

# Editor's Corner

## Problem Solving, Part Two

Engineers and scientists are problem solvers. I stated in the Inaugural Issue of JASET that I had chosen Problem Solving as my initial series topic for discussion in the Editor's Corner section of the Journal. I told a story that took place in WW II. The story illustrated the ramifications of applying solutions to a problem when the root cause of the problem had not yet been identified. The lessons learned from the discussion were general in nature and had application to generic problem solving. I will be discussing actual case studies from industry for the remainder of this Problem Solving series. My objective is neither to embarrass nor to "point the finger." In fact, I will not identify the organizations involved in the cases. My objective is to share with the reader both the experiences in problem solving and the insights from the lessons learned in the discussion of the cases.

I was contacted by a plant manager who told me that he had some problems and needed assistance in arriving at a viable solution. His immediate concern involved a bottleneck at the heat treating furnace. He asked if I could get someone to perform an engineering economics study to determine which of two options would be the more cost effective. He was considering either the purchase of a large, expensive furnace capable of treating multiple lots of work in process (WIP) simultaneously vis-à-vis the purchase of several smaller, less expensive furnaces capable of treating each lot as it arrived at the work station. His goal was to process the WIP as efficiently as possible, and at the lowest cost, in an effort to resolve the bottleneck problem. He stated that once the bottleneck was eliminated he wanted to address his remaining problems. He complained that he was experiencing missed due dates, poor quality, excessive scrap, and customer dissatisfaction. In addition, his energy, material, and overtime costs were high

and he was losing new business because of his lack of sufficient plant capacity.

I tasked a student in my Engineering Economics class to undertake this problem for his class project. A week later, the student informed me that he could not complete his assignment because the need for an economic analysis was no longer necessary. His explanation was quite simple. The student had gone to the plant and met with the plant manager to obtain the information that he would need to conduct the analysis. He asked why the manager needed to evaluate the furnace acquisition options. The manager explained that as the work piece was processed, it became strain hardened and needed to be heat treated to restore the required physical properties. The student asked why was it that the work piece became hardened. The manager, losing patience, explained that the material reacted to the processing in such a manner as to become hardened - and that hardening was unacceptable and must be relieved by heat treating the piece. The student then asked why that particular material was being used to manufacture the part. That question created an enormous silence. The question was finally put to the plant's metallurgist who replied that he wondered about that himself. He stated that he had wanted to use a cheaper material. The cheaper material had physical properties that would preclude the work piece from becoming hardened by the manufacturing process and would eliminate the need for heat treatment. He assured all within hearing that the material was just as suitable, if not more so, than the current material for use in fabricating the part. Thus, the need for an economic analysis no longer existed. The plant manager changed the material and eliminated the heat treating step from his production line.

My student received an A for the course. And why not? He accomplished what engineers are trained to accomplish - he solved the problem. The bottleneck was eliminated.

Lessons learned:

1. Do not rely on the person with a problem to provide the solution (in this case, "I need an economic analysis of my two options in order to eliminate the bottleneck effectively").
2. It is impossible to find an optimum solution to a problem without first identifying the root cause. A more efficient heat treating station may have provided a modicum of improvement, but it would have been suboptimum compared to the improvement realized by eliminating the problem's root cause.
3. Consider input from all concerned before implementing a manufacturing process. The metallurgist's advice should have been followed at the beginning of the manufacturing project. There would have been no bottleneck problem with heat treating.
4. The technique of asking multiple "why's" (usually acknowledged to have originated with Japanese problem solvers) is effective in identifying the root cause of problems.
5. Do not allow your approach to problem solving be limited by "labels." My student's project started out as a problem in engineering economics. Had he limited himself to that "label," he probably would have recommended the re-configuration of the heat treating station and he would have arrived at a sub-optimum solution. He attained the goal of every problem solver. He achieved an optimum solution by identifying and eliminating the root cause of the problem.

And now for "the rest of the story."

The remaining problems that the plant manager wanted to address subsequent to eliminating the bottleneck had also been eliminated once the root cause had been resolved.

1. The delays and subsequent missed due dates no longer existed. Elimination of the bottleneck resulted in a synchronous production line that moved rapidly and efficiently.
2. Quality increased. Workers on the line had

been reacting to pressure from management to speed up the process. One way was to take short cuts at the bottleneck. This was accomplished by inserting the WIP into the furnace before sufficient time was allowed to reach optimum heat treating temperature and / or decreasing the soaking time required for recrystallization. Hardening was no longer a factor in the part quality once the raw material was changed.

3. Increased quality meant less scrap.
4. Quality increase and on time delivery resulted in increased customer satisfaction.
5. Energy costs were reduced significantly, as were costs to operate and maintain a furnace.
6. Material costs were reduced with the introduction of the substitute material.
7. Overtime costs were greatly reduced with the elimination of the bottleneck and concomitant production rate increase.
8. Management realized that sufficient plant capacity existed and that there was no requirement for further equipment acquisition. Additional business was possible without the need to invest capital for additional capacity.

Problem solving is one of the essential elements in a successful enterprise - manufacturing, financial, scientific or other. In order to optimize the problem solving effort, the root cause of the problem must be identified before the viability of proposed solutions can be evaluated. Once again, I quote G.K. Chesterton, "It isn't that they can't see the solution. It is that they can't see the problem."

If you wish to contribute to the discussion in the Editor's Corner, please direct comments to: [editors.corner@jaset.rit.edu](mailto:editors.corner@jaset.rit.edu)

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