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Managing Senegalese Water Resources

Definition and Relative Importance of Information Needs

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Managing Senegalese Water Resources

Definition and Relative Importance of Information Needs

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ABSTRACT

This report provides an overview of the results of the Vital Issues process as implemented for the Senegal Water Resources Management Initiative, a collaborative effort between the Senegalese Ministry of Water Resources and Sandia National Laboratories. This Initiative is being developed to assist in the development of an efficient and sustainable water resources management system for Senegal. The Vital Issues process was used to provide information for the development of a proposal that will recommend actions to address the key management issues and establish a state-of-the-art decision support system (DSS) for managing Senegal's water resources. Three Vital Issues panel meetings were convened to 1) develop a goal statement and criteria for identifying and ranking the issues vital to water resources management in Senegal; 2) define and rank the issues, and 3) identify and prioritize a preliminary list of information needed to address the vital issues. The selection of panelists from the four basic institutional perspectives (government, industry, academe, and citizens' interest groups) ensured a high level of stakeholder representation on the panels.

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FIGURES

FIGURES (cont.)

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INTRODUCTION

The Senegal Water Resources Management Initiative was established to assist in the development of an efficient and sustainable water resource management system for the country. The Vital Issues process[1] served as the first step in the implementation of the Initiative (see Figure 1) and was used to provide information to be incorporated into a proposal for developing a state-of-the-art decision support system (DSS) that will be used by decision-makers in Senegal to help manage the country's water resources. The Vital Issues process was used to assist Senegal in identifying and prioritizing issues vital to water resource management and in compiling the information needed to address these issues and to make the appropriate decisions regarding the development of the water resources management DSS.

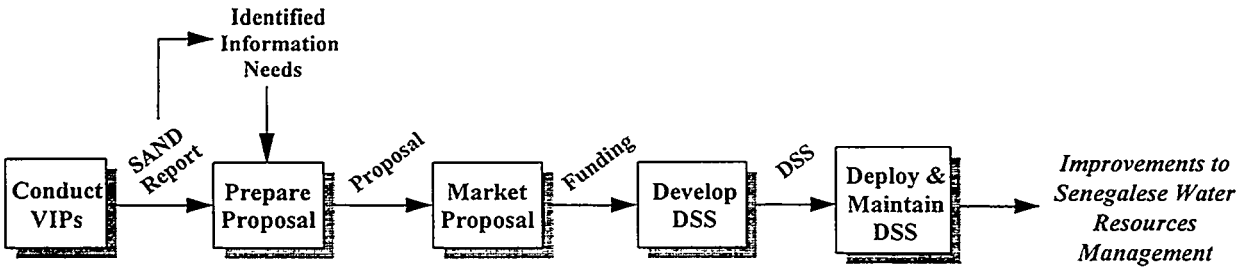

Figure 1. Five phases of the Senegal Water Resources Management Initiative.

Three Vital Issues panel meetings, conducted and facilitated by Sandia National Laboratories, were convened for the Senegal Water Resources Management Initiative, two in August and one in October 1997, to discuss water resource management in Senegal. Each panel was charged with tasks leading to the identification of information needed to manage Senegal's water resources. This report summarizes the results of that process.[2]

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[1] The Vital Issues process involves a multistage series of day-long workshops for identifying and prioritizing a portfolio of issues, programmatic areas, or responses to a specified problem and for identifying the information needed to properly address issues considered vital to managing critical infrastructures. It can also be used to develop portfolios of appropriate policy options and to allocate critical resources.

[2] See Appendices A, B, and C for the final reports for the three panel meetings.

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APPROACH

The Vital Issues process used in the Senegal Water Resources Management Initiative involved three day-long Vital Issues panel meetings (see Figure 2). The three panels were convened to 1) develop a goal statement and criteria for identifying and ranking the vital issues for managing Senegal's water resources (Vital Issues Panel I), 2) define and rank the vital issues (Vital Issues Panel II, and 3) identify and prioritize a preliminary list of information needed to address the vital issues in the proposed water resource management decision support system (Vital Issues Panel III).

