Editor's Corner
Problem Solving, Part One

This section of JASET will be reserved for topics of special interest to our readers. The normal format will consist of a series of articles on a given subject that cannot be covered adequately in one article. The series of articles on the chosen topic will be published individually in subsequent issues of the JASET until the subject has been discussed in full. The editors have exercised the prerogative of choosing the topic for the inaugural issue of the journal. We trust that sufficient interest in this section of the journal will result in our readers telling us what topics would be welcome in forthcoming issues. We encourage comments regarding the published articles, and welcome additional articles on the subject by readers who desire to contribute to the discussion of the topic. We expect this section to stimulate dialogue, discussion of ideas, healthy critique, exchange of diverse viewpoints and debate regarding timely issues of interest to the readers.

The series topic for the Editor's Corner of the inaugural issue of the Journal of Applied Science and Engineering Technology (JASET) is "Problem Solving." I have exercised the prerogative of choosing this topic because I think that it is timely and pertinent to the readers of this journal.

Problem solving is an issue faced by engineers, technologists, managers, and by everyone dealing with life's daily challenges. I am sure that most of us who are practitioners in the world of applied science and engineering technology have faced the issues of "fighting fires" and of having the time to do things over that we "did not have time to do properly the first time." How many times have you seen action taken that momentarily alleviates the problem only to see the same problem surface again and again? How many times have you asked yourself why the problem was not solved and why it keeps reappearing? We will address these questions in this series of articles and maybe we can come up with some answers. Your comments and insights are most welcome. In fact, they are encouraged as we attempt to use the collective wisdom of the readers to answer these ages-old questions.

It appears that we tend to be our own worst enemies when we first take on the task of solving a problem with which we are faced. Consider this reaction to management's "solution" to a problem: "We trained hard…but it seemed that every time we were beginning to form up into teams we would be restructured. I was to learn later in life that we tend to meet any new situation by restructuring – and a wonderful method it can be for creating the illusion of progress while producing confusion, inefficiency and demoralization." Petronius Arbiter made this observation in 210 BC. G.K. Chesterson (English writer, 1874–936) put a new light on the subject when he wrote, "It isn't that they can't see the solution. It is that they can't see the problem." With this pearl of wisdom in mind, I want to tell you a story that I heard years ago that may illustrate the point of applying solutions when the problem has not first been identified.

The story I want to relate took place more than 65 years ago during WWII. I cannot say that all the facts are 100% accurate, but I can say that even if the story is apocryphal, it illustrates an important point in problem solving.

The Allies were confronted in WWII with logistics problems on a gigantic worldwide scale never before faced by war planners. A methodology for dealing with problems of this proportion had to be developed if we were to be effective in provid-

ing our allies and our troops with the supplies and equipment necessary for the successful conduct of the war. Operations Research (OR) was the methodology developed to meet this need.

One of the most challenging logistics problems was the support of the war in Europe. The Germans had a submarine force that had attained startling efficiency. Their ability to sink allied transports was overwhelming and was growing more efficacious each month. The allied researchers discovered a correlation between the number of combat vessels escorting the transports and the transports' ability to survive the Atlantic crossing in the face of the German submarine threat. It seemed that the greater the number of escort vessels accompanying the transports the greater was the number of enemy submarines destroyed and the fewer the number of allied vessels sunk. Hence the objective to "minimize the number of allied transport vessels lost in the Atlantic crossing" was established. Providing the greatest number of escort ships for the transports was of the utmost importance, since the survival of the transports was contingent upon that number. The problem was the constraint imposed by the limited number of vessels available for escort duty. Resources were scarce and were allocated according to priority, availability, and suitability. The logistic planners conceived the concept of the convoy. Instead of sending many shipments each consisting of a small number of ships, they would send a small number of shipments each consisting of a large number of ships. Because the number of shipments was reduced, the available escorts could be deployed more effectively. The previous requirement to provide escorts for many shipments had necessitated that the available escort vessels be allocated to each shipment in limited numbers. Now that the number of shipments was reduced, the number of escort ships allocated per shipment, or per convoy, could be increased significantly.

