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Optimization Process for Screw Injector Stop by using Cause and Effect Matrix

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Abstract: Operational research is a decision making method which is used for finding the optimum solutions within desired objectives and constraints. Operational method aims for executing decisions by providing department with a quantitative basis of decisions regarding the operations under the control. This method is not a new, this method is used to solve problems involving management of large systems of man, machine, materials and money in industry, business etc. The aim of optimization technique for test cases is to minimize the number of input without affecting output of the testing process. This paper is related to taking decision with best output by using "Cause and effect method of optimization''.
Keywords: Optimization technique, cause effect matrix, Operational research, Optimum solution

I. INTRODUCTION

Operational research (OR) is used as tool for taking decision. The contents and the boundaries of the OR are not yet fixed, this method can apply anywhere such as finance application, Production planning, Transportation problem, etc. Operational research can also be treated in the sense of describing, understanding and predicting the system behavior, especially in man-machine systems. Operational research is important to ensure a process in being done optimally. [4] Basically can say that, "Work smarter, not harder". The main purpose of OR is to provide a rational basis for decision making in the absence of complete information, because the system composed of human, machine, and procedures may not have complete information. Where-as the judgment and subjective decision-making is not good enough. Thus, industries look for operation research to have more objective way to make decisions. It is found that the method which is used should also consider the emotional and subjective factors. Thus OR specialist is involved in three classical aspects, as follows:

A. Determining the systems behavior.

B. Analyzing the system behavior by developing appropriate model.

C. Predict the future behavior using models.

The procedure for making decisions with the OR studies generally involves the following phases:

1) Judgment phase: In this phase we can determine the objective, effectiveness of measures, and also determine type of problem, its origin and causes.

2) Research phase: In this phase observation and collection is done for the better understanding the problem .Analyze the available information and verification of hypothesis. Production and generation of results and consideration of results are done in this phase.

3) Action phase: In this phase the recommend previous action to those who first posed the problem this includes the assumptions made, scope and limitations, alternative courses of action and their effect. Then putting the solutions to work implementation is done in this phase. Operational method can be used anywhere but without OR, in many cases, we follow these above phases. By using this phases we can find most suitable solution.[4]

a) *Operational Research*

Operational Research method is an idealized representation of the real life situations and gives one or more aspects of reality. OR provide analyising the behavior of the system for improving its performance. Environment involves physical, social and economic factors which are likely to affect the problem under consideration of Operational research and study the contents including men, material, machine, suppliers, consumers, competitors etc. The OR determines as to which alternative method of action is most effective to achieve the desired objectives. If problem are solved and solution is obtain, this obtained solution should be translated

into operating procedure to make it easily understandable and apply by the system. After applying the solution to the system, OR method must study the response of the system by using OR changes are made in system. [4]

II. OPTIMIZATION METHOD

Optimization is the process of finding the greatest or least value of a function for some limit, which must be regardless of the solution. [3] In short optimization is to provide best output with the least investment. There is different optimization techniques used where best output is required with minimum input, based on various parameters depends upon problem. [1]

There is various optimization methods used to find the suitable output which are

1) Single variable optimization Method
2) Multivariable optimization Method
3) Constraints optimization Method
4) Specialized optimization Method
5) Non-traditional optimization Method
6) Failure mode effect analysis (FMEA) Method
7) Cause and Effect Matrix: Optimization Method

A. Cause and Effect Matrix: Optimization Method

This method is one type of Failure mode effect analysis method. It is mostly used in manufacturing industries, for solving problem like process design and develops. This method provides initial input to the FMEA. When each of the output variables is not correct, that represents potential "EFFECTS". When each input variable is not correct, that represents "Failure Modes".

Steps involved in formation of "Cause and Effect Matrix" is following,

1) List the Key Process Output Variables.
2) Rate each variable on a 1-to-10 scale to importance to the customer.
3) List Key Process Input Variables.
4) Rate each variables relationship to each output variable on a 1-to-10 scale.
5) Select the top input variables to start the FMEA process.
6) Determine how each selected input variable can "go wrong place that in the Failure Mode column of the FMEA.

III. CASE STUDY

We had performed project in General Machine Tools, Ichalkaranji industry. The part considered for project is "Screw Injector Stop". The operations in the manufacturing of above component include honing process which is a super-finishing process. For this purpose component has to outsource them to another vendor.

Above project is focused on replacing the honing process by other convenient process. There are three alternatives processes available at first which are: Grinding, hard boring and diamond reaming. These alternatives are compared with each other by using "Cause and effect method of optimization" based on different parameters.

The alternative processes studied for replacing honing are listed below

1) *Hard Boring:* It is carried out after heat treatment processes. It is a finishing method of removing metal. It is Economical, and from hard to harden metals. It produces machine parts with good dimensional accuracy, surface finish and surface integrity. It has been proved that it can complete successfully with grinding of same Component from both technical and economical aspect.

2) *Grinding Process:* Grinding machines remove material from the work piece by abrasion that can generate substantial amounts of heat; they therefore incorporate a coolant to cool the work piece so that it does not overheat and go outside its tolerance. In very high-precision grinding machines (most cylindrical and surface grinders) the final grinding stages are usually set up so that they remove about 2/10000mm per pass - this generates very little heat even with no coolant.

3) *Diamond Reaming:* It removes up to 0.200" stock in a single pass. Unlike honing process it need not be processed by more than single machine. Therefore it increases productivity as time taken is less as compared to other process.

Tool life is up to 50,000-100,000 pieces which prove to be economical.

Better geometric control – size, roundness, and surface finish – that reduces cost and requirements for downstream honing/bore sizing.

With the help of industrial optimization technique effective process is to be selected, therefore

A. *For selecting suitable process out of three alternatives the cause and effect matrix is generated.*

Fig1.) Cause and Effect Matrix   (Microsoft excel sheet)

To generate above matrix select Key Process Output Variables like cost, capital investment, capacity, quality. Rate each variable on 1-to-10 scale to importance to the customer. Selecting key process input variables like hard boring, grinding, diamond reaming. . Rate each input variables relationship to each output variable on a 1-to-10 scale. For example, for hard boring cost, quality and capacity are highly dependent parameter, so rate given is 9. For slightly dependent parameter rate given is 3 and for independent parameter rate given is 1.

After giving the rating top input variable is selected which is hard boring.

IV.   CONCLUSION

This paper concludes that, "cause and effect optimization method" is very useful for selecting best output. It is helpful to take decision where two or more alternatives are available.

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