TRIANGLE THINKING METHOD

Shoji Seki, CVS
Hitachi Cable, Ltd. – VE Promotion Center

Shoji Seki, CVS, is a senior value engineer in charge of Hitachi Cable's VE programs at its VE Promotion Center. He acquired a Japanese government-registered title of P.E. in 1994. Throughout his 19 years' career as Hitachi Cable's product engineer, he has made a great contributions to improving product quality, productivity and new materials development. His expertise in VE management has led two of Hitachi works to be awarded Miles Awards by the Society of Japanese Value Engineers (SJVE). In 1993, SJVE formally recognized Mr. Seki for his remarkable contribution to VE promotion. He has formal membership not only in SJVE but also in two other professional engineers' societies.

This paper has been selected by the Ministry of International Trade and Industry, as one of the best conference papers of the year, 1998 of All Japan Federation Management Organization.

ABSTRACT

This paper has been prepared to make it easy for members of production management to propose ideas under a wide range of view points, when they contemplate solving problems, they can do so by making the most of management techniques. In order for us to make a simple pattern in thinking, the method dealt in this paper is supposed to consist of three parts in each process and thus it is named 'Triangle Thinking Method'. The method is a mixture of effective motion analysis, cost analysis and VE, which are frequently adopted in the field of production management. The main feature is it's easiness in discovering potentials of improvement in quality and cost, which could have been overlooked. The construction is made up of Three Factor Function Development, Matrix Function Cost and All-spectrum Function Evaluation.

CONTENTS

1. INTRODUCTION

In recent years, in order for many Japanese manufacturers to equip themselves with a competitive edge in the international market, they made their way into developing countries in search of lower labor cost. They, however, have encountered many problems such as: hike of wage; unstable local currency; low level of product quality; and recently worsening environmental conditions have surfaced in these countries. At this time, it is of great importance that they review strategic policy in their management and that they ensure a sound and solid foundation in the production management at domestic plants.

The author once has found out some essential factors while engaged in instructive work related to product improvement in a forming process and chemical reaction of rubber and plastic materials. The quality of the products is guaranteed on the basis of the mixture of these factors. In many cases, the important factors such as selection of material, process and operation are made under obscure condition like in a black box. Then numerical target value for the improvement contains some uncertain element. As a result, an attainable degree of the target is placed at a lower level and a difficult subject that should be coped with is likely to be postponed.

The author, in an effort to clear the above drawback, has developed a new thinking method, which could help solve difficulty faced in production management. The author elaborates such an approach method that a searching work for cost generating elements in detailed product functions and evaluation work of the functions could be performed in a systematic way. With this method, we are ready to offer the new system to probe factors that need improvement. This paper deals with above statement.

2. BACKGROUND OF TRIANGLE THINKING METHOD AND IT'S WAY OF THINKING

Generally speaking, in a production innovation activity, a priority is given to labor productivity in pursuit of working cost. But it becomes necessary to keep a balance of material cost in consideration of material productivity. For this purpose, production engineering becomes a large factor to thoroughly utilize a material of lower cost, even though some difficulties arise in actual use of the material.

In the industrial engineering method, there is an Effective Motion Analysis Method. In this method, for the purpose of improvement of useless overdone, working motion is classified into three parts; Effective Motion Time, Necessary IN-Effective Motion Time, (To supplement the achievement of the Effective Motion), and IN-Effective Motion Time. The author with this idea in mind, as a hint, has tried a new approach to three functions; material function; process function; and operational function, which in turn has made it easy to prepare an action plan for the improvement of total productivity.

Value Engineering is aimed at improving value of both products and services, in an approach to the function as a central core. Much of Cost–Down (hereafter referred to as CD) has been expected out of VE and the outcome has been recognized in many industries in Japan. In this way, quite a few people in the management mistook VE as CD. The author has been taught that VE is not CD. Namely, CD is to bring about cost reduction by means of analyzing three cost factors, material cost, processing cost and expenses. Because these cost items are granted, it is difficult to expect a remarkable cost reduction out of daily activities in production department. On the other hand, VE has the following four functions; 1) Basic Function, 2) Secondary Function required by customers, 3) Secondary Function by the design idea and 4) Unnecessary Function. Here , because 3) and 4) are taken as subjects for improvement , a good result could be expected. But so far, there has been no methodology, made public by analyzing functions 1) through 4), which could lead to a good proposal. At present, the difference between VE and CD is considered conceptual. For a long time, the author has been wondering whether or not 1) and 2) should be left untouched as the subject of improvement, and how to deal with classification of the functions 1) through 4). A thorough probe has been conducted for these questions.

