The Solution Often Lies in the Definition of the Problem

As scientists, we spend a significant amount of time problem solving. Unfortunately, too often, we spend time solving the same problem again and again. Have you ever looked with envy at a dog chasing its tail? At least the dog knew what it was trying to do!

A number of years ago, a client asked us to investigate a problem that had been plaguing the company off and on for 25 years. Many talented scientists on the company's staff had tackled the problem during prior occurrences. Yet the problem continued to reoccur. Because the problem was important, we were granted the opportunity to thoroughly explore the problem in a step-by-step manner. We did succeed in solving it once and for all. On reflection, we found that the solution lay in the proper definition of the problem and a thorough problem-solving process.

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Understand the Problem

A proper understanding of the problem takes a considerable amount of work. Problem-solving courses often explain the process of analysis through the analogy of six people looking at an elephant. Given each person's location, his view of the elephant is incredibly different from anyone else's. Many don't even realize that they are looking at an elephant. In the first phase of problem solving, the problem solver is in exactly the same position as those looking at the elephant.

To work toward solutions, one should interview as many sources as possible to get different views of the problem. Start with those most directly involved with the problem: scientists, line operators, line supervisors, quality assurance personnel, production or distribution management, or consumer complaint operators. Depending on the issue, there may be many other people who can provide a useful perspective on the problem. At this early stage, too much information is definitely better than too little.

A second way to expand your understanding of the problem and to begin to formulate the proper conditions for its solution is to assess the impact of the problem on the various people you interview. From the line supervisor's point of view, the problem may cause downtime or increased shrink in raw ingredients. From the distribution manager's point of view, the problem may cause increased shipping costs. From the sales department's point of view, the problem could cause the permanent loss of a key account. This assessment of impact paints a very different picture of the importance of solving the problem. Also, the range of acceptable costs for solving the problem is likely to be quite different from each department's point of view.

Asking "when, why, and how" provides yet another view of the problem. Understanding what the conditions are when the problem occurs—and the conditions when it does not—may provide important information as to the cause. This same information will be critical to establishing an effective monitoring program to test the solution after it is implemented and confirm that the problem is really solved.

Collect your information in a systematic manner. Many people use index cards (am I dating myself?) or the modern-day equivalent of a sortable database. Once the information is collected and cataloged, it can be sorted in a variety of ways to provide different views of the problem.

One final way to confirm that you really understand the problem is to be able to create the problem at will. If you can't, you don't fully understand the problem. Also, if you can't create the problem, you may not be sure you've solved it. Predictably, these problems seldom occur when you want them to.

Define a Successful Solution

After you have "fleshed out your view of the elephant," restate the problem in light of all the information gathered. At this point in your problem-solving process, you can also begin to provide parameters for a successful solution to the problem.

Clearly define the criteria for a successful solution and a successful outcome. They may be different in some situations. For example, a successful solution to the problem may require three changes in formula and process parameters that cannot be implemented completely until flour from the new crop year is available. A successful outcome, however, would be the immediate implementation of two of the three changes, which together reduce the problem so much that it is no longer noticeable to the consumer.

A successful solution might need to meet certain limitations, including cost constraints, annual sourcing constraints (such as flour availability), completion deadlines set to meet sales calendars, and limitations on changes that can be made to the manufacturing system. Sometimes these limitations combine to form an insolvable problem. If that appears to be the case, prioritize the constraints so that the problem solvers know what can "give" and have the least impact on the system. Indeed, sometimes the problem is "solved" by prioritizing or relieving some of the constraints on an acceptable solution. You may have had the solution in hand all along and just not agreed to implement it.

Approach: Basic Understanding via Model Systems or Empirical Approach?

A very harried scientist told me with great certainty that he did not have time to develop a basic understanding of his food system and the problem at hand. His client was insisting he solve a major problem in less than one month! One month later, after making no progress towards resolution of the problem, the team decided to go back and understand the basic structure and chemistry of the food system. They then defined the problem within the context of that basic understanding and were able to solve it in six weeks.

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We find that using a *blend* of basic understanding and empirical approaches yields the best results. A basic understanding of the system gives a starting point for approaches, evaluation schemes, and ingredients or processes to try. After years of diligent coaching by our statistician, we largely bypass single-variable testing (unless it is critical to understanding the system) and quickly move to experimental designs. We find experimental designs provide efficiency, rigorous comparisons of possible approaches, and, in some cases, unexpected additions to our understanding of the system.

It is also important to plan to fail. Design the experimental approach to see both success and failure. This will show "where the cliffs are" so that the chosen solution isn't near the edge of unacceptable performance. This can be accomplished by expanding experimental ranges to the point at which failures should occur. Indeed, if you don't experience failure at the expected points or experience unexpected forms of failure, you've learned critical new information. Several such approaches are available, including "Robust Design" and "Signal to Noise" techniques, among others.

Collaboration can be a powerful means to develop approaches and hypotheses on mechanisms. If people with a wide range of experiences and backgrounds are included in the problem-solving group, particularly beneficial results can be obtained. Often, the approach or solution to a problem is an adaptation of technology from another totally unrelated area.

Collaboration can also be used prior to implementation. Once a solution has been identified, see if someone else can create the same or similar results with different ingredients and/or equipment. A better or less costly solution may be identified with this process.

Implementation Is Key

Too often, one group is in charge of solving the problem and another is in charge of implementing it. Avoid this organizational setup if possible, since those who solve the problem will have unique insight into what the possible pitfalls might be during implementation.

Have the group responsible for implementation take steps to gain "buy in" before beginning implementation. Reconfirm agreement on the problem to be solved and reasonable parameters for the solution. Remember that no one likes it when change is "done to him," so if those affected by the changes need to have minor modifications made in the solution, accommodate them if at all possible.

Prior to actually implementing the solution, set up a monitoring system to confirm that the problem is really resolved. Agree on objective measurements that will confirm resolution. Finally, review the results of the monitoring system to confirm that the problem is really resolved. Then you can be the dog that finally caught his tail!