CHAPTER EIGHT: STEP THREE - FORMULATING ALTERNATIVE PLANS

"**Think left and think right and think low and think high. Oh, the thinks you can think up if only you try.**" **From Dr. Seuss in *Oh the Thinks You Can Think*.**

Step Three: "Formulation of alternative plans." Principles and Guidelines, Standards, Section III, paragraph 1.3.2(a)(3).

INTRODUCTION

Put on your thinking caps - this is the step where you're going to need them. Your training might get you this far, but nothing quite prepares you for plan formulation. The basic question here is where do plans come from? The answer is they come from people. People devise solutions to problems. They do it individually and in teams, inside and outside the Corps, using an uneven mix of experience, analysis, inspiration, intuition, and inventiveness. The challenge of plan formulation is to guide these diverse inputs in developing an array of good plans.

This chapter describes where plans come from. It begins by defining formulation and its policy framework. The befuddling concepts of formulation and three phases through which formulated plans often pass are then discussed. Some different approaches to formulation are described at some length. The chapter concludes with some practical suggestions for describing and naming a plan.

FORMULATION DEFINED

Plan formulation is the process of building plans that meet planning objectives and avoid planning constraints. It requires the knowledge, experience, and judgments of many professional disciplines. Planners define the combination of management measures that comprise a plan in sufficient detail that realistic evaluation and comparison of the plan's contributions to the planning objectives and other effects can be identified, measured, and considered. Plan formulation requires the views of stakeholders and others in agencies and groups outside the Corps to temper the process with different perspectives. Plan formulation capitalizes on imagination and creativity wherever it is found, across technical backgrounds and group affiliations.

What? Who? How? When?

What do you formulate...plans devised to satisfy planning objectives and constraints.

Who formulates these plans...planners, with input from stakeholders and the public.

How are plans formulated...in teams and by individuals, using experience, inspiration, and anything else that's handy.

When are plans formulated...iteratively, throughout the planning process.

Plans are formulated to address the planning objectives. Formal formulation of alternative plans, as described in this chapter, cannot begin until the planning objectives have been at least preliminarily identified. Formulation of plans implies purpose and that purpose only finds definition in the planning objectives. Generally, a reasonable amount of information (i.e., step two activity) must be available before alternative plans can be formulated.

In most cases, there will be more than one alternative that will meet the planning objectives, although they meet them to varying extents. Good planning will eliminate the least suitable alternatives while refining the remaining alternatives fairly and comprehensively.

Sometimes, the formulation process emphasizes structural details, costs, project outputs, safety, reliability, and other technical matters. That's understandable because many of us are more comfortable with our familiar technical approaches and products. Nonetheless, formulation must be balanced with environmental, social, institutional, and other information that is often less quantified and otherwise less comfortable to consider in building plans. To ignore such information in formulation runs the risk of developing plans that cannot be implemented.

POLICY FRAMEWORK FOR FORMULATION

Plans are composed of **measures.** They can be **structural** or **nonstructural measures.** Alternative plans should be *significantly differentiated* from one another. This is the basis for the distinction we make between alternative plans and refinements of plans. Different levee heights for a given alignment are not different plans, they are refinements of the same plan.

Plans don't have to be restricted to things the Corps has the authority to do. Planners are empowered by the P&G to develop plans that can be implemented by other Federal agencies, State and local government, or other organizations. Despite this leeway, there are limits to what the Corps can do. The priorities of any given Administration define these limits. The P&G do

not make existing authority to implement a plan a requirement for formulating plans that solve problems and capitalize on opportunities. The opportunity to innovate is there.

Policy Constraints

Policy can sometimes place limits on the plan formulation process and the identification of the NED plan. These constraints can affect cost-sharing and the support a plan might receive from the Administration. For these reasons alone, the study team and the non-Federal partner need to be aware of any and all such relevant constraints.

For example, recreation cannot be included as a feature of a flood damage reduction plan until after it has been established that flood damage reduction benefits exceed the cost of the protection. Even then, recreational features can only be added if they are incrementally justified and they increase project costs by no more than 10 percent. However, nonstructural flood damage reduction projects need not have flood damage reduction benefits in excess of costs in order to add recreation features to the plan. Nor is there a limit to the amount of recreation allowed.

Got that? Then you're ready to consider how recreation can enter into commercial navigation or hurricane and storm damage reduction projects. These projects do not have to be justified on the basis of their primary purpose benefits, but those benefits must cover at least 50 percent of the costs of the project. Once that threshold is met, recreation features may be added in any amount as long as the entire project has a benefit-cost ratio of one or more. The catch here is that the benefits must be incidental. That is, they can be obtained without significant increases to the project costs.

Recreation policy is just one example of a policy constraint. Another is the requirement that structural flood damage reduction studies be formulated to address existing development flood problems. Benefits that may accrue to future development in the flood plain may be counted but only when they are incidental to plans formulated to reduce damages to existing development.

Thus, policy constraints can lead to situations in which you "formulate plans for ___" where the blank might be filled in with flood damage reductions, commercial navigation, or some other high priority output. In these cases, planners identify the most cost-effective plan for that purpose and then other purposes are added as policy permits. As this sidebar indicates, these can be confusing situations. Therefore, it is all the more important that the study team and the non-Federal sponsor understand the policies that constrain plan formulation.