Based on the foregoing background, the author has developed a new way of thinking by integrating the three motions time, the three costs item and the three functions. As a result, it has been made easier to shed a light on invisible cost generating elements and to put improvement plan into practice. The new way of thinking consists of such developments as Three factor functional development, Matrix functional chart and All-spectrum function evaluation.

3.THREE FACTOR FUNCTIONAL DEVELOPMENT

Figure 1 shows a three factor functional development. (hereafter function is referred to as "F"). The three factor functional development is made up of three parts as definition of product F, classification into three costs and determination of the function range. The first step begins with definition of product function. As the second step, the defined product function is classified into sub-functions of the three factor cost analysis i.e. Material F; Fz , Process F; Fk and Operational F ;Fg.

Third step divides three cost F into Triangle F (subsequently referred to as TRI-F). At first Fz is classified into Primary material F; Fzb, Material fabricating F; Fzs, and Material management F; Fzu. Similarly, Fk is classified into Validating F; Fkb, Secondary Work F; Fks, Lateral F; Fku. Function Fg is classified into Creative Operating F; Fgb, Communication F; Fgs, Idling F; Fgu. The total number of sub-function comes to nine. The scope of "TRI-F" is left to discretionary selection of the management of a company. As a matter of course, a close examination should be made relative to the basic functions; Fzb, Fkb, and Fgb. As for the secondary work function (Fzu.Fks.Fgu), selection of scope can be of a least necessity to support the basic functions. Because the unnecessary functions (Fzs.Fks.Fgs) contain a large room that needs an improvement, all the works, which do not create value are included in this area from view point of customers.

