Solution Engineering: A Different View of Solving Problems

DISTANCE CONSULTING
"Assistance at A Distance"SM

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Introduction

Solving problems has become a core skill, a key competency in the modern workplace. It is no longer the province of a select few. Many, if not most, employees must now figure out what to do and how to get it done. Moreover, many of these situations do not have a "cause" – root or otherwise; instead, it is more a matter of achieving targeted results, often under varying circumstances. For these reasons – and others – it makes sense to think of "engineering solutions" instead of solving problems. This paper elaborates on that premise.

A Different Point of View

Let's suppose you ask me to provide you with some "food for thought" with respect to "beefing up" the problem-solving capabilities of people at your company. You further indicate you are looking for a "different point of view."

I would answer by saying I encourage you to think in terms of engineering solutions instead of solving problems and, similarly, I would encourage you to say, "Solution Engineering" instead of "problem-solving."

The balance of this paper will make clear the reasons for this different point of view.

Why Solution Engineering?

There are two reasons. First, "problem" is a word that carries a lot of baggage. Second, the term "Solution Engineering" focuses more directly on the heart of the matter; namely, a solution.
To many people a problem is a bad situation, one that shouldn't have happened and for which someone is likely to be punished. Consequently, it is difficult to discuss problems and problem-solving without arousing defensive behavior. Similarly, because problems are often defined as situations in which something has gone wrong, problem-solving is often portrayed as a task of finding and fixing the something that has gone wrong. This cause-centered view of problems and of solving them leads to a reliance on a single problem-solving approach: namely, troubleshooting.

Not all problems are caused, not all causes can be corrected, and troubleshooting is only one approach to solving problems. Finally, owing to the factors just mentioned, we all too often find ourselves playing word games instead of engaging in productive activity, as is the case when we refer to a problem as an "opportunity" (simultaneously sullying a word that has a definite meaning in its own right and ducking the issue at hand).

A solution is a course of action that leads to the desired results. Presumably, a solution is required because desired results are not being realized. Otherwise, action would not be necessary. To act is to change things. To solve a problem is to *intervene*, to change things with a result or outcome in mind.

Solution Engineering: A Different View of Solving Problems

One of the chief meanings of engineer (as a verb) is *to arrange or bring about through skillful, artful endeavor* (as in “He engineered the election.” or “She engineered a turnaround of her division.”). To engineer a solution is to create and carry out a course of action that leads to the desired results. It stands to reason that you must be clear about the results you want to achieve and the means of achieving them before you can intelligently effect the necessary changes. Getting clear about the results to be achieved and the means of achieving them is the essence of Solution Engineering.

The Nature of Solution Engineering

Solution Engineering is a form of knowledge work; specifically, it is a form of intelligence work. It is a gathering of bits and pieces of information in an effort to construct a coherent picture of some situation for the purpose of identifying and then taking appropriate action. Although Solution Engineering is information-based, its aim is action and, through this action, the achievement of specified results.

Solution Engineering is not a linear, sequential, step-by-step procedure. Intuition and insight often play key roles. So does luck. Most important, any investigation entails uncovering and following what are usually referred to as “leads.” Such is the case when engineering a solution to a business problem.

The Definition of Solution Engineering

Solution Engineering is the art and science of getting from here to there, of defining some desired state of affairs and then managing, maneuvering and manipulating conditions and circumstances so as to bring about that state of affairs.

The Solution Engineering Process

The Solution Engineering process consists of two basic phases: *Investigation* and *Intervention* (see Figure 1 below).

The Investigation Phase: Unmasking the Problem					
Describe the Presenting Problem	**Describe the Desired Results**	**Identify the Relevant Structure**	**Create A Map of that Structure**	**ID Points of Evaluation & Intervention**	**Map Out the Solution Path**

The Intervention Phase: Executing the Solution					
Specify the Required Changes	**Identify Methods & Resources**	**Obtain & Allocate Resources**	**Make the Required Changes**	**Monitor & Assess the Results**	**Adjust as Necessary**

Figure 1 – The Solution Engineering Process

Investigation focuses on identifying a solution; Intervention focuses on implementing it. Investigation has two primary aims: 1) specification of the solved state (the results to be achieved) and 2) the identification of a viable solution, that is, a suitable course of action for bringing about the specified results. Intervention has as its ultimate aim the realization of the solved state as a result of carrying out the envisioned course of action.