Some districts do plan beyond what they have existing authority to implement. Under the proper circumstances, they are sometimes permitted to venture into a new area. The Corps' activities are not expanded by great leaps forward as much as by marginal extensions of existing and new authorities.

Plan formulation should pay attention to the mitigation of adverse plan effects. In water resources planning applications, the more common effects mitigated include adverse effects on fish and wildlife habitat; adverse effects on cultural resources; relocation of residential and commercial activities; and induced flood damages. Mitigation is explicitly required for many types of adverse effects; and is otherwise just good planning.

The P&G require the formulation of an **NED Plan** for the Corps' Civil Works water resource studies. This does not mean planners "formulate" an NED plan per se. *They formulate an array of plans that meet the planning objectives and constraints. From these plans they are required to "identify" the NED plan*. Thus, the NED plan is a plan that meets planning objectives and constraints and coincidentally maximizes net NED benefits. Only if planners investigate enough plans that meet the planning objectives and constraints can we be assured that the plan that maximizes net NED benefits has been identified.

Identifying an NED plan requires formulating other plans. The number of alternative plans depends on the complexities and extent of problems and opportunities in the study area, study resources, the availability of different appropriate measures, and the preferences of the stakeholders. The decision-maker will then judge whether alternative plans' contributions to planning objectives are sufficient to justify deviating from the NED plan. The **locally preferred plan** is the name frequently given to a plan that is preferred by the non-Federal sponsor over the NED plan. It is sometimes recommended instead of the NED plan.

FORMULATION CONCEPTS

Plan formulation has spawned a jargon capable of crippling communication. This section defines and describes some of the more important formulation concepts.

SOLUTIONS

A **solution** *is a way to achieve all or part of one or more planning objectives*. Solutions can be **management measures**, **alternative plans**, or **programs**.

Management Measures

A measure is defined as a means to an end; an act, step, or proceeding designed for the accomplishment of an objective. *The definition of a management measure (or "measure") is a* **feature** *or* **activity,** *that can be implemented at a specific geographic site to address one or more planning objectives.* Measures are the building blocks of which alternative plans are made. Measures become more specific and better defined as planning progresses.

Example Management Measures

Features:

breakwaters
jetties
groins
channel modifications
dams
detention basins
levees
floodwalls
water pumps
water control structures
fences
food plots
brush piles
nest boxes and baskets
roosting platforms
relocations

Activities:

actions:
- modifying water releases
- seeding, cutting, & burning vegetation
- applying pesticides

policies that affect actions at a site:
- vessel transit restrictions
- zoning restrictions
- grazing agreements

A feature is a "structural" element that requires construction or assembly on-site. An activity is defined as a "nonstructural" action. An activity can be a one-time occurrence, or it can be a continuing or periodic occurrence. Examples of commonly used management measures are provided in the sidebar.

Features and activities happen somewhere. The physical location or site at which they occur is an important characteristic that distinguishes one measure from another.

Alternative Plans

A plan, according to Webster, is a "scheme for making or doing something." *Our working definition of an alternative plan (also known as, "***plan***" or "alternative") is that it is a set of one or more management measures functioning together to address one or more planning objectives.* Many alternative plans have more than one measure. Different plans have different measures or they combine the same measures in significantly different ways. For example, suppose we have a town with two creeks. Plan A channelizes one creek and builds a levee along the other. Plan B builds the levee along the first creek and channelizes the second. Both plans consist of the same measures. The specific sites of these measures are sufficiently different to constitute two different plans.

Planner-Speak

The Principles and Guidelines tell us "An alternative plan consists of a system of structural and/or nonstructural measures, strategies, or programs formulated to alleviate specific problems or take advantage of specific opportunities associated with water and related land resources in the planning area." Other terms commonly used interchangeably with alternative plan include:

action	increment	program
activity	input action	project
alternate	management action	proposal
alternative	management measure	scenario
approach	management practice	scheme
component	measure	solution
concept	option	strategy
feature	plan	system
improvement	practice	technology

If measures can be actions instead of features, then alternative plans need not involve construction. Changes in the management of resources, institutions, and human behavior can sometimes be more effective than structural projects.

Programs

Just as management measures can be combined to form plans, so, too, can plans be combined to form programs. In a planning context, program means a set of one or more plans, usually located over a large geographic area. For example, there are several continuing authority programs. Examples of other Corps programs or programs in which the Corps is participating are listed in Table 27. Most Corps programs are nationwide in scope, but some are limited by law or policy to certain geographic areas.

SCALES

Sometimes people think of different **scales** of the same measure as different plans. For example, consider a plan with a concrete channel as its single measure. Different channel capacities don't constitute different plans. These are three differently scaled versions of a single plan. Plan scales are mutually exclusive; if you pick one scale you preclude all others.

Scales are most typically thought of as different "sizes" of a plan, but they also apply to other plan dimensions. *Several different properties of a management*

Table 27: Examples of Current Corps Programs

National Programs
- Section 107 Navigation Projects
- Section 205 Flood Control Projects
- Section 1135 Program - Project Modifications for Improvement of the Environment
- Coastal America Program
- North American Waterfowl Management Plan

Regional Programs
- Section 201 Program
- Upper Mississippi River System Environmental Management Plan
- Coastal Wetlands Planning, Protection, and Restoration Act Program ("Breaux Bill"; currently implemented in coastal Louisiana)

Source: EC 1105-2-210, Ecosystem Restoration in the Civil Works Program (June 1995)

measure may be scaled. These include its physical properties, its composition, its location, and its timing and duration.