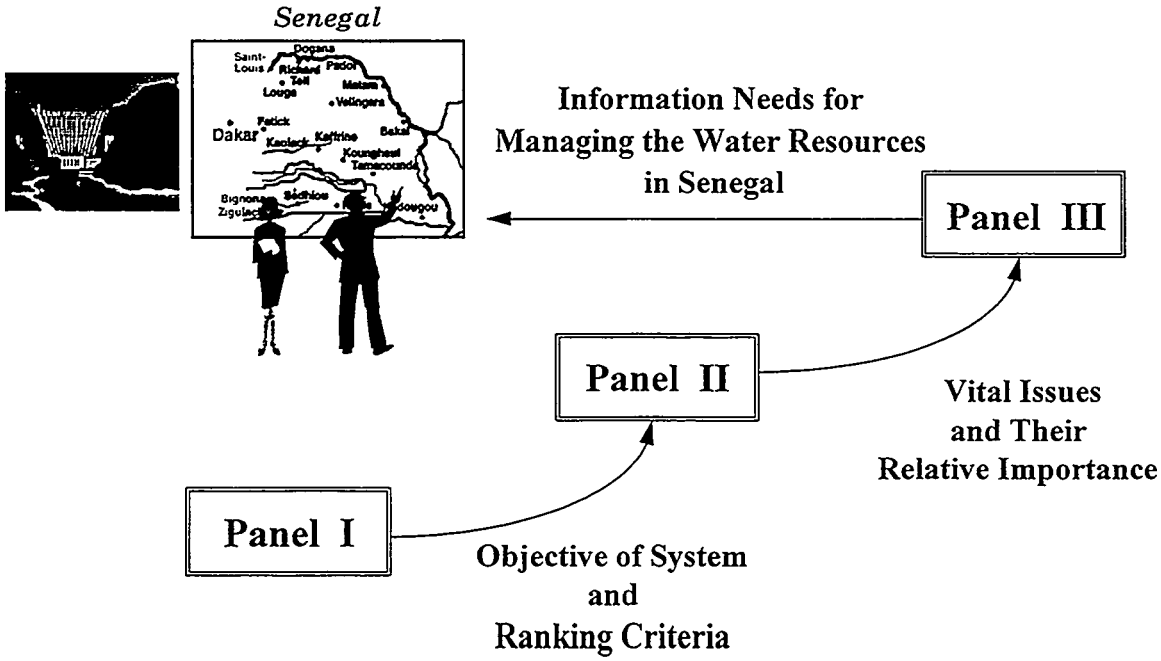

Figure 2. The Vital Issues process as implemented for the Senegal Water Resources Management Initiative.

The panelists for the three Vital Issues panels were selected representatives from the following institutional perspectives:

- government—executive and legislative branches,
- industry/private sector,
- academe, and
- citizen interest groups/nongovernment organizations (NGO).

These four stakeholder groups have the ability to significantly impact, and be influenced by, the management of Senegal's water resources. Their input is thus considered crucial to the successful implementation of a DSS for managing the water resources. The members of the third Vital Issues panel also represented three constituency perspectives: 1) decision maker, 2) modeler or analyst, and 3) data provider (see Figure 3). These perspectives were included to ensure that what was being considered would be both useful to the decision maker and capable of being incorporated into a state-of-the-art DSS.

	Institutional Perspective			
Constituency	Government	Industry	Academe	Citizens' Groups
Decision Maker	X	X	X	X
Modeler/Analyst	X	X	X	X
Data Provider	X	X	X	X

Figure 3. Constituency/perspective template.

The first Vital Issues panel developed a goal statement or "declaration of intent" for the development of a DSS. The panelists then used three *meta*criteria, listed below, to select and rank the criteria to be used by the second panel in defining and ranking the vital issues.

- *Necessary*...elimination of the criterion from the list would allow some important aspect of the goal to go unrecognized.
- *Operational*...the criterion can be used by the next panel to assess the relative importance of issues that are vital to the management of Senegal's water resources.
- *Sufficient*...the collection of criteria recognizes all important aspects related to the goal of managing Senegal's water resources.

The metacriteria were also used by the second Vital Issues panel to define the vital issues.

The procedure used to rank the criteria and the issues consisted of a three-step procedure known as "point-counterpoint-score" (see Figure 4). Each item (i.e., criterion or vital issue) was assigned a "champion" whose task it was to present the item and "sell" it to the other panelists. Another panelist was assigned the task of providing counterpoint arguments to the champion's presentation in the form of constructive criticism. After the point and counterpoint arguments were presented, each item was scored against all items previously presented using pairwise comparisons.

