Importance of Problem Statement in Solving Industry Problems

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Importance of Problem Statement in Solving Industry Problems

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Abstract. Problem statements is a form of natural language used in any problem solvings [17]. A problem statement is described in terms of scope, structure and its purpose. Analysis in problem statement is a critical element of a structured problem solving that has not been included in or explicated by traditional stage models of the process. This paper details out that an analysis stage is needed to develop the implications of a problem's definition and to direct the selection and pursuit of solution strategies. This paper also discusses the importance of problem statement and how a new method of structure is being modeled for an effecient and effective problem solving in industrial environment. Strategies for future research on problem analysis are discussed

Introduction

Solving problems is a complex process and each of us is better at the skills required at some stages than others. Why do people fail to find effective solutions? Many reasons can be listed out, as such; not being methodical, lack of commitment to solve problem, misinterpret problem statement, lack of knowledge of the techniques and process involved in problem solving, using method inappropriate to particular problem, and insufficient or inaccurate information to combine analytical thinking.

The term problem solving referring to the mental process that people go through to discover, analyze and solve problems [20]. This involves all of the steps in the problem process, including the discovery of the problem, the decision to tackle the issue, understanding the problem, researching the available options and taking actions to achieve your goals. It is important to first understand the exact nature of the problem itself (problem statement), before a problem solving occurs [10]. If understanding of the issue is faulty, then the attempts to resolve it will also be incorrect or flawed.

The problem-solving process *is* the vehicle for connecting knowledge and performance; knowledge gains economic value when it is used to solve problems, explore opportunities and make decisions that improve performance [9]. Problem solving is arguably a primary vehicle for learning in organizations; individuals may develop a better understanding of their environment by recognizing, exploring and resolving problems and opportunities. Problem solving may help integrate the diverse thinking in this area [6].

The concept of problem (problem statement), problem solving method and the application of problem solving method to a problem are given precise formulations, based on problem type. These formulation are argued to agree with intuitive understanding of these ideas (mental process), thereby formalizing them [16].

There are a number of different mental processes at work during problem-solving [10]. The problem solving process is a cycle [3, 7, 14] that requires; (1) perceptually recognizing a problem, (2) considering relevant information that applies to the current problem, (3) identify different aspects of the problem and lastly decribe the problem. The first condition of problem solving is problem statement and the main concernunder this preatext is the problem analysis.

Problem analysis is a critical element of problem solving that has not been included in or explicated by traditional stage of problem solving models. An analysis stage is needed to develop the implications of a problem's definition and to direct the selection and pursuit of solution strategies.

Problem analysis is a required key activity for defining a problem statement clearly. The paper explains and applies a different model of What-Why analysis which generates a richer understanding and broader set of solution alternatives. Strategies for future research on problem analysis are discussed.

Problem-Solving Strategies Through Analyzed Problem Statement

A problem statement is a concise description of the issues that need to be addressed by a problem solving team and should be presented to them (or created by them) before they try to solve the problem. When bringing together a team to achieve a particular purpose provide them with a problem statement [19]. The primary purpose of a problem statement is to focus the attention of the problem solving team. However, if the focus of the problem is too narrow or the scope of the solution is too limited, the creativity and innovation of the solution can be stifling [15].

A research-worthy problem statement is the description of an active challenge (i.e. problem) faced by researchers and/or practitioners that does not have adequate solutions available including the argumentation for its viability based on solid peer-reviewed sources as well as theoretical foundation. The research-worthy problem statement should address all six questions: what, how, where, when, why, and who. On the other hand, a statement of the problem is one or two sentences claim that outlines the problem that the study addresses.

Problem solving strategies or method is the key for solving a problem. The important conundrum is to understand the problem statement, and the goal to be achieved. The theoretical basis for this study is research on problem-solving derived from Newell and Simon's [12]. It focuses on the conceptualization process that employed for solving problems. In Newell and Simon's theory, problems are conceptualized as occurring in a problem space. The problem space (figure 1) contains three elements: a problem state, which is the information the problem solver, knows about the problem; a goal state, which constitutes the solution to the problem; and a search space, which consists of all the strategies that may be employed to solve the problem.