Physical properties *of plans include sizes, amounts, counts, and the like*. For example, the size of a site (30 acres, 40 acres, 50 acres), the number of plantings per acre, the percent canopy cover of vegetation, water depth, and discharge capacity of a pump are examples of physical properties of a plan or measure that can have different scales.

Composition *includes different materials and methods that would accomplish the same purpose*. For example, a fence may be constructed as a chain-link fence, or a barbed-wire fence, or a wooden slat fence. The different materials may be thought of as different scales of a fence. In some cases, a levee and a floodwall could be different compositions of the same plan.

Locations *include different sites for the same solution*. Duck boxes at these sites or those sites are different scales of the same plan.

Timing *and* **duration** *include different start and stop times or durations for the same solution.* For example, low flow releases could be scheduled to last 6, 8, or 12 hours. The construction of a navigation channel could be phased over 5, 10, or 20 years.

If you scale the measures of a plan differently you end up with **refinements** *of a single plan, not multiple plans.* If you scale the plans of a program, you end up with refinements of the program.

Let's look at different alternative plans versus different scales of a plan. Suppose we have identified a range of plans to address a flood damage problem. For simplicity, assume each plan consists of a single measure. Plan A is a floodwall, B is a levee, C is a channel, D is a reservoir, and E is flood plain evacuation.

Suppose the evaluation and comparison steps of planning eliminate all but the floodwall choice, Plan A. The next iteration of plan formulation might scale the floodwall. That is, the optimal siting, dimensions, composition, and staging of the same plan can yield different refinements.

A concrete or steel sheetpile wall would not constitute two different plans. They are simply two different compositions of the wall. Likewise, the 10-foot and 5-foot walls are not separate plans but different physical dimensions of the same plan. A wall in front of or behind the railroad is another example of a distinction based on a single plan's siting rather than an example of alternative plans. Questions about whether to build the wall all at once or to construct it in sections over time are also issues of scale.

The final array of plans presented in many studies is not really an array of alternative plans at all. It is often a set of different scales, i.e., refinements, of a single plan. There is nothing wrong with making a final

selection from among a set of refinements of a single plan. Don't get bogged down in terminology. If the final array resulted from a more comprehensive planning process and decision-makers had the opportunity to consider a wide array of truly different plans, then it was a good planning process.

COMBINABILITY

In a planning study, management measures may or may not be mutually exclusive. *Measures that are not mutually exclusive are combinable.* **Combinability** allows us to mix and match measures into different plans. Conversely, some measures may preclude others. When building plans, consider whether two measures may be mutually exclusive because of location, function, or overlapping.

Location *limits combinability when two different measures can't occupy the same physical space at the same time.* For example, at a particular stream site you could create a calm slackwater area by either excavating the channel or by constructing a dam across the channel. You can only do one or the other at the same site.

Function limits combinability when two different measures may work against one another. For example, it probably wouldn't make sense to both build a retaining dike to hold water at a site and install drains to speed the removal of water from the site.

Overlapping limits combinability if one measure is actually a smaller scale, a subset, or an intersection of another measure. For example, you could not combine a 4-acre wetland with a 5-acre wetland to produce a 9-acre wetland if the two wetlands overlap each other.

One way to describe the combinability of measures is to display them in a matrix as illustrated in Table 28. In this example matrix, measures are arrayed against one another and their ability to be combined is indicated by a simple "Yes" or "No." In the example matrix, levees in the protected area are considered potentially compatible with measures 3, 7, 9, and 12 through 22. It has also been determined that levees aren't compatible with measures 2, 4, 5, 6, 8, 10, or 11. Note that the matrix reflects only pair-wise comparisons and does not indicate what measures might be incompatible in combinations of more than two measures.

DEPENDENCY

Some measures may be dependent on other measures in order to be implemented. The **dependency** of two measures can exist for several reasons.

First, one measure may be necessary to the function of another measure. For example, the survival of willow tree plantings may be dependent upon an irrigation system. Without irrigation, the plants will die. In this case, irrigation is necessary for the willows to function.

Dependencies may serve to reduce risk or uncertainty in project performance. For example, a flood forecast and warning system may function perfectly well without an automated telephone notification system for flood plain properties at risk. Combining the telephone notification with the warning system does, however, reduce the risk that a property owner will not hear a flood warning. The success of the forecast and warning system is to an extent dependent on the automated telephone notification system and vice versa.

Dependency can improve project performance. For example, we may elect to improve the growth rate of willow plantings by fertilizing them. The fertilizer is not necessary for the plants to function, nor will it reduce any risks or uncertainties of survival. However, it will improve the willows' performance by producing more mature trees faster. Recognizing dependency relationships among management measures can assist in screening out plans that are not feasible because they fail to meet dependency requirements.

FORMULATION PHASES

The process of building alternative plans from management measures is called **plan formulation**. There are many different approaches you can use to formulate plans. Before reviewing some of them in the next section, consider how the formulation process evolves through three very general phases. *First, you* **identify** *management measures. Second, you* **formulate** *alternatives. Third, you* **reformulate** *plans.* In every study, these phases overlap and are repeated again and again.

