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A PROPOSAL FOR COLLABORATIVE SOLUTION-DISCOVERY

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ABSTRACT

Contemporary issues are highly complex, requiring formal tools to augment human capabilities, allowing collaborative teams to work such issues. Collaborative Solution-Discovery, is a shell within which System Dynamics can be applied to large, complex issues. It has two important features.

1. *Stakeholder engagement, so all significant stakeholder-sourced information is captured, and all stakeholders support the solution-discovery process and its result.*
2. *An epistemologically-based Life Cycle and Solution-Search Path, using System Dynamics to test and refine understanding of the problem, and the solution that emerges.*

Project design includes Life Cycle planning of project phases from initial apprehension of need to disposal of solution remnants at end of life, full Stakeholder Engagement at each phase, a generalized Solution-Search Path for the sub-problems at each phase of the Life Cycle, and a Leadership Style based on managing the process and facilitating the best performance of all participants.

KEY WORDS

complexity collaboration life-cycle stakeholder solution-discovery leadership

CONFRONTING COMPLEXITY

As we enter the third millennium, the serious challenges and exciting opportunities we face often present themselves in the form of systems. Dysfunctional systems (physical-social-economic-political) challenge us to produce answers in the form of new system configurations that fix or replace the dysfunctional ones. New opportunities, too, call us to create new systems, often combining high tech with sensitivity to the human element. For both challenges and opportunities, people-systems will find the answers, then operate and improve them.

Some issues that involve complex systems:	
- Urban planning	- Knowledge management and communication
- Transportation	- Education
- Environmental management	- Health care
- Recycling	- Housing
- Energy production and distribution	- Social services, including the homeless
- Pollution control	- Crime prevention, including illicit drug use

In this author's experience (aerospace systems engineering and involvement in local community issues), the necessary process knowledge to address the challenges and opportunities is available, but not widely known. It is used in fragmentary manner, with no examples of a complete end-to-end issue application known to the author. Collaborative Solution-Discovery is proposed to remedy this situation. It is

presented in a frankly cook book manner, as a guide to be used by people who are committed to resolving the issues, but perhaps lack formal education in the needed process knowledge.

The high complexity of the challenges and opportunities confronting us is the core issue that underlies all specific issues. The complexity stems from the numerous disparate interests to be served and the many interdependent factors in the problem-space. Further, the issues are all interdependent. Complexity piles on complexity. Ashby's Law of Requisite Variety states that a corresponding complexity is required of the solution.

Consequently, solution-discovery methods must be competent to handle all these sources of complexity. Unfortunately, the unaided human cognitive span is woefully inadequate to encompass the complexity of serious contemporary issues. The Law of 7 +/- 2 states that we can keep only about 7 cognates in conscious attention at any one time, yet the problems we encounter present hundreds or thousands, in terms of the number of elements, their interactions, and the quantity of associated data to assimilate. Finding the answer for these massive, complex, interlocking system problems depends on a competent solution-discovery process, carried out through collaboration among sufficient minds and hands to match the size of the job, bringing skills and information needed for the solution. The ability to work effectively with complex system problems becomes, therefore, an important life skill.

The type of deliberations currently used for complex public issue solution-discovery are not meeting the need. They are fundamentally flawed, to the extent they depend on adversarial process, no matter how civil. Systems are unforgiving. They will behave according to the dictates of their structure and their inputs, regardless of our intentions, wishes, or efforts to force them to our will. The Way of Heaven is ruthless, says the Tao Te Ching. Adversarial process tends to ignore such reality, giving it little more than lip service, suppressing and distorting facts, focusing on fragments of the problem while losing sight of the integrated picture, inhibiting thorough and objective analysis, suppressing creativity, advancing rigid positions, and depending on the balance of power to reach a decision that is usually inflexible and incapable of being corrected or adapted to changing conditions. A new paradigm for public issue solution-discovery is needed.

System Dynamics, as a modeling tool of great power, has a central role in answering the need. It is a diagnostic tool for understanding an existing system in order to identify its dysfunctional elements and point to a correction. It is a creative tool used in evolving a new system concept and validating it for its purpose. It is an operational tool, a component of the solution when the job is to address a continual stream of system design and control problems.

But where do the system concepts come from that are modeled? What identifies the need, and quantifies criteria of need satisfaction? What determines the architecture of the system (its arrangement of function and form), and what nominates particular kinds of elements as components to perform the functions of the system?

BUILDING A PROCESS FRAMEWORK

How do we create the needed process framework? Viewing the construction of a competent solution-discovery process as an exercise in epistemology is helpful. (Epistemology is the branch of philosophy concerned with what we can know and why we believe it to be so.) The solution-discovery process begins, in the general case, with the first vague awareness of the problem, along with whatever sporadic knowledge about the problem happens to be available. The process concludes with a thorough understanding of the problem, and a complete, implementation-ready description of the solution,

including justification for the selected solution. This process is one of gathering and creating knowledge, starting in a state of ignorance and ending in a state of adequate knowledge, i. e., it is epistemological. It addresses the questions:

- How do we create need statement N, and why do we believe it to be valid?
- How do we create solution-description S, and why do we believe it to be a good solution to N?

Collaborative Solution-Discovery was developed by examining many current examples of formal process, looking at how they moved from initial awareness of need to full expression of a solution. In this examination, two questions were applied recursively:

- Given what we know now, what can and must we discover to advance a step closer to the solution? (Forward chaining toward the solution)
- Given what we know now, what must we have known at the previous step to enable the current step? (Backward chaining to the initiating point)

The result is to identify the general types of knowledge that must be discovered at each phase of the solution-discovery process. The activities that uncover this knowledge are embodied in four central principles of Collaborative Solution-Discovery, and a general methodology that implements these principles.

