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The Vital Issues Process: Strategic Planning for a Changing World

Dennis Engi, Jessica Glicken

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THE VITAL ISSUES PROCESS: STRATEGIC PLANNING FOR A CHANGING WORLD

Dennis Engi
International Programs/Strategic Technologies Department

Jessica Glicken
Energy Policy and Planning Department
Sandia National Laboratories
Albuquerque, NM 87185

ABSTRACT

The Vital Issues process (VIp) is a strategic planning tool initially developed by Sandia National Laboratories (SNL) for the Office of Foreign Intelligence (OFI)* of the U.S. Department of Energy (DOE). It was further developed and refined through its application to a variety of strategic purposes for a range of public and semipublic organizations. The VIp provides a structured mechanism for assisting organizations in accomplishing specified objectives by identifying and prioritizing a portfolio of strategic issues, programmatic areas, or responses to a specified problem. It employs day-long panel meetings in a specified format to elicit a broad range of perspectives on a particular issue in a nonconfrontational manner and to facilitate the interaction and synthesis of diverse viewpoints on a specific topic. The VIp is unique in its incorporation of two primary approaches in each panel session: a *qualitative* or *transactional* segment, which entails the **synthesis** of the alternatives through negotiations or discussion, and a *quantitative* or *net benefit maximization* segment, an **analytical** approach, which involves prioritization of the alternatives using pairwise comparisons. This combination of facilitated group discussion and quantitative ranking provides input to strategic management decisions in the form of stakeholder-defined and -prioritized items as well as information on potential barriers to the implementation of policies and programs. This is the final volume in the series *Identifying Vital Issues: New Intelligence Strategies for a New World*, a three-volume set that gives an accounting of the VIp as implemented for OFI. This volume provides an in-depth description of the methodology used in the VIp.

* In April 1994, the Office of Foreign Intelligence was renamed the Office of Energy Intelligence.

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EXECUTIVE SUMMARY

The Vital Issues process (VIP) is a strategic planning tool developed by Sandia National Laboratories (SNL). The process provides a structured mechanism for identifying and prioritizing a portfolio of strategic issues, programmatic areas, or responses to a specified problem to assist a sponsoring organization in accomplishing specified objectives. The VIP employs day-long panel meetings to elicit a broad range of perspectives on a particular issue in a nonconfrontational manner and to facilitate the interaction and synthesis of diverse viewpoints on a specific topic.

The initial impetus for the development of the VIP came from the Office of Foreign Intelligence (OFI)* of the U.S. Department of Energy (DOE). The VIP was designed to help OFI respond appropriately to the changed government agenda that emerged with the end of the Cold War and the resulting shifts in the global geopolitical landscape. Since its inception, the process has been used successfully for a range of public and semipublic organizations in support of a variety of strategic purposes.

This is the final volume in the series *Identifying Vital Issues: New Intelligence Strategies for a New World*, a three-volume set that gives an accounting of the VIP. This volume provides an in-depth description of the methodology used in the process. Volumes 1 and 2 are reports on the first and second stages of the process as implemented for OFI. The first stage involved the identification and ranking of Vital Issues, or key world developments, in four areas of interest to the DOE: environmental quality, science and technology/economic competitiveness, national security, and energy security. The results of these meetings provided the input for the second stage, the identification of critical topics or programmatic activities for each top-ranked vital issue identified in the first stage. The reader is referred to Volumes 1 and 2 for the panel discussion summaries and the rankings of the OFI vital issues and critical topics panels.

Each implementation of the VIP follows a specified configuration. The sponsoring organization, with the assistance of the facilitating organization, identifies a goal, a topical area(s) of concern, and the stakeholder interest groups from which the panelists are selected. *Strawman* statements and criteria are then drafted, and the panelists are recruited. Panelists are selected for their ability to represent the interests of the stakeholder communities, their expertise in the strategic area under consideration, and their ability to work well in small, short-term groups.

At least two day-long panel meetings are required. An initial panel clarifies the panel topic and identifies, defines, and ranks the criteria used by a subsequent topical panel(s) to select and rank the portfolio items. To obtain the rankings, the mean relative weight and standard deviation is calculated for each criterion, and the relative values for each portfolio item under consideration are calculated for each panelist. These values are used to obtain a group-averaged criteria-weighted ranking for all of the portfolio items. A written report of each meeting is prepared that provides a summary of the discussions of the panelists and presents the prioritized portfolio

* In April 1994, the Office of Foreign Intelligence was renamed the Office of Energy Intelligence.

developed by the panelists. A measurement of the extent of (dis)agreement among the panelists as to the relative ranking of the items (the standard deviation) is also registered. After review by the panelists and any necessary revision, the final report is published and distributed.

Each panel meeting follows the same basic format, whether the panel is identifying, defining, and ranking the criteria or the portfolio items. Each meeting begins with discussion and clarification of the panel topic. This discussion continues until panelists reach consensus on a working definition of the topic and other key terms. Attention is then turned to the identification and definition of potential criteria or portfolio items. Brainstorming yields a list of items (or criteria) that are ranked using pairwise comparisons, a procedure derived in part from the Analytic Hierarchy Process for Multicriteria Decision Making, developed by Thomas L. Saaty.[†] Ranking is done in a three-step point-counterpoint-score process, in which one panelist champions the item in the context of the selected criterion or criteria, another panelist provides counterpoint or rebuttal to the champion's presentation, and the item is then scored against all items previously presented. After all of the items have been championed and ranked, the panelists perform a consistency check.

The VIP has features that are similar to various other methodologies designed to elicit consensus from experts, such as the Delphi Method developed by the Rand Corporation in the 1950s and '60s. The VIP, however, is unique in several significant ways. Each panel session incorporates two primary approaches into two distinct segments: a *qualitative* or *transactional* segment, which entails the **synthesis** of the alternatives through negotiations or discussion, and a *quantitative* or *net benefit maximization* segment, an **analytical** approach, which involves prioritization of the alternatives using pairwise comparisons. The VIP allows stakeholders to identify a portfolio of strategic or tactical areas and to select and define the criteria with which the portfolio items are identified and prioritized. It also provides stakeholders with the opportunity to modify a portfolio or programmatic objective (the panel topic) to more accurately reflect the problem or question being addressed. The combination of facilitated group discussion and quantitative ranking provides input to strategic management decisions in the form of stakeholder-defined and -prioritized items as well as information on potential barriers to the implementation of policies and programs.

The VIP has demonstrated its capability to provide input that is useful to sponsoring organizations. Stakeholder participation in the strategic planning and decision-making processes can also stimulate buy-in on the part of the broader constituent community and generate a climate that will promote the successful implementation of programs. The VIP can also be used to improve a government organization's accountability to the public.

[†] A major difference between the AHP and VIP is the ranking procedure. In the AHP, each pairwise comparison is performed collectively by the group and yields a single numerical score. The VIP, in contrast, yields a group-averaged criteria-weighted ranking for the items that is based on an aggregate of individually-made judgments. This allows the individual panelists to make judgments on the paired items without the influence or intimidation by other panel members, and captures the level of (dis)agreement among the panelists based on the standard deviation for each item. The two methods also use different comparison scales and consistency checks.

The VIP is still evolving. Although the process is considered to be highly effective and reasonably robust, each time a panel is run, information is obtained that allows the process to be fine-tuned.

INTRODUCTION

The Vital Issues process (VIP) is a strategic planning tool developed by Sandia National Laboratories (SNL). The process provides a structured mechanism for identifying and prioritizing a portfolio of strategic issues, programmatic areas, or responses to a specified problem, to assist a sponsoring organization in accomplishing specified objectives. The VIP employs day-long panel meetings to elicit a broad range of perspectives on a particular issue in a nonconfrontational manner and to facilitate the interaction and synthesis of diverse viewpoints on a specific topic. It affords a high level of key stakeholder¹ involvement, recognizing the impact that stakeholders can have on the successful implementation of policies and programmatic activities. It is specifically designed to provide an explicit and accountable method for identifying and prioritizing relevant issues.

Each implementation of the VIP follows a specified sequence, as shown in Figure 1. The sponsoring organization, with the assistance of the facilitating organization, first identifies a goal, a topical area(s) of concern, and the stakeholder interest groups from which the panelists are selected. Panelists are members of stakeholder communities and selected for their expertise in the area of focus. The meetings are administered by a skilled facilitator who focuses the panelists on the strategic area of concern and facilitates consensus on the selection of the items in the portfolio. Two types of panels are convened. An initial panel identifies and ranks the criteria that will be used by a subsequent topical panel(s). The topical panel(s) identifies and ranks the issues or the portfolio items using the criteria identified by the initial panel.

Each panel meets in a day-long session. In the morning, the panelists develop a working definition of the panel topic using *strawman* statements and goals developed by the sponsoring organization as guidelines, and identify the criteria (initial panel) or the portfolio items (topical panel). In the afternoon, the panelists rank the criteria (initial panel) or the portfolio items (topical panel) using the pairwise comparisons method. A written report of the meeting is prepared and sent to the panelists for review. This report provides a summary of the discussions of the panelists and presents the prioritized portfolio developed by the panelists, specifically registering the extent of (dis)agreement among the panelists as to the relative ranking of the items against identified criteria. After revision, the final report is published and distributed. The time required to conduct one iteration of the VIP is presented in Figure 1. Assuming two panel meetings, eight panelists per panel, and one facilitator, the process can entail at least 41, and as many as 71, working days of effort.

¹ The Vital Issues process employs the working definition of "stakeholder" as follows:

A stakeholder is an individual or a group influenced by—and with an ability to significantly impact (either directly or indirectly)—the topical area of interest.

This definition is used to identify the relevant stakeholder communities. For more information, the reader is referred to the sections on stakeholder identification and panel selection.

Figure 1. Overview of the VIp.

The VIp has features that are similar to various other methodologies designed to elicit consensus from experts.² The VIp, however, is unique in several significant ways. Each panel session incorporates two primary segments: a *qualitative* or *transactional* segment, which entails the **synthesis** of the alternatives through negotiations or discussion, and a *quantitative* or *net benefit maximization* segment, an **analytical** approach, which involves prioritization of the alternatives using pairwise comparisons. The VIp allows stakeholders to identify a portfolio of strategic or tactical areas and to select and define the criteria with which the portfolio items are identified and prioritized. It also provides stakeholders with the opportunity to modify a panel topic to more accurately reflect the problem or question being addressed. Moreover, the process provides an explicit and accountable method for incorporating stakeholder input into management decision making.

² One of the best known is the Delphi Method developed by the Rand Corporation in the 1950s and '60s. The Vital Issues process differs from the Delphi Method in several significant ways. One of the key differences is the real-time face-to-face interaction afforded by the Vital Issues process as distinct from the anonymity of interaction that takes place on a Delphi. For a more complete discussion of the similarities and differences, see Appendix B.

The VIP may be implemented in a series of linked panel meetings to provide as much in-depth exploration of the area under consideration as the sponsoring organization desires. In a multiple-panel scenario, after the initial panel selects and ranks the criteria, the topical panels meet in stages; the top-ranking item of the first topical panel becomes the topical area for the following panel. This second panel identifies, selects, and prioritizes portfolio items within that top-ranking area of concern and the top-ranking item of this second panel becomes the topical area for a third panel. This procedure may be repeated using sets of panels at each level to provide as much breadth and in-depth examination as the sponsoring organization desires. For example, a first panel or set of panels can identify and rank a portfolio of broad issues, a second panel or set of panels can examine specific programmatic areas in depth, and a third panel or set of panels can identify and rank specific activities or solutions.

The initial impetus for the development of the VIP came from the Office of Foreign Intelligence (OFI)³ of the U.S. Department of Energy (DOE). OFI (along with many other federal agencies) was seeking a strategy for responding to the changed government agenda that emerged with the end of the Cold War and the resulting shifts in the global geopolitical landscape. The VIP was designed to help OFI respond appropriately to this complex and rapidly changing geopolitical environment by assisting with the development of an investment portfolio, a set of programmatic investment opportunities, that would help it achieve its mission in this new operating environment. Since its inception, the process has been used successfully for a range of public and semipublic organizations in support of a variety of strategic purposes, such as the selection and prioritization of strategic directions, product lines, programmatic areas and activities, and other resource investment opportunities. (See the Appendix E for a list of the 30 Vital Issues panels that have been held to date.) The methodology described here is based on the refinements that have resulted from these subsequent implementations as well as the initial implementation of the VIP for OFI.

The VIP as designed and implemented by SNL for OFI followed a multiple-panel format in two stages. An overview of the VIP structure as implemented for OFI is shown in Figure 2. The first stage of the OFI VIP used six panels. An initial panel focused on procedural issues and identified criteria for selecting and ranking vital issues. This panel also ranked the criteria to determine their relative importance or weight. The next four panels were charged with selecting and ranking vital issues of interest to OFI in four designated topical areas: Environmental Quality, Energy Security, National Security, and Science & Technology/Economic Competitiveness.⁴ The sixth panel, a composite of the four topical panels, convened to integrate the top Vital Issues from each of the four topical panels into a single prioritized list and to evaluate the process as it had been implemented to date. In the second stage, another set of four panels focused on each of the four top-ranked vital issues identified in the first stage and selected and ranked specific programmatic areas or critical topics meriting further investigation by OFI.

³ In April 1994, the Office of Foreign Intelligence was renamed the Office of Energy Intelligence.

⁴ Three of these topical areas, Environmental Quality, Energy Security, and Science & Technology/Economic Competitiveness were specifically identified in the *National Energy Strategy*, the primary DOE policy document at the time this process was developed. The fourth, National Security, was added because of DOE's historical concern with that area. Although administrations and hence policy rubric have since changed, it is interesting to note that these areas, as defined by the *Vital Issues* panelists, are still of critical concern to DOE.

This is the final volume in the series, *Identifying Vital Issues: New Intelligence Strategies for a New World*, a three-volume set that gives an accounting of the VIP as implemented for OFI. This volume provides an in-depth description of the methodology used in the process. Volumes 1 and 2 are the reports of the first and second stages of the process, respectively. The reader is referred to these earlier volumes for the panel discussion summaries and the rankings of the vital issues and critical topics.

The section following this introduction, the Approach, delineates the context for the development of the process and discusses the Vital Issues methodology in detail, covering such topics as the identification of the topical area, the selection of panelists, and the step-by-step implementation of a panel meeting. The third section describes the general nature of the output of the VIP and reviews the results of the process as implemented for particular organizations. The fourth and final section describes what has been learned during the ongoing development of the VIP, discusses some limitations of the methodology, and explores opportunities for further work.

VIP = Vital Issues Panel
FIP = Foreign Intelligence Panel

Figure 2. Overview of the VIP as implemented for OFI.

