HOW TO USE PUBLIC VALUES IN TWRS DECISION MAKING

INTRODUCTION

Consulting with the public on major decisions is now both normal and expected at Hanford. Guidance on how to consult with the public has been provided to TWRS Project Managers (and is included in Appendix I). But even if public involvement programs are conducted in an effective and skilled manner, the question still remains: "Once we've heard what the public thinks and feels, how do we use this information in decision making?"

Obviously, public involvement is not the equivalent of taking a vote and doing what is most popular, if only for the reason that even the best public involvement programs involve only a small percentage of the public. But equally obviously, if the public takes the time to participate in Hanford's decision making processes, the participation had better mean something, or people will be even more upset than if they hadn't been asked to participate in the first place.

This guide addresses the issue of how public values can be reflected in the decision making process. The emphasis should be on the word "process," because one of the basic premises of this guide is that public values can provide useful guidance during each step of decision making. An understanding of public values can help you define the problem, establish performance criteria, identify the range of alternatives to consider, evaluate alternatives, and shape the final decision itself.

Among the questions this guide addresses are:

- What are values, and why do they matter?

- What is the proper role of public values in technical decision making?

- What is known about public values at Hanford?

- How do values fit in the System Engineering process?

- How can we use public values at each step in the TWRS decision making process?

- Is it possible to use previously identified values as a continuing framework for TWRS decision making?

The guide is divided in two sections. Section I provides an overview to general principles about values and their use in decision making. Section II provides guidance on how to use values at each step in the decision making. You will need to know the material in Section I before using Section II.

Some of the ideas contained in this guide have been used at Hanford and other places within DOE before. Sometimes they have been used successfully, sometimes with only mixed success. This guide endeavors to draw from the lessons learned, and for the first time, put them all the concepts together in a unified package.

But, some of the ideas in this guide are still undergoing evolution. A few of them are even being tried out for the first time. So do not treat this guide as binding guidance. It's the best advice that the writers -- a knowledgeable team of professionals in decision science -- can give you. But make your own judgments about which ideas you want to

try out, and feel free to come up with variations of your own. We'll try to provide enough information so you will recognize when your variations may violate some important principle of methodology. Beyond that, keep pushing the edge of the envelope. We believe you'll find applications that have value for you.

SECTION I

GENERAL PRINCIPLES

Chapter 1

WHAT IS A "VALUE?"

Values aren't a thing or object. An archeologist of the mind can't dig around in our brains and instead of rocks and bones find an object called a "value." As Kenneth Boulding, the eminent economist put it: "The word 'values' is almost as bad as 'it'. Grammatically, it is called a noun, and hence we expect it to be a thing. The search for a thing called a value, however, is likely to be fruitless, for the concept refers not to a thing which can be observed, weighed, and measured, but to a process, the process of valuation." [1]

Robin Williams, a significant contributor to the values literature, defined values as "the criteria, or standards in terms of which evaluations are made." [2] Milton Rokeach, another key figure in the field, defined values as follows: "A value is an enduring belief that a specific mode of conduct or end-state of existence is personally or socially preferable to an opposite or converse mode of conduct or end-state of existence." [3] This definition, while consistent with Williams', adds the additional concept of two or more possible modes of conduct or end-states in tension or opposition to each other. In other words, values are not "things," but relationships between alternative standards by which events or actions can be evaluated.

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[1] Boulding, Kenneth E., "Divine Legitimization and the Defense Establishment," The Humanist, Vol.. XXVIII, 1968, pg. 21.

[2] Williams, R. M. , "Values," in E. Sills (Ed.) International Encyclopedia of the Social Sciences, New York: MacMillan, 1968, p. 265.

[3] Rokeach, M. Beliefs, Attitudes, and Values, San Francisco: Jossey-Bass, 1968. Also see The Nature of Human Values, New York: Free Press, 1973.

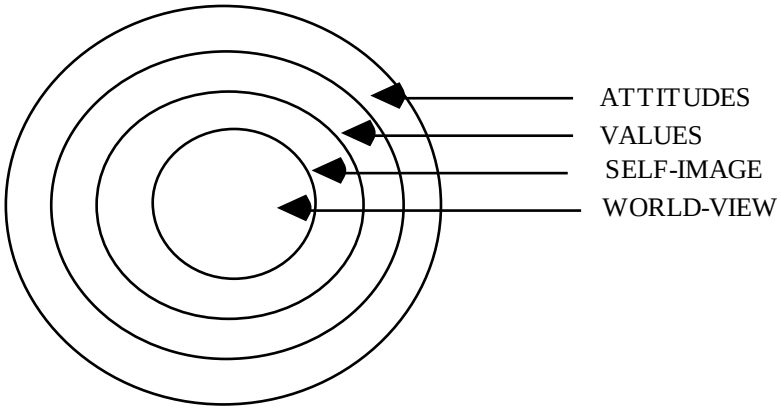
Another way to think of values is that they are "decision rules." Human beings make many thousands of decisions a day regarding the relative value of one action or another -- whether to eat out or eat at home, whether to buy a house or rent, whether to take the bus or drive to work, whether to speed on through a yellow stop light or make a stop. If every decision had to be made from an entirely neutral posture, each decision could chew up incredible quantities of time. The result could be paralysis.

But from the minute we're born we begin to form preferences. We prefer to be fed, to avoid pain, to receive love. Over time, each of us has developed a decision-making strategy to reduce life decisions to a tolerable number. Obviously such a strategy is more useful if the rules are relatively stable and universal. One way to view these decision making strategies is as successive layers ranging from core beliefs, that are relatively permanent, out to more peripheral beliefs, that are relatively transient (Figure 1):

WORLD VIEW AND SELF-IMAGE

At the very core of our personal decision making structures are beliefs about the world and ourselves that are formed very early in childhood, and normally persist for the rest of our lives. Children may learn that "the world is a scary, dangerous place" or "the world is a supportive, caring place." A sense of self-esteem or of being personally worthy, lovable, or capable, also begins to form early in childhood. These perceptions are very important determinants of how we act and present ourselves in the world, but while they predispose us in certain directions, they usually aren't specific enough to predict our attitudes towards specific courses of action. For that, we need to look to values.

Figure I



VALUES

As we've discussed, values are the decision rules we apply to decide what is good/bad, right/wrong, fair/unfair, rational/irrational. Some values are about what really matters in life, the "ends" of life, such as: freedom, happiness, equality, security, salvation, enlightenment. Other values are about how you go about achieving those ends, the "means," such as: helpful, creative, elegant, polite, cheerful. Finally, there are also values about "process," such as: openness, fairness, efficiency.

ATTITUDES

The next rung out consists of attitudes. Attitudes differ from values primarily in the relative ease with which they change. To illustrate: If we were talking about health care reform, one individual's values might predispose him or her to believe that everybody "deserves" health care. This would result from values

such as "equality" or "justice." Another person may believe that every individual should be responsible for their own health care, and the government should stay out of it. This might result such values as "freedom," "personal responsibility," or "free choice." People who hold these values very strongly are unlikely to change their fundamental stance. However, attitudes such as "The President is doing a good job," "the Senate Bill is a reasonable compromise," or "I'm going to be better off if the bill passes" may change very quickly based on new information or events.

This brings us to an important characteristic of personal decision making structures: any time there is dissonance between one of the more central beliefs and a more peripheral belief, the peripheral belief will change. Thus, when people are confronted with the fact that one of their attitudes is in conflict with one of their ends values, they will change their attitude. Also, when people are unable to meet or bring about an ends value, they perceive this as a moral failure or an issue of guilt. On the other hand, failure to meet or bring about a means value or attitude will evoke feelings of inadequacy or ineffectiveness of the sort that would occur when we don't behave as logically, intelligently, or imaginatively as we would prefer.