PRINCIPLES OF COLLABORATIVE SOLUTION-DISCOVERY

1. Life-Cycle Planning

2. Stakeholder Engagement

3. A reliable, powerful and quick Solution-Search Path at each phase of the Life Cycle

4. Leadership Style: Manager-Facilitator

These principles may seem obvious and innocuous. Unfortunately, in practice they are almost always violated. Life cycle planning is left to chance, vulnerable to the inevitable traps and pitfalls. Important stakeholders are left out or intentionally excluded, and there is no reliable mechanism for addressing stakeholder interests. No thought is given to solution-discovery, other than a battle among contending positions. Leadership is either authoritarian, or inept. As we look into these principles, we see they are anything but innocuous; in fact they are quite powerful. Violating them brings the certainty of very undesirable outcomes -- wrangling, bitterness, wasted time, and costly, ineffective solutions. Following them is the best assurance of a good outcome.

Life Cycle Planning

The Life Cycle Plan orders the sequence of activities for setting up to do solution-discovery, discovering the solution, and implementing it, all in the context of the surrounding world.

These sorts of activities will occur, regardless. They are inherent in the way issues come to us, so it is best that they be recognized and planned as early as possible. The image of the Life Cycle presented herein is merely descriptive, calling attention to what, as a matter of course, must occur. There is only one choice: Do it with foresight, anticipating what is to come and building a firm foundation for it, or just stumble along, making up fixes on the spot for every glitch, depending on luck to prevent the glitches from being too numerous and too serious.

Like any good drama, the life cycle of an issue has a beginning, middle, and end. The beginning sets up the background and plot line. The middle carries it through to the climax (knowing the solution). The end carries it out to a happy conclusion. The phases of the generic Life Cycle described below, which expresses this pattern, are offered as a starting point for planning the Life Cycle of any particular issue.

Phase 1. Getting Started (beginning)
- 1A. Need Clarification and Self-Organization
- 1B. Solution-Discovery Process Design

Phase 2. Solution-Discovery (middle)

Phase 3. Implementation (end)
- 3A. Solution-Building
- 3B. Solution Operation and Improvement
- 3C. Disposing of the Solution (at end of useful life)

Solution-Discovery is the critical phase in the Life Cycle, so let's begin with that. Everything subsequent to Solution-Discovery is concerned with implementing the decisions made during Solution-Discovery. Everything prior to Solution-Discovery is concerned with setting up for successful Solution-Discovery.

The Solution-Discovery phase applies the general Solution-Search Path to solving the Root Problem. The Root Problem is the articulation of the need. Often it is the unacceptable consequences of a pre-existing dysfunctional system. The Root Problem launches the issue and is resolved at the end, but we cannot jump directly from identifying the Root Problem into executing Solution-Discovery. First we must design and set up the Solution-Discovery phase. So let's examine in general what needs to happen during Solution-Discovery, in terms of its objectives.

The objective of the Solution-Discovery phase is to find a good solution to the Root Problem.

- Satisfies the stakeholders.
- Actually works to do a good job and avoid undesired outcomes
- Flexible to correct oversights and errors, accommodate change and the unexpected.

This objective leads naturally to sub-objectives:

1. Engage stakeholders.
Certain stakeholders own the Root Problem. All stakeholders provide crucial information, and delineate constraints on the solution. Determine who the stakeholders are. Bring them into the process. Educate them about the problem and the solution-discovery process. Listen to them, respecting their needs and concerns. Keep them informed at every step, and secure their ratification of key decisions before proceeding.

2. Determine desired outcomes and measures of success.
What outcomes do we need the solution to deliver (including undesired outcomes to avoid)? How do we know it's doing a good job? This is determined on information elicited from stakeholders. It is expressed in terms of qualities of the situation at the outcome, but without reference to any features of the solution design that might deliver those outcomes (selecting those features comes later, Objective 4).

3. Set up to search and evaluate.
Set up a search and evaluation process to generate a range of potential solutions and evaluate them against desired outcomes.

4. Search, evaluate, select and validate.
Carry out the search and evaluation, selecting the answer. Demonstrate that it is the best under the circumstances, to the satisfaction of all stakeholders.

These objectives will be realized through an organization and process designed to fit the situation. Some of the factors that influence this organization-process design are:

- Whether the Root Problem calls for a single solution that can be implemented in one pass or a multi-path solution that is implemented in several phases, putting in place a sequence of sub-solutions that build to a final overall solution.
- Level of complexity, and correspondingly, whether an informal or formal approach is needed.
- Level of contentiousness, also determining the need for an informal or formal approach.
- Degree of expertise required and quantity of data to be digested
- Nature of the stakeholder community (monolithic or disparate, disorganized or organized)
- Nature of existing organizations which bear on the problem or its solution
- Degree of innovation required.

When these and any other relevant issues have been examined, the Solution-Search Path is applied as a tool for designing the process and organization to be used in the Solution-Discovery phase. This process design activity is set up and carried out in the Getting Started phase, and its sub-phases.

Sub-phase 1A, Need Clarification and Self-Organization

The job of Sub-phase 1A is:

- To realize that the Root Problem exists and make an initial effort at defining it.
- To get organized for completing the rest of Phase 1A, using the Solution-Search Path as a tool for designing the organization and process for the rest of Phase 1A. This is a self-organizing or bootstrapping task.
- To set up the process and organization to accomplish Phase 1B. The job of designing Phase 1B is also built around the general Solution-Search Path as its primary tool.

In the beginning of Phase 1A, address fundamental questions of identity and appropriate action, like the following suggestions. Think it through, make it explicit, have everyone in agreement before lunging ahead.

- What need calls us together?
- Who are we, individually and as a group (history, social roles, self-defined identity, personal agendas, etc.)?
- What motivates us, individually and as a group?
- By what right do we speak for others?
- Will they accept that?
- What ultimate result (quality of situation) do we aim for?
- What chain of intermediate results leads from where we are to the ultimate result?