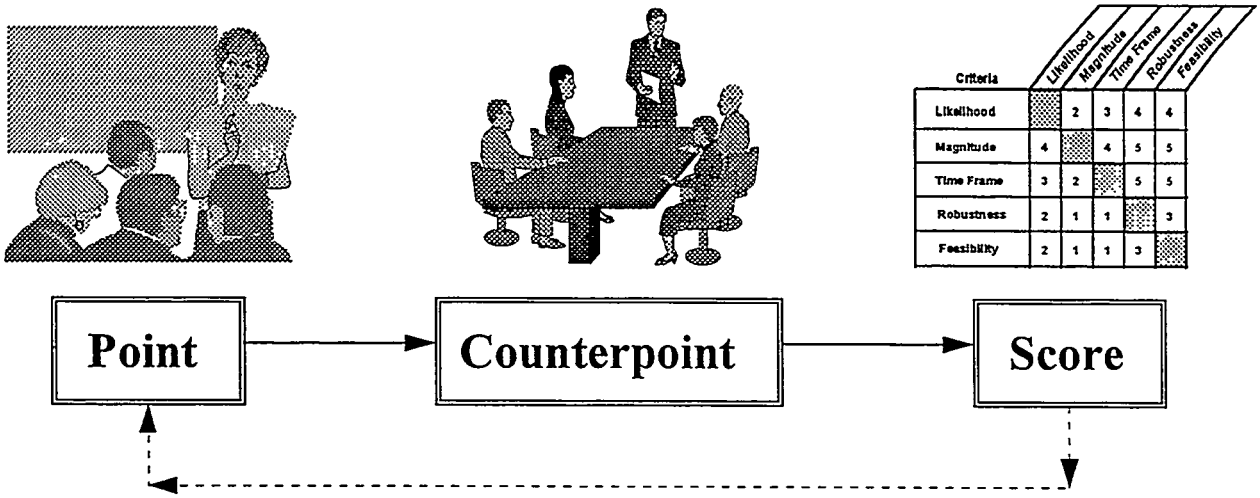

Figure 4. The three-step point-counterpoint-score procedure of the Vital Issues process.

The results of the criteria comparison were used to calculate group-averaged relative weights of the ranked criteria.[3] The results of the comparison of the issues performed by the second panel were then used with the criteria weights to generate a group-averaged criteria-weighted relative ranking of all of the vital issue (means).[4] The extent of the panelists' disagreement with regard to

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[3] The relative weights of the criteria were calculated in the following manner: The scores for each row on each score sheet (one score sheet per panelist) were summed and then divided by the number of criteria minus 1 to obtain the relative value for each criterion for that scoresheet. The resulting relative values were normalized, or divided by the sum of all the relative values, to obtain the relative weights for each criterion for each panelist. These individual panelist weights were then averaged over all panelists to obtain group-averaged relative weights for the ranked criteria.

[4] To calculate the rankings of the vital issues, the relative values were first calculated for all the vital issues on all the scoresheets for each panelist. (The Vital Issues process uses separate scoresheets for each criterion by which the items are compared.) As with the criteria, this was done by summing the scores for each row on each

the rankings (standard deviations) was also calculated. The relative importance of the vital issues in the context of a composite of the three criteria *amplitude, frequency,* and *duration* (a composite ranking characterizing the impact of the issues) and in the context of the criterion *feasibility* (characterizing the benefit/cost of addressing the issue) was calculated. The composite ranking was generated by using criteria weights for *amplitude, frequency,* and *duration* (calculated by dividing each of the relative values by the sum of the three relative values). The single criterion ranking for *feasibility* was generated by averaging the scores for the four issues for the *feasibility* criterion over all of the panelists.

These mean relative values and standard deviations were plotted graphically to produce one-dimensional rankings of the vital issues, one for the composite and one for *feasibility.* A two-dimensional integrated composite ranking was also plotted to show the assessed value for each vital issue in the context of the composite criterion versus the assessed value of each vital issue in the context of the single *feasibility* criterion.

The third Vital Issues panel reviewed the vital issues selected by the second panel and identified for each issue a preliminary list of information needed by decision makers to successfully manage Senegal's water resources. The information needs for each issue were also ranked using pairwise comparisons.

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scoresheet and dividing by the number of items minus 1. All the resulting relative values for a given criterion were then multiplied by their corresponding criteria weights. The resulting values provided a criteria-weighted ranking of the items for each panelist. These weighted values were then averaged for each vital issue across all the panelists to obtain a group-averaged criteria-weighted ranking for each vital issue.

RESULTS

Definition of Goal Statement and Issues Assessment Criteria – Vital Issues Panel I

The first panel met on August 11, 1997 in Dakar, Senegal, to develop a goal statement and to develop criteria to be used by the second panel to define and rank issues that are vital to the management of Senegal's water resources. The panelists also developed a set of suggested issues for consideration by Vital Issues Panel II.