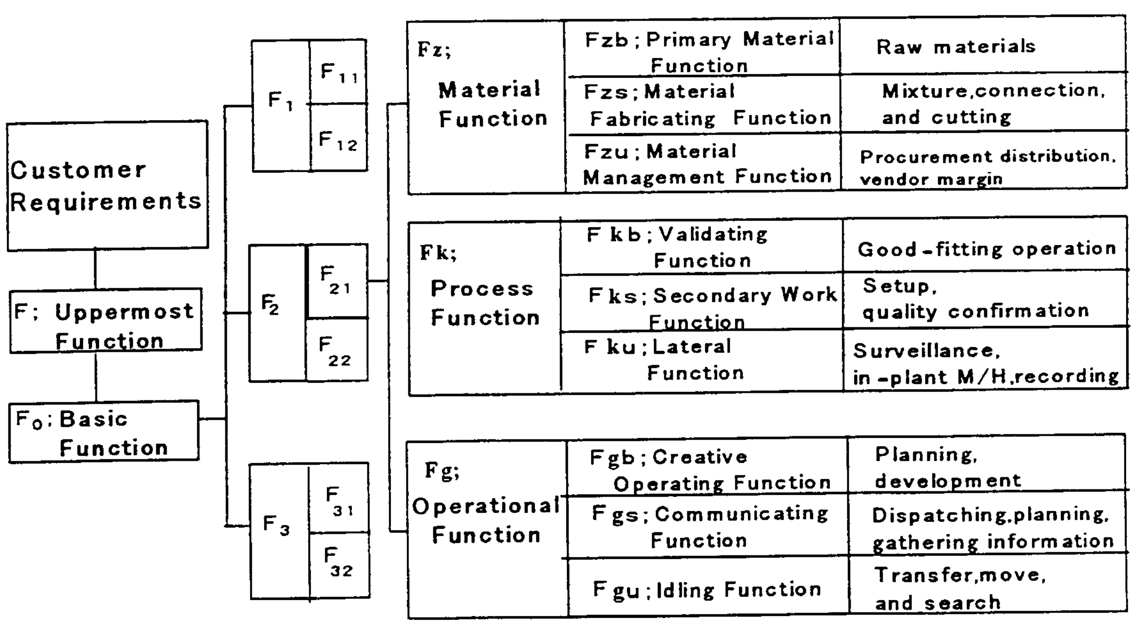

Figure 1. Three Factors Functional Development Chart

4. MATRIX FUNCTIONAL CHART

Figure 2 shows sample of matrix functional chart. Function of product is placed on vertical axis and TRI-F is placed on horizontal axis. As a general tendency, function framework is concentrated around right hand side when function chart is drawn. It becomes difficult to observe the whole function, unless a large sheet of paper is used to cover a large number of functions, which are detailed in fine definition. This difficulty can be solved by aligning on a form of matrix to have a good view of the whole. In addition, it becomes simple to draw evaluated function values by means of inputting costs, which are known from the three factors cost analysis, into each respective TRI-F.