The Role of Models in Solution Engineering

Central to an effective and efficient investigation of a problem is the appropriate use of one or more models. By model, I mean the graphic representation of the structure of the class of problem being addressed. Problems, as the last sentence implies, can be grouped into classes based on what a physician might term “presenting symptoms.” Thus, problems can be and are classified as business problems, performance problems, financial problems, technical problems, legal problems and so on. These different classes of problems have different “structures;” that is, they consist of some set of variables characterized by some more or less definable and structured set of relationships. A human performance problem, for instance, has a structure involving variables such as task clarity, the consequences of performance and of non-performance, the presence or absence of feedback regarding actual performance against intended performance, the availability of the proper tools, and so forth. In contrast, a “financial” problem might involve variables from the income statement, balance sheet, or chart of accounts (e.g., sales, expenses, costs, assets, long-term and short-term debt, etc.).

To solve a problem – any class of problem – is to search in the structure of the situation in which the problem is embedded, looking for variables that can be changed so as to bring about the desired results. This search activity can be organized, disciplined and systematic, or it can be random and haphazard – what the technicians of my day called “Easter-egging.” To the extent that this search activity focuses on those aspects of the problem that are relevant to solving it, the problem-solving process can be both effective and efficient. Models, then, serve to focus search activity on the appropriate factors. They guide the analysis or what might be termed the diagnosis of the problem. The better the model the more effective and efficient the problem-solving effort will be.

The particular model to be used is typically invoked as a result of labeling the problem. Labeling a problem a “financial” problem will invoke a model that in some way or another represents the arithmetic structure of the income statement, the balance sheet or the chart of accounts. Conversely, labeling a problem as a “manufacturing” problem is likely to invoke a model depicting flows of materials and information as well as the relevant manufacturing processes and controls. Unfortunately, the models so invoked typically exist only in the minds of the participants; they operate from memory instead of from what a technician would call a “schematic.” Moreover, each participant's model is peculiar to that individual. Not only do these models vary from one another, they don't always reflect current realities. Thus, the analyses and diagnoses based on these models often go awry. Given that such models are typically invoked as a result of the label placed on the problem, an incorrect label can lead to an invalid analysis and result in a wholly inappropriate course of action.

The Importance of Consensus and Commitment

The goal of all problem-solving efforts is action. Action requires resources and is subject to restraints and constraints. The intervention phase, therefore, is very much concerned with marshaling resources and coping with constraints. It has been well said that the real trick in problem solving is finding a solution that will fit the constraints. Significant also is the ability to muster support for one's point of view – that the problem is indeed a cause for concern and deserving of action. Consensus may also be required regarding the nature of the problem and the probable success of any proposed solution(s). Further, there is the matter of obtaining, in competition with other problems and issues, the resources necessary to implement the selected solution. Problem solving is a very practical *and* a very political matter.

Barriers and Obstacles

Why then do so many problems stay unsolved for so long? From my perspective there are five major factors that prolong problem-solving efforts, thus increasing the cost of the problem as well as the costs of solving it.

1. Too many “disconnects.”
2. Inadequate diagnostic models or no models at all.
3. A failure to develop consensus and commitment.
4. Inadequate problem-solving tools.
5. The wrong mindset or mental frame of reference.

“Disconnects”

“Disconnect” is a term that refers to a severing of the relationship between the definition of the problem and its subsequent analysis and resolution. This typically happens when senior management defines a problem, middle management analyzes it, and line management implements the solution. “Discontinuity” is a term that might also be applied to this breakdown in communication and understanding of the problem and its solution.