- What action do we take to forge the first link in this chain?
- How do we organize to do that?

The stakeholders for Phase 1A are:

- Those who recognize the Root Problem and want to see it solved.
- Those with responsibility for detecting the Root Problem and launching a response
- Those involved in solving the Root Problem
- Those involved in contributing knowledge, skills or resources to the Getting Started phase.
- Those whose turf might be trampled or reputations influenced by the presence of activity on the problem, by success or failure of the solution.
- Those who might feel threatened by progress on the problem or have objection for any reason.

This is a fairly narrow scope of stakeholders. It does not include many who will be involved later, but the planning at this phase should account for those who will need to be included later.

When the identity and intentions of all the active participants have been clarified, use the Solution-Search Path to design the rest of Sub-phase 1A and prepare for Sub-phase 1B.

Sub-phase 1B. Solution-Discovery Process Design

Phase 1B is concerned with designing the Solution-Discovery phase. This is also a solution-discovery job, but it is not yet concerned with finding the solution to the Root Problem. It addresses the question "What's the best process and organization to solve the Root Problem?" It uses the Solution-Search Path to answer that question, thereby setting up the process and organization for the Solution-Discovery phase.

This is a very slippery concept. It is hard to resist the temptation to jump ahead and start designing the Root Problem solution, when the job at hand is to design the process that will address the Root Problem. It is a plan-for-a-plan mode of thought that is very hard to sustain, but it is necessary to maintain the discipline to avoid getting entangled in confused objectives.

With the overall image of the Getting Started and Solution-Discovery phases in mind, it is now possible to lay out the entire Life Cycle in some detail (Figure 1). The full Life Cycle description is provided in Appendix A at the end of this paper. The description there is rather thorough and exhaustive, as suitable for a large, formal project. It is a cookbook recipe, laid out in terms of the objective, stakeholders, activities, and products of each phase. Of course, it can be scaled down and made less formal if appropriate, but only with care that nothing be overlooked, and with caution against moving ahead too fast by skipping important considerations or ignoring certain stakeholders. Use the description in Appendix A as a check list for designing the Life Cycle Plan for a particular issue-response project.

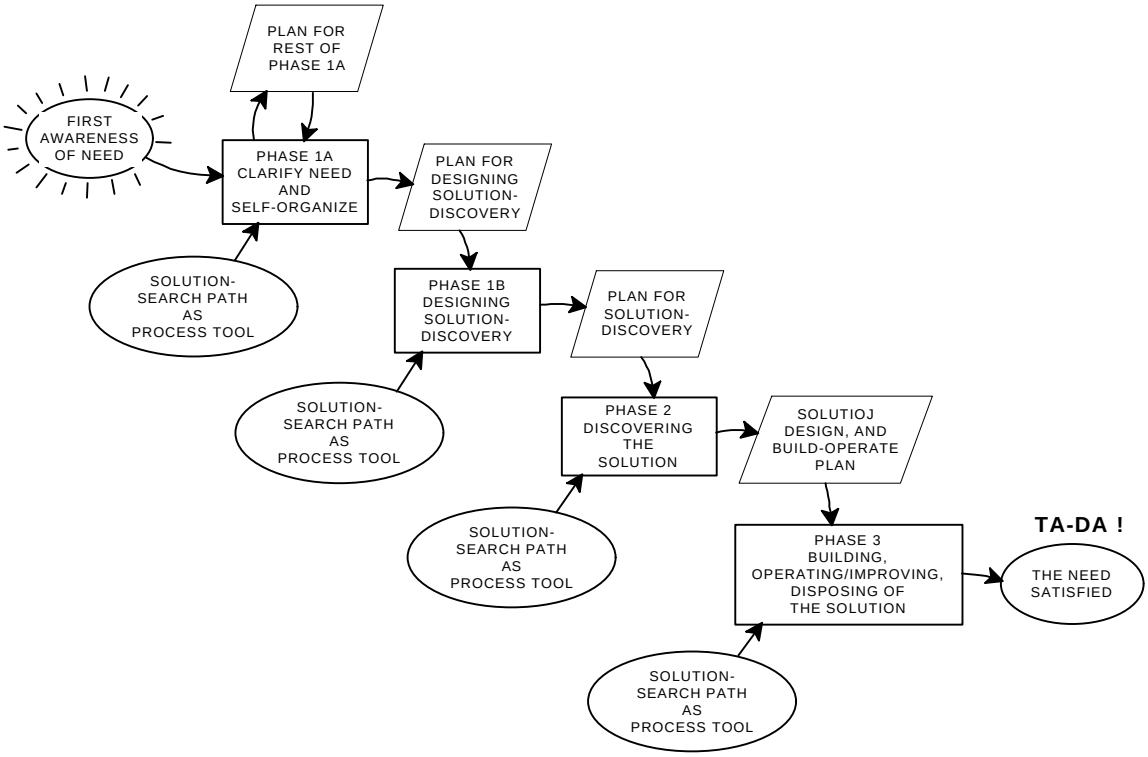

Figure 1. A Typical Project Life-Cycle

STAKEHOLDER ENGAGEMENT

Collaborative process is based on the practical premise that, speaking colloquially, there is a deal to be found out there somewhere, better than any deal that can be won through fighting, resisting, or walking away. The only way to find that deal is for all parties to collaborate on the search team.

Success depends on building a Shared Vision among all the stakeholders, about:

- The Goal -- what constitutes satisfaction
- The Process -- how the path to the solution is found
- The Solution -- what form is put in place to deliver achievement of the goal

Then why do people cling to the adversarial mode? Here are some possible motivations.