IDENTIFICATION OF MEASURES

One phase of formulation requires you to identify the individual pieces, the building blocks, that can be put together to form alternative plans. Plans are most often built-up from measures. Sometimes, you might identify measures by breaking an alternative plan down into its component parts.

Table 28: Pairwise Compatible Measures

Measure	Measure 1	Measure 2	Measure 3	Measure 4	Measure 5	Measure 6	Measure 7	Measure 8	Measure 9	Measure 10	Measure 11	Measure 12	Measure 13	Measure 14	Measure 15	Measure 16	Measure 17	Measure 18	Measure 19	Measure 20	Measure 21	Measure 22
1: Levees	NA	NO	YES	NO	NO	NO	YES	NO	YES	NO	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
2: Floodwalls		NA	YES	NO	NO	NO	YES	NO	YES	NO	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
3: Bridge modifications			NA	NO	NO	YES	YES	YES	YES	NO	YES	YES	NO	NO	NO	NO	YES	YES	YES	YES	YES	YES
4: Reservoirs				NA	NO	NO	NO	NO	YES	NO	NO	YES	NO	NO	NO	NO	YES	YES	YES	YES	YES	NO
5: River diversion					NA	NO	NO	NO	YES	NO	NO	YES	NO	NO	NO	NO	NO	YES	YES	YES	YES	NO
6: River dredging						NA	YES	NO	YES	NO	NO	YES	NO	NO	NO	NO	NO	YES	YES	YES	YES	YES
7: Island removal							NA	YES	YES	NO	YES	YES	NO	NO	NO	NO	NO	YES	YES	YES	YES	NO
8: Channel modification								NA	YES	NO	NO	YES	NO	NO	NO	NO	NO	YES	YES	YES	YES	YES
9: Flood forecast anf warning									NA	NO	YES	YES	NO	NO	NO	NO	YES	YES	YES	YES	YES	YES
10: Evacuation protected are										NA	NO	NO	NO	NO	NO	NO	YES	YES	YES	YES	YES	YES
11: Flood proofing & nonstructural protected area											NA	YES	NO	NO	NO	NO	YES	YES	YES	YES	YES	YES
12: Flood insurance												NA	NO	NO	NO	NO	YES	YES	YES	YES	YES	YES
13: Levees induced area													NA	NO	NO	NO	YES	YES	YES	YES	YES	YES
14: Floodwalls induced area														NA	NO	NO	YES	YES	YES	YES	YES	YES
15: Evacuation induced area															NA	NO	YES	YES	YES	YES	YES	YES
16: Flood proofing & nonstructural induced area																NA	YES	YES	YES	YES	YES	YES
17: Bird islands																	NA	YES	YES	YES	YES	NO
18: Acid mine drainage migration																		NA	YES	YES	YES	YES
19: Fish channels on tributaries																			NA	YES	YES	YES
20: Duck boxes																				NA	YES	YES
21: Watering holes																					NA	YES
22: Wetlands restoration																						NA

FORMULATION OF ALTERNATIVES

Another formulation phase involves matching and mixing management measures into different alternative plans. This process is best served by observing the realities of combinability and dependency. Otherwise this phase is unconstrained and open to all ideas for problem solving.

REFORMULATION

Chapter Five described the iterative nature of planning. **Reformulation** *is a special type of iteration during which alternative plans previously formulated are changed for one or more reasons.* It may be helpful to think of the basic plans that come out of the previous formulation phase as parent plans, and the reformulated plans as their offspring. Reasons for changing plans vary from study to study, as well as over time within a study. Typically, the reasons for reformulation are related to the four evaluation criteria listed in the Principles and Guidelines and are discussed in the next chapter.

Measures may be added, dropped, rescaled, or otherwise modified such that the reformulated plan will better achieve a planning objective or stay within the limits of a constraint. Measures can be modified to develop a reformulated plan that is less costly, i.e., more cost effective, than its parent plan. We may need to add or otherwise modify measures to make sure that a parent plan includes everything that it needs to work successfully. For example, local interests may need to provide navigation berthing areas, or flowage easements, or restoration of adjacent upland habitats, to ensure that a basic Corps plan will indeed work and provide the expected benefits. Stakeholders may request plan modifications that will address concerns or desires beyond those included in the planning objectives and constraints.

"Mitigation" is always a reformulation reason because it is undertaken as a response to the adverse effect(s) of a parent plan. In most studies, mitigation is either a constraint or a necessity for a complete and acceptable plan.

SEQUENCE OF PHASES

Plan formulation begins where you are. Sometimes you will find yourself at ground zero with no prior information. Other times you may have an earlier Corps study that has already done a significant

Plan formulation begins where you are.

amount of formulation. Some studies begin with a plan from another agency or a plan preferred by the local sponsor that needs some reformulation. Plan formulation is not a monolithic process that always begins at the same place using the same processes. Wherever it begins, there is always a process and the next section describes some approaches to formulation.