The first panel developed the following goal statement for the Initiative:

> *"Control of water resources through the development of a sustainable and reliable management system."*

The panelists then selected the following four criteria that could be used by subsequent panels to assess the relative importance of issues that are vital to the management of Senegal's water resources:

- *Amplitude,*
- *Frequency,*
- *Duration,* and
- *Feasibility.*

The four criteria, *amplitude*, *frequency, duration,* and *feasibility,* were scored in the context of their relative importance in assessing the issues. Figure 5 shows the means and standard deviations of the scores (the square is the mean value, and the distance between the circle and the triangle is two standard deviations in the scores). As shown in Figure 5, the ordinal ranking of the relative importance of the criteria is *Amplitude* > *Feasibility* *Frequency* > *Duration.* The ordinal ranking of the level of agreement in the relative importance of the criteria is *Amplitude* *Duration* > *Frequency* > *Feasibility.* Figure 6 presents the criteria weights (the normalized relative values). The criteria weights are used to determine the relative importance of the issues identified by the second Vital Issues panel for the Senegal Water Resources Management Initiative.

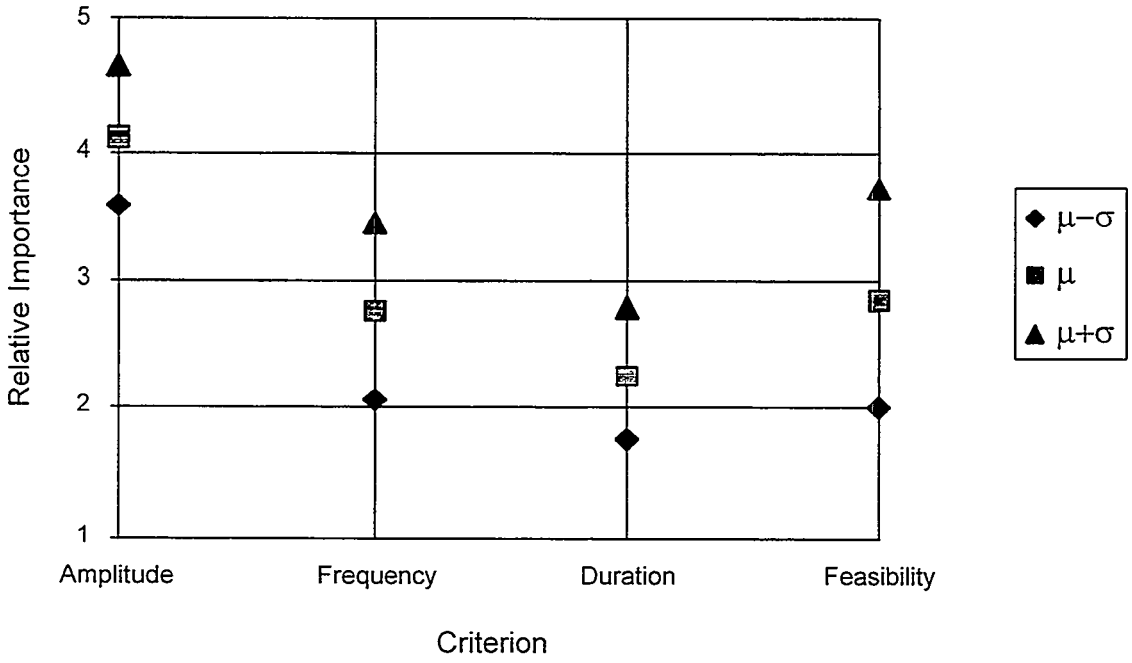

Figure 5. The Senegal Water Resources Management Initiative criteria scoring results.