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APPROACH

Overview of Approach

In the first part of this section, we describe the context for the development of the VIP, and then provide a more detailed discussion of the process itself. We identify the key players and then address the selection of the topical area of focus for a Vital Issues panel. The next part discusses the identification of stakeholders. A detailed discussion of the selection and recruitment of individual panelists follows. The portions on *Panel Session Format* and *Implementation* discuss the format and output of a Vital Issues panel meeting. Finally, we provide an analysis of the VIP, elaborating on the combination of features that is unique to the process, the *transactional* and *net benefit maximization* approaches.

Context for the Development of the Vital Issues Process

OFI serves as an analytic arm of the national intelligence community and is a recipient of information from other divisions of the U.S. government as well as the intelligence community. The Office provides intelligence analyses to the Secretary of Energy, various organizations within the DOE, the U.S. intelligence community, and other U.S. government policy-makers and organizations. It also brings the expertise of the DOE national laboratories, particularly the three weapons laboratories, to the intelligence community. As indicated in its mission statement,⁵ OFI has an exclusively foreign mandate. Its specific charge is to analyze foreign developments that affect DOE areas of responsibility in order to provide information of use to policy-makers.

The VIP was designed to assist OFI with the development of a strategy for responding to the changing government agenda that has emerged with the end of the Cold War. With the demise of the former Soviet Union, the role and focus of the national intelligence function are changing. World political alliances are changing rapidly, new areas of national strategic concern are emerging, and federal priorities are shifting. As is true with any intelligence agency, the OFI challenge is to identify key developments far enough in advance of their occurrence to prepare accurate and timely analyses for policy-makers to help them respond appropriately. The VIP was developed to help meet this challenge by providing OFI customers—policy-makers and the U.S. intelligence community—with accurate and timely information on developments of national significance through the identification and programmatic exploration of vital issues to which DOE is uniquely qualified to respond. Thus, the primary purpose of the VIP, as designed and

⁵ The mission of the OFI reads as follows:

The mission of the OFI is to provide timely and accurate foreign intelligence analyses and reports on DOE core areas of responsibility for the Secretary of Energy and the U.S. Intelligence Community.

The DOE "core areas of responsibility" were identified during the Vital Issues process development stage as nuclear (including weapons, proliferation, special nuclear materials, and civil nuclear power), defense, and the sociotechnical domain (including science and technology, energy and economics, and environment and health). More recently, under DOE Secretary Hazel O'Leary and the Clinton administration, these key areas have been slightly relabeled and redefined. They have been renamed 'core business areas' and five have been identified: National Security, Energy Resources, Environment, Industrial Competitiveness, and Basic Science.

implemented for OFI by SNL, was to assist with resource allocation decisions by identifying a portfolio of vital issues and corresponding sets of prioritized programmatic activities.

Two secondary purposes of the VIP were to establish a dialogue with key customer and stakeholder communities, in recognition of the impact that these groups can have on the implementation of programmatic activities, and, where appropriate, to provide a means for incorporating stakeholder input into the decision-making process. These would raise the profile of OFI by exposing it and its activities to individuals and organizations who otherwise might not have had contact with the organization but who could potentially benefit from its services. An increasing proportion of the information available on many of the issues with which the intelligence community is currently faced, and will be faced in the future, is open-source (as opposed to classified or restricted), allowing involvement of what are nontraditional stakeholder communities in the intelligence function. This participation from outside the intelligence community highlights the changing nature of the intelligence community and the context within which it operates. Changes in the sources of intelligence information are also challenging the role of the intelligence community as a unique provider of analyses and other information products. For example, DOE and the larger intelligence community are examining the roles they may play in the arena of economic competitiveness, considering (in the case of OFI) the unique contributions of DOE and the national laboratories.

Publicly funded organizations such as OFI are defined and constrained by both the broad policy environment within which they operate and by their location within their immediate political environment. Their official "turf" is delineated by Acts of Congress, Executive Orders, and court decisions. They are also embedded in a matrix of constituents and interest groups that can significantly impact their effectiveness. An agency that understands its location within this complex structure can exploit these interconnections and increase its chances for the successful implementation of its programs. Including the input of key stakeholders in the development and implementation of programmatic goals ensures that the sponsoring organization is hearing important constituent concerns and tapping essential knowledge and perspectives (Farhar and Babiuch 1993, 13; Moore 1988, 83). Appropriate identification of stakeholder groups will enhance the robustness of the policy outputs and hence the likelihood of their successful implementation. The VIP was specifically designed to afford a high level of key stakeholder or constituency involvement in and input to the decision-making process by recognizing that stakeholders offer a pool of knowledge and expertise that is frequently not available within the sponsoring organization itself. The varied backgrounds and agendas of the panel members allow the panel to function as a team that can provide the sponsoring organization with access to structured input on an as-needed basis.

Members of a Vital Issues panel are selected for their ability to represent the interests of the stakeholder communities and for their expertise in the strategic area under consideration. Attribution of opinions and statements to individual panelists is deliberately avoided. However, the panelists are known to the sponsoring organization and are identified in published reports of the results of the panel meetings. A Vital Issues panel may thus be characterized as an *ad hoc* group of external policy or strategic advisors, providing an explicit, documentable, and accountable forum for debating policy choices and identifying, and perhaps challenging, assumptions.

The output of a Vital Issues panel is, of course, not binding on the sponsoring organization. It is but one of many inputs to the decision maker. The public policy decision maker may, in fact, choose to achieve the "public good" through other inputs to the policy-making process. For example, stakeholder involvement can tend to promote a purely pluralistic approach to decision making in the public sector and yield decisions that simply represent a balance among competing interests and that do not equal the "public good" (Farhar and Babiuch 1993, 13; Moore 1988, 83). The VIp counterbalances tendencies towards a purely pluralistic approach by allowing the sponsoring organization to examine alternatives—and to explore the dimensions of contention arising from each alternative—in an environment that is nonthreatening because it is nonbinding.

Key Players

There are three players, or sets of players, necessary for implementation of the VIp: the sponsoring organization, the facilitating organization, and the stakeholder panelists. The sponsoring organization is the organization seeking the input into its decision-making process. (Sponsoring organizations for our implementations of the VIp have included federal and state governments and semipublic organizations and consortia.) The sponsoring organization defines the initial objective for a given iteration of the VIp and composes an initial strawman topic statement or goal for each panel to use as guidelines in developing a working definition of the topic area. The stakeholder panelists are individuals selected from the stakeholder communities on the basis of their expertise and their ability to provide input that is essential to the successful outcome of the sponsoring organization's program or activities.

The facilitating organization administers the panel meeting and provides process management. It recruits panelists, provides a facilitator and a rapporteur for the panel sessions, and creates the communications materials that result from the panel meetings (reports, briefings, and/or videos). A sponsoring organization can facilitate its own VIp. However, an external facilitating organization is often able to bring to the process an objectivity that a sponsoring organization may not have because of its closeness to the topic under discussion. Furthermore, an external facilitating organization is less likely to introduce bias into the process through promotion of its own interests.

Identification of the Topical Area of Interest

The first step in the VIp is for the sponsoring organization to identify the topical area of interest it wishes to address.

Areas that the VIp are uniquely suited to address are those of strategic concern to the sponsoring organization that necessitate prioritization or ranking. Problems or questions involving the allocation or distribution of resources among the items in a portfolio are most applicable, whether it be the organization's high-level portfolio of strategic directions or the identification and prioritization of programmatic activities, proposed products, or organizational offerings. Actual applications of the VIp have ranged from the development of a mission statement and

associated strategic directions to the selection of an application environment for the development of a prototype decision support tool.

The VIP provides an organization with the ability to look broadly across a full range of issues or single topical area, or to examine programmatic options in detail. The initial objectives of the sponsoring organization define the overall process configuration as do any time and resource constraints that would affect the number of panels to be run in any given iteration of the process. Should the organization wish a quick look at a specific topic area, one topical panel may suffice. If it has multiple topic areas to address (looking broadly across a particular business dimension) or should it wish to start at a strategic and move to a more operational level, it will require multiple panels.

The identified topic forms the basis for an initial strawman statement of a suggested goal or topic definition to be used by the panelists to develop a working definition of the panel topic. These strawman definitions and examples must be carefully crafted as their accuracy will go far towards establishing the legitimacy of the sponsoring and facilitating organizations. They should also be designed to provoke critical thought on the part of the panelists that will be the basis of discussion during the meeting. The statements are presented to the panelists for review prior to the panel meeting. At the meeting, panelists modify the statement to more accurately reflect the problem or question being addressed. Identification of the initial topical focus may be managed by the facilitating organization, which, with its disinterested and external perspective, may be able to identify important areas of strategic concern that have been overlooked by the sponsoring organization.

In the initial implementation of the VIP, OFI was interested in first examining the full range of possible investment areas in four broad topical areas of interest to DOE and then exploring specific programmatic activities in detail. SNL decided to run a series of panels in two stages. In the first stage, an initial panel identified the criteria to be used by subsequent topical panels to select and rank the portfolio items. A set of four panels then identified and ranked Vital Issues in the four broad topical areas. This stage provided breadth by looking across the full range of possible investment areas for OFI and incorporating the perspectives of a broad range of key stakeholders and constituency groups. In the second stage, an additional set of panels examined the top-ranked Vital Issues from each of the four topical area panels and provided in-depth specification of critical topics meriting further investigation by the OFI. Each of these panels also ranked its respective list of critical topics.⁶

⁶ The reader is referred to J. Glicken, & D. Engi, eds., *Identifying Vital Issues: New Intelligence Strategies for a New World*, Volumes 1 and 2, for specific results of the OFI Vital Issues process including the panelists, the panel discussion summaries, consensus statements, and the rankings of the vital issues and critical topics.

Identification of Stakeholders

Once the objective or topical area of interest for the particular application of the VIp has been identified, the next step is to identify those individuals and groups (the stakeholders) that have a stake or significant interest in the area under consideration.

For the purposes of the VIp,

A stakeholder is an individual or a group influenced by—and with an ability to significantly impact (either directly or indirectly)—the topical area of interest.⁷

The stakeholder identification process begins with the identification of domains of influence or interest, i.e., "individuals or groups influenced by . . ." or that have "an ability to significantly impact . . ." the activities of the sponsoring organization. These are individuals or groups who can be influenced by a resolution of the issue in question as well as those who can impact the implementation of policies or activities designed to achieve that resolution. Those influenced by the resolution of a social issue (which includes policy issues) include both the recipients of benefits as well as those influenced by side or secondary effects. Often those who influence and those who are influenced are one and the same. It is the sponsoring organization's location within a particular environment of constituents and interest groups that provides the framework for the identification of the relevant stakeholders.

Stakeholders can be either formally constituted organizations (such as government offices or nonprofit interest groups such as the Sierra Club) or informal (i.e., not institutionalized) groups or individuals with interests and concerns in the Vital Issues topic area (such as small business owners or researchers). Both of these groups should be considered in the stakeholder identification process. For a public organization, stakeholders also include individuals and groups who can directly influence the implementation of policies and activities, such as agencies funding the implementing organization as well as those who are capable of influencing the organization's activities in other ways.

As the Vital Issues methodology was developed and refined, it became clear that, for any public-sector organization, there were four basic groups of interests that constitute the stakeholder community and that should be represented on a Vital Issues panel. The following template of stakeholder interest groups was developed for public-sector organizations:

- industry/private-sector
- public interest groups
- government (both executive and legislative branches)
- academe

These four groups have the ability to significantly impact, and be influenced by, public-sector activities. Their input is thus considered crucial to the successful implementation of public

⁷ A large literature exists on the formal mechanisms for identifying stakeholders, much of it under the rubric of "social impact assessments" (see, e.g., bibliography in Farhar and Babiuch, 1993). We will not attempt to duplicate those discussions here.

policies and programmatic activities. Private-sector input is important for any activity of the government that has a potential impact upon the economic infrastructure. Public interest groups provide a voice for citizens *qua* citizens of the community to which public organizations must be accountable. Any public-sector organization also needs to consider the government as one of its stakeholders. The inclusion of appropriate perspectives from the fourth stakeholder interest group, academe, also ensures that leading edge issues and thinking are incorporated into the panel's output. The way in which each of these groups is actualized for a particular panel varies by the topic of concern and the institutional environment within which the sponsoring organization is located. (For example, the government stakeholder interest group may include local, state, or federal stakeholders, or some combination of the three). In our experience, the template has been useful for all sponsoring organizations of a public nature.

Selection of Individual Panelists

Once the relevant stakeholder interest groups are identified, appropriate panelists are selected. There should be at least one individual from each stakeholder interest group. It is important to recognize that, as a matter of logistics, the panelists are not delegates or representatives of the stakeholder interest groups, although they may in fact represent the interests of a particular stakeholder entity. They are, rather, members of the stakeholder communities, either as individual stakeholders themselves or as individuals affiliated with stakeholder organizations, who are capable of providing the perspective or vantage point of that particular stakeholder interest group. Stakeholder panelists are selected using judgment sampling on the basis that they must be able to provide input that is essential to the successful outcome of the sponsoring organization's program or activity. They must have credibility within their constituency group and expertise within the topical area of concern as well as an ability and willingness to participate in a panel of this type.

The number of individuals on each panel is a function of both the goal of the sponsoring organization and effective group interaction. Ideally, where the sponsoring organization is in the public-sector, two individuals from each of the four stakeholder interest groups should participate, resulting in a panel with eight members. For panels with a programmatic or activity emphasis (versus a strategic emphasis), panelists should be selected from both the legislative branch (such as a staffer from a key Congressional committee) and the executive branch (such as someone with programmatic responsibilities). This need for dual participation (from both the executive and legislative branches) would hold true at the state or local level as well as the federal. It may also be appropriate to include two individuals from the private-sector stakeholder interest group, one from each of the differing sectors, for example, from the small and large business sectors, or from the manufacturing and service industries.

The goal of the VIp is to solicit a broad range of perspectives and approaches to the topic. It is thus crucial that the panelists represent a diverse range of viewpoints. Two panelists from the same organization should not sit on the same panel unless they represent different stakeholder interest groups. Additionally, because the input from the various stakeholder interests is so important to the successful implementation of a Vital Issues panel, if appropriate individuals

from a stakeholder interest group are unavailable, the panel meeting should be delayed until appropriate panelists can be found.

The number of individuals on each panel is also a function of effective group interaction. The panel should be no smaller than six, with eight to ten as a realistic figure. With groups of six or less, it is often difficult to stimulate productive discussion. The dynamics of optimum group interaction also suggest that group size should not exceed twelve individuals. In the few Vital Issues panels that had more than twelve members, no more than twelve out of the total actively interacted in any given exchange. Figure 3 illustrates an effectiveness curve for the number of panelists on a Vital Issues panel and shows the optimal range for a Vital Issues panel.

Figure 3. Effectiveness curve for the number of panelists on a Vital Issues panel.

If the sponsoring organization determines that there are more than twelve individuals who should participate, two or more sessions may be run in parallel, with each session focusing on some subset of the general topic. Where parallel groups are created, it is important that each group contain individuals representing a diversity of opinion. These panels should not be defined by stakeholder group or discipline but by topic.