Disconnects or discontinuities can also occur laterally. Perhaps the most commonly occurring examples of lateral disconnects are to be found in systems development. The evidence here, of course, consists of statements by the users such as, “That's not what we wanted or needed.” The systems shop, as you doubtless know, then rejoins with, “If only you'd told us what you wanted, we would have given it to you.” (My personal view on this particular issue is that, over the years, the systems shops in this country have lost their ability to identify business requirements and translate them into system specifications and, further, that the users never possessed that capability.)

In any case, the obvious response to disconnects or discontinuities is to provide continuity. As a colleague of mine says about all efforts, large and small, “Sooner or later, the whole thing must pass through and fit in one brain; if not, it isn’t going to work because no one understands it from end to end.” There are many ways of doing this and we can discuss them at a later time.

Absent or Inadequate Models

The importance of models cannot be overstated. As a technician in the United States Navy, I had occasion to do a great deal of what might be termed technical troubleshooting, that is, of diagnosing and repairing malfunctioning weapons systems. I was aided in my efforts by schematics – diagrams of the structure of the system, signal flows, power sources, and the like. Upon entering the management and organizational consulting arena I was struck by the lack of “schematics” for many of the problems facing managers and executives. So, in my own practice I have developed many models to aid me in what I now call “Solution Engineering” instead of troubleshooting or even "problem-solving." Indeed, if I have any proprietary technology at all it consists of the models I use. The chief point being made here is this: without a model to guide the analysis or diagnosis that analysis or diagnosis must be intuitive and is likely to be haphazard instead of systematic. Moreover, success is likely to be a matter of luck instead of logic.

Failure to Obtain Consensus and Commitment

Organizations must be governed as well as managed, which is to say that power and politics are not inherent evils but legitimate aspects of organizational life. Few learn this lesson, and many write off their failures as owing to politics and power games. As regards problem-solving, implementing a solution always requires resources and always signals change of some kind. Additionally, the problem itself can be viewed from many different perspectives, leading to different definitions of the problem and differing views of an appropriate solution. The failure to develop consensus regarding the problem and commitment to the chosen solution has stopped more than one problem solving effort dead in its tracks. In the last analysis what this boils down to is the identification and reconciliation of at least four different views of the problem: technical, financial, social, and political. (In my experience, most efforts focus on the first two.)

An Absence of the Appropriate Tools

The fourth obstacle to effective and efficient problem-solving efforts is much the same as that which is commonly found in any area of endeavor; namely, the absence of appropriate tools for the task at hand. The models or schematics mentioned earlier constitute one kind of problem-solving tool. Checklists, sample questions, worksheets, forms for recording information and data, graphs, charts and all manner of documents and documentation provide other kinds of tools. So, too, do definitions and descriptions of the problem-solving processes to be followed. In these prescriptive processes can be found a fifth and final obstacle: the wrong mindset or frame of reference.

Mindset or Frame of Reference

The practice of problem-solving is plagued by myths and, if I can be pardoned for playing with the language, *myth*conceptions. Chief among them are these three:

- *Myth #1*: *Problem-solving is a linear, sequential, step-by-step procedure or process*. No it isn't. It is linear *and* non-linear, much like a series-parallel circuit. The search for a solution is marked by much bouncing around and the picking up of bits and pieces of information as you go. It is, as I said earlier, a form of intelligence work. Forcing problem solvers to follow a step-by-step approach is counterproductive and dysfunctional.

- *Myth #2*: *To solve a problem, one must seek out the cause of the problem so it can be corrected.* No, you don't. First of all, not all problems can be said to have a cause; that is, problems don't always exist because things were fine and then something went wrong. Even when a cause might be suspected you can't always do anything about it (just ask all the financial firms that are still suffering from the market crash of '87). But the search is always for a course of action that will lead to the solved state.