FORMULATION APPROACHES

Returning to the central theme of this chapter we again ask, "Where do plans come from?" They come from people. Specifically, they are born of ideas driven by planning objectives and constraints. In a series of workshops and training courses held around the country in 1995, over 130 Corps professionals were asked where plans come from. Three recurring and overlapping themes emerged from the great variety of their answers. Plans come from (1) sources outside the Corps, particularly the local sponsor; (2) the study team and their bosses; and (3) other sources such as technical expertise, experience, creative thinking, analysis and politics. The single common thread to these responses is people. People generate solutions. The people who can formulate plans are not limited by technical background or group affiliation.

People's ideas for plans should be driven by the planning objectives and constraints. The objectives define what the planning process is trying to do. The plans define how the objectives will be obtained. Plans emerge over time from a well developed set of objectives and constraints as the study team and public complete the iterative planning process.

This section addresses the "how" of plan formulation rather than the "who" of plan formulation. It begins with the one truth about the how of formulation: there is no one way to do it. The corollary to this truth is that there is no sure way to do it either. The most effective ways, however, begin with and use the planning objectives throughout the process.

The professional literature and experienced planners alike acknowledge two factors in plan formulation, experience and creativity. This section briefly explores ways to exploit both of these factors. Let's begin by considering how we think about plan formulation.

HOW TO THINK FORMULATION

Creativity requires planners to break out of old, self-perpetuating patterns of thinking and generate new ways of looking at things. **Vertical thinking** *(experience) needs to be supplemented by* **lateral thinking** *(creativity)*. Both are needed to succeed in formulation.

General Approaches to Plan Formulation

There are some tried and true ways to generate plans. They include...

- Ask an expert -- Use informed judgment and informed personal intuition.
- Consider plans of others -- Other people may provide you with ideas about solutions.
- Checklists -- Lists capture past experiences in problem solving.
- Formal Problem-Solving Methods -- Some methods provide clues to what measures may work, others help you develop combinations.

Vertical thinking follows the most obvious and probable line of reasoning. It's based on mechanistic information processing principles such as are used in mathematics and logic. Like climbing a stair, it proceeds one step at a time in a predictable direction. It's a more structured and experiential process.

Lateral thinking, on the other hand, tries to get away from patterns that lead in one definite direction. Lateral thinking seeks to break out of one's habitual domain of thought. It is based on biologically-based information processing. It's a more creative process.

Typically, all thoughts, all information gathering and interpretation, and all search at some point in the planning process begin to pull in one direction. The problem solving gets "locked in" through a process that builds logically on all the prior steps taken. This is not undesirable. A logical process that zeros in on a solution is clearly valuable, if the solution is a good one.

Sometimes, however, solutions require a sideways move in another direction. Does flood damage reduction need more or higher levees? That's vertical thinking. Or do evacuation and flowage easements make more sense? That's lateral thinking. Lateral thinking is not necessarily better thinking, but it is necessary to ensure that we make informed decisions. *A good plan, the "best plan," can only be selected if the array of alternatives provides a good set of feasible solutions.* There is no way to get a good plan from a weak

set of alternatives. Great plans come only through purposely challenging and extending one's habitual ways of thinking.

There are many tried and true management measures that are good ideas. The value of levees and floodwalls has been proven time and again. Experience and analysis will frequently be enough to identify these kinds of good ideas. But where do new good ideas come from? That is a far more vexing problem.

There are no fail-safe methods that guarantee good new ideas in every case. However, new ideas might be generated in a number of ways:

- By inventing or introducing new measures to address planning objectives.
- By creating new combinations of old measures.
- By modifying existing measures to meet new objectives.

While these suggestions lend some structure to the attempt to exploit people's inventiveness and creativity, by themselves they are of limited value. These are ways to help us think about new solutions. What we need are some approaches for generating new ideas, for doing plan formulation. We'll start with one of the most familiar approaches, asking an expert.

Ask an Expert - The Heuristic Search Approach

…go down the hall and ask Pat…

The **heuristic search**, *or* "ask an expert" *approach, may be the most common aid in use today for designing solutions to problems.* Heuristic search relies on the use of simple rules of thumb such as: Call up your old professor and ask her for some thoughts; go down the hall and ask Pat, he knows more about this than anyone; find a bulletin board or news group on the Internet and see what you can find out; read the previous report. While it is usually the easiest and most readily available approach, a systematic and deliberate heuristic search is still relatively neglected as a plan formulation tool. When planners seek to exploit the experience of others, how often do they call another district? experts in academia? retired personnel? other outside experts?

Your most immediate and perhaps best place to start a search for alternatives is right in the district. In-house personnel are frequently overlooked, but they can offer years of experience and familiarity with problems and what may or may not work to fix them. Talk with knowledgeable individuals. Hold a one-hour brown bag brainstorming session for everyone in your office to contribute ideas. Conduct a district-wide survey for solutions. When you do, don't forget to include the people in the Regulatory Office who handle permits for your study area; the people in the Real Estate Office who deal with many different local land issues; and the people in the Operations Office, including people at project sites who inspect, repair, and maintain projects and perhaps who even live in your study area. Extend your search to the rest of the "Corps family." Call the hydraulic engineer who retired last year. Now could be the time to call that planner from another district whom you met at a training class.

Professionals outside the agency are also valuable formulation resources. Other public agencies at the Federal, State, and local levels are charged with similar problem-solving missions and can often provide formulation ideas. The academic community, consultants, and professional associations should also be considered, especially those located in the study area.