The individual panelists for a Vital Issues meeting must be carefully chosen. They are required to work intensely for a relatively short period of time with individuals with whom they may have had no previous relationship. As members of a stakeholder community, they are participating in the generation of outcomes that must be credible to their constituency group. Panel members thus are selected on the basis of several equally important criteria.

Expertise in the topic area of the panel is essential. Panelists will need to bring to the discussions a common vocabulary and a general understanding of the topical area. In many cases, they will

know each other directly. In other cases, they will know of each other through recognized technical accomplishments. Credibility within each panelist's constituency group is essential. This criterion also assumes that the individual has some positive visibility within the interest group that is being represented. It is important for the effective functioning of the group that the panelists be peers, both in terms of positions within some authority structure and in their comfort in, and capability of, manipulating ideas at the conceptual level required by the panel topic. Finally, and equally important, the panelists must be the type of individuals who work well within temporary groups. They must be able to present and discuss what may be emotionally-charged issues in a reasonable manner with individuals with whom they may have had no previous acquaintance. It is also important to keep in mind that where multiple panels are run, the selection of panelists should reflect the different expertise that is required for each panel; panelists may thus vary from panel to panel.

Panelists are recruited through an initial telephone solicitation and provided with written explanatory material. Contact is initiated with an individual known either to the sponsoring or the facilitating organization. The recruiter asks the initial contact to provide the names of additional prospective panelists and, with this information, proceeds in a "network" fashion. Because this method has a tendency to produce a group of like-minded thinkers, it is important to use the network in a manner that will yield a panel with a diversity of opinion, for example, by carefully inquiring into the positions of prospective panelists on relevant issues and following up only on appropriate leads. This is a critical part of the recruitment process.

The importance of allowing adequate time for the recruitment process should not be underestimated. Usually at least a six-week lead on the date of the panel meeting is essential to ensure attendance by the appropriate individuals. The difficulty of recruiting depends upon such factors as lead time, the visibility and credibility of the sponsoring and the facilitating organizations, and conflicts in the prospective panelists' calendars. It has taken calls to as many as 65 individuals to recruit an appropriate eight-person panel.

As appropriate, panelists are offered an honorarium for their time and funds to cover travel expenses to the meeting location. (The cost of a given panel thus depends upon how many of the panelists require such funds for participation. Government employees, for example, are restricted in the kinds of funds they can accept. Panelists local to the meeting site will require no travel funds.)

Panelists are provided with written explanatory material prior to the meeting. This material should include a letter that outlines the purpose of the meeting and gives a brief description of the process. Key elements in this letter are proposed, or strawman, definitions of the terms or concepts that will form the basis of the discussion at the panel meeting. For example, prospective panelists for the OFI panel on Environmental Quality were sent a strawman definition of "environmental quality" and examples of Vital Issues that might be appropriate for the panel to address. Where criteria have been formulated by a previous panel, these criteria and their definitions should also be included. It is important to include a short description of the method that will be used to rank the portfolio items. We found that panelists who were unable to review the method in advance had a more difficult time applying it during the panel meeting.

The explanatory material should include information on meeting logistics (time, place, and contact information), a preliminary agenda, and a brief description of all of the methodologies that will be employed during the meeting. The panelists are also asked to come prepared to present their own criteria and/or items. If the panel is part of a series, the prospective panelists should be provided with a copy of the report of the immediately previous panel, as that output will be used as a starting point.

Note that in the case of multiple panels, if any panelist sits on more than one panel, these panels should not be run on consecutive days. Our experience has shown that the process is so intensive that the quality of the output usually falls off considerably by the second day because of fatigue. Consecutive panels also do not provide sufficient time for the facilitating organization to prepare the input material for the second panel (i.e., clearly-crafted definitions of topic areas and other key concepts and the calculations necessary to rank and/or weight the items scored by the previous panel). This, too, will impact the effectiveness of the panelists in the second meeting.

Facilitation and Reporting

Two additional participants are essential for the VIP. These are the facilitator and the rapporteur, or reporter. Both play key roles.

The VIP requires an exceptionally skilled and strong facilitator who is willing and able to take a more active role than is often prescribed for discussions of this type. The composition of the panel will reflect the diversity of opinion that was deliberately sought in the recruitment process. Furthermore, the individuals selected are likely to have strong personalities because they have been selected on the basis of their prominence within their field of expertise. They are also well-informed on the issue at hand. Hence, the facilitator must have adequate knowledge of the topic to be able to avoid blind alleys, to curtail dead-end discussion or discussion on related but ancillary topics, and to ensure that all relevant areas are adequately covered. Finally, the facilitator must be able to summarize key issues and bring the discussion to closure at the proper time. Panelists need to be brought to consensus on working definitions within an allotted time frame in a manner that does not leave them feeling that the topic has received inadequate treatment. In the case of the OFI series, all the panels were facilitated by the same individual to provide continuity of style throughout the series.

The rapporteur has the responsibility of providing a written document of the proceedings. It is important to emphasize that the report will not be minutes of the meeting but a summary of the key issues raised in the movement toward consensus. The rapporteur must be able to document the proceedings in such a way as to register dissension on key points without either directly or indirectly identifying the speaker; only the names and affiliations of the panelists are listed in the report. The report must reflect not only the content of the discussion but its tone. We have found that creating this type of report can be quite challenging and requires a significant level of expertise.

After the meeting, panelists are provided with a draft of the report to review and approve before its presentation to the sponsoring organization or its public dissemination. The report is published as a product of the panel as a whole.

Panel Session Format

Each panel session follows the same basic format, whether the panel is selecting and ranking the criteria or the portfolio items. Each day-long meeting opens with a facilitated group discussion to focus the panelists on the topical area of interest and define the topical area through the amplification and clarification of strawman definitions or topic statements received prior to the meeting. Consensus is reached on a working definition of the panel topic usually after two to three hours of discussion. The panelists then brainstorm to select and define the portfolio items (or the criteria). After selection of the portfolio items (or criteria), the panelists champion and rank each item using pairwise comparisons. This is done in a three-step process known as point-counterpoint-score, wherein one panelist champions the item in the context of the selected criterion or criteria, another panelist provides counterpoint or rebuttal to the champion's presentation, and the item is then scored against all items previously presented. After all of the items are scored, the panelists then perform a consistency check. Figure 4 presents the format of a Vital Issues panel meeting session.

Figure 4. Format of a Vital Issues panel meeting.

As a general rule, an initial panel selects and ranks a set of criteria in a panel session separate from the panel that identifies and ranks the portfolio items. Subsequent topical panels are charged with using these criteria to select and rank the items in the portfolio. The criteria and the portfolio items may be selected and ranked during the same session, although this is not recommended because it does not allow the panelists time to adequately reflect on the criteria before selecting and ranking the portfolio. In either case, because the criteria are used to select as

well as rank the portfolio items, they must be selected and ranked before the items in the portfolio can be addressed. If the panel is part of a series, panelists are to be provided with the report of any previous panels as background material prior to the meeting. In this case, the facilitator should open the meeting with a brief overview of the series and a synopsis of the results of any previous panels, key definitions, rank orders of items, and relative weights of the previously selected criteria.

Panel Topic Definition

Each panel spends the first two to three hours of the day discussing and defining the panel topic and any other essential terms or concepts. The panelists review the strawman definition and other statements, such as strawman goals, strategies, or metrics, that were received prior to the meeting. Where appropriate, panelists are asked to consider the following questions regarding each strawman statement:

- What are its positive aspects?
- What are its negative aspects?
- What is missing that should be included?

Panelists are reminded that their goal is to develop a *working* definition of the topic in the time allotted; it is not expected that the panel will develop a *definitive* definition. Frequent reminders of this distinction during the discussion help prevent paralysis on the part of the panelists as they consider topics with scopes as broad as environmental quality or national security.

In the Vital Issues process as implemented for OFI, the initial panel derived the following working definition of the term *Vital Issue*:

A Vital Issue is an international development that significantly affects—or has the potential to affect—the U.S. and its interests, and for which DOE-produced foreign intelligence information or technology is essential to the determination of potential responses.

This definition was presented to the topical panels to use in the selection of Vital Issues in each topical area under consideration. The four Vital Issues and four Critical Topics panels each developed working definitions for their respective topical areas after clarifying and modifying various strawman statements, goals, strategies, and metrics.

Criteria Selection

Criteria are used in the VIP to provide the panelists with a sieve or filter in the selection and ranking of the portfolio items. The criteria are selected in a facilitated brainstorming session in which all panelists come to agreement on the final list and the scope and definition of each criterion. The criteria can be either qualitative or quantitative, subjective or objective. They must, however, meet the following conditions:

- Each item on the list must be **necessary**, i.e., its elimination from the list would allow some important aspect of the topic to go unrecognized.
- Collectively, the items must be **sufficient**, i.e., all important aspects are recognized.
- The items must be **operational**, i.e., the criteria can be used to evaluate the items in the portfolio.

The criteria that are selected are used at all subsequent topical panel meetings in the process to identify and rank the portfolio items. As an essential preliminary step to the selection and ranking of the portfolio, these criteria are ranked using the pairwise comparisons method, described later in this section, to determine their relative importance or weight in the determination of the relative value of a given item.

Surprisingly and significantly, every Vital Issues panel charged with developing a strategic portfolio for a public-sector agency has arrived at essentially the same core set of criteria:

- **Magnitude** of the effects (both direct and indirect)
- **Likelihood** of the occurrence of a development
- **Time frame** for the occurrence of a development, the resulting effects, and effective responses

The three criteria, *magnitude*, *likelihood*, and *time frame*, are the three components of the **importance** or *net present value* of an item. The importance of an item is a direct function of the relationship between the magnitude of the impact that an item has on a stakeholder's respective interest, the likelihood that such an impact might occur (uncertainty), and the time frame in which that might occur. A discussion of the role that *net present value* plays in the identification and selection of the portfolio items appears in Appendix A.

In addition to the three core criteria, each VIP panel also identified from one to three additional criteria, specific to that sponsoring organization. The initial Vital Issues panel in the OFI implementation, for example, identified the following two additional criteria:

- **DOE comparative advantage** in investigating a development (versus investigation by another institution, reflecting the perception by the panelists of the value added by the DOE's involvement in a particular area)

- **Cost/benefit*** of investigating a development (the marginal benefit to the U.S. versus the cost of an OFI investigation of an issue)

Portfolio Selection

Each panel subsequent to the initial panel is charged with selecting and ranking the items in the portfolio relevant to the panel's topical area, whether strategic issues, programmatic areas, or responses to a specified problem. In a process similar to that used by the initial panel to select the criteria, the topical panelists begin the portfolio selection portion of the meeting with a brainstorming session in which items are solicited from the group and listed without discussion or commentary. This list is reduced to no more than eight through facilitated discussion and consensus.⁸ Items are combined if necessary and carefully defined. The facilitator ensures that all panelists are in agreement as to the scope of each of the proposed items and the definition or referent of any ambiguous terms. This is a critical part of the process, for it ensures that all panelists are comparing the same concepts during the ranking process that follows and that each panelist holds a consistent definition of the items throughout the course of his or her individual ranking activities. All items on the final list should be taxonomically equivalent so that they can be legitimately compared. Failure to allocate adequate time to this phase can lead to significant confusion and ambiguity during the ranking process.

The portfolio items must meet the same conditions that the criteria are required to meet: Each item on the list must be **necessary**, **sufficient**, and **operational**. The portfolio items are operational if they are capable of being realistically investigated or implemented.

Ranking the Items — Point-Counterpoint-Score Pairwise Comparisons

The ranking procedure begins after the selection of the portfolio items (or the criteria) has been completed. The panelists address each item in turn through a three-step process known as point-counterpoint-score. Each item is assigned a "champion" whose job it is to present the item and "sell" it to the other panelists in the context of the selected criterion or criteria. Another panelist is assigned the job of providing counterpoint or rebuttal to the champion's presentation in the form of constructive criticism. After the point and counterpoint are presented, each item is scored against all items previously presented.

The method used to score the criteria and the portfolio items is called "pairwise comparisons." Pairwise comparisons is a structured mechanism that allows for the comparison of two or more items in the context of stated criteria. It results in a relative ranking that indicates both the position of the items and the distance between them. It allows for the relative ranking of judgments against a hypothetical average item rather than an external, absolute scale. The items are ranked in the context of each criterion using the following comparison scale:

* This criteria was restated as **benefit/cost** during the Critical Topics portion of the OFI VIP in order to reflect the positive value weight assigned during the ranking process.

⁸ This is a limitation of the pairwise comparison process, to be discussed later.

With respect to the criterion, Item One is:

much greater than (5)
greater than (4)
the same as (3)
lower than (2)
much lower than (1)

the importance of Item Two.

The criteria, as stated above, must be ranked before the items in the portfolio are selected and ranked. The criteria are ranked in the context of their own criterion which is, generally, the relative **importance** of the criteria vis-à-vis the mission statement of the sponsoring organization or the statement of purpose of the particular iteration of the VIP. This ranking provides the relative values of the criteria and allows for the calculation of a weighted ranking of the portfolio items. The weighted criteria are used to select and rank the portfolio at all subsequent panel meetings for that particular VIP iteration.

The VIP uses a separate score sheet for each criterion by which the items are ranked. An example scoresheet for the five criteria, *likelihood*, *magnitude*, *time frame*, *cost/benefit*, and *DOE advantage*, ranked in the context of their relative importance, appears in Figure 5.

Criteria	Likelihood	Magnitude	Time Frame	Cost/Benefit	DOE Advantage
Likelihood		2	3	4	4
Magnitude	4		4	5	5
Time Frame	3	2		5	5
Cost/Benefit	2	1	1		3
DOE Advantage	2	1	1	3	

Figure 5. Example of a criteria scoresheet.

A scoresheet for the portfolio items, ranked in the context of the criterion *magnitude*, appears in Figure 6. Where portfolio items are to be ranked using more than one criterion, a set of score sheets will be necessary.

VITAL ISSUE ROW	VITAL ISSUE COLUMN						
	Civ./Mil. Nuclear Safety	Nonnuc. Air/Water/Soil Pol.	Anthr. Induced Climate Change	Biological Diversity	Resource Depletion	Deforestation	Human Population Growth
Civ./Mil. Nuclear Safety	X	1	4	4	2	2	3
Nonnuc. Air/Water/Soil Pol.	5	X	5	5	2	3	3
Anthr. Induced Climate Change	2	1	X	3	1	3	2
Biological Diversity	2	1	3	X	1	3	3
Resource Depletion	4	4	5	5	X	3	3
Deforestation	4	3	3	3	3	X	3
Human Population Growth	5	3	3	4	3	3	X

Criterion: Magnitude

Figure 6. Example of a Vital Issues scoresheet.