- *Myth #3*: *Problem-solving is a neat, rational, logical process.* Right and wrong! The problem-solving process is as much dependent upon insight and intuition as it is upon rigorous, systematic analysis. It can be extremely messy. When solving a particular problem there is no substitute for first-hand knowledge of that specific situation. That said, problem-solving is a generalizable process and it can be extended across classes of solutions.

Problem Defined

One generally accepted definition of a problem is that a problem is a discrepancy between *what is* and *what should be*. This view is often associated with the Kepner-Tregoe or "K-T" approach to problem-solving. However, the concept of a problem as a discrepancy or gap between two states is in fact traceable to a logic theorem posed by those two eminent philosophers and mathematicians, Alfred North Whitehead and Bertrand Russell. They postulated that solving a problem was a matter of finding an operand (*q*) such that when this operand was applied to the problem situation (*a*), the problem situation would be transformed into the solved state (*a'*). From this formulation of problem-solving also comes the view of it as a search activity. The later work of Newell, Shaw, and Simon was initially concerned with proving or disproving this particular logic theorem. Newell, Shaw, and Simon, in their efforts to come up with what they called "a general problem solver" took a view that I have adopted; namely, that a problem exists when action is required but the appropriate course of action is not immediately apparent.

Clearly the notion of a discrepancy between the problem state and the solved state runs through what I have been saying. Consequently, a perfectly logical question at this point is, "How is that different from what others have already said?" My answer is that others define a problem in terms of a discrepancy between two states. I am inclined to think that *what makes a problem a problem is not knowing what to do about that discrepancy*. In short, it is uncertainty regarding action that makes a problem a problem.

The second generally accepted definition of a problem is that it is a bad situation, typically one that should not have happened and thus someone should be held accountable. Use the word "problem" in normal discourse in almost any organization at almost any level and then observe the startled looks and the immediate protestations that they don't have any problems. (This reaction leaves little room for speculation regarding the reasons that problems don't get solved.)

For most purposes I define a problem as follows: *You have a problem when you know you need to do something, but you aren't sure what to do*.

Solution Defined

Little needs to be said here except that a solution is a course of action that gets you what you want. What you want us also referred to as "the solved state." A solution, then, is *a course of action that leads to the solved state*. Said a little differently, a solution is a course of action that eliminates the need for action.

Parting Advice

I have said most of what I have to say about problem-solving. Is there more to be said? Of course, but saying it would fill volumes. I will conclude with some parting advice.

If your aim is to upgrade the problem-solving skills of the people in your company you must find ways of eliminating the many barriers and obstacles to effective and efficient problem solving (e.g., "disconnects," the lack of models, etc.). Doing so will lead you deep into the bowels of your organization's structure and its control mechanisms – and that can be a very arduous not to mention painful process.

You must establish a common language and some shared standards for the problem-solving activities of your people. This requirement alone signals a massive training effort because it isn't going to happen any other way. Everyone – and I mean *everyone* – must go through this training. No exceptions.

Be prepared to take some heat. If you are successful these new approaches to problem-solving will challenge existing beliefs, methodologies, authority structures and "turf" boundaries. This will offend some, threaten others and, eventually, result in changes in the culture of your organization. New stars will shine brightly, old ones will fade, and you will be seen as the cause of it all.

My parting advice is that the first step should be one of developing consensus and commitment to the solution you are about to implement and the problem you are attempting to solve. My parting caution is that you shouldn't be surprised if your definition of the problem changes.

Further Reading about Solution Engineering

You can access the papers listed below by clicking on the title.

1. Choosing the Right Problem-Solving Approach
2. Five Kinds of Gaps and What to Do About Them
3. Forget about Causes, Focus on Solutions
4. Reengineering the Problem-Solving Process
5. Solution Engineering: An Introduction
6. Solution Engineering in Action: A Really Good Example
7. Ten Tips for Beefing Up Your Problem-Solving Toolbox
8. Three Cases of Figuring Out What to Do
9. What's Your Intervention Logic? – The Links to the Bottom Line

For More Information

Contact Fred Nickols by e-mail and visit his articles web site. There, you will find more about problem solving and Solution Engineering.