Most problem-solving research has concentrated on what can be described as simple or well-defined problems. Such problems can be described clearly in terms of the nature of the problem, what constitutes an acceptable solution to the problem and the various strategies that can be used to achieve an acceptable solution. It is often the case, however, that complex, ill-defined problems are complex precisely because it is difficult to define each of the elements of the problem space. With complex, ill-defined problems it is often not possible to clearly delineate the problem state

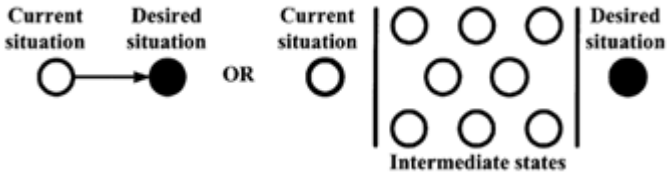

Figure 1: Initial state of Problem solving

When solving problems, people employ two types of strategies to navigate the problem space. The first are algorithms, which are defined as strategies that guarantee a result, with a mathematical formula being an example of an algorithm. Algorithms tend to be useful for problems where it is possible to identify all features of the problem space clearly. The second type of strategy is called heuristics, which are defined as strategies that improve the chances of solving a problem, but cannot guarantee a solution. Complex problems are often complex precisely because, it is not possible to identify the characteristics of the problem. Complex problems are most often solved using heuristics [12].

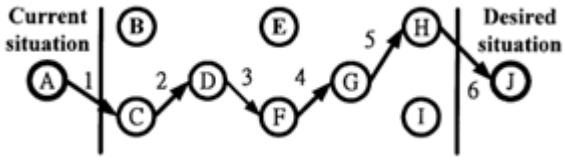

Figure 2: Problem Solving with a chain of intermediate states

A number of heuristics has been identified in the literature. There are two general types, referred to as forward reasoning and backward reasoning [1]. Forward reasoning strategies involve the problem-solver making a smooth traversal from problem state to goal state (figure 2). Forward reasoning is often regarded as a strategy used by people knowledgeable in the topic or domain of the problem and able to choose each step without checking on progress. Backward reasoning involves trying out strategies and monitoring whether they have moved the problem closer to the goal. Trial and error is a common backward reasoning strategy employed by people who do not have extensive experience or knowledge of a problem domain. With problems that require new and creative solutions, a strategy called problem finding [5] has been identified as an important ingredient of successful problem solving. Problem finding has been defined as exploring the problem extensively before attempting a solution and being prepared to change direction when necessary during problem solving [8]

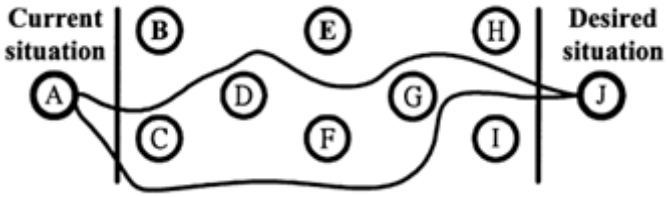

Figure 3: Problem Solving with a Heuristic pattern

An optimization problem consists of searching the best solution, according to a given criterion, among a set of feasible solutions [2]. Optimization algorithms are general step-by-step procedures for solving optimization problems. In other words an optimization algorithm is said to solve a problem if it can be applied to any instance of that problem to produce a feasible solution. Optimization algorithms can be exact if they find the optimal solution or heuristic if they find a good solution not necessarily the optimal one. Heuristics are particularly useful to solve complex problems (Figure 3).

Problem solving is arguably a primary vehicle for learning in organizations; individuals may develop a better understanding of their environment by recognizing, exploring and resolving problems and opportunities [9]. The better the clarity around what it is the team is attempting to fix, the more efficient they'll be in solving the problem, the solution will better 'fix' the issues, and the team can get back to executing the business versus fixing it. Problem solving strategy starts with problem definition as stage 1. Problem definition, a stage where the problem statement is reviewed to have a better understanding of the issue. As mentioned by Kettering (1947) the head of research for General Motors “a problem well stated is a problem half solved”. Performing What & Why Analysis Model (Figure 4) will give clear amplification to the importance of solving the problem. Hence determined the reason behind the cause of stopping the team to solve the problem intially. The fact is, generally from the observations; the grounds of this circumstances happening is eventually reflected from the distance between the problem statement and the segmentation. It is often not been bridged correctly that end- up focusing on inaccurate issues thus resulting into providing non-optimal solutions.