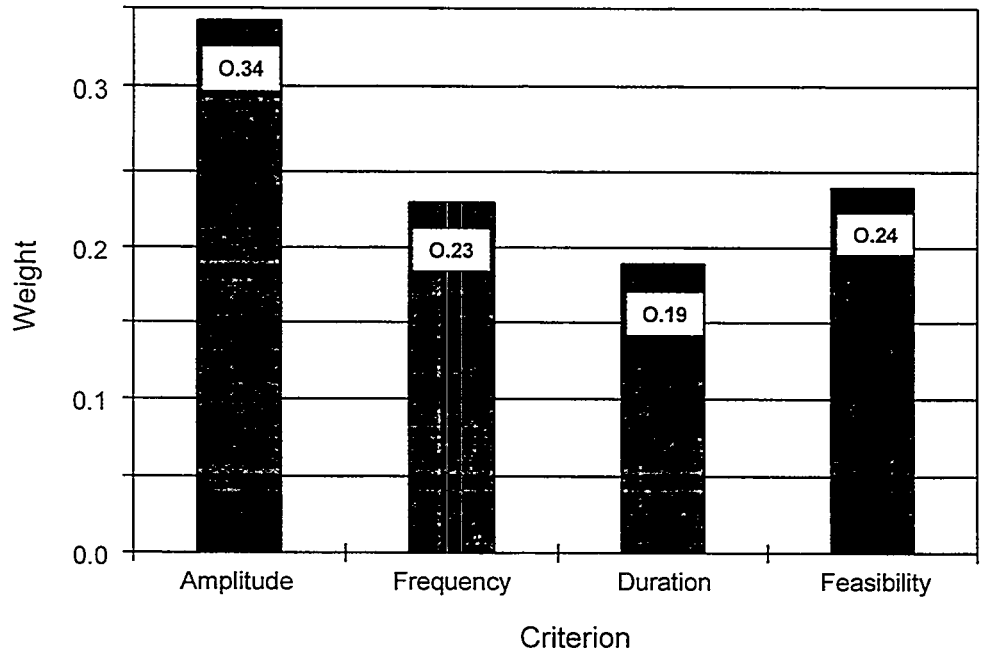

Figure 6. Criteria weights for the Senegal Water Resources Management Initiative.

Definition and Ranking of Issues – Vital Issues Panel II

The second Vital Issues panel for the Senegal Water Resources Management Initiative met on August 29, 1997. The panelists identified the following four issues that they considered vital to Senegal's water resource management and tested them using the metacriteria—*necessary, operational,* and *sufficient*:

1) Insufficient ***knowledge*** about the quantity and quality of Senegal's water resources.

2) Ineffective ***strategies*** for managing Senegal's water resources.

3) Inadequate involvement of important Senegalese water resource ***stakeholders***.

4) Ineffective implementation of integrated, cohesive ***legislation*** for managing Senegal's water resources.

After point/counterpoint discussions of the issues in the context of the four criteria, the panelists scored the four issues using pairwise comparisons. The scores were used with the criteria weights calculated from the results of the first Vital Issues panel meeting to determine the panel-averaged relative importance of the issues. The mean relative values and standard deviations were plotted graphically to produce a ranking showing the assessed value of each vital issues category in the context of a composite of the three criteria *amplitude, frequency,* and *duration* (see Figure 7) and in the context of the single criterion *feasibility* (Figure 8). The range of the panelists' disagreement (one standard deviation above and below the mean) regarding the relative values was also plotted. These two figures provide "one-dimensional perspectives" of the results, the first providing information about the impact of the vital issues, the second providing information about the benefit/cost. The issue with the highest value is the most desirable to address, and the issue with the lowest value is considered the least important. As shown in Figure 7, the ordinal ranking of the relative importance of the vital issues for the composite is *Knowledge* > *Strategies* > *Legislation* > *Stakeholders,* and the ordinal ranking of the level of agreement in the relative importance of the vital issues is *Strategies Legislation* > *Knowledge* > *Stakeholders.* For the single criterion *feasibility,* the ordinal ranking of the relative importance is also *Knowledge* > *Strategies* > *Legislation* > *Stakeholders;* for the level of agreement, the ordinal ranking is *Strategies* > *Legislation Stakeholders Knowledge.* It should be emphasized that

these issues were tested with the metacriterion *necessary* prior to the scoring exercise. Consequently, although *Knowledge* was judged to be more important than *Stakeholders* in terms of both its impact and its benefit/cost, this should not be interpreted as indicating that *Stakeholders* are not important.

In Figure 9, the mean relative values for each vital issue for the composite ranking and for *feasibility* are plotted along the *x* and *y* axes, respectively. The center-points of the elliptical areas on the graph are the plotted means for the panel's assessment of the issues. The ellipses represent the range of the panelists' disagreement (one standard deviation above and below the mean) regarding the relative importance. The vital issues that have the highest values along both axes are the most desirable to address. Those with the lowest values along both axes are the least desirable.

The standard deviations also provide additional useful information. For example, when choosing between issues, a decision maker may wish to address the issue with a lower rank but less disagreement, judging that it may have a greater chance of successful resolution than the one with a higher rank but greater disagreement. An issue with a lower rank and less disagreement may also be preferable to a decision maker who is risk-averse. For example, note in Figure 9 that *Strategies,* the second-ranked issue category, has a narrower range of disagreement than the top-ranked issue, *Knowledge*, which was ranked third in the level of agreement as to its relative importance. A risk-averse decision maker might prefer to address *Strategies* before addressing *Knowledge* because of the lower overall disagreement regarding its relative value.

The second Vital Issues panel also identified and ranked a list of suggested information needs for each vital issue for consideration by the panelists on the third Vital Issues panel.

