

STUDY ON VE TECHNIQUE FOR VALUE IMPROVEMENT OF DISCRETE PARTS

Kageaki Sako, Group Leader,
Development & Planning Group, Tokyo Buhin Kogyo Co., Ltd.



Kageaki Sako, chief engineer of Tokyo Buhin Kogyo (Yamato-city, Kanagawa Pref., Japan), is engaged in designing and development of automobile parts. Having been involved in designing and development of engine cooling water pumps and lubricating oil pumps over many years, he is now the Development & Planning Group leader in charge mainly of cost and progress management for developed products as well as improvement on VE technique.

Mr. Sako is an executive member of the VE studying committee of the Isuzu Kyowa Association organized by affiliates of Isuzu Motors.

ABSTRACT

This paper covers a new VE technique developed in prospect of successful and wider applications of the VE. It is usually difficult to apply the VE to discrete parts (parts consisting of a single member or components serving to a simple function) with little successful results. A new VE technique applicable to such discrete parts which is easy and useful for everyone to implement has been developed. The new VE technique will assure more effective VE job plans and approaches from both products and production engineering aspects.

INTRODUCTION

The VE is a methodology of providing products and services with a higher value. As for the CR (cost reduction), things are viewed as no more than material with redundant costs, if any, to be cut. In contrast, the VE focuses the attention on functions that a thing performs. This approach is known to often lead to fruitful achievements with the originality shown in many ways. The VE is not only applicable to products but can cover all that entail costs to serve a certain purpose. For more successful results, it is necessary to develop a VE technique designed specially for the object in question.

Automobile parts manufacturers have so far implemented VEs for products with successful outcomes. However, now that VEs have been repeatedly applied to products, VE efforts are reaching a level-off with a small possibility of more improvement expected.

There remain significantly many discrete parts which, as yet drawing a minor VE attention though, can provide another room for successful VE implementation and further improvement in the value.

The production engineering VE derived from the job plan for the 2nd look VE rather than the products VE is applied today to discrete parts. This approach also involves such complaints made by VE project members: "there are too many for a discrete part to take care for, and it is not effective enough to attain a desired goal."

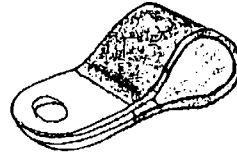
The conventional production engineering VE, which is derived from the job plan for the 2nd look VE, is for itself intended mainly for production processes but not for improving products. Accordingly, this approach is likely to arouse less concern about functions of products, often failing to lead to improvement of products.

Here introduced is a hybrid VE approach of the products / production engineering (P/PE) combination type which is useful, practical and effective for everyone to implement as well as will take at worst as long VE job time as with conventional VE approach.

HOW TO FOLLOW JOB STEPS FOR CONVENTIONAL PRODUCTION ENGINEERING VE

The conventional production engineering VE derived from the job plan for the 2nd look VE is different from the products VE primarily in that definition of production engineering functions depend on production processes in which products are produced. Description here mainly covers steps to analyze functions, ranging from steps to define functions to those to select object fields, taking the

following as an example.



Cost	Production Process	
¥=35.-	1. Blanking	4. Plating
Material	2. Piercing	5. Inspection
SPCC	3. Bending	*6. Coating

*The 6. coating process which is not now in house is not included in objects of the present production engineering VE.

Fig. 1 Object of analysis : Clip

Fig. 2 and Table 1 show examples of formulated function block diagram and function evaluation table.

PROBLEMS WITH CONVENTIONAL PRODUCTION ENGINEERING VE

The conventional production engineering VE involves problems with the functional analysis, especially with steps to define and streamline functions as described below.

Definition of Functions

1. It is laborious work for those who are not familiar with definition of functions.
2. Definition of functions must cover all production processes involved.
3. Continuity of our function-intensive thought filled with originality is once interrupted by the function evaluation stage that must follow each step of VE work. This decreases the efficiency at the ideas developing step.