Immediately after the championing and rebuttal for Item One (or criteria one), the panelists enter that item on the first row and first column of each scoring sheet. No scoring takes place at this point as there is not yet another item with which Item One may be compared. Item Two is presented in the same fashion. After its presentation, Item Two is entered on the second row and second column of all of the score sheets.

The panelists are now ready to perform the first comparison. The comparison is initiated at this stage of the process rather than waiting until all of the items have been championed in order to ensure that the concepts are clear in the minds of the panelists at the time of ranking.

The first item is compared to the second in the context of each of the criteria using the comparison scale. The items in the rows are compared to the items in the columns and the appropriate value (1 through 5) is entered in the cell above the shaded diagonal. (The shaded cells along the diagonal indicate that the items are not to be compared with themselves.) For example, in Figure 5, the item *likelihood*, in the first row, was compared with *magnitude*, in the second column, and was found to be relatively "lower than" in importance than that item. In Figure 6, the item "Civil and military nuclear accidents and pollution" was found to be "much lower" in magnitude than the item "Nonnuclear air, water, and soil pollution." Blocks below the

diagonal are not completed at this time. The comparison of items one and two is repeated for each score sheet.

After presentation and discussion of Item Three, panelists are asked to write that item in the third row and third column of each of the score sheets and to compare that item with the first and second items in the context of each criterion using the comparison scale. This procedure continues until all of the items have been championed and ranked.

After the last item has been ranked, the panelists are asked to check the consistency of their scores in the following fashion. Panelists are asked to cover all completed cells above the diagonal and to score the items in the cells below the diagonal. Because of the mirror nature of the score sheets, values entered above and below the diagonal for each pair of items should sum to 6 to be consistent. The further this sum is from the value 6, on a scale from 2 to 10, the greater is the inconsistency in the particular comparison. A sum of 2 or 10 indicates that there is a big problem with the consistency in the scoring. A sum of 6 indicates that there is no problem with the consistency. Figure 7 graphically presents this phenomenon.

Figure 7. Distance of sum of mirror image scores from the value 6 as a measure of inconsistency.

For example, in Figure 6, the initial comparison of "Civil and military nuclear accidents and pollution" with "Human population growth" resulted in a score of "3." The "mirror" scoring of "Human population growth" with "Civil and military nuclear accidents and pollution" below the diagonal in Figure 6 resulted in a score of "5." The sum of these values is 8, rather than 6, indicating that there is a problem with the consistency of that scoring, and the scorer should be asked to revisit the judgment and change one entry. The procedure is repeated for all of the score sheets. The consistency check was originally intended to provide a scorer with both a consistency check and the opportunity to reevaluate the comparison for any insights. In practice,

however, the process provided only a consistency check because no new insights were disclosed by the panelists during reevaluation.

When the panelists have completed the consistency check, feedback is normally solicited from the panelists regarding their reaction to the VIP. The panel then adjourns.

Pairwise Comparison Results/Data Presentation

The results of the pairwise comparisons process are compiled by the facilitating organization after each panel adjourns. The group-averaged relative weights of the criteria are calculated from the results of the pairwise comparison performed on the criteria themselves. The relative values for each portfolio item are then calculated for each criterion under consideration. The criteria weights and the relative values are then used to derive a composite or group-averaged criteria-weighted ranking for all of the portfolio items. (Individuals' scores are never published. Only the group ranking appears in the panel report.) The standard deviations for both the group-averaged criteria weights and the mean composite rankings are also calculated and provide an indication of the extent of the (dis)agreement among the panelists as to the relative ranking of the items. The calculations and data presentation are discussed below.

Calculation of Criteria Weights

The relative weights of the criteria are determined first in order to make them available to the topical panelists for use in the portfolio selection process. The relative weights are calculated from the relative values of the criteria, which are obtained from the results of the pairwise comparison performed on the criteria themselves in the initial panel meeting. The relative values are calculated in the following manner. The scores for each row on each score sheet are summed and then divided by the number of items (n) minus 1 to obtain the relative value for each item for that scoresheet. The number (n) minus 1 is simply the number of items against which each item was compared. The resulting relative value can be interpreted as the value of the specific item as compared to a hypothetical average item.

To obtain the relative weights, the relative values are normalized, or divided by the sum of all the relative values. The total of the individual weights is, of course, equal to one. The relative weights for each criterion are then averaged over all the panelists to obtain a group-averaged relative weighting of the criteria. The standard deviation for each mean criteria weight is also calculated. These results are provided with the criteria definitions formulated by the initial panelists to the topical panelists to use in selecting and ranking the portfolio items. Figure 8 presents a sample scoresheet for the five OFI VIP criteria showing row sums, relative values, and the criteria weights for one panelist.

Criteria	Likelihood	Magnitude	Time Frame	Cost/Benefit	DOE Advantage	Sum	Relative Value	Weight
Likelihood		2	3	4	4	13	3.25	0.21
Magnitude	4		4	5	5	18	4.50	0.30
Time Frame	3	2		5	5	15	3.75	0.25
Cost/Benefit	2	1	1		3	7	1.75	0.12
DOE Advantage	2	1	1	3		7	1.75	0.12
Total:						60	15	1.0

Figure 8. Criteria scoring sheet showing row sums, relative values, and criteria weights.

Calculation of Criteria-Weighted Ranking of Portfolio Items

To obtain the rankings of the portfolio items, the relative values are first calculated for all items on all the scoresheets for each panelist. This is done, as was done with the criteria, by summing the scores for each row on each score sheet and then dividing by the number of items minus 1. Figure 9 shows an OFI Vital Issues scoring sheet with row sums and relative values for one panelist's vital issues portfolio ranking using the criterion *magnitude*.

All the relative values of the portfolio items for a given criterion are then multiplied by their corresponding criteria weight (as determined by the pairwise comparison ranking of the criteria themselves). For example, all relative value in the scoresheet in Figure 9 are multiplied by the criteria weight for the criterion *magnitude*, which, as indicated in Figure 8, is 0.30. The resulting criteria-weighted values are then summed across all criteria for each item for each panelist. That is, the criteria-weighted value for item one for the criterion *magnitude* is summed with the weighted value for item one for the criterion *likelihood*, and with that for item one for the criterion *time frame*, and so on. The resulting values provide a criteria-weighted ranking of the items for each panelist. These weighted values are then averaged for each item over all of the panelists to obtain a composite or group-averaged criteria-weighted ranking for each portfolio item. The standard deviations for each composite value are also calculated.

VITAL ISSUE ROW	VITAL ISSUE COLUMN								Relative Value
	Civ./Mil. Nuclear Safety	Nonnuc. Air/Water/Soil Pol.	Anthr. Induced Climate Change	Biological Diversity	Resource Depletion	Deforestation	Human Population Growth	Sum	
Civ./Mil. Nuclear Safety	X	1	4	4	2	2	1	14	2.3
Nonnuc. Air/Water/Soil Pol.	5	X	5	5	2	3	3	23	3.8
Anthr. Induced Climate Change	2	1	X	3	1	3	3	13	2.2
Biological Diversity	2	1	3	X	1	3	2	12	2.0
Resource Depletion	4	4	5	5	X	3	3	24	4.0
Deforestation	4	3	3	3	3	X	3	19	3.2
Human Population Growth	5	3	3	4	3	3	X	21	3.5
Criterion: Magnitude								Total: 126	21

Figure 9. Vital Issues scoring sheet with row sums and relative values.

Data Presentation

The composite ranking can be graphically presented to show the relative positions of the items and the extent of (dis)agreement between panelists as to each ranking, as in Figure 10. In Figure 10, diamonds represent the composite value. The item with its diamond furthest to the right is the one ranked highest by the panel. The bars in Figure 10 represent the panel's (dis)agreement as to the ranking of each item (equal to two standard deviations). The longest bar indicates the item for which there was the greatest disagreement as to the ranking.

The composite values and the standard deviations provide useful information to the sponsoring organization. For example, when choosing between two programmatic areas or other items, the sponsoring organization may select the one with a lower rank but less disagreement, judging that it may have a greater chance of successful implementation than the one with a higher rank but greater disagreement. An item with a lower rank and less disagreement may also be preferable to an organization that is risk-averse.

1 - Lowest Ranking
5 - Highest Ranking

VITAL ISSUES

VI 1 - Civil and Military Nuclear Accidents and Pollution

VI 2 - Nonnuclear Air, Water, and Soil Pollution

VI 3 - Anthropogenically Induced Climate Change

VI 4 - Biological Diversity

VI 5 - Resource Depletion

VI 6 - Deforestation

VI 7 - Human Population Growth

Figure 10. Simple composite ranking of the OFI Environmental Quality Vital Issues panel, showing means and standard deviations for each Vital Issue.

The bar graph shown in Figure 10 is but one way to present the portfolio rankings. The criteria can also be combined in logical groupings or subsets, and used to generate integrated composite rankings. As an example, the four criteria, *time frame*, *magnitude*, *likelihood of occurrence*, and *benefit/cost*, can be combined to generate an indicator of the **potential value added** of investigating an issue. *Time frame*, *magnitude*, and *likelihood* can also be combined to indicate the **importance** or **net present value** of an issue, as was done in the OFI case.

Such combined criteria, however, must have been ranked as a unit in the pairwise comparison and their relative values and weights calculated in order to provide an accurate assessment of their contribution to the determination of the relative value of an item in that context. Thus, the decision to combine criteria must be made early in the VIp. These subsets of the complete set of criteria must be identified as an integral part of the VIp planning, so that the ultimate presentation, whether simple composite bar graphs, two-axis graphs, or three-dimensional (3-D) graphs, accurately reflects the relative weights of the criteria.

Rankings using combined criteria can be displayed by graphically plotting the ranking of the items for each criteria subset and the levels of disagreement. For example, if criteria are combined into two groups, the panel means and standard deviations for one group will be plotted along the x-axis, and the panel means and standard deviations for the other group will be plotted along the y-axis. Figure 11 presents an example.

In Figure 11, the mean values for the combined (or composite) criterion, *potential value added*, are plotted against the mean values for the single criterion, *DOE comparative advantage*, as calculated from the results of the OFI Environmental Quality Vital Issues panel. This particular form of presentation of results can bring issues to the attention of the sponsoring organization that it may not be best suited to address, but that are still of critical concern. The diamonds in Figure 11 represent the plotted pairs of means. The ellipses represent the range of the panelists rankings or the level of group (dis)agreement. The vertical dimension (height) of each ellipse shows the extent of agreement on the ranking against the combined criterion; the horizontal dimension (length) of each ellipse shows the range of agreement as to the ranking against the *DOE comparative advantage* criterion. The number next to the diamond in each ellipse indicates the issue under consideration. The curved bands across the graph in Figure 11 represent one possible set of indifference curves, i.e., all points along this curve are of equal interest to the sponsoring organization. Items closest to the upper right hand corner would be the most attractive.

The ellipse with the smallest vertical dimension indicates that the group had the greatest agreement on the ranking of that particular vital issue with respect to the combined criterion. In Figure 11, the vital issue "deforestation" had the greatest agreement among the panelists as to the potential value added, and the vital issues "human population growth" and "anthropogenically induced climate change" had the least agreement.

If the criteria are combined to yield three groupings or subsets rather than two, the same general process can be followed, although a 3-D, rather than a two-dimensional (2-D), figure will be

VITAL ISSUES

- 1 - Civil and Military Nuclear Accidents and Pollution
- 2 - Nonnuclear Air, Water, and Soil Pollution
- 3 - Anthropogenically Induced Climate Change
- 4 - Biological Diversity
- 5 - Resource Depletion
- 6 - Deforestation
- 7 - Human Population Growth

Figure 11. Integrated composite ranking of the Environmental Quality Vital Issues panel.

generated. The panel means for the three groups of criteria are plotted along the x-, y-, and z-axes, respectively. The disagreement among the panelists as to the ranking of a particular item (the standard deviation) is represented by a 3-D figure, an ellipsoid. Analyses using higher dimensions may also be generated with the appropriate computer tools, where the criteria are divided into more than three subsets.

In the OFI case, *time frame*, *magnitude*, and *likelihood* were combined as an indicator of the importance of an issue. The relative contributions or weights of these components of *importance* were determined using pairwise comparisons. The weights calculated from the rankings were used to determine the weighted rankings of the Critical Topics and to generate a ranking based on the composite criterion, *importance*, and the two other criteria, *DOE comparative advantage* and *benefit/cost*. The means and standard deviations of the criteria's relative values for each Critical Topic were plotted against the means and standard deviations of both the *DOE comparative advantage* and *benefit/cost*. Figure 12 shows the ranking of the six Critical Topics identified by the OFI Environmental Quality Critical Topic panel based on these criteria.

In Figure 12, the panel's assessments of *importance* (a composite of the *magnitude*, *likelihood*, and *time frame* criteria), *DOE comparative advantage*, and the *benefit/cost* of an OFI investigation, constitute the axes of the 3-D plot. The topic falling closest to the upper right-hand corner in each figure is considered the most desirable for the OFI to pursue because it has the highest value along all three axes. The topic falling furthest from the upper right hand corner is considered the least desirable of the topics for the OFI to investigate.

For clarification, Figure 12 also shows three 2-D displays, which reflect each side of the cube in the 3-D figure. These show the ranking with respect to the composite criterion *importance*, plotted against rankings for each of the two criteria, *DOE comparative advantage* and *benefit/cost*, and *DOE comparative advantage* and *benefit/cost* plotted against each other.

Panel Reports

A report is produced on every panel meeting. In cases where the VIp is implemented as a series of panels, the reports of two or more meetings may be consolidated into one volume. For example, for the OFI implementation, two volumes, Volumes 1 and 2 of this series, reported on a total of ten panel meetings, the Vital Issues panel meetings and the Critical Topics panel meetings, respectively.

The rapporteur present at each panel meeting is charged with generating a draft report for review by the panelists that, after any corrections are made, will be sent to the sponsor and made available for wider dissemination as deemed appropriate by the sponsoring organization. It is very important to note that this report will *not* be minutes of the meeting, but will summarize the discussions and debates that occurred during the course of the day. The report should capture any areas of ambiguity that are raised in the discussions on policy and strategic direction. It should also present the various interpretations of key terms and concepts as well as the consensus definitions reached by the panelists.

Figure 12. Composite ranking of the six Critical Topics identified by the OFI Environmental Quality Critical Topics panel: (a) *DOE Comparative Advantage* vs. *Benefit/Cost*. (b) *Importance* vs. *DOE Comparative Advantage*. (c) *Importance* vs. *Benefit/Cost*.

In order to encourage full participation on the part of the panelists, remarks made during a Vital Issues panel meeting are not to be attributed to any one individual panelist. Because the panelists have been assured that comments during the meeting will not be attributed to any individual panelist but will be presented as output from the panel as a whole, it is up to the rapporteur to identify and express points of debate and dissension without identifying individuals. The report must convey the tone as well as the content of discussions.