Rokeach summarizes the values research by saying that values will determine an individual's judgments in the following ways: [4] Values will: (1) dictate particular stands on social issues, (2) predispose people to favor one particular religious or political ideology or another, (3) guide presentation of self to others, (4) form the basis to evaluate and judge, heap blame or praise on ourselves or others, and (6) dictate what will be used to persuade or influence others.

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[4] Op cit.

KEY CONCEPTS

- *Values are a system of decision rules, permitting us to more easily make choices between alternative courses of action.*

- *Values are relatively stable, unlikely to change based solely on new information.*

- *Values are useful in predicting the acceptability of proposed actions.*

- *By understanding values we may be able to predict public reaction to a number of potential actions, not just the immediate decision.*

Chapter 2

THE ROLE OF VALUES IN TECHNICAL DECISION MAKING

Imagine for a minute that you are in a community that is bisected by a river. It's known that there is serious pollution in the river -- so much that nobody dares swim or fish in the river anymore. The pollution comes from a number of sources: an upstream manufacturing plant, return flows from upstream agriculture, run-off from city streets.

Who is better qualified to make decisions about what should be done to clean up the river, the public or technical experts?

Most people would agree that technical experts are best qualified if the decision is:

- How much pollution is in the river, and what kind
- How the pollution could be cleaned up
- What the costs ARE associated with each cleanup alternative
- What levels of exposure are associated with health risk

A few people may quibble even with this list. They would argue that our hypothetical technical experts may have blinders on when they consider these decisions. For example, our technical expert might concentrate primarily on contaminants of concern to human health, without doing the same for other species. Experts may look primarily for a technological fix, when changes in social behavior might equally address the problem. Experts might look primarily at economic costs, but not consider

environmental or social costs that the experts believe are "external" to this issue. Finally, issues of risks invariably involve problems of uncertainties and incomplete data, requiring experts to make judgment calls that are driven as much by values as technical expertise.

One of the roles of public involvement in decision making, these people argue, is to "keep technical people honest." This criticism doesn't really suggest that these decisions should not be made by technical experts. It does suggest, though, that even when making clearly technical decisions, values can serve as perceptual blinders that constrain consideration of all the options. Public involvement can point out situations where technical experts drift into applying their own values to decisions where their are alternative values that could be chosen.

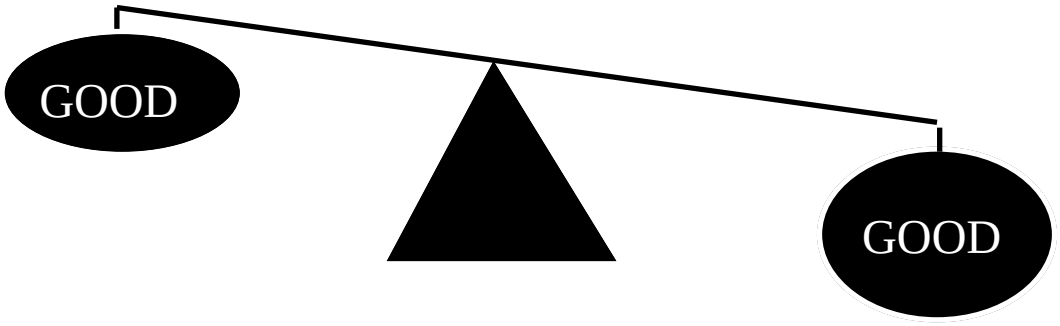
But let's push on with our example: let's assume that the technical experts have made all these judgments, and they have done it without perceptual blinders, so that other technical experts reviewing their work agree that the work was done well and met recognized professional standards. But now it is time to make a decision about how much cleanup <u>should</u> occur. Suddenly, everything gets harder, because cleaning up the river to the point that is once again swimmable and fishable may require shutting down the upstream factory, require expensive changes to irrigation practices, or require installing expensive control valves at service station pumps. As a minimum, the project will use up funds that could have been used for education, housing, health care, or filling potholes.

The distinguishing characteristic of the decisions that can be considered "technical" is that they only involved one values dimension at a time. As long as the only issue is cost, or health risk, or feasibility, technical experts are the best qualified people to make

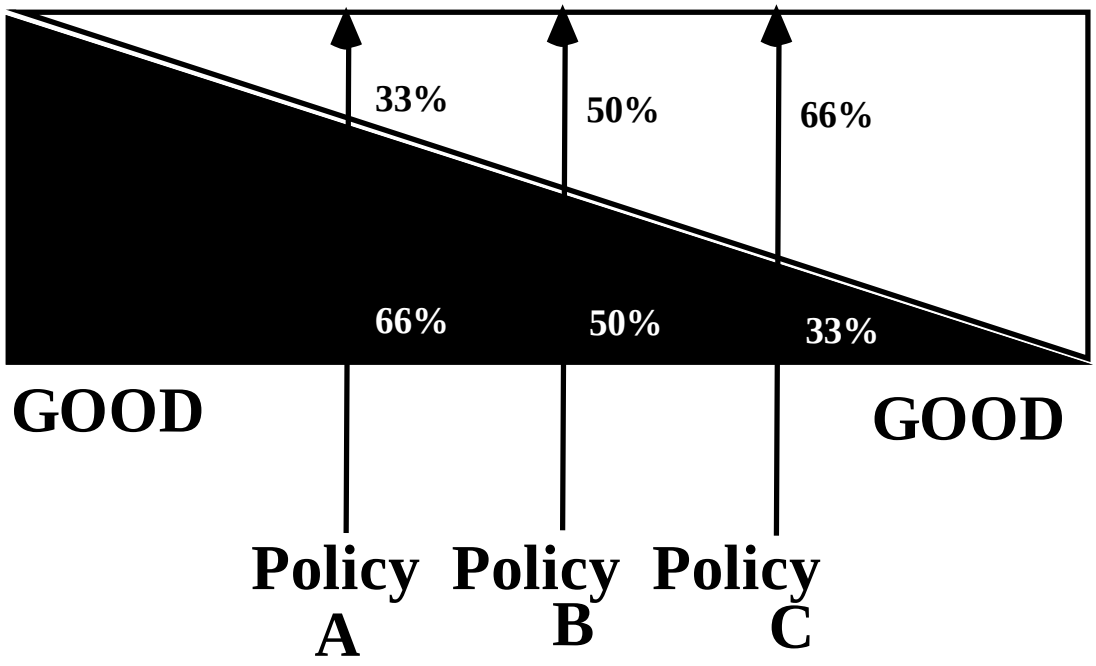
the call. But the minute a technical expert has to choose between two values, suddenly the issue is no longer simply technical, its a decision about what's more important, jobs or clean water, individual freedom or environmental protection, human health concerns or the needs of other species. These decisions, by their very nature, are values choices.

Here's another example of the problem: recent studies show that if the Columbia River is operated in such a way that it maximizes salmon runs, resident fisheries are harmed, electric power rates go up, and communities run a higher risk of flood damage. Which is more important? While that answer may be informed by all kinds of technical information, the technical information alone won't answer the question. Ultimately, someone has to decide whether salmon runs are more important than resident fisheries, or low electricity bills, or higher levels of risk. This is a values choice.

In other words: the hard choices are between one thing society thinks is good and another thing society thinks is good. Often these "goods" are in tension with one



another. For example, costs may go up dramatically with higher levels of protection from health risks. Does that higher level of protection justify the added expense? Most of us find this a dilemma because we want both protection and low cost. Both are good. The real issue is to find the relative balance or weight to give one "good" versus another. Most hard decisions, what are normally called "policy" decisions, are essentially this kind of values choice, informed with technical information.



In the figure above, supporting Policy A means that you believe that the social "good" on the left hand of the scale is twice as important as the "good" on the right hand side. Policy B strives to give them equal weight. Policy C reverses the priority.

There is nothing about technical training that makes technical experts more qualified than others to make values choice -- even when technical experts hold management positions that require they make such decisions. This is not to say that technical experts don't have opinions about such things; in fact, one of the criticisms of engineers is that they often assume that the cheapest workable solution is -- virtually by definition -- also the best. But that simply means that engineering training teaches people to place a very high value on cost. Someone whose primary interest was worker safety, or environmental protection, might believe the engineer's approach was very biased and short-sighted.