Table 1 Evaluation of Functions (Production Engineering VE)

No.	Process name	Function area before VE	F1 Shaping		F2 Sinking over	F3 Quality assurance	F4 Packing for shipment
			F1-1 Punch shaping	F1-2 Shaping of bends			
1	Blanking process	¥5.00	4.7			0.3	
2	Piercing process	¥5.00	4.8			0.2	
3	Bending process	¥10.00		9.7		0.3	
4	Plating process	¥6.00			5.3	0.2	0.5
5	E.a.l. *	¥1.00				1	
6	Material cost	¥3.00	3				
(C)							
Total cost			¥30.00	12.5	9.7	2	0.5
(F)							
Worth			¥22.50	6.7	8.2	1.8	0.5
Room left for improvement(C-F)			¥7.50	5.8	1.5	0	0
(F/C)							
Value			¥0.75	0.54	0.85	0.9	1
Priority of improvement				1	2	3	—
Remarks							
* E.a.l. : External appearance inspection							

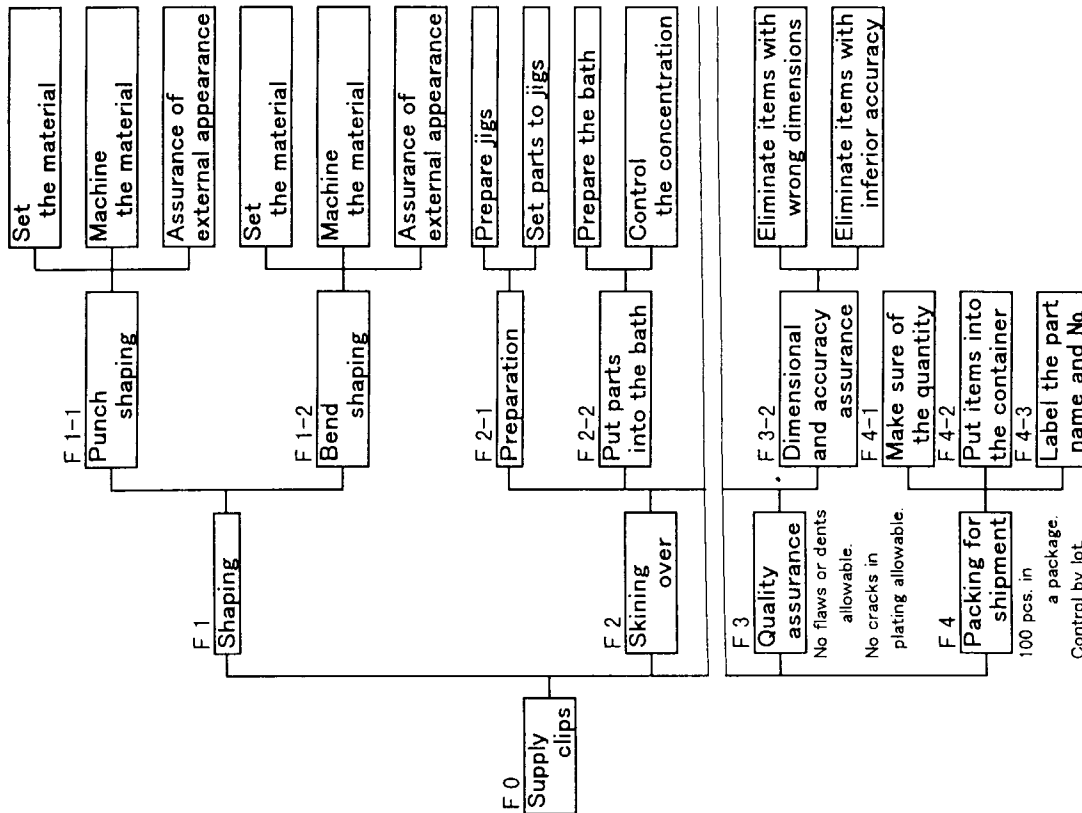


Fig. 2 Function Block Diagram for Clip

Streamlining Functions

1. Steps to define and streamline functions are followed for one production process after another, and therefore it is difficult to identify the function with a product or with a production process (because of the priority of activities given to the production process).
 2. The conventional function block diagram is not suitable for developing ideas for functions of products.
 3. Systematic presentation of functions on the function block diagram requires too much work to do, and therefore it takes too long to formulate the function block diagram.
 4. Priority is given to upstream functions, whereas downstream functions are likely to be neglected.
 5. It is difficult to give rise to additional functions and systematically relate them to others.
 6. Continuity of our function-intensive thought filled with originality is once interrupted by the function evaluation stage that must follow each step of VE work. This decreases the efficiency at the ideas developing step.
2. Seek the slogan "For lower processing cost, product specifications should rather be changed to some extent" to achieve total merits.
 3. Clearly distinguish those steps of VE job which may be simplified from those which should be strengthened, so that a clear-cut and practical VE technique is attained.
 4. Although the VE approach is of a products / production engineering (P/PE) combination type, it takes at worst as long VE job time as with conventional VE approach.