The report consists of two parts. The first part presents summaries of the discussions and debates on the panel topic, the identification and definitions of the items under consideration, and the statements of consensus. The second part of the report is a presentation of the results of the quantitative analysis. A draft report is sent to panelists with a cutoff date for comments. It should be noted at this point that panelists may attempt, as they review the report, to introduce material or information into the report that was not brought up during the meeting. Because the report pertains solely to the events of the meeting, this added material should be considered extraneous and should not be included in the final report, although it may be included in an appendix as appropriate. The rapporteur will incorporate any significant relevant comments received into the report and prepare a final document for publication.

Briefing packages consisting of view graphs and associated hard copy handouts are *de rigueur* in many government circles. Where briefing packages are used they should follow the general format of the report, tracing the discussion to its conclusion in the synthesis of alternatives, then showing the results of the pairwise comparisons process.

Videotapes can also be used to present the results of a panel meeting. Upon two occasions, we produced a short video (10-12 minutes) on the process and its outcomes (U.S. DOE OFI, 1992; Riotech, 1993). The video format allowed us to incorporate excerpts from brief interviews with the panelists in which they presented their views about the overall value of the exercise. (Note that the panel meeting was videotaped with the permission of the participants. Panelists appearing in the videos were identified by name and had an opportunity to view the tape before it was publicly released.) On both occasions, the sponsoring organization found the videos to be particularly useful when communicating with funding sources.

Analysis of the Vital Issues Process

The VIp entails the unique combination of two distinctly different approaches to policy formation and analysis in one session. The first is called the *transactional* approach (*qua* qualitative *qua* synthesis); the second, *scoring* (*qua* quantitative *qua* analysis).

In brief, the transactional approach is based upon the premise that the various stakeholders in the policy- or strategy-making process have different values and agendas and that the route to effective policy or strategy success is a negotiated consensus among them. Hence, the term "transactional," which we have used to highlight the verbal give-and-take transactions that lead

to consensus.⁹ The transactional approach incorporates values and social context into the decision-making process. It accommodates the shifting balance of power among interest groups (stakeholders) and incorporates "analysis-as-argument" (Majone 1988, 157), which uses rhetoric as the tool of persuasion, into the process of devising strategy and policy.

In contrast to the transactional approach with its emphasis on differing values among groups, the scoring approach is acutely rational, seeking what is termed "net regret minimization." It assumes a universal human desire to maximize one's situation under the constraints that are given. While individuals or groups may differ as to the way this is attained, the ultimate goal of maximizing net benefit and the term's definition are assumed to be universal (cf. Sandel 1988, 112). The policy or strategy focus is thus on the logic and process of choice rather than on the definition of goals or integration of values. The methodology is one of management science, decision theory, statistical empiricism, and the like. It incorporates analysis-as-science, which uses quantitative methods and mathematics as the tools of persuasion, rather than analysis-as-argument and its associated tools of rhetoric (see Garson 1986, 10ff; Orren 1988, 14; Dallmayr 1986, 61-62; and Reich 1988, 132ff, for further discussion of the contrast between these two approaches.)

Each of these approaches entails a very different kind of input from panel members and each yields distinct and different results. It is the combination of the two in a single Vital Issues session using the same group of people that yields the outcomes that are unique to the VIP. This combination of approaches also avoids some of the pitfalls that can occur with the implementation of only one approach. Following are discussions of these two theoretical approaches as they are articulated in the VIP.

Transactional (Qualitative) Segment

The VIP is based on the assumption that the success of any strategy, policy, program, or activity is highly dependent upon the accurate definition of the problem or issue being addressed. It is also based on the assumption that the parameters of a topic or an issue (and thus the accurate identification of associated programmatic activities) are time- and context-dependent. The VIP allows for the possibility that the issue may emerge from a panel discussion substantially different from the initial strawman proposition. It is this act of negotiation that synthesizes something new out of the differing perspectives, values, and agendas of the stakeholders. Obtaining the consensus of the participating stakeholders on these issues ensures that the definition and scope of the problem is acceptable to all involved parties.¹⁰ It also brings the policy-making process into a more public forum.

⁹ We have deliberately avoided the term "pluralism," which is often used in literature to refer to this approach. When the results of a pluralistic process are used in isolation from any other inputs to the decision-making process, the final outcome can be significantly skewed by factors such as relative group size, wealth, or other factors that might give one group disproportionate influence (cf. Kelman 1988; Reich 1988, 128). Since the VIP is designed to be only one of several inputs to management decision making, we believe that any of the negative tendencies of pluralism that it might exhibit are controlled and countered by other balancing inputs.

¹⁰ The term "etic" may be applied to externally derived and imposed value frames and "emic" to indigenously developed value frames. If the stakeholder group was asked to work only with the sponsoring organization's

The transactional portion of the VIP encourages panelists to engage in discourse that is essentially valuative. Panelists are urged to express their divergent viewpoints and differing agendas. The process recognizes that the key points of disagreement among group members are as important as the consensus that emerges. The discussion identifies areas of ambiguity in the policy or strategic environment that are likely to arise during program development. These areas frequently form the terms of debate for subsequent policy or strategy formulation and may become critical points of contention in the implementation process. Identifying and defining them early in the policy- or strategy-making process can be key to improving the likelihood of programmatic success.

The social domains and indices of social valuation that are highlighted by the discussion are also accessed through the semantic taxonomy that is expressed through the criteria that are subsequently used to prioritize the portfolio items. Panelists asked to devise a set of criteria by which an organization should choose significant areas of strategic focus are, in effect, being asked to decompose or "unpack" the term *importance*.

Significantly, as mentioned above, every Vital Issues panel charged with the task of developing a strategic portfolio for a public-sector agency *independently* arrived at the same core set of three criteria: *time frame* (where near-term was more important); *magnitude* (large or high being more important); and *likelihood* (with more likely being more important).¹¹ This emphasizes the importance of these three factors in identifying and selecting the items in the portfolio. Figure 13 shows the cognitive, semantic, and valuative taxonomy of the term *importance*.

Figure 13. Taxonomy of the Criterion *Importance*

definition of the objective, the definition would be etic in the context of this group. If the stakeholder group synthesizes its own definition, the outcome is an emic one.

¹¹ To this set each panel added from one to three additional criteria, specific to the sponsoring organization.

The three criteria, *time frame*, *magnitude*, and *likelihood*, are also the three components of a net present value calculation, with the importance of an item being a direct function of the relationship between the magnitude of the impact that the item has on a stakeholder's respective interest, the likelihood that the impact will occur, and the time frame in which that impact might occur. As such, the three criteria can be combined to form a composite criterion that indicates the importance or net present value of an item or issue. A discussion of the role that *net present value* plays in the identification and selection of the portfolio items appears in Appendix A.

Scoring (Quantitative) Segment

The scoring approach uses the group of stakeholders (the Vital Issues panel) to prioritize the portfolio of programmatic options or solutions identified during the transactional portion of the meeting. This quantitative approach provides a prioritized set of strategic issues, programmatic alternatives, or solutions to a specified problem. It also provides a quantified indicator of the level of disagreement in the group as to the rankings. This approach can identify a single top-ranking solution or activity, the implementation of which will minimize dissatisfaction among the members of the group.

The quantitative process used in the scoring segment of the VIP is pairwise comparisons, described above, a decision tool that allows the comparison of two or more items against stated criteria. The method makes explicit a normally implicit, qualitative process. It also yields an interval scale; that is, a scale that both indicates rank and measures the distance between ranked elements in units of equal intervals. The tool allows the decision maker to make *relative* judgments about the issues and the criteria, ranking each issue relative to some hypothetical average item rather than to some external, absolute standard.

The pairwise comparisons process used in the VIP is derived from the paired comparison used in Thomas L. Saaty's well-known Analytic Hierarchy Process (AHP), with some important distinctions. A comprehensive discussion of the similarities and differences appears in Appendix C.

A Unique Combination of Approaches Yields Valuable Results

It is the combination of these two approaches to policy analysis in one session with one group that yields the unique results of the VIP. The transactional, humanistic portion introduces the notion of value and difference to the process and seeks consensus through the clarification of topical statements and the selection of the criteria and the portfolio items. The insistence that the output of the VIP is only one among many inputs to the decision-making process avoids the pitfalls of pure pluralism. The use of the output from this segment of the panel session as input to pairwise comparisons adds rigor that is often lost in pure "analysis-as-argument." The scoring portion of the process introduces the notion of rationality (in its strict definition) by asking the same group of individuals to take the auto-defined (or emic) alternatives and identify the option that will minimize dissatisfaction among group members. The presentation of the level of (dis)agreement in the results re-introduces the concepts of value and difference into the "analysis-as-science" approach.

In the VIP, the scorers, rather than the sponsoring organization, identify and define the items to be scored. This ensures that the items have an emic characteristic (they are indigenous to the group), thus enhancing clarity and reducing the potential for ambiguity that can arise with items that are purely etic in nature. The ranking of the portfolio by the stakeholder panelists (as opposed to the sponsoring organization) also substantiates the assertion that substantive stakeholder input has been legitimately solicited.

Summary of Approach

The VIP was developed in response to the specific need of a government agency to develop strategies to adapt to the post-Cold War geopolitical environment. Since its initial development, it has been refined and used by other public and semipublic organizations. It is now considered robust enough to be used in a wide variety of applications.

There are three key players necessary to the successful implementation of the VIP: the sponsoring organization, the facilitating organization, and the stakeholder panelists. It is the sponsoring organization that defines the initial goal for a given iteration of the VIP and that composes an initial strawman topic statement for each panel. The facilitating organization is responsible for process management, working with the sponsoring organization to determine process objectives, recruiting panelists, facilitating panel sessions, and preparing the final report. The stakeholder panelists provide the substantive input in the form of modified topic statements and goals, a working definition of the panel topic, a set of selection criteria, and a prioritized portfolio of strategic issues, programmatic areas, or solutions to a specified problem.

Once the process objective has been defined, the facilitating and sponsoring organizations together identify key stakeholder groups and available resources, and make a determination as to the number of panels to run. The facilitating organization prepares the recruiting materials and begins to solicit participation from appropriate individuals. Generally, a minimum of six weeks is required for the selection and recruitment of appropriate panelists.

The VIP follows a specified configuration. As a general rule, at least two panel meetings are required. An initial panel selects and ranks the criteria used by subsequent topical panels to select and rank the portfolio items. A panel meeting usually takes a full day. The day begins with discussion and clarification of the panel topic. This discussion continues until panelists reach consensus on a working definition of the topic and other key terms. Attention is then turned to the identification and definition of potential criteria or portfolio items. Brainstorming yields a list of items that should be consolidated to no more than eight. The items are then championed and ranked using pairwise comparisons.

The meeting is led by a facilitator and recorded by a rapporteur. The rapporteur will prepare a report of the meeting that will convey the tone and content of the discussions. The report will be reviewed and approved by panelists before its release. Videos and/or briefing packages may also be prepared.

The VIP offers the unique combination of two problem-solving approaches: a transactional approach to problem definition, exemplified in the discussion and definition of panel topics and items for ranking, and a scoring approach, which uses pairwise comparisons to prioritize the identified items. This combination of facilitated group discussion and quantitative ranking provides important input to strategic management decisions in the form of a portfolio of stakeholder-defined and -prioritized items as well as information on potential barriers to the implementation of programs.

RESULTS

Vip results include the informational input to the sponsoring organization's decision-making process, the sense of "buy-in" or investment on the part of the stakeholder panelists, and the accountability that can be demonstrated by the sponsoring organization. We will discuss each in turn.

Management Information

The primary stated purpose of the Vip is to provide management with a source and type of input to the decision-making process that it otherwise might not obtain. This can be particularly important when government agendas are changing and old points of reference are no longer valid. The following comment from one panelist emphasizes the timeliness of the process: "The [Vital Issues] process has been valuable particularly because we are in a time of a changing world situation . . ."

Sponsoring organizations that have implemented the Vip have been able to effectively use the output of the panels. Taking OFI as an example, we see that the Vital Issue that ranked at the top of each of the four topical panels has indeed become the focus of significant programmatic activity. There is a strong program in "civil nuclear reactor safety," the topic identified as the top-ranking issue of the OFI Environmental Quality panel. The Vip has been used as a management tool within that program to identify key areas of focus for particular projects. The top-ranked issue in the National Security panel, "non-proliferation," is now one of the key focus areas for the Secretary of Energy and DOE as a whole. "Activities of foreign governments in technology development and deployment," was identified as a key issue by the Economic Competitiveness/Science & Technology panel and has since been addressed by several OFI projects. The OFI Energy Security panel identified the "energy infrastructure of the former Soviet Union" as a topic of high interest. Two years later, it remains an area of concern.

Other sponsoring organizations have also used the output of Vital Issues panels that were run under their auspices. DOE's Office of Industrial Technologies in Energy Efficiency and Renewable Energy has used the Vip to craft a response to a section of the Energy Policy Act of 1992 (EPAct), focusing on the key terms and opportunities identified by the panel. An office in DOE's Nuclear Energy (NE) organization also convened a Vital Issues panel to obtain assistance in responding to a particular section of the EPAct. The results of that Vip iteration became the basis for a response to Congress regarding NE's activities in the area of concern. They were also used to implement an NE program. Riotech, a semipublic organization in New Mexico, used the Vip to develop a mission statement and to select areas of focus for an Environmentally Conscious Manufacturing Institute, that Riotech was planning to establish.

Other sponsoring organizations include AMTEX, a consortium of textile industry companies and DOE laboratories, which is currently using the Vip in one of its tasks to help develop prototype decision analysis tools. AMTEX Task 4 participants have identified new perspectives on two approaches to their task through the transactional portion of the process. A series of Vital Issues panels was also convened to identify opportunities for the State of New Mexico for applying

information systems in the health care arena. Proposed legislation was developed on the basis of panel outcomes and submitted to the New Mexico state legislature.

Another important attribute of the VIp is its efficiency. In a relatively short period of time (one day) consensus can be reached among individuals with widely divergent viewpoints on the topic of interest. At the conclusion of one panel, one of the panelists stated that we were able to accomplish more in one day than the sponsoring organization had been able to achieve in nine months of work. In other instances, panelists who voiced skepticism during the recruitment process recanted after the conclusion of the panel and admitted that the facilitating organization had, in fact, accomplished what it set out to do.

Stakeholder Buy-in

Participation in the VIp can give the panelists the feeling that they have some personal interest and have made a personal investment in the successful implementation of the sponsoring organization's activities. If the panelists are properly chosen and have a high profile and significant credibility in their constituent communities, their participation can also stimulate "buy-in" on the part of the broader constituent community.

