Solution Engineering

The Four-Step Model

Fred Nickols

DISTANCE CONSULTING LLC

Solution Engineering: The Four-Step Model

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The Solution Engineering Four-Step Model of the problem-solving process is depicted below.

Four Steps in Solving A Problem

Take Stock of the Situation — **Assess**

Figure Out What to Do About It — **Analyze**

Execute — **Make It Happen**

Organize — **Get Ready for Action**

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A discussion of each of the four steps follows.

Assess: Take Stock of the Situation

The first order of business is to take stock of or get a fix on the situation. This entails the following:

- clarifying the situation

- specifying the outcomes

- classifying the structure

- tending to the politics

Clarifying the situation involves checking and confirming the perceptions and expectations of key stakeholders. What triggered the effort? Is this a reactive or a proactive effort? Is it corrective or preventive? What do they want? Why? What do they believe might be the cause of the problem? Where does the problem stand in their hierarchy of priorities?

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Clarifying the situation also entails defining the problem. Many people are familiar with the requirement to "define the problem" but few can say in detail what that involves. To define a problem is to establish its boundaries, to determine its nature, to come to understand and be able to explain it and, eventually, to describe it to others.

An important step in taking stock of the situation is that of specifying the outcomes to be obtained. Outcomes always relate to differences between what we have and what we want and fall into one of four categories.

One category consists of those conditions or circumstances we are trying to *achieve*. This is the case when we want something we don't have. A second category consists of conditions we are trying to *avoid*. This is the case when we are about to have something we don't want, and we want to ensure that it doesn't come to pass. A third category consists of conditions we are trying to *eliminate*. This is the case when we have something we don't want. The fourth category consists of conditions we are trying to *preserve*. This is the case when we have something we want, and we wish to keep it.

Outcomes must be specified in ways that later enable the determination of the extent to which they were or weren't attained. In short, they must be stated in measurable form.

If you are successful, the outcomes you seek will be brought about as the result of intervening in the structure of the situation; in other words, as the result of changing something. Moreover, because change in complex systems is usually indirect, you must change something at one point so as to bring about results at some other point. For this reason, it pays to have a model, a diagram of the structure of the situation. Such a model enables you to identify linkages between the points of evaluation (i.e., the places where you expect to produce results or evaluate their attainment), and the points of intervention (i.e., the places where you are able to directly change one or more elements of the situation).

You are aided in your effort to diagram the structure of the situation by classifying the situation. Most problems encountered in an organizational setting belong to a small set of basic types and thus a few basic structural models are all that is necessary. The more basic types of problem structures are financial, operational, and behavioral.

Many financial problems typically have some kind of mathematical structure. For example, return on equity (ROE) is the ratio of profits to owner's equity. The current ratio is the ratio of current assets to current liabilities. These kinds of arithmetic structures can be decomposed into great detail and action subsequently focused on the factors that affect them.

Operational problems typically have some kind of a process flow or systems structure. These, too, are amenable to decomposition and analysis so as to identify points of intervention that will yield the desired results at the points of evaluation. Moreover, much is known about intervening in the structure of processes and systems.

Behavioral problems have a structure, too, albeit we know much less about the structure of behavior than we do about the structures of finance and operations.

Models for all three structural types can be developed and used as guides in configuring a course of action to produce the required results.

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It is wise to begin tending to the politics of a problem-solving effort at the very beginning. You must build consensus regarding the problem and, later, regarding its solution. You must marshal support and, possibly, cope with opposition. And, finally, as the business press reminds us all from time to time, you must communicate, communicate, communicate.

To summarize, taking stock of the situation consists of:

- clarifying the situation,
- specifying the outcomes,
- classifying the structure, and
- tending to the politics.

Analyze: Figure Out What to Do About It

A problem is a problem because what to do about it is not clear; hence, the requirement to figure out what to do.

The very first step in this phase is to select an approach. There are three basic choices: troubleshooting, performance improvement, and solution engineering. The approach to select is a function of the nature of the problem to be solved. The best clues regarding which approach to use stem from the manner in which the problem came about.