Outline of New VE Approach

To fulfill the above mentioned objectives, the new VE approach, which is derived from the job plan for the 2nd look VE, consists of simplified function defining/streamlining steps and the strengthened idea developing step. How to follow job steps of the new VE approach derived from the job plan for the 2nd look VE is described next.

<How to Follow Job Steps of the New VE Approach Derived from the Job Plan for the 2nd Look VE>

< 1 > Collect Information:

- In both products and production engineering aspects
- Priority of activities should be given to the production engineering aspect

< 2 > Define functions:

- Define functions on the product side on a function requirement basis.
- To define functions on the production engineering side, divide the production line into production processes. Then define the process function for each production process.

< 3 > Streamline functions:

- Formulate the function block diagram on the product side on a function requirement basis.

NEW PRODUCTION ENGINEERING VE

What the New VE is Intended for

This new VE technique has been derived from the VE applied to a part "clip" taken as an example. The new approach can be further developed so that the VE technique fulfills the following objectives.

1. VE technique easy for everyone in (automobile) parts manufacturers to implement

- Designate functions of the 2nd highest order or next to the uppermost (F0) as function fields into which functions should be grouped.
 - Based on process functions defined at step <2> above, formulate the function block diagram on the production engineering side. Process functions should be accompanied by their process name labeled below it.
 - Arrange function block diagram on the product side and that on the production engineering side so that both can be collated. Draw lines to connect product functions and production process functions which are related to each other (called "hybrid function block diagram of the products / production engineering combination type" or "P/PE hybrid function block diagram" from now on).
- <4> Cost analysis for each function:
- On the product side, distribute costs among function fields. Each function on the function block diagram should be accompanied by an associated cost indicated above them.
 - On the production engineering side, analyze each function for costs in the same manner as for the conventional production engineering VE.
- <5> Evaluate functions:
- On the product side, check whether there is any problem for costs distributed among function fields.
 - On the production engineering side, evaluate functions in the same manner as for the conventional production engineering VE.
- <6> Select object fields:
- Everything on the product side should be the object field.
 - On the production engineering side, select object fields based on evaluation results for functions.
- <7> Develop ideas for products.
- As for process functions on the production engineering side, develop ideas while making sure of product functions.
 - To help develop ideas for details of each production process, steps to define and streamline functions and develop ideas must be integrated into an uninterrupted series. This allows these steps to be followed consecutively for one object fields after another in the same sequence (as production processes occur) as selection of object fields at step <6> above. Use the FAST as tool for developing ideas.
- <8> For the outline evaluation and subsequent steps, mostly follow detailed steps of the 2nd look VE.
- How to Formulate P/PE Hybrid Function Block Diagram
- The P/PE hybrid function block diagrams on both products and the production engineering sides are so devised that it takes short time to formulate them. The outline evaluation and subsequent steps can be followed in the same manner as conventional approaches. Another advantage of these function block diagrams is that it is possible to make sure of the relationship between product functions and production process functions in the systematic presentation of functions. Fig. 3 shows the procedure of formulating a P/PE hybrid function block diagram and an example of such presentation.
- < How to formulate a P/PE hybrid function block diagram is described below >
- (1) Define functions on a function requirement basis.
 - (2) Divide the production line into production processes. Then define the process function for each production process.

- (3) Formulate the function block diagram on a function requirement basis.
- (4) In the function block diagram on the products designate functions of the 2nd highest order or next to the uppermost (F0) as function fields into which functions should be grouped.
- (5) Each function shown in the function block diagram on the products side should be accompanied by associated cost labeled below it, which have already been distributed among function fields for "Cost analysis for each function". This will help understand the relationship between product functions and cost.
- (6) Based on process functions defined at step (2) above, formulate the function block diagram on the production engineering side. Process functions should be accompanied by their process name labeled below it.
- (7) Arrange function block diagram on the product side formulated at step (3) above and that on the production engineering side formulated at step (6) above so that both can be collated. Draw lines to connect product functions and production process functions which are related to each other. One function on the product side or on the production engineering side is not always related to only one but more than one or none.
- (8) Each function shown in the function block diagram on the product side should be accompanied by associated cost labeled below it, which have already been distributed among function fields for "Cost analysis for each function". This will help understand the relationship between product functions and cost.