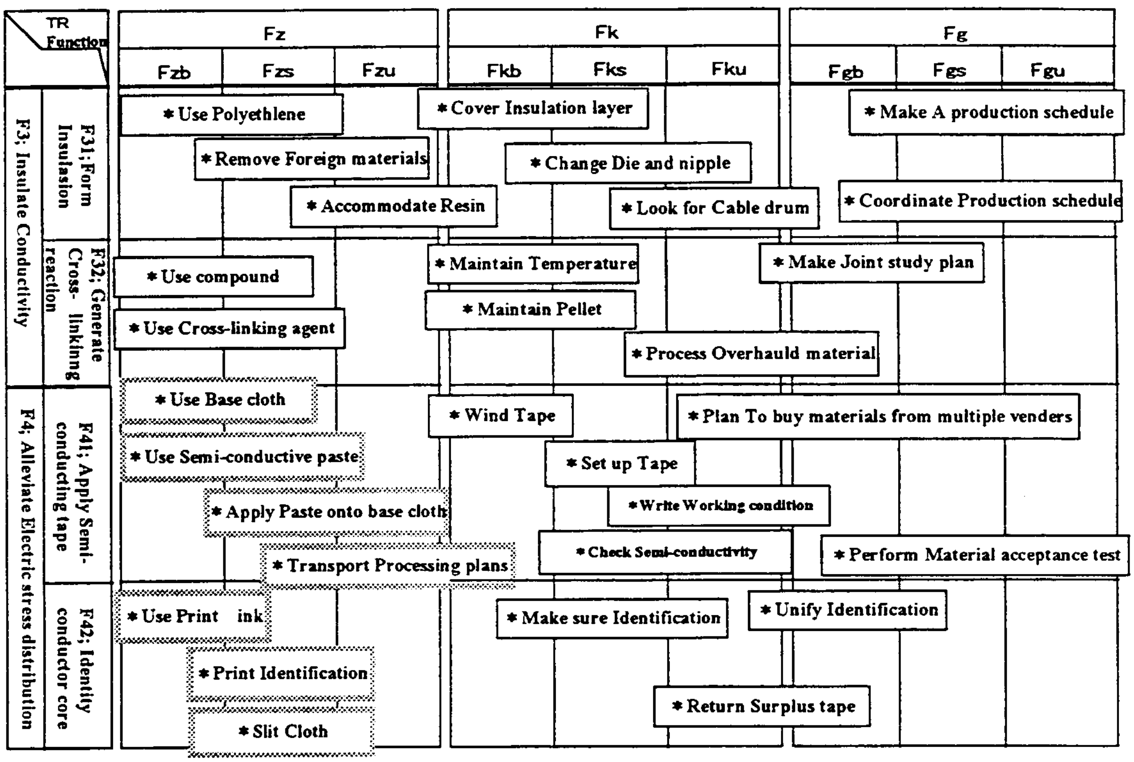

Figure 2. Matrix Function Chart

5. THREE FACTORS COST ANALYSIS

By analyzing the three factors cost analysis in detail process, cost generating factors in the black box, which have previously been undetectable can now be easily detected. The figure 3 shows an example of cost analysis conducted by the author for material function at a plant. This deals with a cost analysis of product sub-function Fz < f31; Apply Semiconductor tape>. Even though this material looks like a piece of black cloth at a glance, it consists of semiconductor layer applied onto a special cloth. The person in charge of purchase who did not know the manufacturing process was evaluating the cost by the unit price by the kind of cloth referring to the cost for cross sectional area offered from a supplier as a measure. Actually he has overlooked existence of variety of cost generating elements besides quality of the cloth. We have allowed an adequate time for analyzing the tape material, which seemingly looks like a simple substance from the first spinning process of yarn to shipment from the plant. It has been found that the material in question has passed through eight different companies and transshipped five times. In this way, <Fzu> is revealed, and in addition it has been found that material processing process <Fzs> has much room that requires rationalization for production inclusive of improvement in quality. In this example of improvement proposal<Fzu>, production processes scattered to many different locations have been summed up at a plant in Fukui prefecture and supplied as finished product in a minimum number of processes. <Fzs> became a high quality tape with a good flat surface, owing to a joint study with raw material manufacturers concerned and 30% cost reduction has been achieved. Moreover, a cost improvement by quality improvement has been made through applying an entirely different manufacturing technique. In this way, a new type of tape has been produced one after another to meet the specification of high-grade electric cables. Many patents derived from the newly developed tapes have been applied. The material supplier, who took part in this joint study, has achieved a position of leader in the industry of èlectric cable materials and is enjoying enlarged business opportunities.