That's where public involvement comes in. Public involvement provides decision makers with information about the relative importance the public assigns to the values choices that underlie a particular decision. In a democratic society, "the people" ultimately make the important values decisions. That doesn't mean that knowing the public's values gives you the answer. As we discussed earlier, "the public" in public involvement is never the entire electorate. Furthermore, segments of the public are often in strong disagreement with each other. It's possible to understand the values that each of these segments has -- and as we'll see later in this guide, that is useful information -- but this doesn't tell you what the decision should be. It's even possible for people in the local community to have relatively high levels of agreement on values, only to find that the "national public" doesn't agree. For example, the public in any community typically wants very high levels of protection regarding health risk, often higher than the Congress (which presumably represents national sentiment) is willing to pay for. Conversely, when cleaning up the environment costs local jobs, the local community might be quite willing to settle for a lower standard than Congress has set. So public involvement can inform the decision making process, sometimes you may even discover there is a consensus, but public involvement won't make the decision for you.

KEY CONCEPTS

1) *Experts are the best source of information when the discussion is about a single values dimension or objective.*

2) *Most important decisions are ultimately values decisions -- they require assigning relative weight or importance to things we all believe are good, but to different degrees. The real issue is "valuing," weighing the importance of one value in comparison to another*

3) *The public provides important information about the relative weight or importance that should be given to competing social "goods" -- but public involvement usually doesn't make the decision for you.*

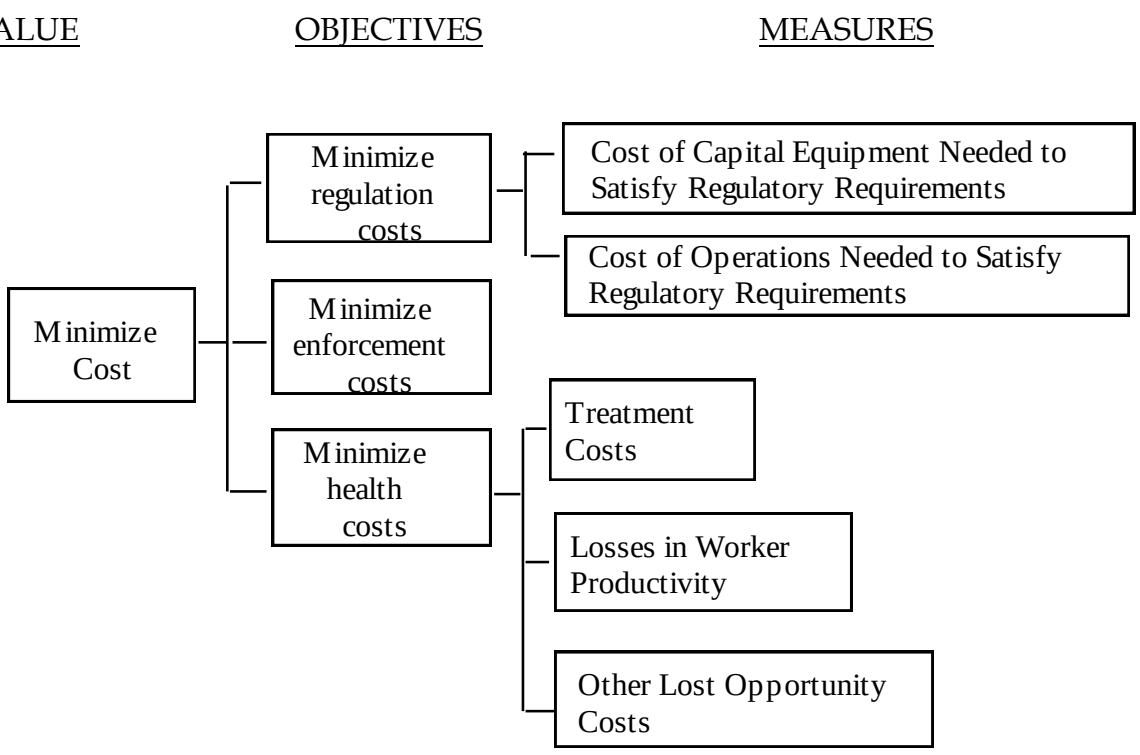
Chapter 3
MEASURING VALUES

Values are often expressed indirectly, implied but not explicitly stated. When they are stated, they are stated in a rather abstract form -- "protect worker health" -- that is sufficiently general that is seems obvious and trite, like motherhood and apple pie. To make values useful in the decision making process, we are going to have to turn them into measures, constraints, performance criteria, goals, or objectives.

VALUE TREES

This is often done by expressing values in the form of a hierarchy going from the abstract concept to very specific ways of measuring the concept. These hierarchies are sometimes referred to as *objectives hierarchies* or *value trees*. The image behind the use of the term "value tree" is that the value itself is the "trunk," the next level of specificity (objectives), is the "branches," and the measures (the ways you can tell whether the objectives are being met) are the "twigs."

Below is an example of a fairly simple "tree." Only two of the three objectives "branches" have been developed into measures.



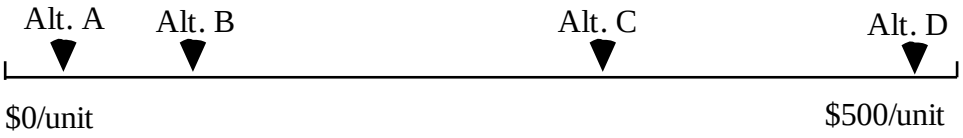
As you can see, identifying objectives consists primarily of breaking the values down into their components parts, and indicating the desired direction, e.g. minimizing cost.

CONSTRUCTING MEASURES

The real work comes in developing the measures. The tree above shows the beginnings of sprouting "twigs" or measures, but to be really useful, each of the measures shown needs to be broken down further. To prepare a complete set of measures it would be necessary to take a measure like "cost of capital equipment" and develop more specific measures such as "Annual $ Spent in Categories X and Y." Frequently it takes more than one statistical measure before people are comfortable that something is adequately characterized. For example, someone might argue that the cost of regulation isn't just the direct increase in cost, but the loss of resources that could have been put to other

productive uses. So measures may need to be developed that address the question of what economists refer to as "opportunity costs."

It's possible that cost information already exists that would adequately measure "capital equipment," "operations," and "treatment costs." Similarly, if you were addressing issues of health risk you might find there were existing measures such as annual population cancer risk (probability x consequences), annual offsite dose (rem), number of severe accidents in a severe accident (consequences), or maximum credible number of cancers in a severe accident. These measures are referred to as *natural measures* both because the information already exists (or could be readily obtained) but also because they lend themselves naturally to scaling, i.e. we all agree that $30 is 3 times more than $10, or that the interval between 1 death per million and 2 death is the same as the interval between 2 deaths and 3 deaths. Because of this, it is possible to construct a scale showing precise intervals. An example is the scale below showing the relative cost of various alternatives:



But for some objectives there may not appear to be any readily available data that adequately describes that dimension. The "lost opportunity costs" above, for example, may be of this sort, although economists have developed sophisticated ways of evaluating opportunity costs. But when there isn't readily available data that lends itself to scaling, then it is necessary to develop *constructed measures* in order to capture that objective.

To illustrate: If you're objective was "minimize use of previously undeveloped land," and you were comparing alternatives which resulted in the use of previously undeveloped land for waste storage, the first, rather obvious, measure would be "numbers of acres lost." That's a natural measure. That data's going to be readily available, and you can scale it.

But some bright person is going to say: "Hey, wait a minute! Not every acre has equivalent worth in terms of its biological value, not so mention that some of those acres might contain wetlands." With a sigh, you admit this person is right, although you can anticipate the problems that lie ahead. How are you going to decide which is more important, an acre of forested land or an acre of wetland? How much more is an acre of forested land worth than an acre that is currently in agricultural use? Are "native" biological communities more valuable than others?