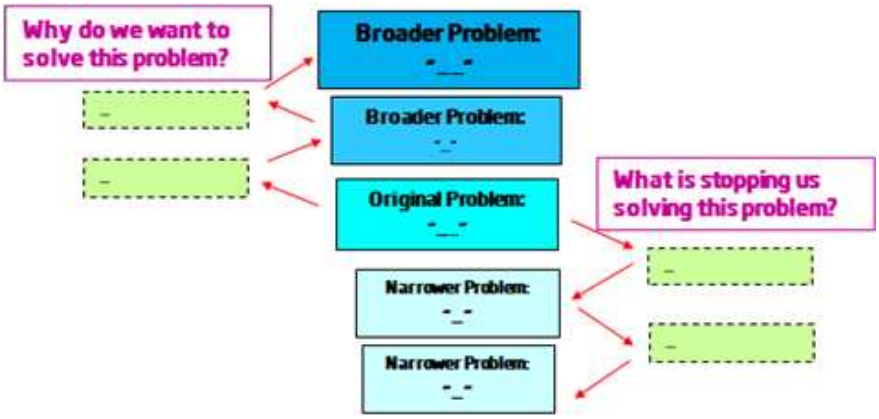

Figure 4: Why-What analysis model

The team needs to identify the broader problem space by understanding why do they want to solve the problem, and similarly the team need to understand the narrower problem space by understanding what is stopping them to solve the problem. By doing this, it will detail out the actual problem statement and clarifies the connection between broader and narrower problem space. To evaluate the effectiveness of the proposed What-What analaysis model an industrial case study is used.

Industrial Case Study Of What – Why Analysis Model

In this section it will detailed out on the problem statement by espousing the What - Why Analysis model through a validation process using case study. Case study research is one of the most powerful research methods in operational management, particularly in development of new methodology [18]. A manufacturing case study has been identified and presented to show the What-Why analysis model being adopted for resolving critical issues within a month time frame. The key problem of the case are two folds; first relating to quality problem faced by a double unit stacked and second is on the high equipment down time involving a unit drop in a modular station.

A class test (tester used for testing an integrated circuit during the assembly process) that consists of 3 sub-modules; tester, handler and TIU (test interface unit) will be the equipment choosen for the validation of What-Why analysis model. The handler module (known as Rxx), which is a mechanical interface unit which performs PnP (pick and place) of units among 3 sub class test modules. In the past, a few double stack quality incidents occurred (impacting >2000 units with substrate damage and fillet crack which impacted to high cost expenditure). To alleviate the risk, the company has put a quick solution through a manual screening of test summaries to prevent the problems occuring. However, the solution adopted is unfeasible as it requires intensive resources that eventually increased the cycle time, and also flagged many false failures. This has triggered the management to identify a more foolproof solution for this problem. In order to solve the problems, the issue has been analyzed through 2 method; (1) the usual way which is state the problem and finding the goal that requires to be pursue. Base on this the problem statement would be double stack on Rxx handler and how to eliminate double stack, and (2) What-Why analysis model as a fundamental and foundation base for the problem analysis.

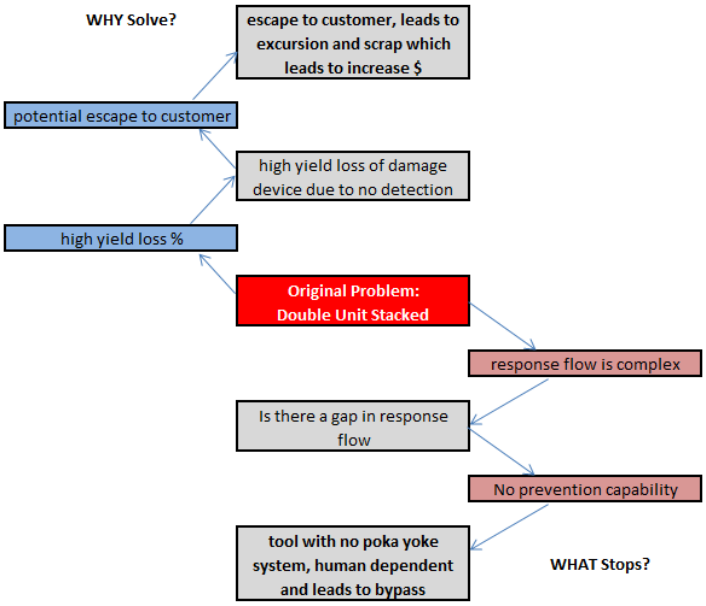

Figure 5: Double stack what - why analysis

In reference to the problem of the mentioned case study and referring to Figure 5, it is clear that the importance of the problem is to avoid any excursion that has the potential to occur. This is due to the reject been allowed to escape to the customer. The rationale of the problem not being solved properly is because there is no full proof system been put in place to detect and stop the system from continuing inducing the rejects. The research has detailed out [11] a full proof solution space with structured problem solving model known as evolved theory of inventive problem solving(ETRIZ).

