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Problem Solving Approach

Arkeya Pal[1], Er. Faruk Bin Poyen[2]

[1]Army Institute of Management, Kolkata, India
[2]Dept. of AEIE, UIT, BU, India

Abstract**—***Problem is something that we can never get rid of, how much we try and howmany anticipatory actions we take. Therefore, to deal with problems in our everyday life, every project implementation is to solve the problem as and when required. In this article we will try and study about problems and the techniques and methods by which we can solve it or mitigate the situation. Again it is worthy to mention as a prelude and also to conclude that problem solving is an individual skill and it therefore varies from person to person and from situation to situation and there exist no thumb rule to redress ay problem as a generalized rule. By the end of this article, we will try and develop certain tools by which we may approach a problematic situation before redressing the problem.*

Keywords— Problem, situation, operational research, decision making, DMAIC, PDCA.

I. INTRODUCTION

Before we talk about problem solving, it is mandatory to define problem. A problem is defined as any event or situation, unforeseen, unwanted and therefore unwanted in any project or job which needs to be addressed and resolved before it becomes too complexing. In our personal life, business events or for any other matter, always something or the other happens that was not foreseen and therefore was not planned to address to. Problem may originate from family, work, health issues, social agendas, or it may even arise from within an individual. Under such circumstances, we need to come up with certain contingency plans which is defined as, problem solving. Problem can also be defined in other terms as the deviation from what is expected to happen and what is actually happening. Thus, arises the issue of solving a problem in order to achieve ones particular objective. Problem solving is defined as the area of cognitive psychology which deals with the processes involved in solving problems.

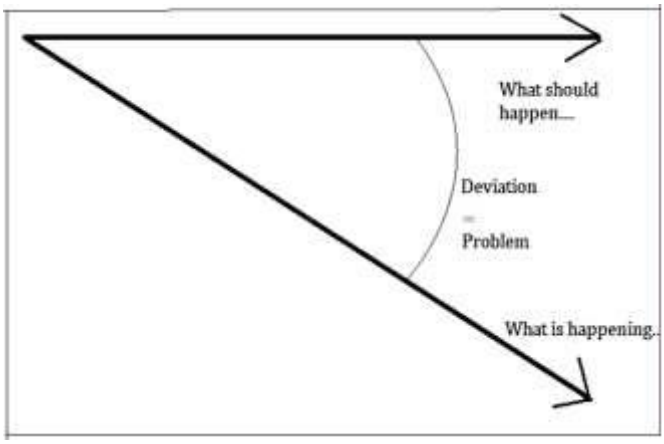


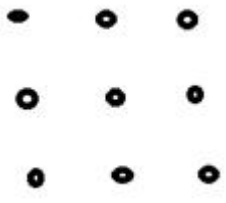
Fig. 1: Deviation is Problem

Problem solving depends on individual skill and capacity. The prerequisite of problem solving is that one has to be the owner of the situation. Unless and until one owns the problem, one cannot possibly solve the problem.

In order to establish the point, let us discuss two cases

Case I: Certain arithmetic and interpretational operations

a. Putting of arithmetic operators in between four 4s to obtain 20.
    a. i.e. $4 \quad 4 \quad 4 \quad 4 = 20$
b. Finding the sum of 1 to 100 without applying Arithmetic Progression formula.
c. Express $613 = A^B + B^A$
d. Draw four straight lines without lifting the pen and cutting across all the nine points as shown in figure below.



e. Hens lay eggs, crows lay eggs, certainly all birds lay eggs, but peacocks do not. Why?
f. With three match sticks, form a number which is greater than 3 but less than 4, without breaking the match sticks.

Solutions:

a. $(4 \div 4 + 4) \times 4 = 20$

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b. $X = 1 + 2 + \cdots \ldots + 100$

$$X = 100 + 99 + 98 + \cdots . \ldots + 2 + 1$$
$$2X = 101 + 101 + \cdots \ldots . . + 101\ (100\ times)$$
$$X = (101) * \frac{100}{2} = 5050$$

c. $613 = 612 + 1; A = 612; B = 1;\ 612^1 + 1^{612} = 613$

e. It is because peacocks do not lay eggs, peahens do.

f. π

The point of submission here is that different set of people will take different amount of time to solve the given problems; even there will be a group of people who will be totally unable to solve these problems. And hence we come to the inference that problem solving depends on individual skill and capacity.

Case II: Two incidents with equal conditions but with little differences.

A. A boat with four passengers viz. you, your parent, your spouse and your ward, caught up in turmoil and one needs to be abandoned to save the others. Nobody knows swimming which means imminent death of being abandoned. Whom will you abandon from boat?