The result of this approach was heartening. The researchers had provided the answer to what had been an appalling loss of shipping. The German submarine threat had been reduced and greater numbers of our transport vessels were surviving the Atlantic crossing. It appeared that the story had reached a successful conclusion; however, it wasn't over yet. The OR researchers continued their work after the war and searched for applications of their methodology in the postwar world. In revisiting the "convoy problem" of WWII they made a significant discovery. While the objective to "minimize the number of allied transport vessels lost in the Atlantic crossing" had been met to an acceptable degree, the solution to the true objective had been sub-optimum. Postwar researchers unearthed the following shortcomings in their solution:

1) The large number of vessels comprising a convoy necessitated partial staging at various ports on the East Coast of the U.S. as no one port could accommodate the entire convoy at one time. The convoy could not proceed to its European destination until all the vessels had been loaded, staged, assigned a position in the convoy, and moved to the rendezvous for departure. This time-consuming procedure, that was necessary for the convoy system, imposed an inordinate delay on the arrival of vitally needed supplies in Europe.

2) The vessels pressed into service during WWII included many that were of old age. They were slower than the modern ships built during, and just prior to, the beginning of hostilities. The integrity of the convoy had to be maintained because the safety of the convoy depended upon the ability of the escorts to screen the ships contained therein. The ships had to proceed at the same speed in order to maintain convoy integrity. The greatest speed at which the convoy could sail was dependent upon the maximum sustained speed of the slowest vessel. This constraint imposed yet another delay on the arrival of vitally needed supplies in Europe.

3) The receiving facilities at the destination were overwhelmed when the convoys arrived. The ports were not equipped to handle the large number of ships nor the enormous volume of supplies contained in them. Docking space, lighters, material handling equipment, transportation from the docking area, and personnel, were all taxed far beyond capacity. Ships waiting in the queue contained vitally needed supplies that were delayed in reaching the troops in the field. These vessels also repre-

sented transport capacity that should have been on its way back to the U.S. to pick up the next shipment. Instead the ships were idle in the queue awaiting unloading. This situation at European destinations imposed still another obstacle to achieving an optimum solution to the logistics problem.

The objective determined by the WWII planners had been met. Ship losses had been reduced; however, the overall result of their "solution" to the problem was sub-optimal because the basic goal was faulty. German submarine losses had increased, the threat to allied shipping had been reduced, and the number of transports surviving the Atlantic crossing had increased, BUT the amount of tonnage arriving into the hands of the troops in the field in a timely fashion had been reduced. The stated objective should have been "maximize the timely delivery of tonnage into the hands of the troops in the field." This change in the goal places the emphasis on getting the vital supplies to the correct destination when needed in lieu of just surviving the Atlantic crossing. Smaller, faster convoys with quick turnaround times would have provided a solution to the true logistics problem of maximizing tonnage. That solution would have provided results closer to optimum than the solution that focused on survival – but admittedly, at a cost in lives and transports lost. "Survival" in the wartime scenario translates to "cost of doing business" in the peacetime scenario. It is not my intention to debate the moral issues involved in the relating of this story. It is my intention only to examine the lessons learned as they apply to problem solving. If survival were a necessary objective, then expansion of port capacity and the upgrading of the other facilities needed to unload the supplies, and insuring a timely delivery to the troops, must be accomplished. If there were insufficient resources of time, money, material, and labor to accomplish this needed increase in port facilities, a decision would have to be made regarding tradeoffs in survival and timely delivery. Correct identification of the true goal would aid in making the correct decision and in reaching the optimum solution to the problem.

The lessons learned in examining this story are important:

1) Identification of the correct objective is essential in problem-solving. Had the planners realized that the tonnage delivered was the objective they would have concentrated on minimizing turnaround time and on increasing port capacity. Identification of the true objective forces the problem solver to see the issue in the proper perspective and take action leading to optimization of the solution.

2) Identification of the correct objective leads to the effective allocation of resources. Resources would have been expended with the view of maximizing the timely delivery of supplies to the troops in lieu of survival. In keeping with the objective of maximizing delivery, the planners would have been forced into directing resources to upgrade the ports rather than considering that their job was done once they had minimized shipping losses.

In subsequent articles in the Editor's Corner, we will explore the efficacy of choosing the correct objective. We will examine the relation of the objective to both the identification of the problem and the identification of the root cause of the problem. We will also explore the ramifications of expending resources on eliminating the constraints that interfere with our ability to optimize our solutions to problems. Case studies will be our primary source of discussion.

If you wish to contribute to the discussions in the Editor's Corner, please direct comments to: editors.corner@jaset.rit.edu.

Correspondence to this address will not be subject to editorial requirements for publication in JASET.

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