- Lack of imagination. Conflict is the only mode they've seen and they cannot imagine collaboration in the circumstances they're used to.
- Fear. As underdog or as besieged power center, they fear that collaboration is inviting the enemy to take over.
- Power. The lust for power is strong. Shifting from power-over to power-with is a wrenching experience.
- Pride. Having vested their identity in the supremacy of conflict over cooperation, they cannot abide the loss if face should they be proven wrong.
- Fun. Battle is exhilarating. Collaboration is dull.

Stakeholders are the source of need definition, hold the ultimate authority to ratify the proposed solution, and also provide a rich source of information about the problem and creative ideas for a solution. What must we do for successful stakeholder engagement?

a. Include all stakeholders.
Stakeholders are all who have an interest in the outcome, whether they know it or not, and all who claim to have an interest, whether they do or not.

Stakeholders who are excluded or marginalized will cause trouble. If they are sufficiently outraged, they will organize to impede or totally block all progress. At best, neutralizing them will suck up energy that could be better employed. Neutralizing hostile stakeholders will slow down the process, increase costs, and degrade the outcome. At worst, angry stakeholders will shut down the process entirely, permanently.

All stakeholders possess information about the problem, and can contribute situation knowledge, expertise, and creativity to the solution. Excluding them detracts from the quality of the solution.

Yes, it may be inconvenient to work with the numerous and often unruly stakeholders, and at times it seems like welcoming the enemy, but the pay-off is worth it.

It is definitely not sufficient merely to hang out a notice saying "Y'all come." Stakeholders must be identified, sought out, actively recruited, and given assistance with understanding the issue, organizing and articulating their interests.

b. Empower the stakeholders.
Provide them with knowledge about the problem situation. Educate them in the solution-discovery process and win their buy-in as participants. Give them standing. If necessary, help them organize.

c. Engage stakeholders from inception to conclusion.
Do not work in elitist fashion and expect to sell the package to stakeholders at some later date. Bring them on board at the very beginning. For how, see details under Life Cycle Planning and Solution-Search Path.

THE SOLUTION-SEARCH PATH

Each phase in the Life Cycle recapitulates the general pattern of moving from need (whatever it is in each phase) to solution (the product that satisfies the need in each phase). This pattern involves a sequence of decisions of general types. Each type of decision is epistemologically dependent on the preceding ones. The sequence of information gathering/generating tasks to support this decision sequence is called the Solution-Search Path.

The Epistemology of Solution-Search

Why does application of the Solution-Search Path lead to the belief that we have a good understanding of the Root Problem, and have found an effective Solution System?

1. The Solution-Search Path is necessary and reliable.

It employs a universal process framework common to solution-discovery for all complex systems, based on the Form Follows Function principle (determine the Functions necessary to satisfy Need, then select a Form that will perform the Functions). The framework is in terms of a logically sequenced set of decisions that cannot be avoided. The twelve steps of the Solution-Search Path, described below, are designed to address these decisions. After examining the twelve steps, apply the test of asking these questions:

- What if one of these decisions were ignored or bypassed?
- What if one were established out of order?

2. The Solution-Search Path structures the assault on complexity.

The complexity of the issues and their solutions far exceeds the informal powers of human cognition. We need a roadmap to keep everyone on the same page and moving in the same direction. We need guidelines for breaking the job apart into small enough chunks so that task teams can work the chunks, and then reassemble the chunks into an effective solution. We need knowledge management methodologies and tools to gather, organize and process data, to organize and interpret results. We need to enable self-coordination among multiple interdependent tasks that cannot effectively be managed from above. The twelve steps of the Solution-Search Path provide a checklist to ensure that all these issues are addressed, and set up a process framework that integrates the specific implementations chosen to resolve each issue.

b. Structured process is Faster-Better-Cheaper.

It gets off to a slower start than a process that lunges straight at the answer, but the investment pays off.

- Faster: avoids mis-coordination, false steps, and backtracking.
- Better: systematically homes in on the demonstrably better solution, avoids traps of premature commitment to partial/poor solutions.
- Cheaper: Since it gets to the answer quicker with fewer mis-steps, it saves cost. The solution is better designed, therefore cheaper to implement and operate. The solution is more productive, delivers a better outcome at lower operating cost.

c. Avoids Plunging and Lunging

Plunging and Lunging are the twin fatal sins of systems process that we are tempted to commit because of our impatient, concrete-detail-oriented human nature.

- Plunging into the familiar, concrete details to avoid the uneasy experience of confronting the mind-stretching uncertainty and ambiguity of the abstract big picture.
- Lunging at the first plausible looking solution and running off with it in our impatience to get to the answer, without first doing the homework to set up a good solution-evaluation screening process, and without searching for better options.

The discipline provided by Collaborative Solution-Discovery is an antidote to plunging and lunging.

Stages and Steps of the Solution-Search Path

We've already seen the four main stages of the Solution-Search Path, in the form of the four objectives of the Solution-Discovery phase described above. Now we'll expand them in terms of the steps to carry out each stage. The Solution-Search Path is expressed as a sequence of questions (following the epistemology theme). Each question is followed with a description of activities to get answers. The Life Cycle Plan, plus documentation of questions and answers raised by the Solution-Search Path at each phase of the Life Cycle, documents the project.

STAGE 1: Stakeholder Engagement

Step 1: Who are the stakeholders?

Using all available sources, determine all individuals and groups, by name or by type, which have an interest in the outcome, or may claim to. Include all who have jurisdiction over the outcome, are involved in providing any kind of support (e. g., financial), will be responsible for producing the solution, etc., as well as those directly benefited or impacted by the solution.

Step 2: How do we enlist and empower the stakeholders as partners in the process?

Actively go after them. It is definitely not adequate to simply post a notice and hope people will show up. Help them organize. Don't expect them to get together on their own. Group them according to common interests. Establish two-way lines of communication. Educate them -- about the issue and about the process of solution-discovery that they will contribute to. Gain their trust and buy-in. Show them that they have a part in influencing the outcome. Also show them that success depends on collective respect for one another.