A second case study was related to mechanical part of the equipment which induce high equipment down time involving a unit drop in a modular station. The issue creates unnecessary high equipment downtime, where fall as high pareto %. This issue potentially induce those drop device reject escape to customer if the process is not followed accordingly. This problem has been a pain in the neck since start up, and it has been an unknown root cause for almost 3 years. Standard way of defining the problem statement would be to eliminate or reduce the CNT drop unit. The problem came to an end by coaching the technician and engineers with the foundation stage of What-Why analysis model follow by a structured problem solving method. Performing the analysis (Figure 6) elaborates the importance of solving the problem, and also what is stopping the team to solve it.

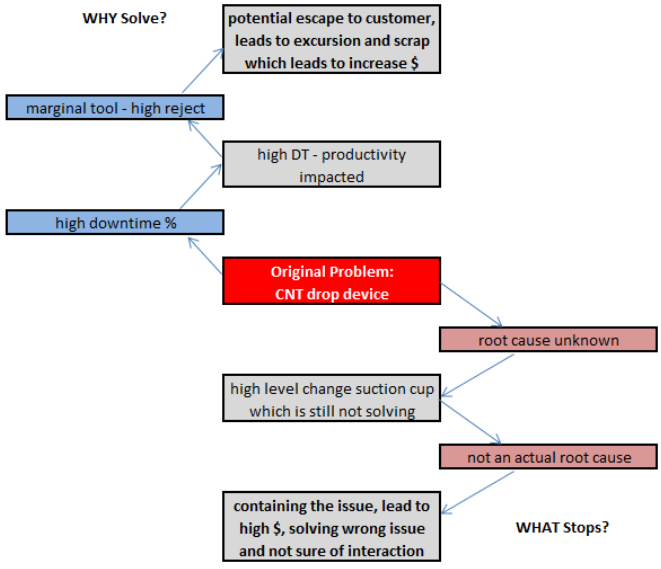

Figure 6: Drop unit what-why analysis

The CNT drop device is important to be resolved as it induce high fall out of the issue and potentially leads to escapee and lead to excursion alarm to factory. The challange to solve this issue was due to unknown root cause, where the engineers and technicians has been containing the issue by changing the unit pick suction cup, which leads to high spare part expenses. The issue was then resolved starting with What-Why Analysis model, with clear understand on the issue, which also reduced the duration of solution finding thru a structed problem solving methodology.

Discussion

Rapid problem solving is a key distinguishing feature between organization which excel and those which struggle. Problem solving requires not only skilled individuals, but need to understand the problem statement to tackle complex problem. Industries utilize many types of problem solving methodologies and most of the time the usage of methodology is being neglected either due to ineffective or too complex. Such situation leads to user confusion and not able to devote their time successfully on any of the methodologies particularly in relating to manufacturing issues. The paper describes the important of problem statement in problem solving strategies and how it has been evolved in fundamental foundation stage of problem definition thru What-Why analysis model which enhance the usage of the methodology to solve the manufacturing issues.

Problem statement is the fundamental structure that need to be clearly decribed, prior to moving to the subsequent steps of problem characterization and segmentation [11]. Most of the time problems are being tackled and resolved in a quick manner, where it is eventually containing the issue, instead of identifying the actual root cause and resolve the issue/problem for good. This can lead to repeated issue occurence! What do we want? A strong fundamental understanding of the problem statement which is known as foundation of a problem. This is required in industries mainly to avoid any repeated breakdown occurrences. The paper describes a sucessful research and two case studies of enabling clear problem statement thru introducing What-Why analysis model vs the standard way of defining the problem statement without a depth understanding.

A full understanding of What-Why Analysis model requires substantial investment in time and resources, due to its extensive scope and evolution. The key part of the evolution referred to, is the difficulty in choosing the right tools from those that are available in the market [4]. Applying the wrong set of tools often results in a waste of effort [13].

Conclusion

Problem solving methodologies appears to be a lack in problem statement part and problem characterization, that requires substantial effort and commitment to understand and lacks an accepted standard for its application. The benefit of the What-Why analysis model and its ability to yield innovative ideas and solution remain prominent and appear widely accepted thru a combination of structured problem solving methodology.

The paper describes the research methodology and explains the research activities of What-Why analysis model development. Then, the model validation and case study through its concept has been presented. The real life case study has demonstrated its capability and accuracy of identifying actual root cause and providing solution for solving manufacturing problem in industries. Organizations interested in pushing the boundaries of innovation and remaining competitive should consider this What-Why analysis approach if they have the means and patience to understand it and embed it in their innovation strategy and processes.

In summary, What-Why analysis model promises strengthening the problem statement which enables a good innovation ideas and solutions, which many organizations see as a source of competitive advantage.

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