In business or organizational settings, problems are often defined in terms of a discrepancy or "gap" between expected or required results and perceived or actual results. Such gaps occur in three basic ways. In the first case, things are going along just fine and then something goes wrong, often quite suddenly and with no warning. In the second case, things are again going along just fine but, for various reasons, a decision is made to "raise the bar," to "aim higher," to achieve some new level of performance. Here, actual conditions remain unchanged. The cause of the gap is raised expectations. In the third case, goals are being set for the very first time and the means of attaining them is not clear. The gap comes about not because of a fall off in results, or as the result of raised expectations but, rather, as the result of setting initial expectations.

In the first case cited above, the one where things have gone wrong, the proper approach to use, at least initially, is a troubleshooting or repair approach. The task at hand is to find and fix the cause of the problem. In the second case, an existing system is place and the task at hand is to improve upon its performance. The approach to use in this case is essentially one of performance improvement. In the third case, there is no existing system or process to troubleshoot or improve. The task at hand is to engineer a solution, to design and carry out a course of action that will produce the required results.

As mentioned earlier, to solve a problem is to change things at one point so as to create certain desired effects or conditions at some other point. Any point at which you change things is referred to as a "point of intervention." Any point at which you seek to create defined effects or conditions is known as a "point of evaluation." It is essential to be able to trace the linkages between these two points. On the one hand, for a given result, you want to be able to specify the actions that will lead to it. On the other hand, for a given action, you want to be able to state the effects it will create.

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The ability to link ends and means rests squarely on your knowledge of the structure of the situation in which you will be intervening. If you know it as well as the back of your hand, fine. You can probably make the connections. If you don't, then drawing a diagram of the structure of the situation will go a long way toward making sure your intervention produces the desired effects. Perhaps the single most important task in solving any problem is that of constructing an adequate diagram of the structure of the situation in which the problem is embedded.

Figuring out what to do is a matter of examining the structure of the situation for the purposes of identifying which elements in that structure must be changed in which ways to produce the desired results. Additionally, the means of making these changes must also be determined. Once these change targets have been identified and the means of making the necessary changes have been determined, the general form of the solution is known.

To recap this phase, figuring out what to do involves the following:

- choosing an approach

- diagramming the structure of the situation

- identifying change targets

- specifying the general form of the solution

Organize: Get Ready for Action

Getting ready for action or planning for the implementation of the solution consists of four major steps:

1. reconciling restraints and constraints

2. preparing an action plan

3. settling on a change management strategy

4. tending to the politics (again)

Restraints are the things you can't do. Constraints are the things you must do. Whatever you set out to do must be consistent with the restraints and constraints you face. This does not mean that you have to accept all restraints and constraints; indeed, it is important to surface and challenge them. But, at some point, you will be faced with operating within some set of limits. Some of the more obvious limits are related to policy, resources, time frames, and so on. Some of the less obvious limits are related to acceptable and unacceptable forms and modes of action and behavior. Reconciling restraints and constraints results in authorization to proceed with the planned course of action, funding to support it, and the allocation of any necessary resources.

Action plans set forth assignments, schedules, milestones and deliverables, and any contingencies. Basically, they say who is to do what when.

Action plans define interventions, efforts aimed at changing things with some purpose or outcome in mind. This requires that thought be given to a change management strategy. There are four basic change management strategies:

1. persuasion

2. education

3. coercion

4. adaptation

Persuasion is useful when appealing to people's self-interest. Education helps when barriers and resistance owe to lack of information or knowledge. Coercion in one form or another is almost always necessary. This can be mild, as is the case when recognition and reward systems are modified, or severe as when those who oppose the changes are ousted and serve as object lessons to those who remain behind. Finally, there is the strategy of adaptation, of creating a new unit or organization and gradually moving people from the old arrangement to the new, where they have little choice except to adapt.

As before, it is necessary to tend to the politics. Consensus must be maintained throughout the process. Confirmation of approaches taken, and actions planned is necessary on at least a periodic basis. Support must be regularly verified, and opposition continuously monitored. And, of course, communication is an ongoing process.

Execute: Make It Happen

Here is where the rubber meets the road. The solution is carried out and its impact on the situation is appraised. In addition to evaluating the effectiveness of the solution, its efficiency must also be evaluated, that is, did it create any new problems and to what extent do they offset the value of solving the original problem? The implementation process must also be evaluated. How effectively and efficiently was the solution carried out?

The idea of evaluating the implementation of a solution separately from the solution itself is an important one. It is sometimes the case that a perfectly good solution fails to produce the desired results because of poor implementation, not because the solution was the wrong course of action. Thus, instead of looking for a new solution, which is what all too often happens, the botched job of implementation should be corrected.

