VALUE ENGINEERING FOR MANUFACTURE OF LARGE-SIZED PRODUCTS

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INTRODUCTION

The Japan Steel Works, Ltd. has its head office in Tokyo and four plants in Muroran, Tokyo, Yokohama and Hiroshima. Also, we have seven business offices throughout Japan and three overseas offices. Since the company's foundation in 1907, we have been engaged in the production of large-sized castings and forgings, quality steel plates and various industrial machines, with distinctive features.

The Muroran Plant has for many years traditionally specialized in large-sized castings and forgings, which have been the mainstay of our production, but in recent years with a view to increasing our capacity of using our steel materials to make finished products, we are broadening our product line by adding various steel plate structures and industrial machines.

Since the introduction of Value Engineering in 1968, members belonging to the design-engineering department have been trained in VE by workshop seminars and on-the-job training course, centered on the industrial machines of our own design. To date, the number of Value Engineers trained has reached 140, of which 80 are in the design-engineering department. In the design-engineering department we are training Value Engineers from time to time by on-the-job training course, with a view to firmly establishing VE in our routine work.

In the belief that the merit of VE is small unless it is applied to products made to order and to variegated products manufactured in small quantity, VE has been carried on in the forgings and castings department, examples of which are herein introduced.

Also, in the various shops and departments such activities as Value Engineering, Industrial Engineering, Quality Control, etc. adaptable to existing conditions have been carried on chiefly by Value Engineers, resulting in substantial improvement in quality and reduction in cost.

VE ACTIVITIES IN FORGINGS AND CASTINGS DESIGN-ENGINEERING DEPARTMENT

1. Just after obtaining orders, the section chief selects the products to which VE will be applicable, appoints the team leader and organizes the team (If necessary, he requests assistance from other departments.)

2. Normally the team is composed of the following members:

Value Engineer (team leader)	1
Value Engineers (one is section chief)	1-2
Persons in charge of designing of subject product	1-2
Engineers in manufacturing department	1-2
Other designers	3
Total about	9

3. Schedule
   The schedule is planned by the team leader and the person in charge of designing the product.

4. VE Steps
   The following steps are taken
   (1) Explanation of the outline and structure by the responsible designer
   (2) Explanation of the reasons for selection by the section chief and establishment of the target of cost reduction
   (3) Definition of the functions of each part on the assembly drawing
   (4) Brainstorming for each part
   (5) Rough evaluation of ideas and collection of information (an alloted task for all members)
   (6) Detailed evaluation of ideas and making concrete improvement proposals (designers incorporate such ideas in their work)
   (7) Examination of improvement proposals from the viewpoint of cost
   (8) Submission of the drawing to the costomer for approval, if necessary
   (9) Making up of VE reports on the results

VE ACTIVITIES IN HULL CASTINGS

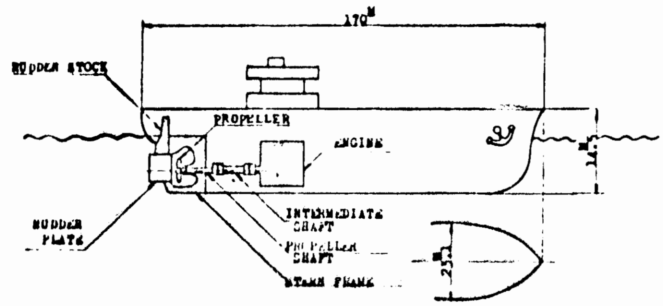
1. Hull Castings as VE Object Product
   Parts of large ships now under construction are not necessarily all manufactured at the shipyard, but some of the parts (e.g. hatched parts in Fig.1) are dependent on speciality makers. At the Muroran Plant we manufacture parts of engines, intermediate shafts, propeller shafts, propellers, rudders and stern frame on orders received from leading domestic and overseas shipyards.
   The requirements of the quality and specifications of these parts are very strict and such parts have to pass inspection of Bureau of Shipping. Therefore, the system for the quality assurance is established in the plant

and based on our long experience, we make drawings and specifications for manufacturing, including the detailed manufacturing instructions, to meet such requirements. We have recently manufactured the rudder, stern frame and other parts for the 500,000 ton super-tanker, the largest in the world, named "GLOBTIK TOKYO" which has already entered service.