B. Same situation as above and here instead of four passengers there are now five passengers, the fifth being your boss.

From rigorous surveys, it was found that in situation B, people without hesitation chose their boss but in situation A, people got confused, perplexed and came up different answers.

So the inference may be drawn as in situation A, people were actually not bothered about the boss, they were just concerned. But in situation, people got confused because it was their situation i.e. they were the owner of the situation and hence it is a problem to them.

II. PROBLEM SOLVING TOOLS

There exists variety of problem solving methods, among them the two very popular ones are DMAIC (Define, Measure, Analyse, Improve, Control) and PDCA (Plan, Do, Check, Act) [4]. In the PDCA model, P does a huge part of the job as it emphasizes on what, why, how and when. In DMAIC model, all the steps are equally important, starting from defining the problem to controlling it. All these methods rely on different tools of Problem solving. Here we will speak about a few on them. These tools find application when one sets goals to determine the root causes of the problem. Multi-Disciplinary Teamwork (MDT), Brainstorming, Pareto analysis (80/20 rule), Fishbone Diagram (cause – effect analysis), 5W tool, Check sheet and Control Chart (CC) are very popular tools in this domain.

MDT finds its success through thinking "out of the box",as a heterogenic cluster of individuals look upon the problem from different vantage points. Brainstorming tool is somewhat ubiquitous in its application domain. Check sheet and Control Chart are more of an objective approach when judgment is based on pure numbers and their representations. Pareto's principle, very popularly known as "vital few and trivial many" believes in the doctrine that 20 % of something is always responsible for 80 % of the outcome. In the 5 W tool, it is assumed that the 5th Why is the root cause of the problem and hence it is the one that should be improvised upon. The 5 whys also form parts of the fishbone structure. The fishbone model, by far and large the most preferred and popular tool operates on the basis of cause – effect analysis. The head of the fish structure denotes the outcome whereas the skeleton bone analyses the cause – effect relationships. The fishbone can be constructed with 6 Ms or 6 Ps as the vertices where the 6 Ms denote Man, Machine, Method, Material, Mother-nature and Measurement and 6 Ps denote Procedure, Policy, Plant, Person, Planet and Programs respectively.

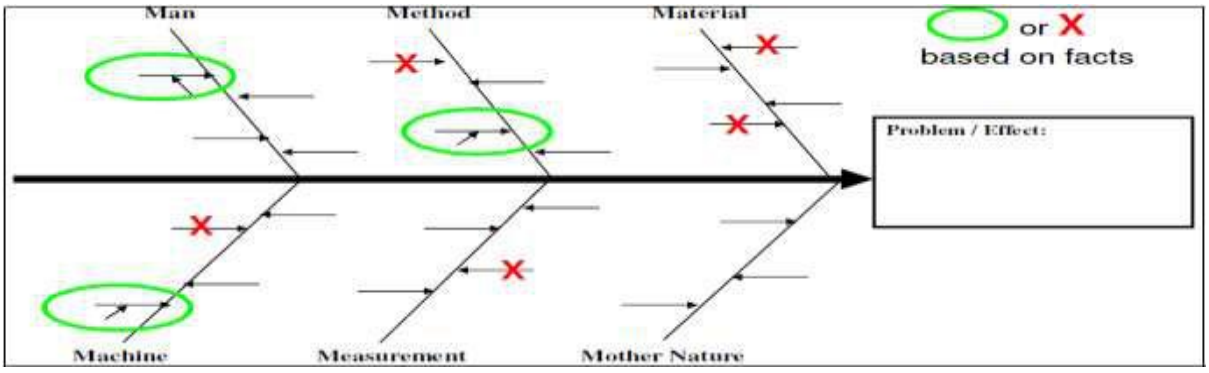

Fig 2: Fishbone Diagram

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Preliminary steps towards attending a problem:

Whenever a problematic situation arises, we should proceed towards the situation as shown in the under given flowchart. [1] (R B Shivagunde et. al.). We select our tool of choice for preference in analysing these steps. Here we can look at the situation in two ways, firstly in the Deductive Analysis Approach where huge data is collected, followed by analysis and eventually we come to conclusions drawing recommendations. The second approach is Inductive Analysis Approach where we start with a hypothesis, analyze its subsistence and thereby draw a result to validate the conclusion with some recommendations. A point to mention here is that there is no such best tool dedicated for any particular problematic environment. It depends and suits one's individual intuition and capability.

Step I: What should happen !!!

Step II: What is happening !!!

Step III: Why is it happening !!!

Step IV: Prioritizing the causes of problem.

Step V: What should be done!!! Finding solution to the causes.

Step VI: What has been done!!! Applying the solution to solve the problem.