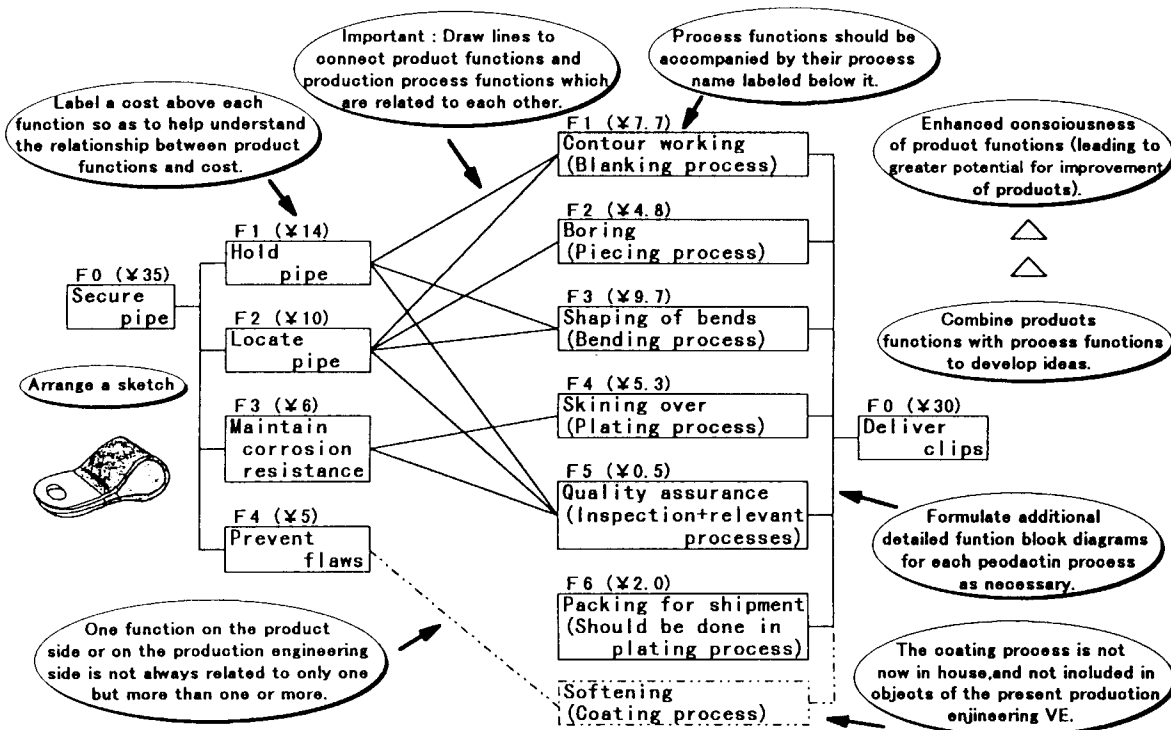


Fig. 3 P/PE Hybrid Function Block Diagram for Clip

How to Develop Ideas

What extremely matters for VE work is steps to develop ideas. To help find out better alternatives, we adopt the following policies to develop ideas.

1. Approaches from both the product and production engineering aspects must be possible.
2. To encourage idea development for each production process, our thought should be function-intensive and filled with originality so that good ideas are developed. Accordingly, steps to define and streamline functions and develop ideas must be integrated into an uninterrupted series and followed consecutively.
3. To induce us function-intensive thought filled with originality, FAST (Functional Analysis System Technique) diagram should be used as tool for developing ideas so as to take full advantage of Ruggles type FAST.