Hereunder, an example of VE in the manufacture of the rudder is outlined, although the rudder cited is relatively small.

Fig. 1

D.W. 25,000 TON



2. Structure of Rudder (see Fig. 2)
   The rudder is composed of the following parts which are connected by bolts mechanically or welding.
   (1) Rudder Stock
       It is made of steel forgings and connected to the upper part of the rudder to hold and turn the rudder.
   (2) Rudder Body
       It is welded structures using 15 - 40 mm steel plates bend to stream lining. In its shell, the latticed reinforcing ribs are welded to stand the force of water at turning. Standardized steel plate for shipbuilding is used.
   (3) Upper Rudder Frame
       It is steel castings welded to the upper part of the rudder and connected to the rudder stock. The surface condition between this part and the rudder stock needs precision finishing, and accordingly, manual finishing for fitting is required.
   (4) Lower Rudder Frame
       It is steel castings welded to lower part of the rudder and connected to the lower part of stern frame. And it is fulcrum for rudder.

3. Reasons for the Selection
   (1) In the Muroran Plant, the rudder is one of the relatively small products, and the margin of profit is very narrow.
   (2) There is possibility that by consulting with engineers of the customer modification of design may be allowed.
   (3) In the Muroran Plant, 8 - 10 rudders of the same design are manufactured a year.
   (4) VE is applicable to other large-sized hull castings.

4. VE Activities
   After carrying out VE steps mentioned in Para. 4. (page 1) and negotiating with the customer several times, the rate of adoption of our proposals has reached 90%. As a result, improvements shown in table 1 have been obtained. We have applied these improvements to other large-sized hull castings and some of them have already been adopted by several companies.

CONCLUSION

As can be seen from the example mentioned above, VE activities at the Muroran Plant have obtained the following results. We first thought that there might be a limit to applying VE to the hull castings in which we do not take part in the basic designing, but by studying the manufacturing designing in detail we have attained better results than expected. Such VE activities have been instrumental in arousing consciousness of cost reduction which has permeated among the shops. Thus, we have attained remarkable shortening of manufacturing time and about 20% cost reduction by implementing at the same time the following IE and QC improvement activities:

Establishment and enforcement of standards for manufacturing and working
Making check sheets for each process of working
Improvements in yield of materials and efficiency of manufacturing

Based on the experience mentioned above and with the success attained as illustrated in the case study as a momentum, it is our intention to promote and develop VE activities throughout the design-engineering, manufacturing and administration departments, integrating Value Engineering with other management techniques such as Industrial Engineering and Quality Control.

