Solution Engineering

An Introduction

You have a choice. You can solve problems, or you can engineer solutions. In the first case, you're likely to set off on what can prove to be a pointless and fruitless search for the cause of the problem. In the second, you're going to focus on crafting a course of action that will produce the results you're after. This paper introduces the Solution Engineering approach to producing results. It covers basic concepts, presents a model of the Solution Engineering process and points to additional readings.

Solution Engineering: An Introduction

Overview

Let's begin with the obvious: To solve a problem, you must change something. If you don't, then the problem continues unresolved, or matters take care of themselves. In neither case can you take credit for solving the problem.

For the kinds of problems typically addressed in complex organizations, change is usually indirect, that is, you don't change *it*, you change something else, and *it* changes as a result. In other words, you change things "over here" so as to create the desired effect "over there."

It follows that the effects you wish to create and the changes you make must somehow be connected – and so they are. They are connected by way of the structure of the situation in which you intervene. The effects or results you seek and the things you can change are both embedded in the structure of some larger situation. Thus it is that changes you make at one point (the Point of Intervention) ripple through the structure of this situation and produce the desired effects at another (the Point of Evaluation).[1] It also follows that if you do not fully grasp the structure that links the ends you seek with the means at your disposal, the actions you take might not produce the desired results. Equally important, they might also produce other, entirely unintended and unwanted effects.

Consequently, to solve a problem or, better yet, to engineer a solution, you must be concerned with the following kinds of activities:

1. Identifying the required results, the effects you wish to create and their associated Points of Evaluation (i.e., the places where you will measure the extent to which the required results have been achieved).

2. Identifying and often mapping or diagramming the structure in which these effects and their associated Points of Evaluation are embedded.

3. Identifying suitable Points of Intervention, that is, places in the structure of the situation where (a) direct and immediate changes can be made and (b) those changes will in turn ripple through the structure of the situation, producing the desired effects at the Points of Evaluation.

4. Configuring planned courses of action, that is, formulating intentions regarding actions to be taken, changes to be made, and results to be monitored.

5. Marshaling support for your view of the desired results, the actions that will lead to them and their value in relation to the resources required to obtain them.

[1] I sometimes use Points of Action and Points of Intervention interchangeably. I also refer at times to the Point of Impact and the Point of Evaluation. These, too, may be treated interchangeably at times but not always.

6. Carrying out the proposed courses of action, including adjusting those courses of action as necessary to accommodate new information and changes in circumstances.

Basic Terms

Solution Engineering

"Solution Engineering" is my label for the process by which solutions are configured and carried out. By "solution" I mean a course of action that, once carried out, brings about some desired state of affairs. The use of engineer in this context is as a verb meaning "to arrange or bring about through skillful, artful contrivance." This usage of engineer shows up in statements such as, "The top management team engineered a remarkable turnaround in the company's financial performance."

Solutions

As stated above, a solution is a course of action that, once carried out, brings about some desired state of affairs. This new state of affairs is often referred to as "the solved state."

Solutions might be broad or narrow in scope, quite complex or extremely simple, and short-lived or long in duration. A solution might cost a few dollars or many millions and require the efforts of only one or a few people or it might involve a cast of hundreds or even thousands. Thus, the term "solution" encompasses courses of action that range from mundane, everyday acts such as fixing a bug in a software program to feats of organizational artistry such as turning around a failing company.

Problem

One can hardly use a term like "solution" without speaking to the other term generally found in its company: "problem."

A problem is a situation in which action is required and difficulty is encountered because the action to take is not known. In many ways it is uncertainty regarding action that makes a problem a problem. As one person wrote, "Problem solving is what you do when you don't know what to do."

A requirement for action suggests an existing, looming or potential discrepancy between actual and required conditions. Four possibilities exist: (1) you want something you don't have; (2) you have something you want to keep and it's in jeopardy; (3) you're about to have something happen you don't want to happen, or (4) you have something you don't want, and your aim is to get rid of it. These four possibilities give rise to four corresponding categories of goals: *Achieve*, *Preserve*, *Avoid* and *Eliminate*.[2]

[2] See my paper in this series titled "The Goals Grid" for a more elaborate treatment of these four possibilities.

On occasion, the gap between actual conditions or results (*what is*) and required conditions or results (*what should be*) comes about as a consequence of something going wrong. At first, conditions are acceptable, then something happens, and conditions are no longer acceptable: reject rates soar, sales plummet, margins disappear, and share of market rapidly erodes. Problems needn't be on such a grand scale; often they involve something as simple as a PC that won't boot up or an employee who is habitually late to meetings. In all cases, however, there is an unacceptable difference between actual and required conditions. Consequently, action is required.