Step 3: What are the aggregate stakeholder interests?

Elicit stakeholder views:

- The values they hold
- Their interests in terms of what they need or expect the outcome to deliver (good outcomes to promote, bad outcomes to avoid)
- Their priorities for resolving conflicts among values.

Stakeholders will have trouble with the abstraction of starting with qualities of outcome, and will tend to offer solutions in terms of specific features they advocate. This is premature, a manifestation of Plunging and Lunging, but don't criticize. Affirm them for their contribution, explaining how it will be used later when the time comes to search for solutions. Then, as route to eliciting deeper values, interests and priorities, it is of prime importance to find out what they believe is good about their proposed solution, and bad about other solutions.

It helps to look at each of the subsequent stages and steps along the Solution-Search Path to determine what information from stakeholders is needed to support each step, and to elicit that information at the appropriate time.

System Dynamics is a powerful tool at this stage. It can model the problem system in support of better understanding the problem. It can model solution fragments suggested by stakeholders in order to expose their consequences. Engaging the stakeholders as interactive participants in model development and operation will help the stakeholders discover the gaps in their own thinking and vastly improve their understanding of the whole problem definition and solution discovery process.

As the product of this stage, compile all this information into a Composite Stakeholder Interest Statement (Values, specific Interests, and Priorities), and review it with stakeholders until they are satisfied. Do not at this point attempt to resolve conflicts, but clearly recognize that they are there. A Definition of The Root Problem is part of this statement.

STAGE 2: Defining the Outcome

Step 4: What is the Mission of the Solution?

The Mission Statement serves as a guiding star, to focus attention on the common result that all are working toward. It is a brief, concise statement of the job to be done by the solution, in terms of the desired outcome, distilled from the Composite Stakeholder Interest Statement,

Step 5: What do we expect the Solution to do, and not do?

The What-Do's are what we want the system to deliver, in terms of actions that produce desired outcomes. The What-Not-Do's are what we want the system to avoid or prevent. All of these are the actions or behaviors the system carries out in order to accomplish its mission, expressed in terms that are independent of any means that might be employed.

Early in the solution-discovery process, this will focus on External Behaviors, or stimulus-response. Given some particular situation in terms of input stimuli presented to the hypothetical solution, what output response would we want it to deliver? Later, when we have agreement on External Behaviors and are beginning to home in on the broad features of the solution, the focus will shift to Internal Functions. How does the hypothetical solution work internally to convert inputs to outputs? In formal terms, this creates the Functional View of the eventual Solution System.

Step 6: How well, within what constraints?

Establish, where appropriate, the quantitative levels of performance we expect from the What-Do's, and the constraints (natural and institutional) within which we must operate. How do we know we're doing well enough? These are the Measures of Effectiveness we want the solution to fulfill. The ability to meet these Measures of Effectiveness becomes part of the criteria used to select the better solution from among the candidates. Later, the detailed design is crafted to meet the Measures of Effectiveness.

STAGE 3: Search and Evaluation

Step 7: What are the selection criteria?

Screening criteria are needed to sort out the better solution from the available candidates. These should be no more complex or extensive than necessary to support the screening process. They are not the detailed Measures of Effectiveness, although degree of satisfaction of the Measures of Effectiveness can be one of the criteria. Others could be ease of producing the selected solution, confidence that it will work, risk of cost or schedule overrun, acceptability to interfacing entities, robustness and flexibility in the face of changing and unexpected conditions, social and political acceptability, etc.

Step 8: How will we search?

The objective is to get to the better solution, with reasonable confidence that something still better has not been overlooked, but quickly and with acceptable expenditure of resources. This leads to conflicting approaches: look outside the box, be thorough, sift quickly. Many methodologies that support this option creation process are described in the literature. Stakeholder suggestions for the solution provide some of the input to the search process.

Step 9: How will we analyze and evaluate, leading to a selection?

Set up the models that will be used to evaluate the performance of candidates in relation to the selection criteria. System Dynamics comes into play here. When the stakeholders are engaged in developing and

validating the model, it contributes greatly to their confidence in the solution to be selected later. Determine how data, needed to support the analysis, will be gathered. Adopt methods of decision analysis (such as Weighted Scoring or Multi-Attribute Value Analysis) as appropriate to lead the stakeholders through the subjective parts of the evaluation.

STAGE 4: Search, evaluate, select and validate

Step 10: What possible solutions should we examine?

Use the search strategy from Step 8 to generate a set of candidate solutions to be evaluated.

Step 11: Which one is best?

Use the methods set up in Step 9 to rank the candidates, against the criteria of Step 7.

Step 12: Are we confident in the selection?

Can the rivals be made better? What variations can be made on the front runners -- modifications, mixing and matching to combine best features and bolster weakness -- to improve the standing of top candidates? Is the selection process sound? Challenge assumptions and subjective judgments that went into the decision. What if parameters were different within reasonable limits? Would the ranking change? What risk factors have we missed? What risks or other adverse consequences peculiar to each candidate have not been considered? Does that change the ranking?

General Process Guidelines

Throughout this whole process, some general guidelines apply:

1. Be sure that each step is complete and done well before proceeding. Have quality criteria so you can be sure the work is adequate.

2. Keep stakeholders engaged at each step. Utilize their inputs. Inform them of results. Win their approval before proceeding to the next step.

3. At each stage, exercise feedback and feedforward loops. Examine decisions made at earlier stages. Do they remain sound in light of current knowledge? On the basis of current knowledge, what do we anticipate will occur in subsequent stages? Are we on a path that will lead to a solution and not up a blind alley?