< Next, to actually develop ideas, steps outlined below should be followed. >

- 1) Using P/PE hybrid function block diagrams that were formulated at the step to streamline functions, develop ideas in the following manner.
 - 1-a) Based on the function block diagram on the product side, develop ideas for products.
 - 1-b) As for process functions on the production engineering side, develop ideas (for lower functions on the production engineering side) while making sure of product functions.
- 2) Develop ideas (for lower functions on the production engineering side) in the same sequence (as production processes occur) as selection of object fields at step <6>.
 - 2-a) Define functions for each production process.
 - 2-b) Referring to questions "Why", "How" and "When", formulate a FAST diagram to streamline functions. Fig. 4 shows an example of formulated FAST diagram.

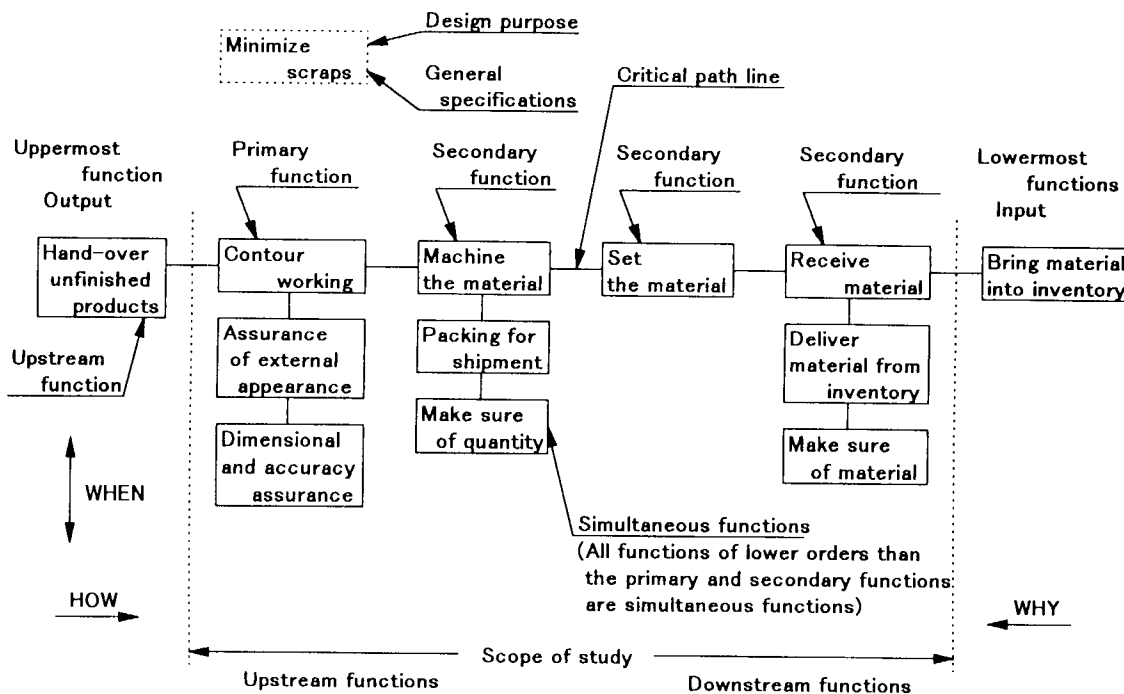


Fig. 4 FAST Diagram for Blanking Process

2-c)Based on the FAST diagram formulated at step 2-b) above, develop ideas.

Steps 2-a), 2-b) and 2-c) should be followed consecutively for each production process in question.

3)For the outline evaluation and subsequent steps, mostly follow detailed steps of the 2nd look VE.

Comments on Application of FAST

Why the FAST is applied to idea development steps of the new VE technique is described here.

FAST (Functional Analysis System technique) is relatively easy to use to systematically relate functions to each other. Another advantage is that its application induces us to have function-intensive thought filled with originality. With all these merits, the FAST is not common in Japan. This is because, according to Study on FAST (9) /1/: "Function block diagrams in use today in Japan are related to a technique to evaluate functions and develop ideas, whereas it is difficult to understand how to evaluate functions systematically related by the FAST, to develop ideas based on the evaluation and to find out better alternatives."

This discussion could lead to a conclusion that the FAST would not be useful if used in a same manner as function block diagrams in use in Japan. But, it may be helpful enough for a tool to develop ideas. To realize its potential, we made the following efforts.

1. The new VE approach was already applied to formulation of P/PE hybrid function block diagrams, and has proved to be as useful as conventional technique for function related work including evaluation of functions and selection of object fields.