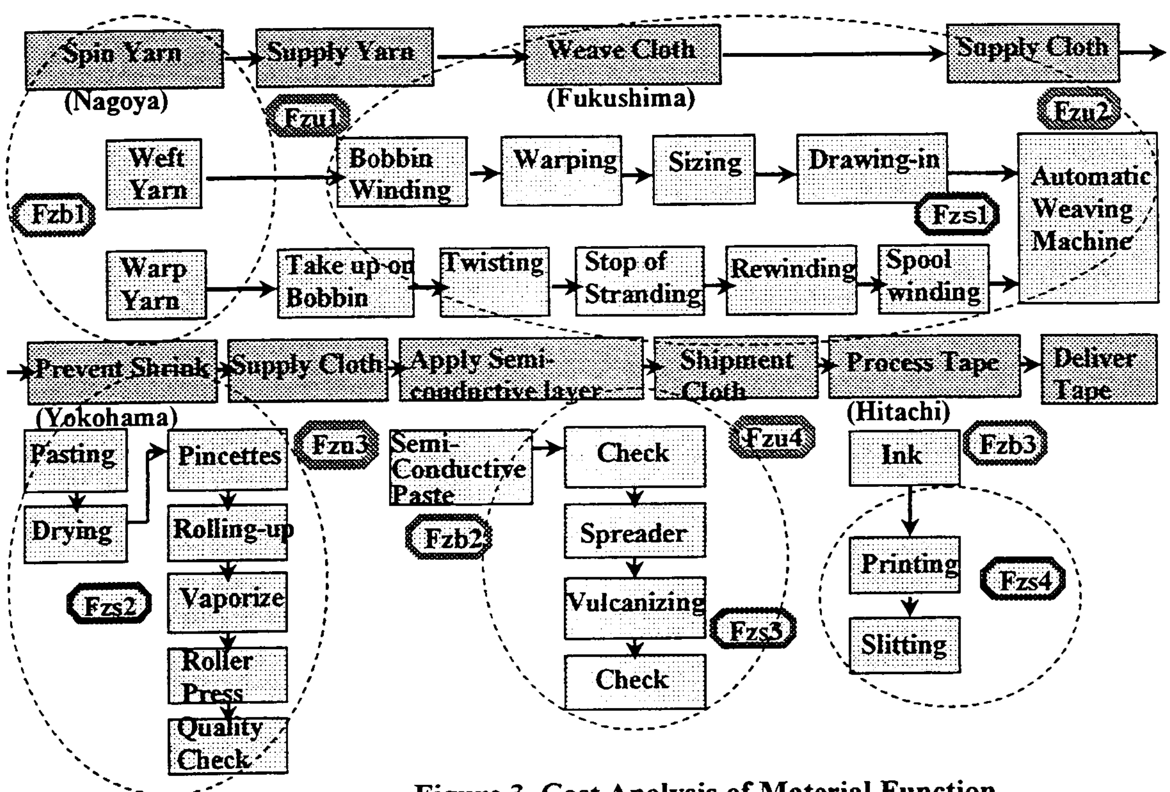

Figure 3. Cost Analysis of Material Function

An example of the process function analysis is stated in the following. As a clothing function of electric power cable in figure 2, <F7; at first, cable core is classified into such functions as <process F>, <working F>, and <motion F>. Then, we look for a cost, which is necessary to attain the motion function by analyzing each motion time. The result obtained here is classified into such functions as <Hkb>, <Fks>, and <Fku>. This classification reveals where improvement potential lies. As for <Fkb>, a new project team of medium scale is be organized to cope with development of a new breakthrough production technique. In this instance, a production by two men par line was reduced to one man and the production speed was raised to one and a half points faster than before, and the total cost was reduced to one third. The analysis method of process function cost is generally employed in the production VE and also widely used in QC circle activity to cope with the theme. The analysis is well accepted as a handy improvement tool in the production site in plants. A schematic diagram for process analysis < Fig7;protect assembly core> is shown in figure 4 as an example.

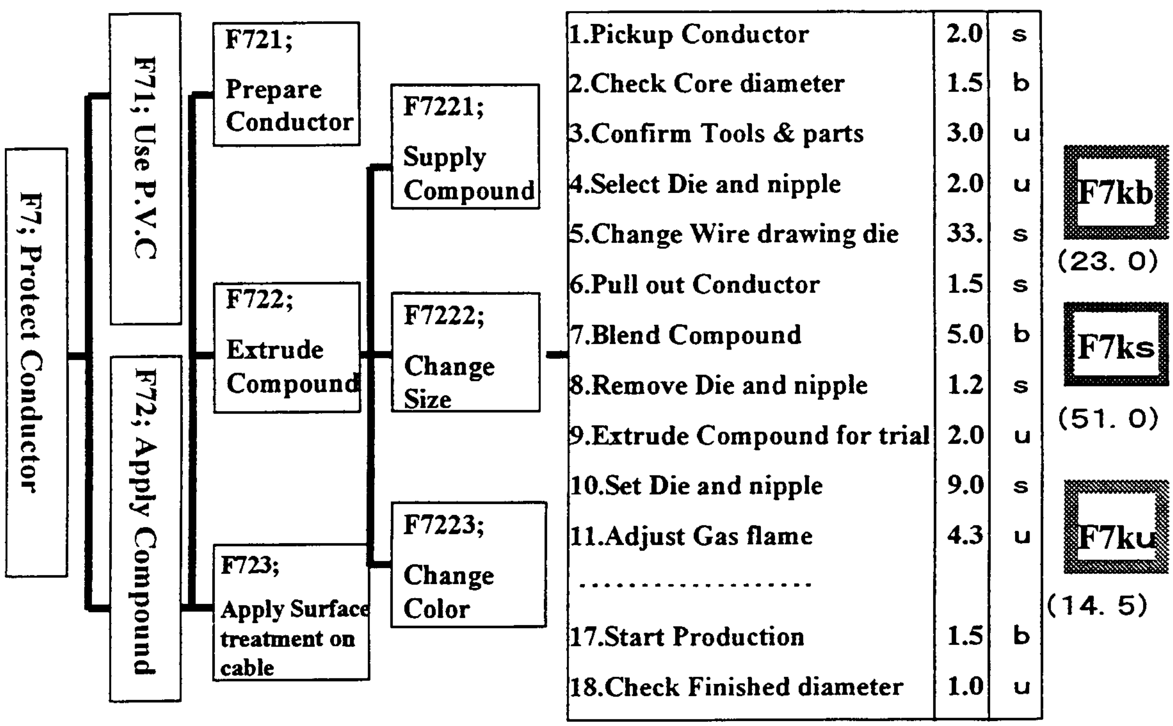

Figure 4. Analysis for Process Function Cost

6.ALL-SPECTRUM FUNCTION EVALUATION

			Fz			Fk			Fg			Σ
			Fzb	Fzs	Fzu	Fkb	Fks	Fku	Fgb	Fgs	Fgu	
F3; Insulate Conductivity	F31; Form Insulation	C_{31}: C_{311}, C_{312}, C_{313}										
		Ct										
		F_{31}	Ct×0.9	Ct×0.7	Ct×0.5							
		V_{31}										
		$C_{31}-F_{31}$										
		Starting order						⑤A				
	F32; Generation Cross-linking reaction	C_{32}: C_{321}, C_{322}, C_{323}										
		Ct										
		F_{32}	Ct×0.9	Ct×0.7	Ct×0.5							
		V_{32}										
		$C_{32}-F_{32}$										
		Starting order	①A									