Fig. 2

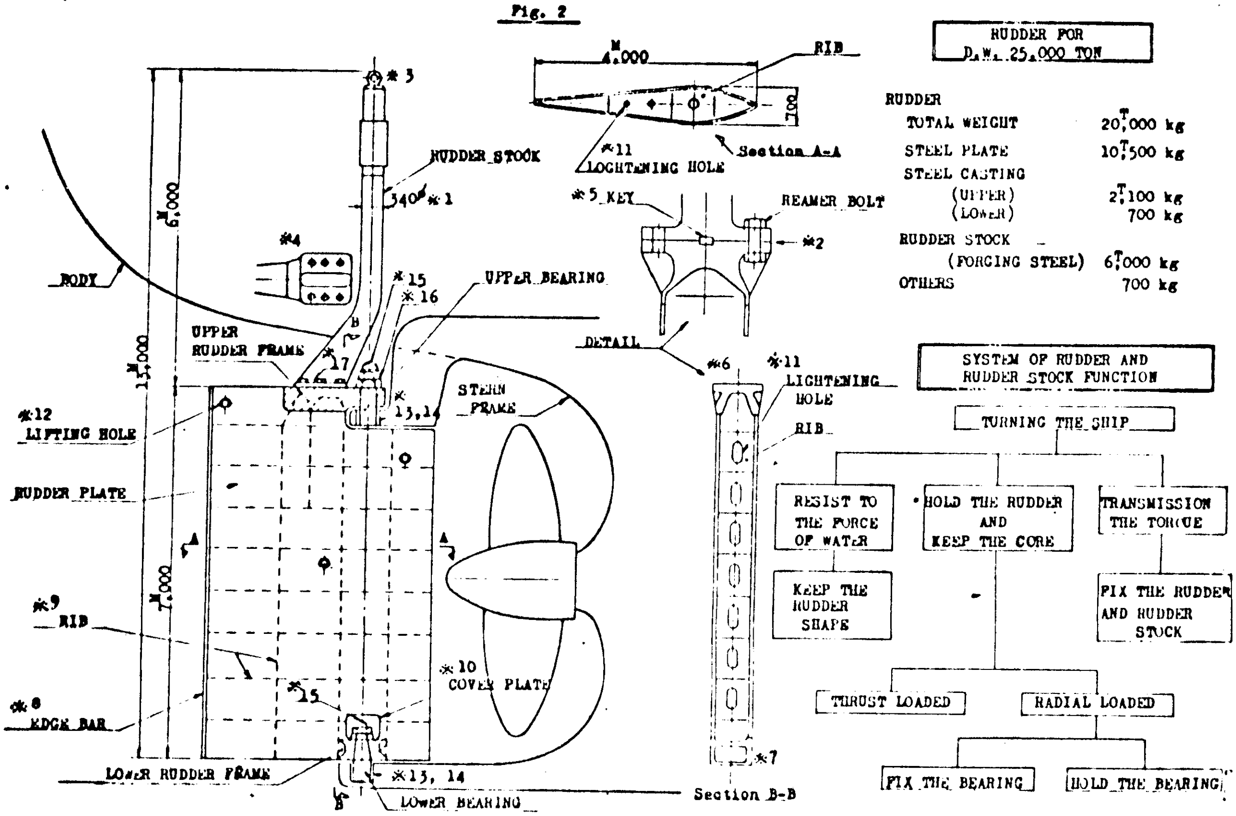
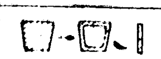
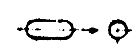
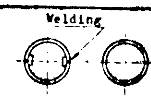
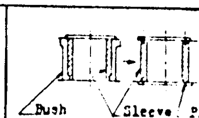
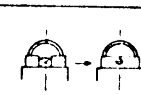
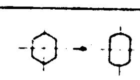


Table 1
VE Proposals and Results
(See Fig. 2)

Cost reduction achieved — 9.38 % (Target was: 6.0 %)

o : Adopted x : Not adopted

No.	Modification (Proposal)	Note	o or x
	RUDDER STOCK CONCERNED		
1	Increasing tolerance of shaft of rudder stock	Reduction of finishing allowance and time of machining	o
2	Reducing fitting areas	 fitting area	o
3	Using standard (JIS) bolts on sale as lifting bolts		o
4	Reducing radius of corner of flange		o
5	Abolishing key and key way		o
	UPPER AND LOWER FLAME CONCERNED		
6	Modifying shape of upper bearing partially		x
7	Modifying shape of lower bearing partially		x
	RUDDER BODY CONCERNED		
8	Changing material for edge bar		o
9	Unifying steel plate thickness to J.I.S.		x
10	Reducing radius of corner of cover plate		o
11	Reducing number of lightening holes and simplifying hole shape		o
12	Using standard pipe for lifting holes	 Welding	o
	BEARING CONCERNED		
13	Simplifying way of preventing the bush from dislocation and rotation.	 Bush, Sleeve, Pin	o
	Abolishing bush		o
14	Modifying sleeve shape	 Sleeve	
15	Modifying shape of locking bar and groove		o
16	Changing double nuts to single nut		o
	REAMER BOLT CONCERNED		
17	Changing head shape of reamer bolt to both side beveled type		o