One thing you could do is ask people to rank different types of land. For example, your alternatives might be:

A = 1 acre of urbanized land
B = 1 acre of agricultural land
C = 1 acre of previously disturbed land
D = 1 acre of undisturbed desert community
E = 1 acre of mature second-growth forested land
F = 1 acre of virgin forest
G = 1 acre of endangered species habitat

By having people tell you the rank order of importance, you would soon form a picture of the relative importance of each type of land.

If you were a sophisticated methodologist you might recognize that your statistical reliability would be improved dramatically if instead of just asking people to put the alternatives in rank order you were to force them to make comparisons between alternatives by asking: "Which is more important, A or B, A or C, A or D, B or A." This would not only give you a rank order, with better predictive ability, but would also give you the ability to cross-check answers because you asked them the same questions two ways: "Which is more important A or C?" and "Which is more important C or A?" [Although, being an intelligent person, you've undoubtedly noticed that you've improved your statistical reliability at the expense of creating a more cumbersome and potentially annoying series of questions.]

> Detloff: Is there a need for a better explanation of why to use paired comparisons instead of simple rank order?

In the course of asking your questions you may hear comments like: "There isn't an awful lot of difference between presently farmed land and previously disturbed land, but there's a huge difference between either of those and virgin land." In other words, people want to talk not only about the rank order, but also the distance or interval between the ranks. This is promising. People seem to think naturally in terms of scales. The challenge is how to get there.

So you might begin to ask questions designed to elicit information about the appropriate intervals between alternatives, such as" "Is it twice as important, three

times as important?" or "How many acres of farmed land does it take to equal an acre of virgin forest?" Asking these questions begins to tell you something about the intervals between items, and if you listen carefully to people's rationale for their decision, you'll also find out something about what is really driving their estimates.

Without going into all the details of how to do this -- more information will be provided in subsequent chapters -- you can develop scales using constructed measures based on the information obtained from these questions. Table 1 shows such a scale, comparing different land types. This scale was developed through considerable interaction with the respondents, so that there is a high level of confidence that respondents accept the interval between Attribute Level 1 and Attribute Level 2 as the same distance as between Attribute Level 5 and Attribute Level 6 (or any other adjoining attribute levels).

Table 1. A Constructed Measure

Attribute Level	Description of Attribute Level
0	Complete loss of 1.0 mi^2 of land, which is entirely in agricultural use or is entirely urbanized; no loss of any "native" biological communities.
1	Complete loss of 1.0 mi^2 of primarily (75%) agricultural habitat with loss of 25% of second-growth forest; no measurable loss of wetlands or endangered species habitat.
2	Complete loss of 1.0 mi^2 of land which is 50% farmed and 50% disturbed in some other way (e.g., logged or new second-growth); no measurable loss of wetlands or endangered species habitat.
3	Complete loss of 1.0 mi^2 of recently disturbed (e.g., logged, plowed) habitat plus disturbance to surrounding previously disturbed habitat within 1.0 mi of site border; or 15% loss of wetlands or endangered species habitat.
4	Complete loss of 1.0 mi^2 of land which is 50% farmed (or otherwise disturbed) and 50% mature second-growth forest or other undisturbed community; 15% loss of wetlands or endangered species habitat.
5	Complete loss of 1.0 mi^2 of land which is primarily (75%) undisturbed mature "desert" community; 15% loss of wetlands or endangered species habitat.
6	Complete loss of 1.0 mi^2 of mature second-growth (but not virgin) forest community; or 50% loss of big game and upland game birds; or 50% loss of wetlands and endangered species habitat.
7	Complete loss of 1.0 mi^2 of mature community or 90% loss of productive wetlands and endangered species habitat.
8	Complete loss of 1.0 mi^2 of mature virgin forest and/or wetlands and/or endangered species habitat.

USING VALUES IN DECISION MAKING

Why are we so concerned with developing scales? To understand the need for scales, we need to jump ahead to one of the important ways we will be using values information.

In the following chapters we will be showing you how to use information about values to shape the way you define the problem. to develop evaluation criteria or performance standards, and to determine the range and kind of alternatives you consider. During these decision making stages we will be using values information largely to be sure we are considering all possibilities, and haven't unconsciously imposed on our own

personal values on the definition of the problem, the evaluation criteria, or the range of alternatives considered.

But once we move to evaluating the alternatives, an important thing happens: when evaluating alternatives, there's no single right answer. The "best" alternative is the alternative that performs best to satisfy the values of a specific individual or group. But since individuals and groups hold very different values (or more accurately, assign different weights to the values), the alternative that one group thinks is "the best," may match up poorly with another group's values.

What we can do that is useful, though, is to tell each group how well each alternative performs in meeting its values, and what characteristics of the alternatives cause them to perform well or badly. For the decision maker we can provide information both about the commonalties -- those areas where there is a high level of agreement -- and clarify what the value issues are that are generating the controversy.

But, in order to perform these tasks effectively, we're going to need to translate measures into scales. To understand why, it's necessary to return to two important principles discussed earlier:

> *Technical experts are the best source of information when you are considering only one value.*
>
> *The public is an essential source of information when you are assigning weights between values.*

Applying these principles to a value tree, you come up with the following observations:

Technical experts are the best source of information about how well each alternative performs for each measure.

The public is a crucial source of information about the relative importance that should be assigned to each branch (objective) or trunk (value).

We'll be applying those principles in a methodology that produces a score for how well each alternative performs in satisfying the sets of values held by each active group or individual. To get there, there will be two parallel activities. Technical specialists will be working to identify how well the alternatives perform for each measure, e.g. acres of land lost, dollars spent per unit, cancer risk, etc. The final product for each measure will be a scale with a numeric score for each alternative, somewhere between 0.0 and 1.0, with the sum of the scores equaling 1.0. For example:

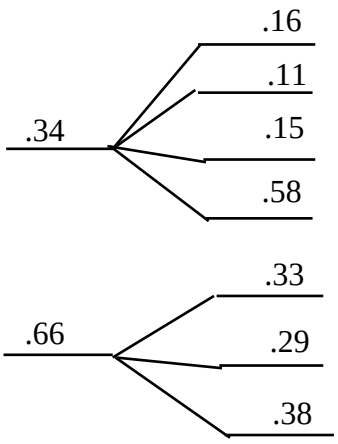
Alt. A - .32
Alt. B - .12
Alt. C - .40
Alt. D - .16
1.00

Simultaneously, the public will be invited to assign relative weights to each objective and value. Again the weights would be between 0.0 and 1.0, with the sum equally 1.0. For example:

Protect Public Health and Safety - .45
Protect the Columbia River - .35
Local Economic Development - .20

1.00

Each participating group or individual would then have a value tree with weighted branches like this:



With a little sophisticated statistical analysis you can multiply the weighted scores (values) by the performance scores (of the alternatives) developed by the technical experts, to come up with a score showing how well each alternative matches up with each set of branches. Keep in mind that the performances scoes (alternatives) stay the same -- this is the "factual" component of the analysis -- while the weighted scoes (values) will change for each individual or group.

Detloff: Two things: (1) Please check the description above for how you get a product of the weighted scores and performance scores, and (2) I think we need one or more examples of entire value tres with weights and performances scores.

A word of caution, though: One thing you should **not** do is take Group A's scores, Group B's scores, and Group C's scores and combine them into a single composite score, then claim that one alternative does the best job of meeting everybody's needs because it best corresponds with the composite score. This is roughly akin to saying to a man with one foot in a block of ice and the other in a bucket of boiling water that on the average he's comfortable. People deeply resent just being thrown together in some statistical pool.

Once you've completed your statistical analysis you can now go to Group A, and say: "Here's how well each alternative performs given your values, and here are the attributes of the alternatives that cause them to score this way." Then you can do the same for Group B, Group C. and so on.