What types of solutions do homeowners, boaters, owners of businesses, and others with day-to-day familiarity and experience with the problems think will work? What alternatives would they like to see? Which ones do they oppose?

A broader and more innovative array of alternatives can also be obtained by using published materials like professional journals, textbooks, earlier Corps reports, and related reports. The information superhighway is a promising new avenue. Literature research, in all of its manifestations, should continue to play an important role in formulation.

The information superhighway is a promising new avenue.

If people come up with plans, then a systematic effort to involve as many people as possible can only help. *Making the heuristic search more systematic will immediately improve the plan formulation process. It may be the cheapest, quickest, and best way to improve your array of solutions.*

Creative Problem-Solving Techniques

Another way to generate ideas for plans is to use some structured approaches to creative thinking. Such approaches, collectively called **creative problem**

solving techniques, are essentially systematic ways to generate ideas that can be used to formulate solutions to problems. Table 29 lists 46 such techniques.

Table 29: Idea Generation Techniques

- Individual Techniques
  - Analogies
  - Progressive Abstractions
  - Metaphors
  - Hypothetical Situations
  - Reversals
  - Wishful Thinking
  - Attribute Listing
  - Catalog
  - Checklists
  - Focused-Object
  - Free Association
  - Fresh Eye
  - Listing
  - Nonlogical Stimuli
  - Relational Algorithms
  - Circumrelation
  - Lateral Thinking
  - Morphological Analysis
  - Idea Tracking
  - Packays Scientific Approach
- Group Techniques
  - Battelle-Bildmappen-Brainwriting
  - Brain writing Pool
  - Classical Brainstorming
- Group Techniques (Continued)
  - Collective Notebook
  - Crawford Slip Writing
  - Force-Fit Game
  - Gallery Method
  - Gordon / Little
  - Method 6-3-5
  - Phillips 66
  - Pin-Cards
  - Semantic Intuition
  - Successive Integration of Problems Elements Method
  - Stimulus Analysis
  - Synectics
  - Systematized Directed Induction
  - Trigger Method
  - Visual Synectics
  - Wildest Idea
  - Bobele-Buchanan
  - Coca-Cola
  - Creative Problem Solving
  - Delphi
  - Nominal Group Technique
  - Phase of Integrated Problem Solving
  - Problem-Centered Leadership

Source: Van Gundy's *Techniques of Structured Problem Solving*, p. 29.

Some techniques are designed for use by individuals, others for use by groups like an interdisciplinary team. The techniques vary in complexity. Some can be used immediately, others require training. Although it is not practical to review all of these techniques in this manual, interested planners can find a discussion of each, as well as additional references, in Arthur B. Van Gundy's *Techniques of Structured Problem Solving* (1981).

Objectives-Measures Matrix

Another formulation technique is to develop an **objectives-measures matrix.** This technique recognizes that alternative plans are made up of one or more compatible and feasible management measures that contribute significantly to a set of planning objectives. Thus, a reasonable starting point for plan formulation is an examination of the relationship between objectives and measures. A simple preliminary formulation exercise would be to ask your experts to identify and list as many measures as possible, but at least one, for each planning objective. This will give substantial emphasis to each objective. If there was diversity in specifying the planning objectives and there is creativity and diligence in the identification of measures, this approach should ultimately produce a truly differentiated array of alternative plans.

For example, let's suppose for the moment that three planning objectives were identified in the first planning step of your study. *The first step in building an objectives-measures matrix is to ask your experts to identify management measures that address each planning objective, either directly or indirectly*. A composite list that could result from this type of questioning is shown in Table 30. Identification of measures is the most critical phase in the entire plan formulation process. It is the "A number 1" activity in the third step of the six-step planning process. As many measures as possible should be identified. This is the time to "think the thinks you can think." More creativity is required in identifying measures than in assembling them into plans.

We cannot be sure we have the best plan unless we have the best set of alternatives from which to choose. Our alternative plans will only be as rich and as good as the measures that are combined to create them. Choice requires more than one option. *Though multiple measures will not always be possible for each objective, it remains a modest goal*. Under no circumstances should there ever be an objective that is not addressed by at least one management measure. An objective that is not paired with a measure cannot be attained. Consequently, it is either not an objective or the formulation process has been inadequate.

The second step in building an objectives-measures matrix is to array the planning objectives against the full set of identified measures in the matrix format. Then indicate which measures are expected to contribute to which objectives. Table 31, a 3 by 22 matrix, is an example. The columns show the objectives to which a particular measure contributes. In this example, reservoirs and floodplain evacuation contribute to each of the three objectives. The rows of the matrix show the various measures that will contribute to a specific objective.

As planning progresses, an objectives-measures matrix can be prepared for each formulation iteration. Then, cognizant of the combinability and dependability of measures, plans can be constructed to meet the objectives. This technique is just one example of how planners might approach the assembly of alternative plans.

Consider Plans of Others

Anyone, at any time, may offer you a plan. To them, it may be "the" plan. It may come from the local homeowners' association, from the port authority or from a coalition of environmental groups. They may hand it to you before you even have a study authority. You might get it the day before the final report goes to print. It may be detailed or general. It might be nonsense or right on target. *Regardless of from whom, when, and in what form they're offered, the plans of others are legitimate pieces of the plan formulation process.*

What do you do with a plan developed by someone else? The first and most important thing to do is to take the presenter of the plan seriously. No plan should be dismissed out of hand. Each idea, regardless of its source, should receive appropriate consideration. Too often, ideas that do not arise from the study team or non-Federal sponsor, are regarded as lacking in credibility. They may not receive appropriate consideration. On the other hand, not every idea floated by a member of the public is worthy of serious consideration. The important point is to *be willing to consider feasible suggestions and good ideas, no matter where they come from*.

