of A^*. According to the following formula definition, the correspondent value of contributions of spare part x_i is: $a_i=k_i(a_{i1}+a_{i2}+\ldots+a_{im})$. Where k_i is the number of elements which are not zero in the vector $(a_{i1}, a_{i2}, \ldots, a_{im})$. For example, in whose correspondent horizontal vector $(a_{11}, a_{12}, \ldots, a_{1m})$, only a_{11} and a_{12} are not zero, i.e., the rest are zero, then value of function contributions of spare part x_i is: $a_1=2(a_{11}+a_{12})$. Obviously, the larger the value of function contribution a_i of spare part x_i is, the larger k_i is as well as the non zero a_{ij}. That is to say, spare part x_i can contribute to many kinds of functions greatly. A spare part with many functions cannot be the object to improve in general sense, because many functions of the product will be related to or concerned if improve it. On the other hand, if a_i is much little, which means k_i is much little as well as the correspondent non- zero a_{ij}, function contributions made by spare part x_i are little too, and improvement should be made. In particular, if $a_i= 0$, which means excessive function is being made by spare part x_i, the improvement or rejection should be made. So for a spare part x_i, the bigger the value of its contribution is, the less its potential improvement possibility is, so does the opposite. Now given a little constant a_0, we can take out the spare part's x_i in A category that satisfy that a_i is no more than a_0 and form a new spare part collection $x_1, x_2, \ldots, x_t$, obviously if the $a_i= 0$, then the spare part x_i is the improvement object.

THIRD

In the third step, suppose that the present cost of every spare part x_i in the category A is b_i, then the present cost c_j of every function F_j in the second step can be accounted. We know that the present cost can be accounted by making such a table.

TABLE 2

PARTS		ALL THE FUNCTIONS AND SHARE VALUE
No.	Cost	F_1 F_2 . . . F_m
x_1	b_1	c_{11} c_{12} . . . c_{1m}
x_2	b_2	c_{21} c_{22} . . . c_{2m}
.	. .	. . . . . .
.	.	. . . . . .
.		. . . . . .
x_t	b_t	c_{t1} c_{t2} . . . c_{tm}
Present COST		c_1 c_2 . . . c_m

In the table, c_{ij} is the weighted distribution coefficient of function F_j share by spare part x_i and the matrix $C=(c_{ij})_{t,m}$ made up of all c_{ij} is called function share coefficient matrix. In the table, c_j is the present cost of function F_j, when we use some method to determine the c_{ij}, the present cost of F_j is

$$c_j=c_{1j}b_1+c_{2j}b_2+\ldots+c_{tj}b_t$$

$(j=1,2,\ldots,m)$.

Now, if the value of c_j is much large, then non-zero elements in the vertical row j in the matrix C are much more, which denoting that many spare parts contribute to function F_j, and since every spare part belongs to the category A, whose cost is high, we can know that some spare parts have overlapping functions; or although non-zero elements in the vertical row j in the matrix C are few, the share coefficient itself is large, and the cost ofcorres-pondent spare parts is high, i.e., function F_j is realized by higher cost so it is possible to reduce the cost of function F_j. Alternatively, if c_j is little, then c_{ij} itself is much less, or the number of non-zero c_{ij} is small and the correspondent b_j is little, so it is of little possibility to reduce the cost of function F_j. We can select the first largest one and the second largest one among $c_1, c_2, \ldots, c_m$, for example, they are c_1 and c_2, then, their correspondent function F_1 and F_2 are improvement objects in our value engineering activities. The function analysis finishes now.

SUMMARY

The goal of the first step in successive contactible method described above is to select the spare parts with much higher cost, the second one to get rid of the spare parts with many functions, the third one to select the functions with high present cost.

The advantages of successive contractible method are followings, first it avoids the function goal cost that is very difficult to get in the VE Secondly it can be generally applied to microcomputer and to process software packages. Whatever the concrete meanings of spare part x_i and function F_j are, as long as we put the index $(n,m,A^*,C\ ,b_i)$ into a computer, then we can get the results of function analysis from the computer.