This kind of value analysis also holds the potential for *predicting* public response to new alternatives, combinations, or variations. If you have the appropriate scores for the measures, then you could compare with existing value sets and develop an estimate to the probable acceptability of the new alternative. This could have considerable value for decision makers. We are planning now to develop a library of values expressed by major stakeholders that you will be able to reference -- with some cautions about when it is all right to use historical information, and when it is necessary to consult directly -- during decision making.

All of this material will be covered in greater detail in future chapters. At this point it is sufficient to understand that the reason for developing numeric scales is that it provides a valuable tool for comparing the value sets of various interested public parties with the

performance scores developed by the experts, to determine how well the alternatives perform for each values set.

VALUES AND SYSTEM ENGINEERING

Those of you who are familiar with the System Engineering process now in use at Hanford will recognize much of the thinking presented above. System Engineering is intended to structure a decision making process that: (1) logically proceeds from careful examination of fundamental premises; (2) is hierarchical in nature; (3) is designed to systematically consider all alternatives; (4) actively seeks to understand public values and uses differences in public values to clarify choices; and (5) carefully documents decisions and the assumptions underlying these decisions, so the basis for decision making is clear and so decisions can be revisited when assumptions prove to be invalid.

System Engineering assumes the ability to assign a weight to important values dimensions, and it was this requirement that provided the impetus for this guide. In truth, it would make it easier for the System Engineering process to use a single composite value set that represented the public's values. But as discussed above, that is not credible to the public, nor is it sound methodology. Instead, the system proposed in this guide tries to deal with the complexity that is really there by admitting that there are many "right" answers depending on people's values, and the job of good decision analysts is to understand that complexity and work with it to arrive at an implementable decision.

KEY CONCEPTS

- *Value trees provide a powerful tool for portraying all the components of a decision, ranging from values, through objectives, to measures.*

- *Some measures already exist, and can easily be scaled. But even when there is no pre-existing measure for a particular objective, it is normally possible to construct a measure and scale derived from interaction with affected parties, and acceptable to them..*

- *Technical experts are the best source of information about how well alternatives perform on each measure. The most appropriate role for the public is to assess the relative importance of the values and objectives.*

- *Once scales are developed, it is possible to provide feedback both to interested parties about how well each alternative performs based on their expressed values, and to decision makers on how to shape alternatives that might gain acceptance.*

Chapter 4

HANFORD VALUES

Understanding public values requires two steps: (1) understanding the value dimensions that matter to the public; (2) and obtaining weights for the importance of these values and their associated objectives. Much of this guide addresses the second task. Much of the first task has already been accomplished at Hanford.

Several public involvement programs at Hanford have explicitly focused on public "values." Efforts to identify public values were included as part of these studies: *Defense Waste Remediation Program Redefinition Study* (1991), *The Future for Hanford: Uses and Clean-up* (1992), the Hanford Tank Waste Task Force (1992), the *TWRS Decision Analysis Report* (1993) and the *Hanford Technology Needs Assessment* (1994). Values were also expressed in the *Washington and Oregon State Department of Ecology Guidance for Hanford WM and ER* (1993) and *TPA Renegotiation Criteria for the New Technical Strategy* (1993). Because of all the work that has already been done, the starting point for this current values research project was to summarize the conclusions from these efforts.

HANFORD VALUE TREES

Armacost el al [5] have carefully analyzed the results from the public involvement efforts cited above and have developed a composite list of values that captures the public values (but NOT the weights) that underlie most decisions at Hanford. As will be

[5] Armacost, L.L., D. von Winterfeldt, J. Creighton, M. Robershotte, Public Values Related to Decisions in the Tank Waste Remediation System Program, Pacific Northwest Laboratories, 1994.

discussed in subsequent chapters, this composite list can be used as a starting place for identifying the values dimensions that are relevant for specific decisions.

These values have been organized into three value trees:

End Values: Values that have to do with desirable end states.

Means Values: Values that have to do with the means by which the ends are accomplished.

Process Values: Values about the process by which the decision is reached.

These trees are provided on the following pages.

[Pages 9-11 from the Armacost et al report go here]

HANFORD MEASURES

Detloff Von Winterfelt and others have been working with Battelle to develop measures for the primary Hanford values. Future reports will contain a "menu" of measures that can be used. Figure __ provides a summary of some of the measures that have been identified to date for each of the values shown in the trees above. [6] The phrase "selected constructed measures" could just as easily read "to be developed." It means simply that the other items show appear to exhaust the natural measures, and additional measures

[6] Op cit

will need to be constructed. As you can see, the list is incomplete. It is intended to suggest an approach rather than be the definitive list of measures.

Table 2.
TWRS Values, Sub-Values, and Measures

VALUE	COMPONENT OBJECTIVES	MEASURES
	ENDS VALUES	
Protect Public Health and Safety	Reduce Risks from Normal Operations - Facility	
	Reduce Radiological Risks	Annual population cancer risk Annual inventory of radionuclides Annual offsite dose (rem)
	Reduce Non-Radiological Risks	Hazard Index Amount and toxicity of hazardous materials
	Reduce Accident Risks - Facility	
	Reduce Radiological Risks	Annual population cancer risk (probability x consequences) Annual offsite dose (rem) Number of cancers in a severe accident (consequence) Maximum credible number of cancers in a severe accident

	Reduce Non-Radiological Risks	Hazard index Amount and toxicity of hazardous materials
	Reduce Accident Risks - Transportation	Annual population risk from transportation Vehicle miles off site
Protect Worker Health and Safety	Reduce Risks From Normal Operations	
	Reduce Radiological Risks	Annual worker cancer risk Annual inventory of radionuclides Annual offsite dose (rem)
	Reduce Non-Radiological Risks	Hazard index Amount and toxicity of hazardous materials
	Reduce Accident Risks - Facility	
	Reduce Radiological Risks	Annual worker cancer risk (probability x consequences) Annual offsite dose (rem) Number of cancers in a severe accident (Consequence) Maximum credible number of cancers in a severe accident

	Reduce Non-Radiological Risks	Hazard index Amount and toxicity of hazardous materials Annual construction worker risk Industrial lost worker hours
	Reduce Accident Risks - Transportation	Annual worker risk from transportation Vehicle miles off site # of railcar shipments to repository m^3 of HLW transported
Protect the Columbia River	Protect Fish	Number and type of fish lost Selected constructed measures
	Protect Other Wildlife	Number and type of wildlife lost Selected constructed measure
	Protect Drinking Water	Amount and toxicity of chemicals in drinking water Selected constructed measures
Protect the Environment	Protect Animals	Number and type of animals lost Reproductive success rate Changes in threshold/endangered species Selected constructed measures

	Protect Plants	Number and type of plants lost Biodiversity index Soil fertility Changes in threshold/endangered species Selected constructed measures
	Reduce Soil Pollution	Amount and toxicity of polluted soil Soil fertility Cubic meters of polluted soil Selected constructed measures
	Reduce groundwater pollution	Gallons of liquids at toxicity level Selected constructed measures
	Reduce Air Pollution	Tons of pollutants (by type) emitted Selected constructed measures
	Protect Sites With Special Religious and Cultural Relevance	% defilement of known sacred sites Selected constructed scales
	Protect Historical and Archeological Sites	% defilement Selected constructed scales

(Clean Up to the Level Necessary to) Enable Future Use Options to Occur	Increase Area of Unrestricted Use	Square miles of unrestricted use Percent of site that is available for unrestricted use
	Maintain Opportunities for Restricted Use Areas	Inventory of materials left in restricted areas
Capture Economic Development Opportunities Locally	Provide Steady Employment	Average increase (decrease) in employment per year Maximum increase (decrease) in a given time period Number of additional (less) employees
	Increase Diversity of Employment	Number of types of employment Spin off industries Selected constructed scales
	Reduce Stresses on Local Infrastructure	Selected constructed scales
Protect Rights of Native American Indians	Compliance with Treaties	Selected constructed measures