If the plan cannot be used as is, does it have components that might be useful in other plans? Does a plan that does not contribute to your planning objectives suggest an objective that you may have missed? Even when another's plan is not directly useful, it may contain information useful to your planning process.

Consult a Checklist

Management measure checklists are simply that, lists of different measures. Management measure checklists capture past experience in problem solving. They are convenient ways to keep track of what has worked in the past. A checklist can be a ready source of potential solutions that can provide you with a place to start your formulation.

Some checklists are simple lists of measures. Other useful lists were not designed as lists. For example, you might thumb through the manual "Flood Proofing Techniques, Programs, and References" prepared by the U.S.

Table 30: Objectives and Measures

Objective 1:	Reduce flood damages in riverside communities
Measure 1:	Levees
Measure 2:	Floodwalls
Measure 3:	Bridge modifications
Measure 4:	Reservoirs
Measure 5:	River diversion
Measure 6:	River Dredging
Measure 7:	Island removal
Measure 8:	Channel modifications
Measure 9:	Flood warning and preparedness
Measure 10:	Evacuation of floodplain
Measure 11:	Flood-proofing
Measure 12:	Flood insurance
Objective 2:	Minimize induced flood damages and flooding in communities upstream and downstream of the study area
Measure 4:	Reservoirs
Measure 5:	River diversion
Measure 6:	Dredge river
Measure 7:	Island removal
Measure 8:	Channel modifications
Measure 9:	Flood warning and preparedness
Measure 12:	Flood insurance
Measure 13:	Levees in induced flooding area
Measure 14:	Floodwalls in induced flooding area.
Measure 15	Evacuation of floodplain in induced flooding area
Measure 16:	Flood-proofing in induced flooding area
Objective 3:	Maintain or increase the quantity and/or quality of fish and wildlife habitat in protected area
Measure 4:	Build Reservoirs
Measure 10:	Evacuate floodplain
Measure 17:	Create bird islands
Measure 18:	Mitigate acid mine drainage into Big River
Measure 19:	Construct fish channels on Big River tributaries
Measure 20:	Construct duck boxes
Measure 21:	Construct watering holes
Measure 22:	Restore Wetlands

Table 31: Objectives-Measures Matrix

Measure	Objective 1	Objective 2	Objective 3
1. Levees	X		
2. Floodwalls	X		
3. Bridge modifications		X	
			X
4. Reservoirs	X		X
			X
5. River diversion	X		X
6. River dredging	X		X
7. Island removal	X		X
8. Channel modification	X		X
9. Flood warning and preparedness	X		X
10. Evacuation		X	
			X X
11. Flood-proofing	X		X
12. Flood insurance	X		X
13. Levees induced area			
			X
14. Floodwalls induced area			X
15. Evacuation induced area			X
			X
16. Flood-proofing induced area			
			X
17. Bird islands			
			X
18. Mitigate acid mine drainage			
			X
19. Fish channels on tributaries			
			X
20. Duck boxes			
			X
21. Watering holes			
			X
22. Wetlands restoration			
			X

Army Corps of Engineers National Flood Proofing Committee to compile a list of flood proofing measures. Topical reports, their tables of contents and indices can sometimes serve as sources of lists, although that was never their intention.

What might you do with a plan offered by someone else?

- Take it seriously and give it appropriate consideration.
- Use its component measures in other plans.
- Verify the objective or constraint it's intended to address.

Formal Methods

Another formulation approach is to use a **formal methodology**. These are different from the idea-generating approaches mentioned earlier in that they comprise formal methodologies that encompass the entire problem-solving process. These methods are more than simple tools to aid the thought process. They go well beyond the heuristic search methods and checklists that are most commonly used. The methods involve the design, what we call "formulation," of alternative means of problem solving. They help develop decision options of one type or another. In instances where a structured and systematic approach for formulating plans is desired, one or more methods may be worth investigating. These techniques include the analysis of interrelated decision areas (AIDA, Luckman 1967, and Morgan 1971), the morphological box (Zwicky 1969), the IDEALS concept (Nadler 1967), idealized design (Ackoff 1978), issue-based information systems (IBIS, Dehlinger and Protzen 1972), the strategic choice approach (Friend and Jessop 1977), and strategic options development and analysis (SODA, Eden 1989). The interested planner is directed to the referenced material for additional details.

Habitat suitability index (HSI) models are often used to estimate environmental outputs of ecosystem restoration projects. A thoughtful examination of HSI models can provide valuable clues for finding successful management measures. *Sometimes the analytical models used in planning can provide focus and clues to potentially successful management measures.*

Examining HSI models may suggest that management measures that alter habitat variables farthest from their optimal conditions may be more fruitful. The mathematical structure of the models often identifies a limiting variable that suggests that plans that affect limiting variables may be more effective than plans affecting non-limiting variables. Other insights are also available from these models. *The important point is to look for ideas and insights in the generation of plans wherever they may be found.* Sometimes this includes

the analytical models.