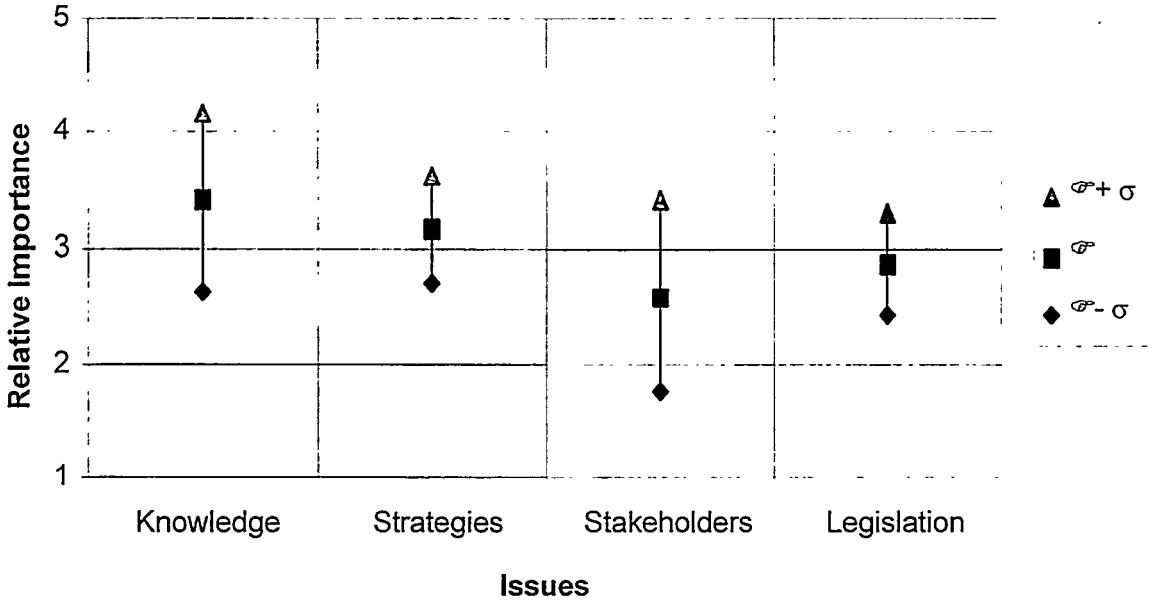

Figure 7. Composite ranking of the vital issues in the context of the composite criterion (characterizing the impact of the issues).

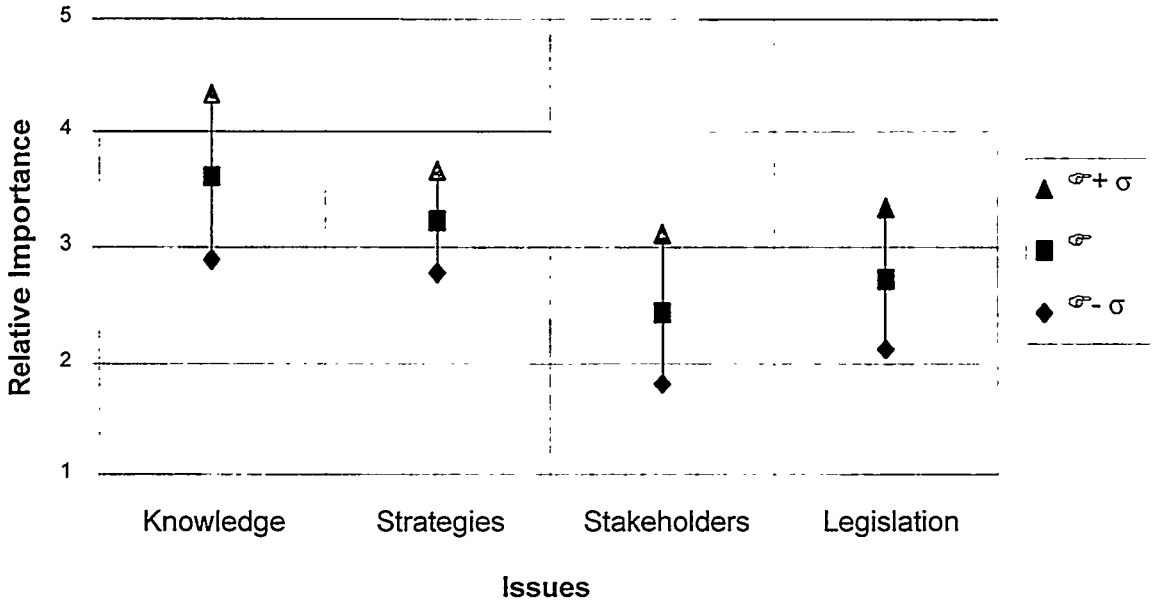

Figure 8. Relative importance of the vital issues in the context of the *feasibility* criterion (characterizing the benefit/cost of addressing the issues).