	Protect Native and Traditional Uses of the Environment	% restrictions of access to Hanford lands # of restricted acres Selected constructed measures
Ensure Compliance	With Laws and Regulations	Selected constructed measures
	With Agreements	Selected constructed measures
	With DOE Orders	Selected constructed measures
Enhance Technology Development	Applicability to Other Missions at Hanford	Number of missions Selected constructed measures
	Applicability to Other Sites	Number of sites Selected constructed measures
	Applicability to Other Problems	Number of other problems Selected constructed measures
Reduce Cost	Total Life Cycle Cost	Total discounted cost Capital cost plus O&M
	Cost Profile Considerations	Maximum annual percent increase in program cost Maximum annual percent increase in site budget

	MEANS VALUES	
Deal Realistically and Forcefully with Groundwater Contamination		
Clean Up Areas of High Future Use Value		# of acres cleaned
"Get on With the Cleanup" to Achieve Substantive Progress in a Timely Manner	Early Closure	
	Meet TPA Milestones	# of milestones met # of milestones not met
Use the Central Plateau Wisely for Waste Management		
Transport Waste Safely and Be Prepared		# transport accidents minor/major Emergency preparation readiness evaluations
Do No Harm During Cleanup or With New Development		
Improve Waste Management	Reduce New Wastes	m^3 of new wastes produced

	Recycle Existing Wastes	m^3 of recycled existing wastes
Use Mature Technologies		# of mature technologies utilized
	PROCESS VALUES	
Involve the Public in Future Decisions About Hanford		Survey
Use A Systems Design Approach That Keeps Endpoints In Mind As Intermediate Decisions are Made		
Establish Management Practices That Ensure Accountability, Efficiency, and Allocation of Funds to High-Priority Items		DOE/GSA Audits
Enhance Public Acceptance		Public acceptance survey
Use Open and Fair Processes		Survey
Increase Efficiency		DOE/GSA Audits

SECTION II

GUIDELINES FOR USE OF PUBLIC VALUES IN HANFORD TWRS DECISION MAKING

Chapter 5

BASIC STEPS IN THE DECISION MAKING PROCESS

This guide is intended to be a companion document to existing TWRS Public Involvement Guidance (#, date, etc.). Both public involvement and decision analysis (the name used in this guidance for analyzing and using public values in decision making) are effective only to the extent they are an integral part of the decision making process. Most of their effectiveness is lost if they are just an "add-on."

The public involvement guidance describes a basic decision making process -- it could be called a "generic" process -- in the guidance, and relating the public involvement activities to specific steps in decision making. The same decision process is presented in this chapter, and like the public involvement guidance, susequent chapters each cover a specific step in the decision making process and discuss the use of public values during that step.

> Group: I've used the exact steps spelled out in the public involvement guidance. They have the advantage of being designed with values in mind. They do break up the process into a number of steps, and don't correspond exactly to the way that the earlier report spells things out. We should talk about whether keeping things consistent with the public involvement guidance should be the determining value here.

STEPS IN THE DECISION MAKING PROCESS

The public involvement guidance specifies the following sequence of steps that will be followed during decision making:

1) Develop a problem statement.

2) Identify the values sets to be portrayed in alternatives.

3) Formulate conceptual alternatives.

4) Evaluate conceptual alternatives.

5) Present a comparison of conceptual alternatives.

6) Select alternatives that should be considered in greater detail. [This step may include combining alternatives or modifying alternatives to reduce unacceptable impacts].

7) Refine the remaining alternatives.

8) Identify the values sets to be used in evaluating the refined alternatives.

9) Evaluate the refined alternatives. [Including sensitivity analysis]

10) Present a comparison of the refined alternatives.

11) Select a preferred alternative. [This will be the DOE recommendation that will then go through the appropriate regulatory process].

WHAT'S BEING DECIDED AT EACH STEP

The list below describes in more detail exactly what decisions are being made at each step. This can be helpful in determining the points at which value information can be utilized.

DEVELOP A PROBLEM STATEMENT

When is the appropriate time to initiate this decision process?

What's the mission?

What's the statement of the problem?

What are the functions needed to address the problem?

What constraints or requirements will apply?

Is public involvement needed, and what kind?

IDENTIFY THE VALUES SETS TO BE PORTRAYED IN ALTERNATIVES

How will the values be used?

How will the values be identified?

Whose values must be identified, e.g. national, regional, and/or local?

How much weight will be given to different values in developing alternatives?

FORMULATE CONCEPTUAL ALTERNATIVES

For which values sets (how many) do alternatives need to be developed?

Who participates in formulating these alternatives?

Which alternatives best portray these values sets?

How well do the alternatives portray the values sets?

EVALUATE CONCEPTUAL ALTERNATIVES

Are the alternatives consistent with the constraints?/Do they meet the minimum requirements?

What evaluation methodology should be used?

How well does each alternative perform on each values dimension?

How adequate are the studies of performance?

What level of uncertainty exists about performance?

What are the sensitivities of alternatives to changes in the values weightings?

PRESENT COMPARISONS OF CONCEPTUAL ALTERNATIVES

Is the information displayed in an objective manner?

How should the information be displayed to be of use to the public? Technical staff? Decision makers?

SELECT ALTERNATIVES TO BE CONSIDERED IN MORE DETAIL

How can the conceptual alternatives be modified or combined to make them more acceptable?

Which alternatives justify further study?

REFINE THE ALTERNATIVES

What information will be needed to make a choice among the alternatives?

What is the appropriate level of detail at which alternatives should be
developed?

What are the features of the refined alternatives?

IDENTIFY THE VALUES SETS TO BE USED IN EVALUATING THE REFINED ALTERNATIVES.

How will the values be used?

How will the values be identified?

Whose values must be identified, e.g. national, regional, and/or local?

How much weight will be given to different values in evaluating alternatives?

EVALUATE DETAILED ALTERNATIVES

Are the alternatives consistent with the constraints?/Do they meet the
minimum requirements?

What evaluation methodology should be used?

How well does each alternative perform on each values dimension?

How adequate are the studies of performance?

What level of uncertainty exists about performance?

What are the sensitivities of alternatives to changes in the values weightings?

PRESENT COMPARISONS OF REFINED ALTERNATIVES

Is the information displayed in an objective manner?

How should the information be displayed to be of use to the public? Technical staff? Decision makers?

SELECT PREFERRED ALTERNATIVE

Which alternative does DOE believe is the "best" alternative?

What was the basis for making this decision?

How well does this decision satisfy the values of the various stakeholder groups?

Chapter 7
DEVELOPING A PROBLEM STATEMENT

The first step in the decision making process is to develop a problem statement.

Experience shows that many people skip over this step, assuming that the problem is obvious. What they often fail to notice is that other people agree it is obvious -- but have an entirely different definition of the problem.

Experience shows it works best to view developing a problem statement as a consensus-building process, rather than a single finite task. This may take more time than you're used to, but it saves time later on. Nothing is more expensive that having to retrench part way through the study because of disagreements over the problem defintiion, or worse yet, finishing the study only to have management conclude that it addresses the wrong problem.

There are two typical problems in writing a problem statement:

1) Determining the appropriate level for the decision, and

2) Avoiding pre-judging major values issues by how you define the problem.

Determining the Appropriate Level for Decision Making

Here are three different levels of decision making for a recent decision process at Hanford, a decision about sub-surface burial systems:

Level I: Which of the available sub-surface barrier systems justify being tested?

Level II: Which is the best SSAB?

Level III: Which strategy is better, an SSAB, mechanical sluicing without barriers (the baseline strategy), or alternative strategies such as robotic sluicing without barriers, surface barriers only, etc.?

There are genuine differences between these three levels. Levels I and II assume that some subsurface barrier is needed. The answer to the Level I questions may be that there are multiple systems that justify testing, while the answer to the Level II problem statement requires that the field be narrowed to a single answer, "the best" system. Deciding which systems should be tested might be a rather modest decision. made by technical people without much management involvement. The values being considered are likely to be cost and efficiency. It will be more expensive to do the work necessary to make the Level II decision, and the decision may require considerable management involvement. Looking at Figure __, decision Levels I and II consider Alternatives 6-11 only.