Again in step I, when we are expecting what should happen, it has certain aspects towards its determination. We expect things to happen based on

- What plans we have made,
- Expectation
- Experience
- Intuition
- Social norms

DIMENSION	NATURE OF QUESTIONS
IDENTIFICATION OF PROBLEM	WHAT IS HAPPENING ?
GEOGRAPHIC LOCATION	WHERE IS HAPPENING ?
TIME OF OCCURENCE OF PROBLEM	WHEN DID IT HAPPEN ?
DEGREE OR EXTENT OF PROBLEM	HOW MUCH IS HAPPENING?

Fig 3: Problem Analysis

Step II has two sub steps for determining what is happening and they monitoring and feedback with time limiting to zero i.e. $\lim_{t \to 0} Feedback$

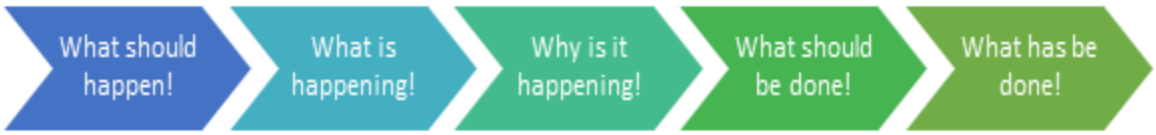

Fig 4: The flowchart of problem solving

Operations Research in Problem Solving:

Operations research was developed keeping in mind of problem solving area where the nature of problem is complex and also there exists no clear cut or in fact no solution. It is a mathematical based analysis method to provide a quantitative basis for tough managerial decisions. (Hillier and Lieberman et. al.)

As elaborated in *"Introduction to Mathematical Programming"* by Hillier and Lieberman, it prescribes seven element analysis towards problem solving. The seven elements are enumerated as defining the problem,

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value system design, synthesis of alternatives, system modelling and analysis, optimization of alternatives, decision making, and finally planning for action. As these are mathematical based analysis they rely on a lot of mathematical and statistical tools as validation methodology.

Problem defining step is marked by research, data analysis and knowledge application. Needs analysis, input – output analysis and objective trees clarify and organize the goals and boundary conditions. Value system design organizes objectives into a hierarchy tree with the help of tools like weighted criteria tree, flow charts and causal loop diagrams. Quality Function Deployment (QFD) matrix helps generate alternatives based on these tools. Different alternatives are prognosticated in synthesis of alternatives to satisfy the demands. Methods like nominal group technique, computer simulation, Zwicky's morphological box are exercised in the step.

Systems modelling and analysis step develops models for analysing and comparing the alternatives. Techniques that find application here are data analysis, probability theory, econometric modelling, regression, forecasting, queuing, networks, reliability analysis and mathematical programming. To make substantial comparison, numerical iteration, derivative calculus, calculus of variations and graphical methods and used in the optimization of alternatives and effect of changes is measured through parametric sensitivity analysis.

In the decision making step, evaluation of alternatives gives the operator the end result to choose from options. Tools used are multi – attribute utility (MAU) theory, game theory, risk analysis, influence diagram, decision analysis, data analysis and statistical methods. Effect of changes in judgment is measured by value system sensitivity analysis. Final step is planning for action where the implementation is carried out and documented by resource planning scheduling.

III. ANALYSING THE PROBLEM AND SOLUTION

This section speaks about analysing the domain and depth of problem before proceeding to solve it. Any set of problem can be represented in a set of four quadrants, the axes being problem and solution extending from simple problem to complex and solution available to solution unavailable respectively.[7][8] The following diagrams depicts the quadrants involved in solving problems. Firstly we have to locate in which quadrant, a particular problem rests and then based on that, we need to proceed towards solving it. So we start from first quadrant and finish at fourth quadrant. [9]

Quadrant I: Problem is of simple nature and also the solution to it available. Here we apply the solution immediately before the problem can shift from simple to complex.

Quadrant II: Here problem has complex nature but still the solutions are available. In this case, we start applying solutions one after another, if there exists more than one solution. We actually are searching for the best possible solution through trial and error method.

Quadrant III: In this region, the nature of problem is complex and also no solutions are available. This particular quadrant gives rise to a very important statistical tool viz. operations research to address and redress these kind of situations. It has three sub components and they are formulation, analysis and interpretation. Here in this quadrant, we sectionalize the problem into small pockets and try and fit them in the three other quadrants. This way we can reduce the effect of the problem. After this is done, there may still remain certain sections which remain in third quadrant. We again repeat the process until we can minimize the problem to the least.

Quadrant IV: In this quadrant, the nature of problem is simple but no solutions are available to redress. Here, one needs to be creative thorough innovation either at individual scale or in groups. In order to illustrate the situation, we will do a very popular case study.