Figure 5 Three Function Analysis

An evaluation of function, related to targeted reduction rate TRI-F, is done for cost reduction TRI-F. Based on this evaluation, the order to start and confirmation of the reasonableness of the target value is determined. This procedure is named "All-spectrum Function Analysis". The target cost in the fulfillment of the project is determined by deducting a reasonable profit from the market price. Namely, the CD rate of product is expressed in the following formula.

CD rate (%) = target reduction amount:

(present cost-target cost)/present cost x 100

In order to raise the high achievement rate (realization), the author has developed a new function evaluation method by adding a composition rate of < three factor cost analysis> and <TRI=F>.

This method makes it possible to determine the starting order for TRI-F and find out an expected achievement rate in the scope of the study of the project. Figure 5 shows an instance of All-spectrum function evaluation. The procedure is given below.

1) The current costs <C> of Fz, Fk, and Fg, which are analyzed per sub-function of the product in question are collected at each TRI-F.
2) The CD rate<Fcd> of three factor functions is determined depending on their specific conditions of the function. In the case of the electric power cable, as example , Fu is set at a drastic rate of 50%, Fs is set as 30% in hope of an improvement effect, and Fb is set as 10% in hope of the improvement effect to be made for the time being.

3) F value <Ft=Ct x Fcd> of the sub-function is to be set for each TRI-F.

4) Values <Vt=FT/Ct> for each TRI-F and targeted reduction value<It=Ct-Ft> are to be calculated, and then the starting order is decided in order of large It value to small Vt value for each TRI-F.

5) A,B,C, rank wise analysis is to be made in the starting order, and A rank function of TR-I is selected. The number of the sub-function of the product in this paper is fifteen, the starting order comes to one hundred thirty five when nine is multiplied to TRI-F. But if we put a limit to A rank, which is eighty percent of the whole, one tenth of improvement in TRI-F can serve the purpose.

6) By comparing the total value of A rank <Ct-Ft> with targeted value set at first, we confirm that total value get higher. If we set the final achievement rate as eighty percent of the target, and the total value is higher than twenty percent, the achieved rate become one hundred percent. If the value is low, a reasonable value is to be made by trading off the value of Fcd.

With use of this function evaluation, we are able to determine which sub-functions out of Fb, Fs, and Fu should be given the priority. In seek for ten to twenty per cent of TRI-F, we can estimate an attainable rate of the whole scheme. In this way, it has become much easier to focus on points of the improvement than the function evaluation in each sub-function heretofore conducted.

7. SUMMARY

So far, the author has stated the way of thinking and it's steps in the Triangle Thinking Method. The result of analysis performed in this paper is summarized below:

1) The thinking is easy and simple in that the whole consists of three parts.

2) This method is accepted and practiced among employees in a variety of industrial fields owing to favorable wording of three operation time, three cost factor and three function.

3) By thorough analysis of TRI-F, the cost generating factors, which were left in a black box, have light thrown on them. As a result, the cost generating factor is not left unsolved and such a spiritually strong atmosphere has been has been created that the improvement factors can be found for sure.

4) With use of the TRI-F evaluation method, it has been made possible to foresee achievement rate of the target and take measure of importance.

The creative activity for proposal promotion, which incorporates the Triangle Thinking Method, is being operated in making sure of TRI-F and the relevant features. As for the basic F factor, we make an improvement proposal inclusive of technical development for future. As for the secondary F factor, we make a proposal for re-design of products in search of uniqueness. As to the unnecessary F factor, it is recommended to encourage workers in charge to propose ideas which can bring about immediate effect. Thus the Triangle Thinking Method is a system, which facilitates it easy to offer proposals depending on stepwise difference of the improvements. The author would like to further develop the method, which can be applied effectively depending on type and state of business.