[Figure 3.1 from DvW paper goes here]

Level III, on the other hand, involves Alternatives 1-11. This means that the Level III decision is a major strategic choice. It will involve the highest levels of management in decision making, will require the involvement of major stakeholder groups, and involves values such as protecting the environment,

worker safety, schedule implications, and political considerations. How you frame the problem drives the nature of the study itself.

In the past, at Hanford, the chances are high that different people and parts of the organization would be working on all three of these levels. The result was often both miscommunication and inefficient use of resources. One of the functions of the System Engineering approach is to establish a hierarchy so that decision makers know which level they are working on. In theory at least, the next more general decision should already have been made, with clear documentation of the alternatives, assumptions, and final choice. Because Hanford is still in transition to System Engineering, this clarity may not yet exist. For this reason, it is essentia, as a first step, to get agreement on how the decisionis framed.

Avoiding Pre-Judging Major Values

This is a related issue. One of the considerations in deciding which level of decision making is appropriate is whether the way the problem is being defined would exclude the values of major stakeholder groups.

Let's use a non-Hanford example to illustrate the problem: The nation's solid waste facilities are rapidly being filled up. New land fills are not only expensive, meeting mcuh higher technical standards than they did in the past, but community opposition has made it almost impossible to site them. Given this statement of the problem, it would be easy to assume that the problem is how to site sufficient landfills to meet the anticipated waste stream. But this definition of the problem will be vigorously opposed by most environmental groups, who

> would be inclined to state the problem as "How do we reduce the waste stream sufficiently to reduce the need for additional landfills?" A more general statement of the problem might be "How do we solve our solid waste disposal problems," a problem definition that could include both additional landfills and changes in social behavior.
>
> The point is that some definitions of the problem prejudge the issue by excluding all the options that would be consistent with the values of major stakeholder groups. When this occurs, these groups no longer consider the decision making process to be valid. There is little reason for them to participate in and be supportive of a decision making process that excludes them from the beginning. If you want the participation of all major stakeholders, you need to define the problem at a level that doesn't automatically rule out all the options they believe should be considered.

How to define the problem involves both internal and stakeholders. Normally the first step is to consult with internal stakeholders, so that Hanford isn't sending confusing messages. Once that is done, though, if the issue is potentially controversial, it may be necessary to consult with stakeholders in interviews, or in a "framing conference." The idea of a framing conference is discussed in more detail in the next chapter, since there are several tasks in the next decision making step for which the framing conference is particularly important.

Experience suggests that consultation with the public about problem definition should be targeted primarily at stakeholder groups -- active groups of people who perceive themselves as having a stake in Hanford decisions as a result of economics, use, health & safety, proximity, governmental mandate, or values. This is not the stage to strive for

a cast of thousands. What is important, though, is that you consult with groups representing the full range of values. If you consult only with groups that represent a small spectrum of opinion, you'll find that you are far more likely not to ask the key questions, and end up framing the decision poorly, or pre-judging major values decisions.

Chapter 8
IDENTIFY THE VALUES SETS TO BE PORTRAYED IN ALTERNATIVES

Typically organizations develop alternatives by starting with the known technical approaches, combining them in various combinations. This often gets you where you need to go, but the approach is susceptible both to group-think and pre-judging of major values issues. Often it simply produces "variations on a central theme" -- the team starts out thinking it knows the answer, then tinkers with that answer slightly just to show it considered alternatives. Technical team tend to be made up of people who have been trained to believe that cost is an overriding consideration, so that often dominates their thinking. Also, technical people tend to think of engineering solutions to problems (while some stakeholder's think first of changes in social behavior).

To avoid these problems, both the public involvement guidance and this document recommend that you start not with the technical options, but with the basic values of the various stakeholders (internal and external), using those value orientations to drive the alternatives you develop. The result will be a set of "conceptual" alternatives that illustrate the fundamental choices that need to be made.

Experience suggests that when alternatives are developed in this manner, the range of alternatives will be considerably broader than those considered when the starting point is available technology. The good news is that stakeholders are far more likely to support a process where they can see alternatives they portrat their values. The bad news is that the range of alternatives is likely to sufficiently broad that you will not be able to evaluate all the alternatives at the level of detail to which you are accustomed. Instead, you will need to do a preliminary round of evaluation, assessing the

effectiveness, costs, and impacts of the alternatives as objectively as you can. Then, in discussion with internal and external stakeholders, you will make a decision about which alternatives should be given more detailed evaluation. This step may include combining alternatives or modifying alternatives to reduce unacceptable impacts. By the end of this process you will have gone through two rounds of developing and evaluating alternatives, one at a "conceptual" level, and another at a more detailed level.

Here are the steps you need to follow to get ready to formulate alternatives:

1) **Identify the major values that may be affected by the decision**

   Pages ___ - ___ present a comprehensive list of Ends, Means, and Process values, based on previous public involvement programs at Hanford. The first step is to look at this list and determine which of these values are likely to touched by the decision. Many values on the list may not apply in your situation. If they don't help you distinguish between alternatives, or you cannot otherwise see how a particular value is impacted by these decision, eliminate the value from your list. You'll be doing plenty of hard work defining measures for those values you keep, so don't keep anymore than you have to. To illustrate, Figure ___ shows those values that were considered important in the subsurface burial decision, with the shaded squares identified as the important values for that decision.

   [Figure 3.2 from DvW paper goes here]

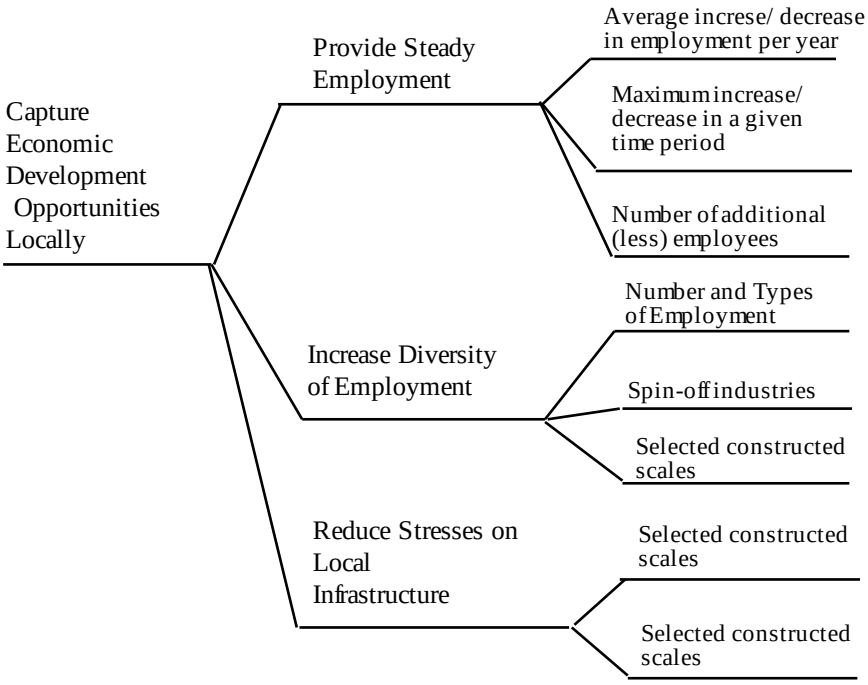
   There's no magic formula for determining which values are relevent. You may even find that some important value dimensions become visible only when you begin to evaluate alternatives. Remember that the best way to find out which

values are important is to ask people what they believe the issues could be, then listen carefully for the values that are implied by the issues they raise. Techniques for doing this include interviews or a framing conference. In the future we hope to have a library of value weightings for major stakeholder groups. Since it isn't going to be possible to conduct interviews or hold framing conferences for all decisions, it may be possible to consult this library and ascertain the important values that would apply, since one of the characteristics of values is that they are relatively long lasting, It may be possible to apply value weightings from stakeholder groups from one decision to the next. That's on the "cutting edge" of decision analysis methodology, so further guidance will be forthcoming on that issue.