The entire problem-solving effort should be critiqued. Note should be taken of any mistakes made and lessons learned. Also of interest are any beliefs or assumptions that did or didn't prove to be the case. The objective here is to profit from experience in the form of tips for the next time. Post-mortem critiques, then, should be open, candid, and have absolutely no punitive measures whatsoever attached to them.

Finally, it should be noted that the four-step process is a loop; it is iterative in nature. Once initial action has been taken, it is important to again take stock of the situation to see if the changes made are having the desired effects. That assessment might lead to the identification of new problems, searches for additional solutions and revised or refined actions.

Closing Comments

No article this brief can hope to capture the richness and complexity of the process of solving important financial, operational, and behavioral problems in a business or organizational setting. It has been my hope, however, to provide a glimpse of the kind of structured, systematic and yet very simple process that has been of use and value to me for many years in a variety of roles and

organizations. There are many good books available that touch on some of the points raised in this paper. Some of the more relevant ones are listed below under the heading of Recommended Reading. It should be pointed out, however, that none of these books, singly or collectively, touch on all the issues raised in this article. There are, then, fresh ideas in this article and it is the author's hope that its readers make good use of them.

Reference

1. Lewin, K. (1951) *Field theory in social science; selected theoretical papers.* D. Cartwright (Ed.). Harper & Row.

Recommended Reading

1. John Dewey (1910). *How We Think*. D.C. Heath.

2. Chester Barnard (1938). *Functions of the Executive*. Harvard University Press.

3. Richard Weil, Jr. (1940). *The Art of Practical Thinking*. Simon and Schuster.

4. G. Polya (1945). *How to Solve It*. Princeton University Press.

5. Alex Osborn (1953). *Applied Imagination*. Scribners.

6. Herbert Simon (1960). *The New Science of Management Decision.* Harper & Row.

7. Charles Kepner and Benjamin Tregoe (1964). *The Rational Manager*. McGraw-Hill.

8. Edward de Bono (1970). *Lateral Thinking*. Harper & Row.

9. Allen Newell and Herbert Simon (1972). *Human Problem Solving*. Prentice Hall.

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11. Russell Ackoff (1978). *The Art of Problem Solving*. John Wiley & Sons.

12. John Arnold (1978). *The Art of Decision Making.* ExecuTrak Systems.

13. Harvey Brightman (1980). *Problem Solving: A Logical and Creative Approach*. Georgia State University.

14. Stephen Andriole (1983). *The Handbook of Problem Solving.* Petrocelli.

15. Edward de Bono (1985) Six *Thinking Hats*. Little Brown.

16. Gerald Nadler and Shozo Hibino (1990). *Breakthrough Thinking.* Prima Publishing and Communications.

17. Sidney Parnes (1992). *Source Book for Creative Problem Solving*. Creative Education Foundation Press.

18. Peter Frensch and Joachim Funke (1995). *Complex Problem Solving: The European Perspective*. Lawrence Erlbaum.

More Recommended Reading

In addition to the books listed above, I encourage you to read some of the articles I have published over the years. All are available on my web site at the links below and under the heading of Problem Solving & Solution Engineering. The following are the most relevant:

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1. "Understanding Your Company's Performance Architecture." (September 2005). Business Process Management Institute.

2. "Yes, It Makes A Difference: Choosing The Right Tool for Problem Solving Tasks" (January 1996). *Quality Progress*. ASQC: Milwaukee.

3. "Reengineering the Problem Solving Process: Finding Better Solutions Faster" (Vol. 7, No. 4, 1994). *Performance Improvement Quarterly*. Learning Systems Institute, Florida State University: Tallahassee.

4. "Ten Tips for Beefing Up Your Problem Solving Tool Box" (July 1994). *Performance & Instruction*. NSPI: Washington, D.C.

5. "Figuring Out What to Do" (August, 1991). *Training*. Lakewood: Minneapolis.

6. "Why Those Darned 'Training' Problems Won't Go Away" (1990). *Performance & Instruction*. NSPI: Washington, D.C.

More Information

Contact Fred Nickols by e-mail to share any comments or request additional information, and be sure to visit the articles section of his web site at www.nickols.us/articles.html. There, you will find more about problem solving and Solution Engineering.