The transactional portion of the process, in which the panelists negotiate and synthesize consensus statements, allows for the diffusion of what otherwise might be strong opposition to certain courses of action. As one panelist commented, ". . . the product, while it was partially predictable...gave you dimensions you couldn't have predicted" It is also worthy to note that, of the more than 200 individuals who have participated on Vital Issues panels, only one asked that his name not be associated with the final report and, in that instance, the panelist's objections were to the process itself, not to the specific panel outcomes. Another panelist, who was familiar with the pairwise comparison method, felt only that it was inappropriate to use the method in the particular context in which it was being used.

Perhaps one of the strongest endorsements came from a panel convened for a DOE agency. Recruitment of the members of this panel was particularly difficult as relations between the sponsoring organization and its stakeholder communities had become rather strained. The panel meeting was scheduled to last for two days; most recruits reluctantly agreed to attend the first day and indicated that they might not be able to stay for the second. All panelists returned for the second day and participated fully. The panelists have also remained engaged in the implementation of the programmatic activities that resulted from the Vital Issues session. This buy-in was very likely stimulated by the emic nature of the process.

This kind of buy-in can be critical to a sponsoring organization as it seeks to implement its chosen policies or programmatic activities. Public organizations are embedded in an environment of social institutions with competing agendas. Increasing the organization's advocates at key points in the social network can provide an organization with significant leverage and can dramatically increase the potential for programmatic success.

Accountability to the Public

The current administration has been very vocal on the issue of the accountability of government to the public. By soliciting input from external stakeholder groups and producing reports that set forth their interests and concerns, a sponsoring organization can demonstrate that it has solicited public input in a structured fashion that produces documented, reliable results. As one panelist commented, "[this process] has flagged a number of important issues and did it in a way that I think is defensible" The panelists' names and stakeholder affiliations are also listed in the reports, which are disseminated through the personal networks of the panelists and the sponsoring organization. The outcome of the process as well as the sources of the input are thus visible to all concerned parties. This reinforces the perception that the sponsoring organization is both concerned about and involved with its various constituency groups. This can ultimately improve the accountability of government organizations to the wider public.

Summary of Results

The VIp has demonstrated its capability to provide input that is useful to sponsoring organizations. Stakeholder participation in the sponsoring organization's strategic planning and decision-making processes can also stimulate buy-in on the part of the broader constituent community and generate a climate that will promote the successful implementation of programs. A government organization can also use the VIp to improve its accountability to the public through the solicitation of input from external stakeholder groups and the production of reports that set forth their interests and concerns.

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COMMENTARY

The VIP provides important input to strategic management decision-making in the form of a prioritized portfolio of programmatic objectives designed to assist in accomplishing the sponsoring organization's objectives. It has been implemented for a wide variety of public and semipublic organizations at both national and state levels. Panel topics have been as diverse as broad strategic objectives and individualized test beds for the development of decision analysis tools. Stakeholder panelists have included individuals from communities as diverse as the Natural Resources Defense Council, the fiber and textile manufacturing industries, hospitals, Washington "think tanks," universities, and the uranium production industry.

Lessons Learned

The VIP works extremely well when applied to the kinds of tasks for which it was designed (the selection and prioritization of a portfolio of items). Successful implementation requires a diversity of opinion among panelists, which can be achieved by proper recruitment of stakeholders with an appropriate range of viewpoints. In the one instance in which we used panelists with similar opinions on the panel topic, we were unable to stimulate discussion that could identify areas of ambiguity or tension or reveal potential resistance to implementation.

The process should always be implemented in its entirety. We were tasked at one time to execute a pairwise comparisons exercise independent from the transactional portion of the VIP, using criteria that were developed by another group and for a different purpose. The panelists found the criteria highly ambiguous and not operational in some instances, and experienced the exercise as threatening. It is the combination of transactional interactions with pairwise comparisons that synthesizes panelists' opinions by recognizing and incorporating key points of differences, minimizes net regret, clarifies areas of ambiguity, and reduces any threat the panelists might feel from the possible later implementation of panel results. Participation in only the transactional element does not allow the panelists to prioritize the alternatives; participation in only the pairwise comparisons does not allow negotiation and the resolution of differences.

Limitations of the Process

Limitations of the VIP lie primarily in the numbers: the number of panelists that can participate on a given panel, the number of issues that can be ranked using the pairwise comparisons process, and the number of panels that can be run consecutively.

As noted earlier, the dynamics of group interaction suggest that group size should not exceed twelve individuals, with eight to ten as an optimum figure. Most organizations can identify more than ten key stakeholders. This problem can be accommodated by the running of a series of panels. Doing so, however, can increase the time from process inception to final result and can significantly increase the resources required. The benefits gained through accessing the full range of stakeholder input and the subsequent stakeholder buy-in, however, are worth the cost. This has been corroborated by the sponsoring organizations with which we have worked.

The same cost/benefit tradeoff is made with the pairwise comparisons process. The cost is the limitation of the number of portfolio items to no more than eight, which is required by the demanding nature of the pairwise comparisons method in terms of time and fatigue. In the few occasions when the number of panelists exceeded eight, scorer fatigue significantly impacted the ability of the panelists to effectively implement the process. By the same token, scoring that takes place late in the day may not be as valid as scoring that takes place earlier in the day. Limiting the number of items also allows for fairly quick process closure (in the course of a single day) on what is often a quite contentious topic. Because pairwise comparisons provides an explicit and accountable method for prioritizing alternatives against clearly defined criteria, it was determined that its use was well worth the cost of limiting the size of the portfolio.

The final limitation was discussed earlier: the problems that arise when two panels are run on consecutive days using the same panelists. The intensity of the process and the quality of the input required from the panelists leads to significant fatigue that can seriously impact the quality of the output from the panelists on the second day. This means that the time between the first and the last panel in a series may need to be significant. This would require that the sponsoring organization begin the implementation of the VIp well in advance of the time when input for management decisions is required.

The VIp is still evolving. Although we believe that the process described in this paper is highly effective and reasonably robust, we find that each time we run a panel we obtain information that allows us to continue to fine-tune the process. We intend to develop and implement these refinements on an on-going basis.

As it currently stands, the VIp is complete at the end of a panel or series of panels. A formal mechanism that involves stakeholders beyond their participation on a Vital Issues panel, to provide input during the implementation of any resulting programs, could be useful to the sponsoring organization. A tool that elicits formal comments on the VIp output could be an effective way to begin this post-panel process.

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APPENDIX A:

A Discussion of Net Present Value

A significant outcome of the VIp to date is that every Vital Issues panel charged with the task of developing a strategic portfolio for a public-sector agency *independently* arrived at essentially the same core set of three criteria: *time frame* (where near-term was more important); *magnitude* (large or high being more important); and *likelihood* (with more likely being more important).¹ These three criteria also serve as the three components of a net present value calculation, with the importance of an item being a direct function of the relationship between the magnitude of the impact that the item has on a stakeholder's respective interest, the likelihood that the impact would occur, and the time frame in which that impact might occur. The concept of *net present value* thus plays an important role in identifying and selecting the items in an investment portfolio.

Net present value can be expressed as a mathematical equation as follows:

$$v = mi^{-t}$$

where v is the net present value, m is magnitude, i is the (social) discount rate, t is the time frame for the impact of the issue under consideration, and (i^{-t}) is the appropriate discount factor. The discount factor is the discount rate (i) associated with an understood time interval raised to a power $(-t)$ corresponding to the negative of the number of time intervals from the time of the investment until the realization of the impact. This "exponentiation" of time translates the rate into a factor that discounts the magnitude of the impact commensurate with the time frame required to realize the impact. The impact of the issue can be either positive or negative and either qualitative or quantitative.

Stakeholders are unlikely to think literally in the context of the equation shown above. The importance of an issue, however, is a function of the interrelationship of two of the constituents in the equation, namely, magnitude and time frame of the impact of the issue in question. Stakeholders tend to think in the context of these two constituents when considering the impact of issues on their respective interests or objectives. If the magnitudes of two items are equal, but these impacts occur in different time frames, then the time frame consideration can have the determining influence on the selection. For example, if two issues have the same positive magnitude of impact but one has an impact that occurs next week and the other ten years from now, then the decision maker is likely to prefer the nearer-term issue. By contrast, if the magnitude is the same but the impact is negative, then the longer term will probably be preferred.

The likelihood of an issue's impact is related to the net present value in that it incorporates the three variables of that dimension, magnitude (m), time frame (t), and discount rate (i). The likelihood can be considered in the context of the joint probability distribution function, $f(m,i,t)$,

¹ To this set each panel added from one to three additional criteria, specific to the sponsoring organization.

and the first and second moments of v . The expected value of v (μ_v) and the variance of v (σ_v^2) can be expressed using Stieltjes integration as follows:

$$\mu_v = \iiint m(i)^{-t} dF(m, i, t),$$

and

$$\sigma_v = \left\{ \iiint m^2(i)^{-2t} dF(m, i, t) - \left[\iiint m(i)^{-t} dF(m, i, t) \right]^2 \right\}^{1/2},$$

Vital issues panelists will, of course, not have the means or the desire to carry out the explicit computation of these measures for each potential item in the portfolio within the time frame and format of a Vital Issues workshop. Nonetheless, the elements of a *probabilistic net present value* approach (magnitude, time frame, discount rate, and likelihood) are the essential factors in the evaluation of portfolio items during the Vital Issues process. One of the more important insights gained through application of the VIp has been the tendency of stakeholders (panelists) to consistently and independently choose the components of probabilistic net present value as selection criteria.

APPENDIX B:

A Comparison of the Vital Issues Process with the Delphi Method

The Delphi Method is one of the best known methodologies for eliciting consensus from experts. It was developed by the Rand Corporation in the 1950s and 60s. When SNL designed the Vital Issues process for OFI, it considered the Delphi Method and determined that various features of that method were inappropriate for OFI's purposes. This discussion describes the Delphi Method, compares the two processes, and provides the rationale for the choices that were made in the design of the Vital Issues process.

Similar to the Vital Issues process, the Delphi method provides a structured format within which expert opinion may be elicited. Unlike the Vital Issues process, a Delphi is administered through a series of prepared anonymous questionnaires that provide statistical feedback at each iteration. A Delphi can be used to obtain consensus on an issue or to amass information about an area of interest. Delphis have been used primarily to forecast specific events (Linstone & Turoff 1975, 4), but they have also been used to qualitatively and/or quantitatively evaluate sets of alternatives. Delphis are useful in situations where anonymity must be assured and where input is needed from more individuals than can effectively interact in a face-to-face meeting.

The Delphi questionnaires are typically administered in a paper and pencil format, although they may also be administered by mail, through personal interviews, or at an online computer terminal (Linstone & Turoff 1975, 5). The basic tool, however, is the structured formal questionnaire. A monitor or monitor team designs and administers the questionnaires and compiles the results. A Delphi can be designed in various ways depending on the information needed. Delphi questionnaires, however, usually consist of statements or items that are to be ranked by the respondents using either a quantitative or a qualitative scale. The items may be generated by the respondents, the monitor, or both. Written justification for a particular opinion may be requested from a respondent. However, the respondents need not give the basis for their opinions. Delphi questionnaires are also administered in a manner that protects the anonymity of the respondents. Although a Delphi monitor may list the participants by name and affiliation in the final written report, the respondents are normally not known to each other and their individual responses are kept anonymous throughout the process.

A Delphi is administered in two or more rounds. The first round is typically used to explore the subject under consideration, to set the terms of the debate, and to identify initial options, developments, or alternatives. The monitor may or may not present a list of potential items for inclusion. The questionnaire results are tallied, summarized, and statistically analyzed by the monitor or monitor team and used as the basis for designing the next questionnaire. In the second round, the respondents review the statistical analysis of the results of the prior questionnaire, usually in the form of a mean and a measure of the deviation or dispersion, and are provided with an opportunity to revise their views. Respondents outside a designated consensus range may be asked to support their position. The types and amount of statistical feedback, however, are determined by the monitor and may or may not include commentary. Subsequent iterations are used to reach a better understanding of how the issues are viewed and how the

participants understand terms such as "importance," "desirability," and "feasibility." The subsequent questionnaires are designed to move the group towards consensus through the compilation of responses, statistical feedback, and the design of follow-up questions. Iteration continues until satisfactory convergence of opinion is reached, as determined by the monitor.

There are several significant differences between the Vital Issues and the Delphi Method: the real-time face-to-face interaction afforded by the Vital Issues process as opposed to the anonymity of the Delphi; the panel meeting format versus the structured questionnaire of the Delphi; and the different methods for obtaining consensus and the different outputs that result. Unlike the Delphi Method, the Vital Issues format provides for discussion and negotiation to both formulate and define the criteria as well as to select the items in the portfolio. Arguments for and against the inclusion of an item in the portfolio as well as its position in the ranking are presented openly in a facilitated group discussion. The Vital Issues structure specifically provides for the open communication of the panelists' justifications for their opinions. The Vital Issues panelists are known to the decision maker and are identified in the workshop report. By virtue of the face-to-face interaction, they are also known to each other. The process as well as the outcome are thus visible to all concerned parties.

The anonymity of a Delphi is intended to encourage participation where disagreements among individuals are so severe or viewpoints so politically unpalatable that anonymity must be assured (Linstone & Turoff 1975, 4). It also has the advantage of avoiding the fear of repercussion or loss of face and other difficulties that can arise from publicly contradicting majority opinions (see Turoff 1975, 86). Similarly, an anonymous questionnaire format avoids control of the process by domineering personalities or sheer strength in numbers.

The Vital Issues process, like the Delphi Method, recognizes the importance of nonattribution of individual responses and statements. The process, however, also attempts to establish credibility and accountability through the explicit identification of the panelists and their stakeholder affiliations, the explicit selection of panelists who have recognized expertise in the areas of concern, and the face-to-face interaction on a panel. This allows interested parties to assess the credibility of the process outputs, a critical factor in a public policy-making environment where the credentials of a policy proponent are frequently as important as the content of the policy itself to the acceptance of a proposed course of action. Because policy formation involves ongoing debate about alternative choices of action, the process of policy-making is as important as the outputs of that process. Focusing attention on the outputs and away from the process, as can occur with a Delphi, can tend to obscure the terms of the debate. Additionally, the discussion and negotiation that takes place on a Vital Issues panel are guided by a skilled facilitator in order to avoid or minimize control of the process by domineering personalities. The face-to-face interaction on a Vital Issues panel enhances brainstorming and reciprocal education on diverse viewpoints.

The Vital Issues process also specifically acknowledges and incorporates a critical dimension of policy-making: its expression in language. Semantic categories are often imprecise or ambiguous. Words or phrases having valiative concepts, such as importance, feasibility, and desirability, almost always are subject to more than one interpretation or value. It is crucial in an

evaluative scheme to ensure that the participants have common interpretations of the scales used for evaluating the items. This can be difficult to accomplish in an anonymous questionnaire format. Group agreement on a policy often requires face-to-face negotiation to come to consensus on the meaning of critical terms. The Vital Issues process accords high importance to this process, recognizing that the keys to the parameters of the debate, and hence indicators of future social directions, lie in the analysis of these terms.