For a problem to exist there must be more than a requirement for action, there must also be some impediment, some difficulty, some doubt or uncertainty about the action to take. For many people, a flat tire presents no problem at all. Action is required and the required action is apparent and capable of immediate execution. Open the trunk, get out the tools and the spare, jack up the car, change the tire, put everything away and be on your way. But, let the jack be missing, or the spare be flat, or the motorist frail, and a different situation ensues. Now the course of action is not so clear. Hailing another motorist might work. A call placed via the car or cell phone might move things along, too. Waiting patiently for a state trooper to come along seems to be an option used by many. Hiking down the road to a gas station is a course of action chosen by others. There is, then, as an old saying has it, "More than one way to skin a cat." We have options, choices, different courses of action available to us or that we can configure to suit our aims, requirements, and the limits under which we must operate.

Not all problems are the result of something gone wrong. A search for "cause" isn't always called for. The cause of a flat tire might or might not be relevant. In any case, a discrepancy between what is wanted and what exists can come about as a result of other factors such as raising one's sights, of not being willing to accept the status quo. Continuous improvement programs generate a never-ending stream of problems as a consequence of regularly ratcheting up expectations regarding performance. Problems are also created as a consequence of defining some new, never before achieved state of affairs. President John F. Kennedy created precisely this kind of problem when he announced the goal of putting a man on the moon.[3]

Key Concepts

Solving Problems and Problem Solving

As stated, a problem exists when action is required but the action to take is not known. This means someone must figure out what to do. The process of figuring out what to do is commonly known as "problem solving."

More is required to solve a problem than figuring out what to do; one must also get it done. Actually solving a problem hinges on intervening, on changing things with some purpose or out-

[3] See my paper in this series titled "Forget about Causes, Focus on Solutions" for a review of the five basic sources of gaps between *what is* and *what should be*.

come in mind. And, because change is indirect, intervention is concerned with changing things in one place so as to realize results in another place.

As mentioned earlier, it is useful to think of Solution Engineering as having two phases: *Investigation*, and *Intervention*. Investigation is concerned with figuring out what is going on, what to do about it and how to do it. Intervention is concerned with doing it and, along the way, adjusting your course of action so as to adapt to changes and new information.

Point(s) of Evaluation

Whatever result, effect or impact is being sought, the extent to which it is realized must be measured.[4] The where and how of measuring a business result determines its Point(s) of Evaluation. Suppose, for instance, that "financial health" is a key business result. Suppose, further, that one chooses to measure this through some combination of measures of profitability, liquidity, and new revenue generation. The specific measures used and where and how they are applied define the Point(s) of Evaluation for the result called "financial health."

Structure of the Situation

Point(s) of Evaluation are tied to the structure of the situation in which the problem may be said to be embedded and in which the desired results are to be achieved. That structure consists of some network of variables, connections, and relationships. These structures have two very different yet complementary aspects; one is abstract and arithmetic, the other is concrete and operational. Profit, for example, is an abstract, arithmetic structure that, in its simplest form, consists of the difference between revenue and expense. Revenue and expense, in turn, are tied to still other abstract, arithmetic variables (e.g., the sum of individual sales, and the sum of various expense categories). Other structures are much more concrete and operational (e.g., the flow of raw materials into and through a production line). Through a process of analysis and decomposition, it is possible to establish the links between the abstract, arithmetic aspects of the structure of a situation and its concrete, operational aspects. In other words, one can identify and trace the linkages between the variables that enter into the calculation of profit and much more concrete factors such as people, activities, events, and materials. You can make the connections to the bottom line.

Point(s) of Intervention

These are places in the concrete aspects of system structure where actions have direct, immediate, observable effects. Moreover, these direct, immediate effects "ripple through" the system structure, creating secondary effects at other places in the system structure. One can, for example, increase the price of an item and, assuming all other factors remain constant, increase revenue and thus profit. (Of course, other factors rarely remain constant, and price increases can lead to loss of business, reduced revenue, reduced profits, loss of market share and a host of

[4] On occasion, the intended impact cannot be measured directly (e.g., as is the case with “financial health” or “improving morale”). In such cases, indirect measures or “indicators” of the end result must be used (e.g., in the case of improved morale, we might use indicators such as reduced turnover or lowered grievance rates). When we can measure desired results directly, the Point(s) of Impact and the Point(s) of Evaluation are one and the same. When we must measure results indirectly, the Point(s) of Impact and the Point(s) of Evaluation must be treated separately.

other undesirable consequences.) In any case, places in the system structure where the effects of actions taken will have the desired effects at other, predetermined places in the system structure are known as Point(s) of Intervention.

The Solution Engineering Process

As mentioned earlier, the Solution Engineering Process consists of two phases: Investigation and Intervention. Each phase has six steps (see Figure 1).