> Group: One of the problems developing here is that the framing conference could serve as the approach for several of these steps. In fact, it would probably be wish to use the framing conference to verify conclusions reached in Chapters 7-9. The problem is, where do we stop and spell out the details of how to design and conduct a framing conference? One possibility if to put it in a sidebar in the previous chapter, when it is first mentioned, or here.

2) **Develop a value tree for the remaining values, including objectives and measures.**

The next step is to develop a decision tree that displays the relevent values, objectives related to each value, and measures for each objective. An example showing the development of just one value is shown below:



As in previous chapters, the phrase "selected constructed scales" means there are aspects of a particular measure that cannot be measured using a natural measure. In these cases, a "constructed scale" will need to be prepared. An example of a constructed scale is shown below. This scale was developed to compare the attributes of acres of land taken for storage or other uses. It is designed to take into account that the biological value of one acres land can be vary considerably. It was constructed in consultation with stakeholders, such that they accept that the distance from Level 1 to Level 2 is the same interval as, for example, between Level 7 and Level 8.

Table 1. A Constructed Measure

Attribute Level	Description of Attribute Level
0	Complete loss of 1.0 mi^2 of land, which is entirely in agricultural use or is entirely urbanized; no loss of any "native" biological communities.
1	Complete loss of 1.0 mi^2 of primarily (75%) agricultural habitat with loss of 25% of second-growth forest; no measurable loss of wetlands or endangered species habitat.
2	Complete loss of 1.0 mi^2 of land which is 50% farmed and 50% disturbed in some other way (e.g., logged or new second-growth); no measurable loss of wetlands or endangered species habitat.
3	Complete loss of 1.0 mi^2 of recently disturbed (e.g., logged, plowed) habitat plus disturbance to surrounding previously disturbed habitat within 1.0 mi of site border; or 15% loss of wetlands or endangered species habitat.
4	Complete loss of 1.0 mi^2 of land which is 50% farmed (or otherwise disturbed) and 50% mature second-growth forest or other undisturbed community; 15% loss of wetlands or endangered species habitat.
5	Complete loss of 1.0 mi^2 of land which is primarily (75%) undisturbed mature "desert" community; 15% loss of wetlands or endangered species habitat.
6	Complete loss of 1.0 mi^2 of mature second-growth (but not virgin) forest community; or 50% loss of big game and upland game birds; or 50% loss of wetlands and endangered species habitat.
7	Complete loss of 1.0 mi^2 of mature community or 90% loss of productive wetlands and endangered species habitat.
8	Complete loss of 1.0 mi^2 of mature virgin forest and/or wetlands and/or endangered species habitat.

Page ___ (Chapter 3) contains a list of possible measures for a number of Hanford values. But it may be necessary for you to construct scales appropriate to your specific situation Here are some instructions for preparation of constructed scales:

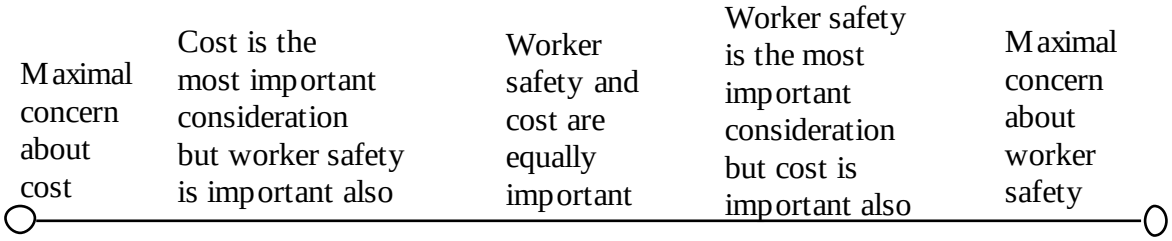
Detloff: I need some simple instructions here.

Also, should we save the list of measure until here, or repeat it here? Right now it's in Chapter 3.

3) Identify Value Premises for Conceptual Alternatives

The next step is to identify the value premises that will drive the development of conceptual alternatives. One way to visualize what we're talking about is to imagine that you are developing alternatives for four or five different clients. All of them have the same problem to solve, but each approaches the solution from a different value perspective. Your job is to develop a technically feasible alternative for each client that is consistent with their values.

The starting point is to develop verbal descriptions of the premises for each alternative. Often this is best done by capturing the most important value issues as "trade-offs" on the same dimension. For example, on the subsurface burial decision, the most important trade-off was between cost and worker safety. If this were true in your case, you might set up a scale that look like this:



Detloff: Please advise if there is better langauge for the scale

A second tradeoff that might guide development of alternatives would be the choice between use of existing technologies, that might be implemented quickly, versus development of new technologies that might do a better job of cleanup, or solve more problems, but might require a longer testing period. For purposes of our example, let's assume that the value chocie underlying these positions is

"urgency to address the problem" versus "maximum long-term benefit." The two trade-offs could then be combined in a matrix such as that below. Not all the spaces have been filled in, but the examples given are sufficient to suggest how this could be done.

Long-term benefit/ maximal concern for cost				Long-term benefit/ maximal concern for worker safety
Balance of cleanup urgency with long-term/ maximal concern for cost		Balance of short-term and long-term/cost and worker safety equally important		
Urgency of cleanup/ maximal conforn for cost				Urgency of cleanup/ maximal concern for worker safety

One way to cross-check whether you have captured the key issues, it to think about the actual or anticipated positions of the various stakeholders and see whether you can locate them on the matrix. If you can, you've probably done a good job of characterizing the issue.

For each position on the matrix occupied by one of more significant stakeholders, write up a "policy statement" that captures the premise to be used in developing alternatives. For example:

ALTERNATIVE A

This alternative stresses the need to get on with cleanup on an urgent basis, and therefore will rely on existing, proven technologies. In choosing technologies, greater concern will be given to worker safety than to cost, although both are important.

ALTERNATIVE B

This alternative starts on the premise that worker safety is by far the most important issue. The choice of technologies should be based on which technology provides greater protection to workers, with cost only a secondary consideration, and whether or not the technology already exists.

ALTERNATIVE C

The emphasis in this alternative is on cost effectiveness. The technology chosen should be the technology that provides the lowest cost over the life of the cleanup process. Cost considerations should override except when there is an acute risk to worker health.

If you find there are "unoccupied" spaces in your matrix, i.e. no stakeholders, internal or external seem to hold the position in that maxtrix, there is no need to develop an alternative the captures those values. In other words, the range of value captured in the alternatives should reflect the range of values held by the stakeholder, not some theoretical list of all possible options.

Chapter 9
FORMULATE CONCEPTUAL ALTERNATIVES

formulate not screen

Chapter 10
EVALUATE CONCEPTUAL ALTERNATIVES

Chapter 11
PRESENT A COMPARISON OF CONCEPTUAL ALTERNATIVES.

Chapter 12
SELECT ALTERNATIVES THAT SHOULD BE CONSIDERED IN GREATER DETAIL

[This Step May Include Combining Alternatives Or Modifying Alternatives To Reduce Unacceptable Impacts].

Chapter 13
REFINE THE REMAINING ALTERNATIVES

Chapter 14
IDENTIFY THE VALUES SETS TO BE USED IN EVALUATING THE REFINED ALTERNATIVES

Chapter 15
EVALUATE THE REFINED ALTERNATIVES

[Including Sensitivity Analysis]

Chapter 16
PRESENT A COMPARISON OF THE REFINED ALTERNATIVES.

Chapter 17
SELECT A PREFERRED ALTERNATIVE

[This Will Be The DOE Recommendation That Will Then Go Through The Appropriate Regulatory Process].