4. Document appropriately. Keep a record of all inputs, and the rationale for each decision. This will be invaluable when presenting the case to stakeholders and responding to critics. It is also the basis for future action.

The Process Wheel

In practice, many passes along the Solution-Search Path are required, with much looking ahead and checking back, as the process moves from vague initial awareness of the need to final detailed description of the solution. The path is not a straight line, but a spiral superimposed on a wheel. The 12 spokes of the wheel are the 12 steps along the path in logic-space. The spiral is the main path we follow in real space and time as we address the 12 steps again and again, each time adding detail and certainty as we home in on the solution. We will also make side trips across the wheel, jumping to steps ahead as our imaginations prompt us with ideas of what is to come, or checking back to be sure previous steps remain valid. We always returning to the main path to honor the logical dependency of subsequent steps on what was done earlier.

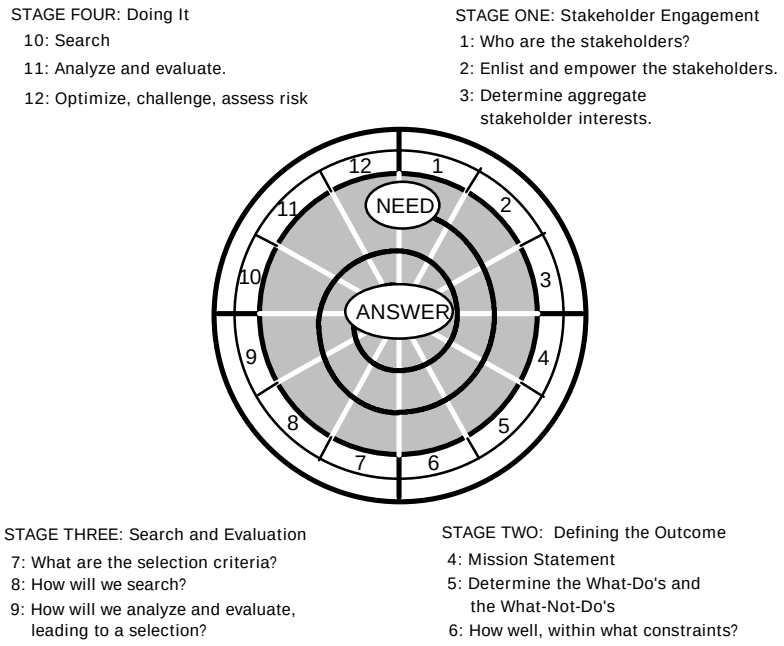

Figure 2. The Process Wheel

Implementing the Solution-Search Path in the Real World.

The sequence of decisions in the stages and steps of the Solution-Search Path is logical, not chronological. In the real world, jumping around is OK, cannot be avoided, and is a constructive part of creating and proving the solution. A lot can be learned, a lot of communication between clients and problem-solvers can happen, in terms of back-of-the-envelope doodling of possible solutions. But be careful that these doodles are not taken seriously as real solutions that are worth anyone's commitment. They are just tools for understanding. In the final reckoning, be sure the sequence of logical dependence is respected in reviewing all the decisions before committing.

Application to Each Phase of the Life-Cycle

There is a general formula for generating the plan for each Life Cycle phase. What is the objective for each phase? Who are the stakeholders? What products satisfy the objective? Then adapt the Solution-Search Path as the tool to develop what is needed. Sometimes the job is simple; the options are not complex and the choices are fairly obvious. The Solution-Search Path serves merely as a checklist to ensure that important factors are not being overlooked, but it is not carried out in a formal manner. In other situations, particularly the Solution-Discovery phase, the job is very complex and the Solution-Search Path is applied in a full and formal manner as the backbone of the activity.

It is helpful to view the Life Cycle as an evolution of systems. What is the process-organization problem presented at each phase of the Life Cycle? What is the existing process-organization system at the beginning of each phase, and how do we morph that into the best process-organization system to carry out that phase of the Life Cycle? What systems are operating to produce a product? What systems are produced as the output product at each phase? Does that product provide readiness to proceed to the next phase?

Now, specifically, how is the Solution Search Path applied during each phase of the Life Cycle?

Phase 1A, Need Clarification and Self-Organization

The primary job here is to get an organization formed that includes the right stakeholders, and to be sure everyone buys into the overall concept of working through a sequence of phases, each with its own objectives, products, and process. The leaders keep the Solution Search Path in mind as a checklist to structure the discussion, keeping the task focused on setting up Phase 1B, Solution-Discovery Process Design, which follows. An important point to get across is the use of the Solution Search Path as a tool in subsequent phases.

Phase 1B, Solution-Discovery Process Design

The Solution Search Path is used, in a full and formal manner during this phase, to design the Solution-Discovery Process that will be applied to solving the Root Problem. That Solution-Discovery Process is, of course, also built around the Solution Search Path.

Phase 2, Solution-Discovery

The Solution Search Path is the primary tool used to solve the Root Problem in this phase.

Phase 3A, Solution-Building

During Solution-Building, the job is primarily the execution of the plan created during the previous phase. However, in the course of that activity, problems will be encountered that could not be fully solved, or even anticipated, during the previous phase. For these problems, the Solution Search Path is a primary tool.

Phase 3B, Solution Operation and Improvement

During the Solution Operation and Improvement phase, the Solution Search Path may be used in two ways.

- As opportunities for improvement become evident, the Solution Search Path is used to determine what should be done.
- In some cases, the job of the Solution System itself may be to address a continual series of problems that arise out of ongoing needs. In such cases, the Solution Search Path is a component of the Solution System, the tool for addressing those problems.

Phase 3C, Disposing of the Solution (at end of useful life)

Disposal of the Solution System at end-of-life may itself be a complex system problem (as for example, cleaning up the nuclear waste left from our weapons program). In such cases, the Solution Search Path is the tool for designing the system that will carry out the disposal process. The best practice, of course, is to anticipate this back during Phase 2, Solution-Discovery, and build disposal capability into the Solution System from the start.