The "all possible combinations" method is the ultimate tool for mechanistic formulation. As its name conveys, for a given list of management measures, it will provide you with the set of every conceivable combination of those measures. In principle, this method is very simple. It must be used judiciously, however, or it can easily get out of hand.

Is "No Action" An Alternative Plan?

Yes and no.

Yes, "no action" is an alternative future condition that you could elect to choose. As we'll discuss in Chapter Eleven, it's the first default recommendation. "No action" is an alternative just like the future conditions that would result from any alternative plan.

On the other hand, the "no action" alternative does not require the Corps to do anything. Just like its name says, it represents the future that will occur if we take no action. Alternative plans require that we take some action to meet the planning objectives. Therefore, while "no action" is an alternative future, it is not strictly speaking an alternative plan.

The all possible combinations technique is a tool, not a requirement. It can be used in any situation in which planners find it helpful. Step-by-step instructions for the all combinations method are presented in *Evaluation of Environmental Investments Procedures Manual Interim: Cost Effectiveness and Incremental Cost Analyses*, IWR Report #95-R-1, May 1995.

CHARACTERISTICS OF SOLUTIONS

How do you know when you've done a good job identifying solutions? How much do you need to know about a solution before it's really a solution? Experience shows that the answers to these questions are very situational. At a minimum, however, every solution be it a measure, a plan, or a program , should have the following describable characteristics:

Subject - What is it, a feature or activity?
Verb - How would it come about, through excavation, enforcement, etc.?
Site - Where would it be located?
Purpose - What planning objective(s) is it intended to address?
Cost friendly - Can you *estimate* its dollar costs?
Output friendly - Can you *estimate* what, and how much, you expect to get from it in the later planning steps?

Good solutions emerge from a rational, iterative planning process that has considered a comprehensive set of alternatives. At some point in the process, good solutions are sufficiently differentiated from one another so as to offer a full range of truly different ways to achieve the planning objectives. Good solutions are more complete, more effective, more efficient and more acceptable than bad solutions. Good solutions are not constrained for lack of authority. Good solutions make significant contributions to the overall set of planning objectives and do not violate planning constraints. Good solutions are hard to formulate.

NAMING ALTERNATIVE PLANS

Talking about solutions means we have to name them. So, how do you know what to call different measures or plans? There is no universal convention for naming alternatives, and the short answer is you can call them whatever you want. However, it is most helpful if the names have some easily communicated meaning. Some commonly used naming conventions are described below.

Geographic sites. Name alternatives after neighborhoods, towns, villages, land forms, or other geographic sites. For example: "Downtown Plan," "Lake Sullivan Plan," "Ravenswood Plan," and the like. These are often the most descriptive, hence the best names.

Management measures. Name alternatives after their dominant management measures. For example: "Channel Plan," "Levee Plan," "Relocation Plan," and the like; combine measures and sites, e.g., Downtown Channel Plan. When dealing with plan refinements like a levee raising perhaps simple descriptions like "One-foot raising" or "Agnes level" will serve the purpose of effective communication. These names are also descriptive.

Numbers. Simply number alternatives: "Plan 1," "Plan 2," etc. This is very logical, but not very descriptive. It often requires the reader or listener to continuously refer back to a description.

Letters of the alphabet. Like the numbering scheme the alphabet can be used: "Plan A," "Plan B," etc.

It is likely that people outside the study team will be discussing your plans at some point. *Short descriptive names can be an effective way of communicating a great deal of information in a shorthand fashion*. Try to avoid complex and opaque naming schemes like 290BC2 that contain elements or symbols that stand for design flows (290,000 cfs), geographic regions (Bitter

Creek) and versions (second) of the plan. Although logical to anyone with a history of the project and a table that describes the plan elements, it remains cold and opaque to the public.

SUMMARY AND LOOK FORWARD

Lesson One. Planning objectives drive plan formulation.

Lesson Two. A plan is one or more compatible measures that make significant feasible contributions to the set of planning objectives. People identify measures and plans.

Lesson Three. In water resource planning under the Corps' Civil Works Program, the P&G require the identification of an NED plan from among the alternatives considered. Ecosystem restoration planning, for example, does not require an NED plan.

Lesson Four. A good plan can only emerge from a good set of truly differentiated plans and optimized versions of these plans.

Lesson Five. The are many different approaches and methods available to assist the formulation process.

The most rational way to move from an array of many solutions toward identification of one best solution is by evaluating their effects. Evaluation is the fourth step in the planning process and it is the subject of the next chapter.

SUGGESTIONS FOR FURTHER READING

If you'd like to read about the heuristic search approach to formulating alternative solutions, you might consider one of the following:

Marquis, D.G. 1969. "The Anatomy of Successful Innovations." *Innovation*, 1 (1969): 28-37.

Pounds, W.F. 1969. "The Process of Problem Finding." *Industrial Management Review*, 11 (1969): 1-19.

Simon, H.A. 1977. Models of Discovery. Dordrecht, Holland: D. Reidel.

A particularly good book to investigate if you want some ideas about techniques for generating ideas is Van Gundy's: *Techniques of Structured Problem Solving*. It includes a discussion of 46 creative solving techniques.

You can find out more about the other techniques by consulting the sources cited in the chapter's text.