Consensus on a Vital Issues panel is obtained in a very different manner than that obtained on a Delphi. Consensus in the Vital Issues process is a result of dynamic group discussion, negotiation, and reciprocal education on the differing viewpoints. On a Delphi, the monitor moves the participants to consensus using statistical feedback and reiterative questionnaires. In the Vital Issues process the portfolio items are ranked to provide an indication of the relative priority of the items that were selected through consensus. The mean and distribution of the rankings are not used to drive the consensus, but rather to provide the decision maker with information on the extent of disagreement. Because the Delphi procedure moves the participants toward consensus through statistical feedback and the reformulation of questions rather than through group negotiation and reciprocal education, it may in fact "deliberately manipulate responses toward minimum dispersion of opinion in the name of consensus." (Sackman 1975, 51).

The formal questionnaire format itself also has potential limitations and pitfalls. (Linstone 1975, Sackman 1975). Because the design of the questionnaires and the process itself are controlled by the monitor or monitor team, the danger exists that the preconceptions of the problem and the views of the monitor will be imposed on the respondents. Excessive specification or vagueness can reduce the amount and the accuracy of the information obtained. Poor summarizing and superficial analysis of the responses are also a potential problem. Additionally, failure to pursue the underlying reasons for divergent opinions can lead to inaccurate results.

The Delphi Method has been criticized for its adherence to the superiority of anonymous over face-to-face formulation of opinion, the dubiousness of the resulting consensus, and the method's systematic inhibition of the adversary process and avoidance of face-to-face confrontation (Sackman 1975). The method's potential limitations and pitfalls have also been recognized by its strongest advocates (see Linstone & Turoff 1975, 6; Linstone 1975). Some of these pitfalls can be avoided through careful design of the questionnaire. A Delphi can also be used to supplement a face-to-face meeting in order to avoid some of these problems.

SNL, in designing the Vital Issues process, considered the features and reviewed the advantages and disadvantages of the Delphi Method. It was decided, for the reasons discussed above, to utilize a format that combined facilitated group discussion with a quantitative ranking procedure. The structure would encourage participation through nonattribution yet promote credibility and accountability through face-to-face interaction and explicit panel selection and identification. Consensus would be derived from dynamic group discussion and negotiation rather than through the compilation of questionnaire responses. The pairwise ranking would provide a standardized procedure for ranking the portfolio and a quantified indicator of the level of disagreement in the group as to the rankings. The outcome of the panel meeting would be a useful management tool

consisting of a prioritized portfolio of strategic directions or programmatic areas and a written report that presented both summaries of the group discussions and the results of the pairwise comparisons rankings. The result is the Vital Issues process.

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APPENDIX C:

A Comparison of the Vital Issues Process with the Analytic Hierarchy Process for Multicriteria Decision Making (AHP)

The Analytic Hierarchy Process for Multicriteria Decision Making (AHP), developed by Thomas L. Saaty, is a decision-making methodology that uses hierarchical structures to represent decision problems in order to facilitate the prioritization of alternatives. The method uses paired comparisons to judge the relative importance of the elements arranged at each level of the hierarchy. The VIP is similar to AHP in the general sense in that both AHP and the VIP use a structured format to select alternative courses of action, moving from the general to the particular, ultimately ranking alternatives in a pairwise fashion in the context of specified criteria. When SNL designed the VIP, it derived the pairwise comparison segment of the process from the paired comparison used in the AHP, making certain significant modifications. This discussion briefly describes the AHP method and discusses the differences between the two systems.

Briefly, an AHP hierarchy is a set of all of the elements that are relevant to a particular problem arranged in levels that reflect the effect that the elements in one level have on those in the next level (Saaty 1990). The hierarchy includes, in its simplest top-down form, the goal, the criteria, and the alternatives themselves. In more complex systems, there are additional levels of subcriteria and other evaluative factors as well as attributes common to the alternatives. Once the structure has been completed and the elements defined, the priorities of the elements relative to the goal are determined using pairwise comparisons. Beginning with the lowest level, the importance of the elements in each level are judged with respect to some or all of the elements in the next level. When the matrix (scoresheet) is completed, a "vector of priorities" is computed using one of a number of suggested calculations (Saaty 1990). If there are more than two levels in the hierarchy to compare, the various priority vectors are combined into priority matrices that yield one final priority vector for the bottom level (Saaty 1990). AHP also measures the level of internal consistency in the matrix (or scoresheet).

A major difference between the VIP and AHP is the ranking of the items (VIP) or elements (AHP). The pairwise comparison in AHP is performed as a group (Saaty 1990). Only one numerical score is entered for each comparison of two items, and each score is a product of consensus achieved through group discussion or a procedure such as majority vote. A polling or mean of individual judgments is used only where the participants cannot reach agreement on a specific score. In any case, the voting is performed publicly and the ultimate ranking is obtained from the set of agreed upon scores for all comparisons. Group-derived scoring was considered and rejected by the designers of the VIP in order to allow the panelists to make individual judgments on the paired comparisons without being influenced or intimidated by other panel members, and to capture the level of agreement among panelists. The compilation of the results from a Vital Issues panel yields a group-averaged criteria-weighted ranking for the items that is based on an aggregate of individually made judgments, rather than on group-driven consensus, and allowing for the calculation of the extent of (dis)agreement among the panelists based on the standard deviation for each item.

Both AHP and the VIP enter numerical values reflecting the paired comparisons in a scoresheet with complementary rows and columns allowing the entry of reverse comparison judgments. The two methods, however, use different comparison scales for ranking items and alternatives,¹ use different procedures for the entry of the reverse comparison judgments, and make different use of the information obtained from the reverse comparisons. In AHP, reverse comparison values are entered in the corresponding boxes, immediately after an initial judgment is obtained. In the VIP, in contrast, reverse comparisons are performed as a second comparison of the items after all of the initial comparisons have been performed without viewing the entries for the initial scores. This reverse comparison functions as a "consistency" check, providing the panelists with an opportunity to reevaluate their judgments. If the reverse comparison is "inconsistent" with the original entry, the scorer is asked to revisit the judgment and change one entry. AHP typically does not provide for this type of individual reevaluation.

Both AHP and the VIP calculate a prioritized list of alternatives or items from the raw scores that result from the paired comparisons. AHP suggests a number of possible calculations that may be used (Saaty 1990). The designers of the VIP selected one, that of summing the elements in each row and normalizing. The VIP, however, ultimately combines and averages the individual values to derive a group-averaged ranking, and also registers the extent of (dis)agreement among the panelists. The (dis)agreement is derived from calculating the standard deviations for each mean relative value and weighted value. The AHP paired comparison procedure does not register the degree of (dis)agreement between the participants, information which SNL considered particularly useful to a sponsoring organization. For example, when choosing between two programmatic areas or other items, the sponsoring organization may elect to choose the item with the lower mean but less disagreement, judging that it may have a greater chance of successful implementation with that item than with the one with the higher mean but greater disagreement. Fundamentally, an item with a lower rank and less disagreement may be preferable to an organization that has a risk-averse nature.

The AHP uses a mathematical consistency check that was not incorporated into the VIP. In AHP, a matrix (or scoresheet) is considered consistent, for example, where items judged to be twice as important as another, and found to be four times as important as a third, have also been judged to be two times as important as the third. This type of consistency, which is, in effect, an

¹ The VIP scale runs from 1 to 5, with a score of "3" indicating "the same as." The values "1" and "2" are reverse comparison values to "5" and "4," respectively. The AHP scale, in contrast, runs from 1 to 9, with "1" indicating equal importance and "9" indicating "absolutely more important." Reciprocal values of the comparison scale are used for reverse comparisons, and the numbers 2, 4, 6, and 8 are also used for compromise values. When designing the paired comparison segment of the VIP, SNL decided to use a scale that was less refined than that used in the AHP in order to avoid the imposition of precise numerical distinctions. This was done to simplify the paired comparison process and emphasize the relative nature of the value judgments. The VIP asks the panelists to make general distinctions regarding the relative importance of the items ("Is item one much greater than, greater than, the same as, lower than, or much lower than the importance of item two?"). Additionally, in the VIP, the items are not compared with themselves, and shaded boxes are left along the main diagonal where rows and columns that contain the same item meet. In AHP, the value "1" is entered in these boxes to indicate the judgment "equally important." See the subsection entitled *Portfolio Selection* in the Approach.

ordinal measurement of transitivity and for which transitivity is a condition, is not demanded by either AHP or VIp.² Both methods recognize inconsistency as a real consequence of a paired comparison selection process. AHP does, however, measure the level of this consistency by generating a *consistency index* for each matrix (or scoresheet) and comparing it to a corresponding *random index*, derived from a randomly generated reciprocal matrix (Saaty 1990; Saaty 1994). The ratio of the two values must be less than or equal to 0.10 to be considered acceptable (Saaty 1990; Saaty 1994). If the value is in the unacceptable range, the matrix is revised using one of several mathematical methods and consistency is "forced" until an acceptable degree of consistency is reached (Saaty 1990).

The designers of the VIp did not incorporate the AHP consistency measurement into the VIp, although it is possible to perform such a check on a Vital Issues scoresheet. As with AHP, neither the transitivity type of consistency measured in AHP, nor transitivity itself, is demanded by the VIp. A reverse-comparison type of consistency check was considered more useful to the panelists and the sponsoring organization than a mathematical test for transitivity, as it provides a second opportunity to perform the pairwise comparisons and allows the stakeholder panelists to personally reevaluate any inconsistent scores based on their own interaction with the choices and criteria at hand.³

An important distinction between AHP and the VIp is in the outcomes of the two methods. The results of the AHP consist solely of the prioritized alternatives to the designated problem. The Vital Issues panel, however, provides not only a prioritized portfolio, but one that specifically registers the extent of (dis)agreement among the panelists. It also provides a summary of the discussions and debates that occurred during the meeting, consisting of modified topic statements and goals and a working definition of the panel topic and reflecting the synthesis of the panelists' diverse viewpoints. The VIp focus is on providing not only a prioritized set of alternatives, but input in a form that can be crucial to the successful implementation of programmatic activities because it promotes stakeholder buy-in.

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² For a discussion on transitivity, see Appendix D.

³ Saaty himself stated a preference for correcting inconsistencies through personal judgments. He cautioned against excessive use of the mathematical methods to "force" the values of judgments, recognizing that "distortion" can result. He stated, "One would rather have naturally improved judgments arising from experience." (Saaty 1990).

APPENDIX D:

The Vital Issues Process and Arrow's Impossibility Theorem

It should be made clear that my impossibility theorem is really a theorem that the impossibilities are possible, not that they're necessary Since we can't get perfection, let's at least try to find a method that works well most of the time Its not in that sense a completely destructive negative feature any more than, let's say, the second law of thermodynamics means that people don't work on improving the efficiency of engines You'll just have a system that will occasionally break down, occasionally lead to some violation of one of my axioms. But, all right, let's just try to do it in a way which doesn't happen too often.

Kenneth J. Arrow (Annenberg/CPB Collection, 1987)

Basing his conclusion on an elaborate mathematical proof, Kenneth J. Arrow asserts in numerous works written over the past half century on the theory of social choice and the social welfare function that it is impossible to derive a rational social choice from a set of ordered alternatives. Arrow stated: "The fundamental problem of public value formation . . . is the construction of constitutions," where "a constitution is a rule that assigns to any set of individual preference orderings a rule for making society's choices among alternative social actions in any possible environment" (DeLong 1991, 5). Arrow defined "environment" as "the set of alternatives available" (Arrow 1963, 15). In his work, Arrow set forth several conditions and assumptions that he believed were prerequisites for a social choice function to be considered rational. Because these assumptions could not all be satisfied in any single social choice process, he argued, it is impossible to find a rational social welfare function based on an ordering of alternatives. This general possibility theorem for social welfare functions thus came to be called "Arrow's Impossibility Theorem."

The pairwise comparison portion of the VIP is, fundamentally, a procedure for prioritizing a portfolio of items (or in Arrow's terminology, deriving a set of ordered alternatives). It is not a social choice function. Because Arrow's theorem raises questions about the rationality of deriving social choices from ordered preferences, the designers of the VIP decided to address the issues raised by Arrow's theorem.

There are four principal conditions imposed by Arrow's Impossibility Theorem. These are Collective Rationality, the Pareto principle, the Independence of Irrelevant Alternatives, and Nondictatorship.¹ The VIP satisfies each of these conditions to a certain extent. The designers of the VIP, however, do not agree that all of these conditions must be met for a social choice function (or a rank ordering procedure) to be considered rational. Each of the principle conditions is discussed below.

¹ This discussion relies on the principal conditions as summarized by Howard DeLong in the 1991 publication, *A Refutation of Arrow's Theorem*. Numerous versions of Arrow's proof were published over a four-decade period beginning in 1950. See also Arrow, 1963.

The first condition of Arrow's Theorem, the principle of Collective Rationality, requires that social choices be derivable from a set of ordered preferences. According to Arrow, such a set presupposes assumptions regarding consistency. These include what Arrow termed "connectedness" and "transitivity." Connectedness demands that for any pair of alternatives, either the first is preferred to the second, or the second to the first, or they are indifferent (Arrow, 1963, 13; DeLong 1991, 15). The designers of the VIp acknowledge the appropriateness of assuming connectedness in the rank ordering of alternatives, and the VIp subscribes to the concept of Collective Rationality to that extent.

The second assumption of Collective Rationality, transitivity, is a property whereby a relation that holds between a first element and a second, and between the second element and a third, also holds between the first and third elements (Arrow 1977, 609). In terms of preferences, a relation is transitive where, for any three alternatives, if the first is preferred to the second, and the second is preferred to the third, then the first must be preferred to the third. A preferential ordering that violates transitivity and results in a circular relationship rather than a prioritized set of alternatives occurs when there is a definite choice between any pair of alternatives but no single element is preferred over all the others (DeLong 1991, 18-21).

The designers of the VIp disagree with Arrow's assertion that an ordered set of elements or alternatives must be transitive to be rational. They subscribe to an argument presented by H. DeLong that it is not irrational for society to have a definite preference with regard to any pair of alternatives while having no definite preference with respect to all of the alternatives. Preference is not a transitive relation (it is neither transitive nor intransitive (DeLong 1991, 17-18)), and it is therefore not logical to impose the condition of transitivity on a rank ordering procedure, such as a paired comparisons, that is based on individual preferences. It has also been suggested that intransitivity among preferences is a natural phenomenon rather than a consequence of judgmental error or aberration (Saaty 1990, 52). As stated by DeLong, circular preferences merely reveal social indecision. DeLong also notes the use of random devices or other "rational" tie-breaking procedures in democratic societies under such situations and concludes that using the principle of transitivity as a condition for rational social choice is both unreasonable and misleading.