A person has 17 gold coins and he has three heirs A, B and C. On his death bed, he declares that A will receive half of the coins while B will receive one-third of the coins and C will get one-ninth of the coins. Here the problem is known and simple but the solution is not available as 17 is not divisible by 3.

Solution to the above case: I add one gold coin to 17 gold coins and then carry out the calculations as declared by the person. Now we have 18 gold coins. So A will receive 9 gold coins i.e. half the property. B will receive 6 gold coins, one-third of the property and C will get 2 gold coins, one-ninth of the share. Therefore total gold coins distributed are (9+6+2) = 17 and then take back the extra gold coin. Thus the solution is creative through innovation.

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Fig 5: Solution Analysis based on problem criticality.

Thus we can solve problems by addressing them through the above methods. Hence it can be rightly said that finding the cause through analysis and then by applying the required remedies, we can minimize the deviation and therefore can solve the problem or minimize it.

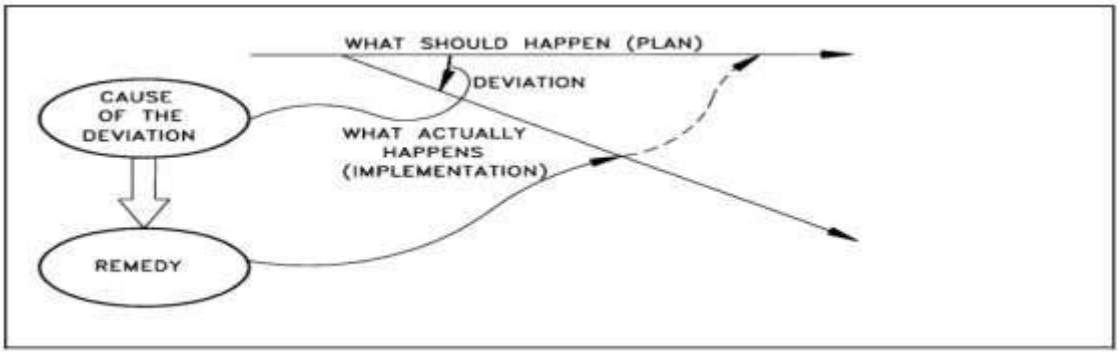

Fig 6: Post Problem Solving Technique Application

IV. DECISION MAKING

One very vital entity of solving problems is making the right decisions. Decision making is a very important skill one should possess to effectively and efficiently guide a team or run a project. Decision making is defined as the way of inspecting potentials, equating them and thereafter selecting a course of action. The back bone of a good decision making is gathering plethora of data regarding the situation in hand. And then analysing and scrutinizing them very minutely to have a very clear understanding of the situation. Factors that influence decision making are vision, mission, perception, priority, acceptability, risk, resources, goals, values, demands, styles and judgment. [5]

The DECIDE model is a very effective technique for making a more logical decision. The acronym DECIDE [2] stands for

D = Detect change
E = Estimate significance of change
C = Choose outcome
I = Identify options
D = Do best options
E = Evaluate results.

Rule of 6 C's of Decision Making.

1. Construct: a clear picture of what needs to be done.
2. Compile: A list of requirements.
3. Collect: Information on alternatives.
4. Compare: Alternatives.
5. Consider: What might go wrong.
6. Commit: The action.

V. CONCLUSION

Things can go wrong & they will. Problems will occur while implementing a project or job in spite of all possible preventive measures taken, be itpersonal domain

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or professional, "object" problem or "people" problem. So the best and only way to cope with the situation is to face the problem and try and minimize the effects if it cannot be solved in totality. We therefore prescribe certain remedial steps by which things can be dealt with. If activity is not properly defined, problem solving is impeded. It is therefore mandatory to define the situation in its totality. One must also know where an event starts and where it ends. The event must be constantly monitored to keep the problem within check before it gets too complicated or messy. To put all aspects in a nut shell, to solve a problem, one must identify it and then focus on one aspect to address at one time and while doing so, must gather information on potential causes to come to a solution. [3] Applying the solution in the desired area, one must reassess the issue and redress the situation with a revised plan. All the steps mentioned must be recursive until one completes the job. Quick action to any and all problems ensured lesser and controllable deviations. However the potential lacuna of problem solving is jumping to conclusions without thorough analysis. And always it is easier to solve object problems over problems related to people. As the concluding statement, we may point here that there exist so many techniques viz. TPS 8 steps, PDCA, Six Sigma DMAIC, MDF and 8 D model and they all approach the solution in their own ways which maintain congruency among each other. And it is totally the onus of the individual to use these tools and methods efficiently with good efficacy to achieve the best possible results.

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