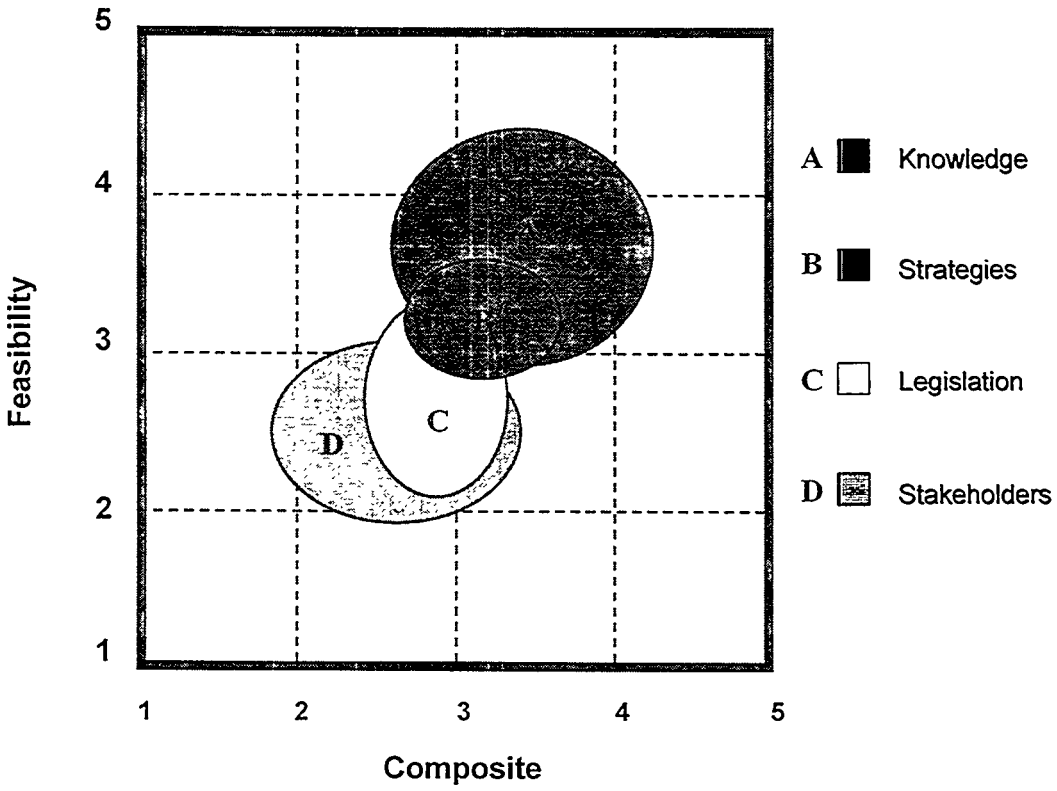

Figure 9. Integrated ranking of the issues vital to the management of Senegal's water resources.

Identification and Ranking of Information Needs – Vital Issues Panel III

The third Vital Issues panel met on October 15, 1997, and focused on their primary task, that of identifying information needs for each issue defined by the second Vital Issues panel. They reviewed the information needs suggested by the second Vital Issues panel and adopted those listed in Table 1. The results of the ranking of the information needs for each vital issues appear in Figures 10-13.

Table 1. Information Needed to Address Each of the Issues Considered Key to the Management of Senegal's Water Resources

Issue	Information Needed
Insufficient ***knowledge*** about the quantity and quality of Senegal's water resources	1) Typology of water resource pollution (types of pollution, sources, standards). 2) Available potential and evolution (quantitative studies to be performed on groundwater and surface water, incoming and outgoing water balance, basic quantification, static level of water table, location of water resources, water value). 3) Typology of the primary uses of water.
Ineffective ***strategies*** for managing Senegal's water resources	1) Critical inventory of current strategies. 2) Institutional framework and policy drafting mechanism. 3) Mobilization and use of potable water resources. 4) Dakar Region water supply. 5) Resources follow-up. 6) Assessment of wastewater. 7) Alignment of needs/resources. 8) Strengthening capacity. 9) Operation and maintenance of hydraulic works. 10) Integration of strategies in global planning. 11) Preservation of water resource.
Inadequate involvement of important Senegalese water resource ***stakeholders***	1) Identification of actors (government, decision makers, private sector, users, scientists, financial backers or development cooperation organizations, local cooperatives). 2) Implication of the actors in the design, implementation, and management of hydraulic infrastructures. 3) Identification of skills and capabilities of the various actors. 4) International context: shared basin. 5) Information, awareness, and reinforcement of the capabilities of the actors.