LEADERSHIP STYLE: MANAGER AND FACILITATOR

Collaborative solution-discovery for a complex public system problem will be carried out by a core team of highly motivated, competent, creative, self-directed people who are working with the broader community of stakeholders. Since success depends on the cooperation, competence, and enthusiasm of

all the people on the solution-discovery team, the leadership style must be one that brings out the best in people, as well as keeping the project on-track.

- The appropriate leadership style is manager of the process and facilitator of the people.
- The traditional charismatic hero model will not work because the job is just too big and complex for one person, no matter how brilliant, and the arrogance of the hero will alienate the participants.
- The traditional authoritarian boss model will not work because the job is just too big and complex for one person, and the authoritarian approach will alienate the participants.
- The traditional position-advocate leader model will not work because the leader's job is to integrate the interests of all positions and find the solution that is the best possible deal for all concerned. It is not the job of the leader to push for some particular solution and thereby set the stage for interminable conflict.

The leader's focus is on managing the process and facilitating the people. If the process is good, the product is assured. If the process is bad, a good product is virtually impossible. The leader's job is to be sure the process is properly planned and executed.

COMPLEMENTARY DISCIPLINES

The System Process described above is one of three complementary disciplines that work together for success in addressing a complex issue. The other disciplines are Organizational Dynamics and Conflict Management.

Organizational Dynamics contributes to setting up and continually improving the organizations that operate during each phase of the Life Cycle. This discipline provides expertise on what the organization must do, what options to consider for the form of the organization, what criteria to apply in selecting the best form, what Measures of Effectiveness apply to the performance levels of the organization, how to detect the need for improvement and what to do about that.

Within the application of Organizational Dynamics, the Solution-Search Path can be used as a tool for designing the organization at each phase.

Conflict Management is the necessary discipline when conflict arises in the course of the Life Cycle. No contentious issue can be addressed without conflict. Conflict can be the source of creative tension, if it is approached in the spirit of collaboration. Unfortunately, not all stakeholders are prepared, initially, to do that. At the beginning they will be suspicious, hesitant to trust one another and the process, perhaps hostile. Conflict Management skills are important to bring people on board the collaborative process, to build trust and respect, and to open up communication. During the course of the Life Cycle, the collaborative spirit may break down for various reasons. If that happens, Conflict Management is critical to bringing the project back on track

The Collaborative Solution-Discovery framework contributes to Conflict Management by providing an open and fair playing field on which all participants can feel their interests will be respected, and met to the highest degree possible.

APPENDIX: LIFE CYCLE PHASES

Phase 1A. Need Clarification and Self-Organization (Bootstrapping from zero)

The Life Cycle begins with first awareness of the problem, no matter how dim, incomplete and inaccurate. It is initially spontaneous and unplanned, i. e., people are doing it without realizing it. It is important to become conscious that the process is under way and bring it under intentional planning as early as possible.

a. Stakeholders:

Conduct a Stakeholder Audit to identify stakeholders for each phase of the Life Cycle. Stakeholders may be identified either as specific individuals or groups, or as classes. Engage those who need to be directly involved in the Getting Started phase. Consider the rest in the planning. Stakeholders for the Getting Started phase are:

- Those who recognize the Root Problem and want to see it solved.
- Those with responsibility for detecting the Root Problem and launching a response
- Those involved in solving the Root Problem
- Those involved in contributing knowledge, skills or resources to the Getting Started phase.
- Those whose turf might be trampled or reputations influenced by the presence of activity on the problem, by success or failure of the solution.
- Those who might feel threatened by progress on the problem or have objection for any reason.

Note: DO NOT attempt to engage stakeholders whose interests belong in later phases, but DO consider their interests in the planning.

b. Objective: Get the Life Cycle and its processes consciously planned, organized, and on-track.

c. Products, to be produced in sequence:

- A working organization to carry out the rest of the Getting Started phase, with buy-in from all participants.
- A statement of understanding regarding the identity of the initiating organization, addressing issues such as: the history of the organization to date, who its members are, the members' individual agendas and motivations, why the organization has the right and authority to initiate a solution-discovery effort in the name of all stakeholders.
- Agreement on an initial statement of the Root Problem.
- An initial roadmap through the rest of the Life Cycle.
- A process for the rest of Phase 1A, Need Clarification and Self-Organization, that will set up Phase I-B, Solution-Discovery Process Design.
- A Plan for Process and Organization to execute Phase I-B.
- The organization and resources in place and ready to go for Phase I-B.

Note: At this point in the Life Cycle, we are still at the Plan-for-a-Plan-for-a-Plan stage, two steps away from the final solution to the Root Problem. DO NOT attempt to jump ahead prematurely. Complete the job at each phase before moving on.

Phase 1B. Solution-Discovery Process Design

When all the products of the Need Clarification and Self-Organization phase have been completed to the satisfaction of all stakeholders, the Solution-Discovery Process Design phase can begin.

Note: We are NOT YET addressing the Root Problem. That task is still one phase away. The task at hand is to design the Solution-Discovery Process and Organization that will then address the Root Problem. This is a very slippery concept. Very strong discipline is required to keep the organization on-task at this phase, because of the natural human tendency to jump directly to the final solution.

a. Stakeholders

- Revisit the Stakeholder Audit.
- Keep those stakeholders from Phase I-A who remain relevant and interested.
- Engage stakeholders with a vital interest in the outcome of the Root Problem Solution.
- Engage stakeholders with an interest in successful process design, aside from interest in the outcome of the Root Problem Solution.
- Continue to consider stakeholders in future phases and accommodate their interests in the planning.

b. Objective: Readiness to address the Root Problem.

c. Products:

- Updated statement of the Root Problem
- A Plan (description of process, organization, timeline, needed resources) for Phase II, Solution-Discovery.
- The organization in place to start Solution-Discovery
- The resources, facilities, skills, and knowledge in place to begin.