2. Steps to develop ideas are one of what extremely matters for VE work, and must be given the highest priority.

On the other hand, it must be kept in mind that steps to define and streamline functions can serve as tool to develop ideas as well.

Accordingly, steps to define and streamline functions and develop ideas should be integrated into an uninterrupted series and followed consecutively. This can be an effective means to augment the step to develop ideas because:

- Steps integrated into such a series induces us to have function-intensive thought filled with originality; and
- Function-intensive thought filled with originality can readily develop good ideas.

3. Function block diagrams, in so far as The Ruggles type FAST is applied to the idea development for production processes, are improved compared with conventional diagrams for the following reasons.

- On conventional function block diagram, all functions are examined for purposes and means to make systematic presentation of functions on the diagram, whereas, on the Ruggles type FAST diagram, examinations for "Why" and "How" have to be conducted only for one critical path function there is on the diagram. This way, systematic presentation of functions is easier to make on the FAST diagram.
- Systematic presentation of functions on the FAST diagram does not require too much work to do, encouraging function-intensive thought filled with originality.
- The FAST diagram contains time-dependent conception as well, which can be visualized on the diagram in the form of simultaneous and all-the-time functions (the processing sequence is also an important factor for the production processes).

4. Since steps to define and streamline functions are simplified for the new VE technique, application of the FAST to the step to develop ideas does not result in an increase in the overall VE job time.
5. Discussion about the FAST has successfully led to a VE approach with best possible use made of the FAST for the VE job plan.

EXPECTED EFFECTS OF NEW VE APPROACH

Expected effects of the new VE approach include the following.

1. Those steps of VE job which may be simplified have been clearly distinguished from those which should be strengthened, so that a clear-cut, practical and easy to implement VE technique is attained.
2. The new VE technique will assure approaches from both products and production engineering aspects, allowing a wider variety of ideas to be developed. Fig. 5 shows a result of an idea developed by the new VE technique. Changes of this type involving a change in specifications would not be made by conventional production engineering VE intended mainly for production processes.

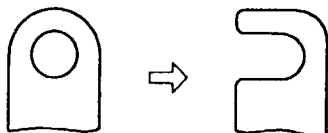


Fig. 5 Example of New VE Approach: Eliminated Piercing Process

3. Since steps to define and streamline functions are integrated with the idea development step into an uninterrupted series for each production process, there may be some processes that proves to be redundant depending on which process to deal with first or how to develop ideas for production processes (e.g. a simultaneous blanking process substituted for the piercing process, Fig. 5).
4. Steps to define and streamline functions integrated with the idea development step into an uninterrupted series to be followed consecutively are expected to result in more efficient idea development and further-going investigation than with conventional approaches, leading to development of ideas of better quality.
5. The VE job plan which is efficient to implement will take at worst as long VE job time as with conventional VE approach, with more successful results expected.

CLOSING

At a VE studying session organized and held by automobile manufacturers, there were many opinions expressed seeking for a new easy to implement and productive VE technique, for more fruitful application of the VE. Such a situation accounts for a reason why this report was written.

Two P/PE (products / production engineering combination type) function block diagrams are used here depending on applications as intended for with the new VE technique. One is a newly proposed P/PE (products / production engineering combination type) function block diagram, and the other is the Ruggles type FAST diagram which is so devised that it is formulated with the progress made for the idea development step. As a result, the VE job plan can

development step. As a result, the VE job plan can now be implemented more efficiently, with a wider variety of ideas developed and further-going investigation made.

According to literature dealing with the VE, "The FAST is a technique suitable for software for production and other processes, especially with more successful results if applied to the production process." Investigation into the FAST, however, proved that it was not applicable to the VE job plan in the same manner as to conventional function block diagrams. Discussion about the FAST has successfully led to a VE approach to take advantage of merits of the FAST for the VE job plan.

A FAST diagram as introduced above serves as a useful tool to explain the production process to someone or members of a team so that they understand one another, as well as a tool to facilitate idea development with the progress made in formulation of the diagram.

Although essential concepts and procedures of the new VE approach are covered in this paper, there are some unsolved factors including practices remaining to be investigated further. Experiences in field activities with the new VE approach should be gained to refine the VE technique.

QUOTATION

- /1/ Kaneo Akiyama: "A Study of FAST - Series 9," Society of Japanese Value Engineering, 1987

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