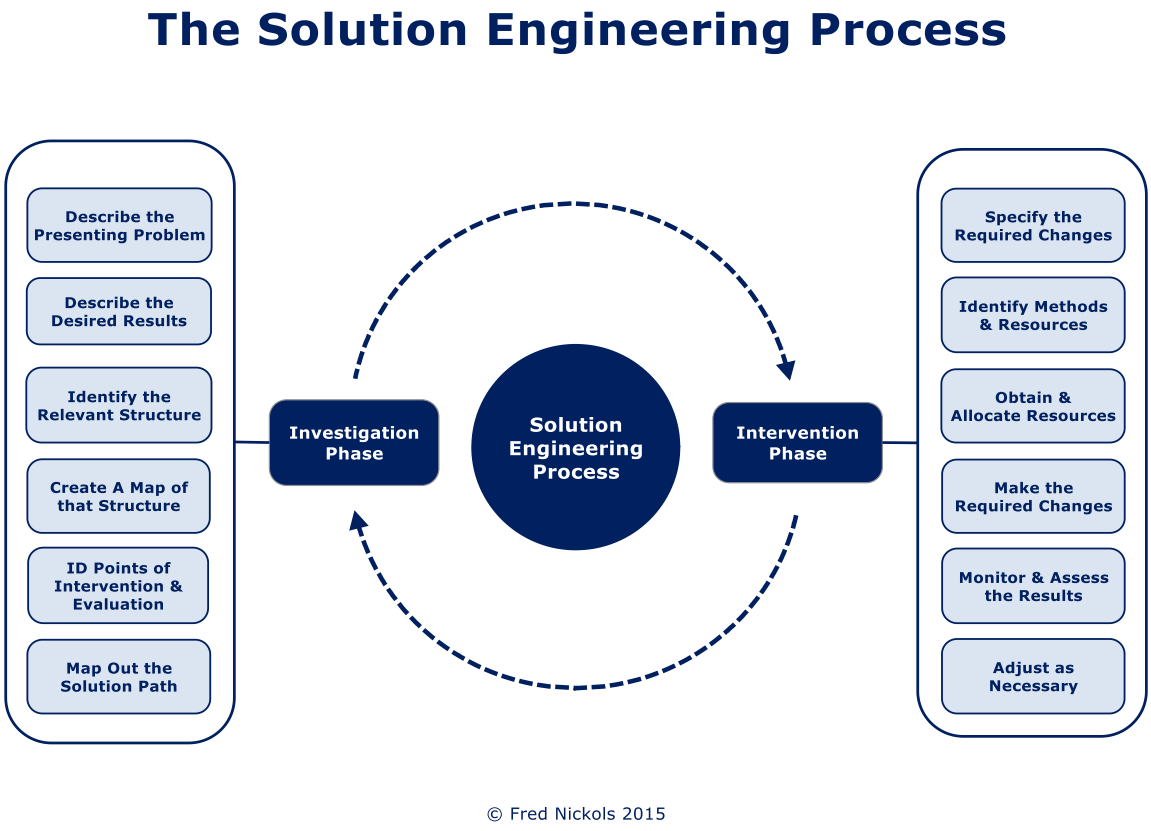

Figure 1 – The Solution Engineering Process

The Investigation Phase

The Investigation Phase focuses on figuring out what to do. It begins by describing the presenting problem and then moves on to specifying the desired results, what some would call "the solved state." Next it identifies the relevant structure and then creates a map of that structure. The map (i.e., a diagram) is used to identify Points of Evaluation – where and how those results will be measured. That map is also examined to see where and how various factors or variables

can be changed in ways that will affect the Points of Evaluation. The places where things can be changed are known as Points of Intervention. The last step in the Investigation Phase is to identify the solution path, that is, how the Points of Evaluation and Points of Intervention are linked and the paths that changes made at the Points of Intervention will follow and make themselves felt at the Points of Evaluation.

The Intervention Phase

To intervene is to change things with some outcome or purpose in mind. The purpose or outcome of the Intervention Phase consists of the desired results, the "solved state." The Intervention Phase begins by specifying the changes that will be made at the Points of Intervention. What will be changed? How will it be changed? With these changes in mind the next step is to identify the methods that will be used and the resources that are required to effect the changes. These resources are obtained and allocated, and the changes are made. Their effects are monitored and assessed, and any necessary adjustments are made. These adjustments can include revisions to conclusions and plans made during the Investigation Phase.

Summary

To engineer a solution is to configure and carry out a course of action that produces desired results. This is accomplished by examining the structure of the situation in which the problem is embedded so as to identify Points of Evaluation, Points of Intervention and the paths connecting the two. This mapping of the structure of the situation enables the solution engineer to configure a course of action commonly called a solution. Once a course of action or solution has been configured, it must be carried out. This entails marshaling support and resources as well as managing the actual change effort. The aim is to make changes at the Points of Intervention, to have the effects of these changes ripple through the structure of the situation altering circumstances at the Points of Evaluation and to have these altered circumstances be those that define desired results or what might be termed "the solved state."

Further Reading about Solution Engineering

The papers listed below can be accessed by clicking on the title of the one you wish to view.

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

For More Information

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