Phase 2. Solution-Discovery

When all the products of the Solution-Discovery Process Design phase have been completed to the satisfaction of all stakeholders, the Solution-Discovery phase can begin.

NOW AND ONLY NOW are we ready to address the Root Problem.

a. Stakeholders

- Revisit the Stakeholder Audit.
- Keep those stakeholders from earlier phases who remain relevant and interested.
- Engage all stakeholders with interest in the outcome of the Root Problem Solution. If they are not available in person or through representatives, assign surrogates to represent their interests until they show up.

- Engage stakeholders with an interest in successful execution of the Solution-Discovery process as such, aside from interest in the effectiveness of the Root Problem Solution.
- Continue to consider stakeholders in future phases and accommodate their interests in the planning. In particular, consider users and clients of the Root Problem Solution System, and those with interest in final disposition of the Solution System at end-of-life.

b. Objective: A design for an effective, robust Root Problem Solution System.

c. Products:

- Updated statement of the Root Problem.

  Note: The Root Problem may be a moving target, which requires continual updates so the Solution System design remains abreast of the need.
- A Design for the Root Problem Solution System, i. e., the System that delivers the satisfaction of the Root Problem. This is the core product of the entire Life Cycle.
- Justification for the selected design, including all supporting data, decisions made along the way, and reasons for discarding other options.
- A Plan (description of process, organization, timeline, needed resources) for building and operating the selected Solution System.
- The organization in place to start building the Solution System.
- The resources, facilities, skills, and knowledge in place to begin building the Solution System.

Note: For larger systems, the system design process may occur in rolling phases, with initial portions complete and ready to build while later portions are still under design.

Phase 3A. Solution-Building

When all the products of the Solution-Discovery phase have been completed to the satisfaction of all stakeholders, the Solution-Building phase can begin.

Note: "Build" and "construct" are used here in the broadest sense, applied to putting together systems of people and information as well as to bricks-and-mortar.

a. Stakeholders

- Revisit the Stakeholder Audit.
- Keep those stakeholders from earlier phases who remain relevant and interested.
- Engage stakeholders with an interest in building the solution (the building process itself, or whether the process succeeds or fails), aside from interest in the outcomes to be delivered by the Root Problem Solution.
- Continue to consider stakeholders in future phases and accommodate their interests in the planning: users and clients of the Root Problem Solution System, and those with interest in final disposition of the Solution System at end-of-life.

b. Objective: The Root Problem Solution System in place and ready to roll.

Note: For larger systems, system completion may occur in rolling phases, with initial portions in place and operating while later portions are still under construction, to be integrated as they are completed.

c. Products:

- Updated statement of the Root Problem.

  Note: The Root Problem may be a moving target, which requires continual updates even during the building phase so the Solution System remains abreast of the need.

- The Root Problem Solution System, realized.
- Justification for the as-built Solution System, including all supporting data, decisions made along the way, and reasons for changes.
- A Plan (description of process, organization, timeline, needed resources, operating instructions) for operating and improving the Solution System.
- The organization in place to start operating and improving the Solution System.
- The resources, facilities, skills, and knowledge in place to begin operating and improving the Solution System.

Phase 3B. Solution Operation and Improvement

When all the products of the Solution-Building phase have been completed to the satisfaction of all stakeholders, the Solution Operating and Improving phase can begin.

Note: For larger systems, initial portions may be in place and operating while later portions are being integrated and phased in.

a. Stakeholders

- Revisit the Stakeholder Audit.
- Keep those stakeholders from earlier phases who remain relevant and interested.
- Continue to engage stakeholders with an interest in operating and improving the solution (the process itself, or whether the process succeeds or fails), aside from interest in the outcome of the Root Problem Solution.
- Engage users and clients of the Root Problem Solution System, and those with interest in final disposition of the Solution System at end-of-life.

b. Objective: Satisfaction of the Root Problem through operation of the Solution System, i. e., fulfillment of the original need (in updated form) which launched the project.

c. Products:

- Updated statement of the Root Problem, which may be a moving target that continues to evolve even during operation of the Solution System. Continual updates may be needed so the Solution System remains abreast of the need.
- The organization in place to operate and improve the Solution System.

- The resources, facilities, skills, and knowledge in place to continue operating and improving the Solution System.
- Continual updates to the Plan (description of process, organization, timeline, needed resources, operating instructions) for operating and improving the Solution System.
- Justification for updates to the Plan, including all supporting data, decisions made along the way, and reasons for changes.
- Delivery of Satisfaction of the Root Problem through operation of the Solution System.
- Justification for why the delivered Root Problem Satisfaction is adequate, and/or analysis of any inadequacies as basis for improvements to the Solution System.
- Plans for implementing improvements to the Solution System to correct its inadequacies.
- Improvements in place and operating.

Phase 3C. Disposing of the Solution (at end of useful life)

When the Root Problem has been fully satisfied, or has evolved to a condition where the current Solution System is no longer relevant, the Solution System should be removed from existence

a. Stakeholders

- Revisit the Stakeholder Audit.
- Engage stakeholders with interest in final disposition of the Solution at end-of-life, either as a direct interest in the outcome, or indirectly as it affects their turf or reputation.

b. Objective: When the Solution System is no longer useful and effective, i. e., at end-of-life, dispose of it with minimum adverse impact and maximum residual benefit.

c. Products:

- Parts, materials, resources, people and information products of the Solution System dispersed or re-allocated.
- Damage and pollution cleaned up and/or mitigated.
- "Lessons-learned" captured and communicated.