Rather than demanding transitivity where it simply cannot be satisfied or completely disregarding the utility of a rank ordering procedure because of the intransitive nature of individual preferences, the VIp allows instead for the possibility of indecision and may in fact reflect the real tradeoffs made by the individual panelists. Although a procedure for doing so was not specifically incorporated into the VIp, it can be a useful exercise to measure the level of inconsistency in a pairwise comparison scoresheet (by calculating an ordinal measure of transitivity).²

² See Appendix C for a discussion regarding consistency in the VIp and a brief overview of the mathematical consistency check used in AHP.

The second condition of Arrow's Impossibility Theorem is the Pareto Principle: if every individual prefers alternative *x* to alternative *y*, then the social choice will also rank *x* above *y* (Arrow 1977, 617; DeLong 1991, 25). The Pareto principle has been criticized as an unreasonable condition to impose on a rational social welfare function because, in conjunction with the belief that an individual's preference implies choice, it can "justify acts that are contrary to the ethical basis of democracy" (DeLong 1991, 29). This concern is also illustrated by the phenomenon known as the "tragedy of the commons," in which a community of rational decision makers will individually make decisions that will collectively destroy commonly held assets or will neglect to invest in social infrastructure that contributes to the commonweal rather than to individual gain (Hardin, 1968).

The VIp pairwise comparison procedure satisfies the Pareto principle. In line with the concerns raised above, it also recognizes that an ordering derived from a pairwise comparison process may not in fact be the "best" in terms of the right decision for all members of society. As stated above, however, the VIp is not a social choice function. The VIp was designed to assist the OFI with resource allocation decisions by identifying a portfolio of vital issues and corresponding sets of prioritized programmatic activities. A secondary purpose of the VIp was to establish a dialogue between a sponsoring organization and its key customers and stakeholder communities, and, where appropriate, provide a means for incorporating stakeholder input into the decision-making process. By its very nature, the VIp was designed to promote democratic principles and avoid any need to justify acts that might be contrary to the ethical basis of democracy. To a certain extent, it circumvents the phenomenon of the tragedy of the commons because it provides a format for obtaining information that can lead to investment in social infrastructure that contributes to the commonweal as well as to individual gain.

The VIp is able to do this because it provides information to a sponsoring organization unavailable from a single preferred alternative or set of prioritized alternatives. The Vital Issues panel is populated by members of the relevant stakeholder groups and the panelists select, define, and champion the items that they ultimately prioritize. The results of a Vital Issues panel thus reflect a synthesis of the diverse viewpoints and not merely a prioritized list of alternatives that may or may not in fact reflect the individual panelists' preferences. The panel discussions and debates published in the report also, potentially, provide information to the sponsoring organization about the bases of the panelists' opinions. The extent of (dis)agreement among the panelists that is registered with the prioritized items provides an organization with the flexibility to invest in a programmatic area with a lower mean but less disagreement over one with a higher mean but greater disagreement. It also provides information that can be useful in the case of a tie. While the VIp cannot and does not pretend to meet the ideal social choice function, it does provide an explicit procedure for obtaining information considered crucial to the successful implementation of public policies and programmatic activities because it stimulates stakeholder buy-in to public programs.

The third condition of Arrow's Impossibility Theorem, the Independence of Irrelevant Alternatives, has been stated in a number of different ways: 1) The social choice made from any environment depends only on the orderings of individuals with respect to the alternatives in that environment (DeLong 1991, 5). 2) The choice made from any fixed environment should be

independent of the very existence of alternatives outside that environment (Arrow 1963, 26). 3) The social decision between two feasible alternatives should depend only on the preferences of the voters between them. Preferences among infeasible alternatives or between feasible and infeasible alternatives should have no bearing on the outcome (Arrow 1977, 614).

Arrow has been criticized for not clearly defining relevancy and for using the term interchangeably with "feasibility" (DeLong 1991, 33). DeLong has also shown counterexamples to the principle; for example, sometimes "the judgment of whether A or C is better depends on whether the 'irrelevant' B is taken into account." The principle can also have the effect of forcing the voters to assume that there are no relationships among all of the possible alternatives that they might consider relevant when choosing one over another of the possible alternatives (DeLong 1991, 35).

The designers of the VIP recognize that viable alternatives that have not been included in a portfolio might, if included, result in a different ranking of the items in the pairwise comparison procedure. They also recognize that this result is an unavoidable consequence of defining and delimiting an environment. The VIP, however, mitigates this problem by attempting to ensure that all relevant alternatives are included in the portfolio. This is done by including on a Vital Issues panel at least one individual from each of the relevant stakeholder interest groups and selecting panelists that are able to provide input essential to the successful outcome of the sponsoring organization's program or activity. During the portfolio selection process, the panelists are also required to select items that meet the conditions of necessity and sufficiency. The VIP is thus designed to include as much significant input as is practical and to include, through the portfolio selection process, all "relevant" items. The VIP cannot guarantee that all relevant alternatives have been included, nor does it pretend to do so. If an item is excluded, however, its consideration by a sponsoring organization is not precluded by the VIP. The output of a Vital Issues panel is not intended to be binding on an organization. It is but one of many inputs to the decision maker.

The fourth condition of Arrow's Impossibility Theorem is Nondictatorship. According to Arrow, dictatorship in its purest form means that social choices are to be made by one individual, and that whenever the dictator prefers one alternative to the rest, so does the society. Arrow includes the condition of nondictatorship in his theorem in order to ensure that the decisions in his social choice function are made collectively. The inclusion of nondictatorship as a condition of the rational social choice function, however, has been criticized as being a mistaken presumption of democratic institutions and because democracy does not necessarily preclude the use of a dictator, where the dictator protects the fundamental belief systems of the democracy (DeLong 1991, 37).

The designers of the VIP agree that for the purpose of the VIP, that of soliciting information from stakeholder groups, nondictatorship must be satisfied to the greatest extent. Thus, within the context of a VIP panel meeting, no single panelist is placed in a position of "dictatorship" or of selecting the alternatives or prioritizing the alternatives for the whole group. Each panelist's vote is equal to every other panelist's vote. A Vital Issues panel can be viewed as a "new society" that derives a set of alternatives from an environment that it defines. When the panelists enter the

Vip in the morning, they bring to the group their predetermined ideas about what the alternatives should be and what choices should be made. In the course of the day, the "new society" (the Vital Issues panel) forms and develops its own set of alternatives (environment). These may in fact be a subset of those that were brought to the meeting in the morning and/or may include alternatives that were synthesized during the day by the new society. It is also a significant result of the Vip that every item on the list is important to at least one person on the panel. Thus, within the confines of the Vital Issues panel, nondictatorship is satisfied.

In summary, the Vip satisfies, to a certain extent, each of the four principal conditions of Arrow's Impossibility Theorem: Collective Rationality, the Pareto principle, the Independence of Irrelevant Alternatives, and Nondictatorship. For various reasons, however, the designers of the Vip disagree with Arrow's conclusion that all of these conditions must be met for a social choice function (or a rank ordering procedure) to be considered rational. The Vip recognizes the limitations in rank ordering a list of alternatives that can arise. It does, however, attempt to address the potential problems. Rather than demanding transitivity, the Vip instead allows for the possibility of indecision and may in fact reflect the real tradeoffs made by the individual panelists. Rather than attempting to obtain the "best" alternative in terms of the right decision for all members of society, the Vip is designed to obtain the most comprehensive, well-informed, and well-reasoned sampling possible in order to help effectuate the successful implementation of an organization's programmatic activities. The Vip also attempts to ensure that all relevant alternatives are included in the portfolio. And, finally, within the context of a Vip panel meeting, the Vip satisfies nondictatorship to the greatest extent possible.

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APPENDIX E:
Vital Issues Panels Held to Date

Panel Topic	Sponsor	Panelist Affiliations
Definitions & Procedures	DOE/IN/OFI	Resources for the Future Massachusetts Institute of Technology Committee on Foreign Relations, U.S. Senate Sandia National Laboratories Lawrence Livermore National Laboratories Los Alamos National Laboratory DOE/OFI
Environmental Quality	DOE/IN/OFI	U.S. Environmental Protection Agency Natural Resources Defense Council RCG/Hagler, Bailly Inc. (Energy Economics) Merchant Marine & Fisheries Committee, U.S. House of Representatives New Mexico State University, Biology Dept. DOE/OFI Sandia National Laboratories
National Security	DOE/IN/OFI	National Security Industrial Association Hughes Corp. Orion International Technology Sandia National Laboratories
Energy Security	DOE/IN/OFI	Resources for the Future Charles River Associates, Inc. University of Texas, Austin, Bureau of Economic Geology El Paso Natural Gas DOE/OFI Sandia National Laboratories
Economic Competitiveness	DOE/IN/OFI	American Enterprise Institute General Motors Corp. Resources for the Future Office of Senator Jeff Bingaman (D-NM) DOE/DP-4 DOE/OFI Sandia National Laboratories

Vital Issues Panels Held to Date (cont.)

Panel Topic	Sponsor	Panelist Affiliation
Process Audit and Review	DOE/IN/OFI	American Enterprise Institute Permanent Select Committee on Intelligence, U.S. House of Representatives University of Texas, Austin, Bureau of Economic Geology Natural Resources Defense Council Orion International Technology DOE/EP-2 DOE/OFI Sandia National Laboratories
Civil and Military Nuclear Accidents and Pollution	DOE/IN/OFI	Committee on Governmental Affairs, U.S. Senate Future Resources Associates, Inc. Massachusetts Institute of Technology Institute for Resources and Security Studies Sandia National Laboratories DOE/NE DOE/OFI
Activities of Foreign Countries in the Development and Utilization of Significant Energy Resources	DOE/IN/OFI	Westinghouse Electric Corp. University of Texas, Austin, Bureau of Economic Geology DOE/CE DOE/OFI Sandia National Laboratories
Proliferation of Nuclear Weapons and of Political Entities with Access to Control Over Nuclear Weapons	DOE/IN/OFI	SAIC Institute on Global Conflict and Cooperation Committee on Governmental Affairs, U.S. Senate DOE/AN DOE/OFI Lawrence Livermore National Laboratory Sandia National Laboratories

Vital Issues Panels Held to Date (cont.)

Panel Topic	Sponsor	Panelist Affiliation
Future of the Energy Infrastructure of the CIS and Its Impact on the Global Energy Market	DOE/IN/OFI	Center for Strategic and International Studies U.S. Geological Survey Batelle - Pacific Northwest Laboratory Washington Analysis Corporation Spears and Associates, Inc. New Mexico Institute of Mining and Technology, Petroleum Recovery Research Center DOE/FE DOE/OFI Sandia National Laboratories
Environmentally Conscious Manufacturing	Riotech	National Science Foundation National Academy of Engineering Digital Equipment Corp. Purdue University National Center for Manufacturing Sciences Office of Senator Jeff Bingaman (D-NM) University of New Mexico, Mechanical Engineering Department Riotech Sandia National Laboratories
Environmentally Conscious Manufacturing	Riotech	DOC/CE Honeywell Defense Avionics W. Alton-Jones Foundation, World Wildlife Fund Waste Management Education & Research Consortium, New Mexico State University Environmental Defense Fund Center for Innovation Management Studies, Lehigh University BDM International, Inc.
Nuclear Reactor Safety Criteria	DOE/IN/OFI	Batelle - Pacific Northwest Laboratory U.S. Nuclear Regulatory Commission Oregon State University University of New Mexico DOE/OFI Sandia National Laboratories

Vital Issues Panels Held to Date (cont.)

Panel Topic	Sponsor	Panelist Affiliation
Consequences of a Nuclear Reactor Accident	DOE/IN/OFI	Idaho National Engineering Laboratory Sandia National Laboratories Georgetown University Batelle - Pacific Northwest Laboratory Monterey Institute of International Studies Westinghouse Corporation Institute for Resources and Security Studies DOE/OFI
Federal Policies on the Export of Domestic U.S. Uranium (Civil Sector)	DOE/NE	U.S. State Department U.S. Department of Commerce COGEMA, Inc. NUKEM SAIC NUEXCO Uranium Resources, Inc. Moorehouse College Office of Senator Pete Domenici (R-NM) DOE/NE Oak Ridge National Laboratory Sandia National Laboratories
Field Program Planning (2 panels)	OIT	Argonne National Laboratory Brookhaven National Laboratory Idaho National Engineering Laboratory Los Alamos National Laboratory Lawrence Berkeley Laboratory Oak Ridge National Laboratory Batelle - Pacific Northwest Laboratory Sandia National Laboratories Solar Energy Research Institute DOE/OPA

Vital Issues Panels Held to Date (cont.)

Panel Topic	Sponsor	Panelist Affiliation
Defining a Focus for the Development of Decision Analysis Tool (6 panels)	AMTEX	Russell Corporation Spartan Mills L.L. Bean Milliken & Company Target J.C. Penney Wellman, Inc. Haggar Apparel Co. Burlington Industries, Inc. Fieldcrest Cannon Greenwood Mills, Inc. Sandia National Laboratories Idaho National Engineering Laboratory Oak Ridge National Laboratory Batelle - Pacific Northwest Laboratory
Desired Outcomes for New Mexico's Health Care System	New Mexico Health Care Task Force	New Mexico citizens
	New Mexico Health Care Task Force	New Mexico citizens
Portfolio Analysis for the Energy Research Program of the E&E Sector	Energy & Environment Sector, Sandia National Laboratories	Energy Research Program managers, Sandia National Laboratories
Portfolio Analysis for the Applied Energy Program of the E&E Sector	Energy & Environment Sector, Sandia National Laboratories	Applied Energy Program managers, Sandia National Laboratories
Portfolio Analysis for the Nuclear Energy Technology Program of the E&E Sector	Energy & Environment Sector, Sandia National Laboratories	Nuclear Energy Technology Program managers, Sandia National Laboratories

Vital Issues Panels Held to Date (cont.)

Panel Topic	Sponsor	Panelist Affiliation
Portfolio Analysis for the Nuclear Waste Management Program of the E&E Sector	Energy & Environment Sector, Sandia National Laboratories	Nuclear Waste Management Program managers, Sandia National Laboratories
Portfolio Analysis for the Environment Program of the E&E Sector	Energy & Environment Sector, Sandia National Laboratories	Environment Program managers, Sandia National Laboratories
Opportunities for Energy-Efficient Pollution-Prevention Technology Demonstrations	Industrial Waste Reduction Program, DOE	DOE-Environmental Liaison American Petroleum Institute Stone Container World Wildlife Fund U.S. EPA Pennsylvania State University Princeton University Sandia National Laboratories
Energy-Efficient Pollution-Prevention Technology Demonstrations in the Petroleum Industry	Industrial Waste Reduction Program, DOE	University of California, Los Angeles University of Texas, Austin National Academy of Sciences M.W. Kellogg Gordon & Lawton, Inc. Chevron Texaco U.S. DOE Bartlesville Project Office Sandia National Laboratories

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