Table 1. Information Needed to Address Each of the Issues that are Key to the Management of Senegal's Water Resources (cont.)

Issue	Information Needed
Ineffective implementation of integrated, cohesive ***legislation*** for managing Senegal's water resources	1) Inventory of statutory laws and their application. 2) Degree of applicability. 3) Alignment of sectoral legislation regarding water management. 4) Customary laws. 5) Popularization of statutory laws. 6) Drafting of statutory laws. 7) Water authority. 8) Inventory and prevention of potential conflicts. 9) Ultimate purpose of legislative enactments.

The relative value rankings for the vital issues that resulted from the pairwise comparisons performed on the information needs for each vital issue are presented in Figures 10 through 13.

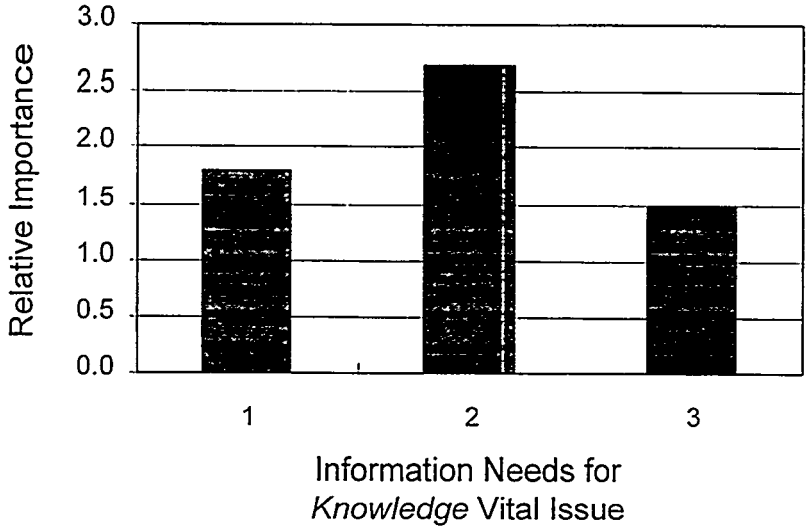

Figure 10. Relative importance of information needs for *Knowledge* vital issue.

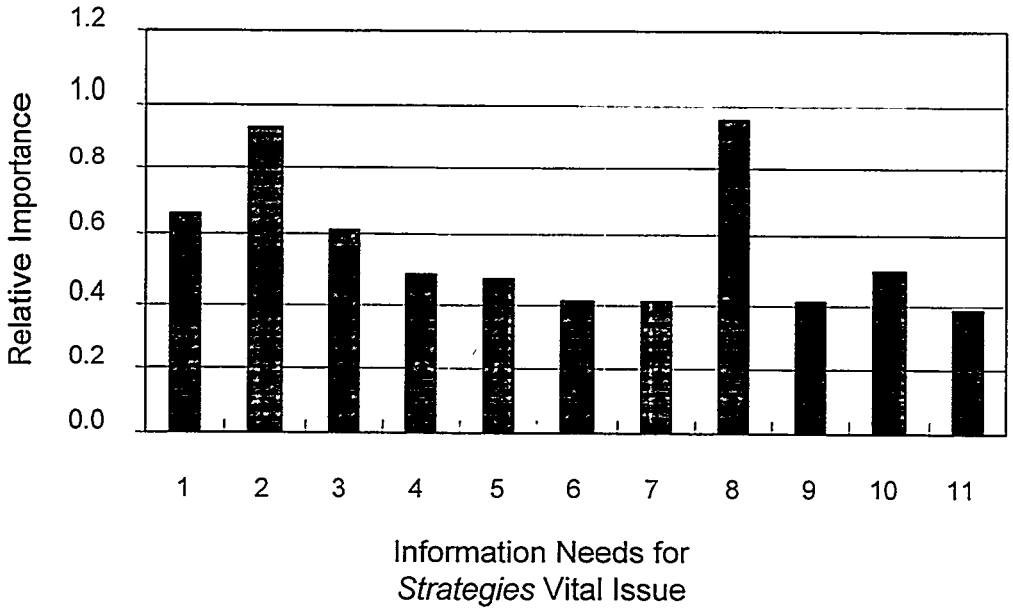

Figure 11. Relative importance of information needs for *Strategies* vital issue.

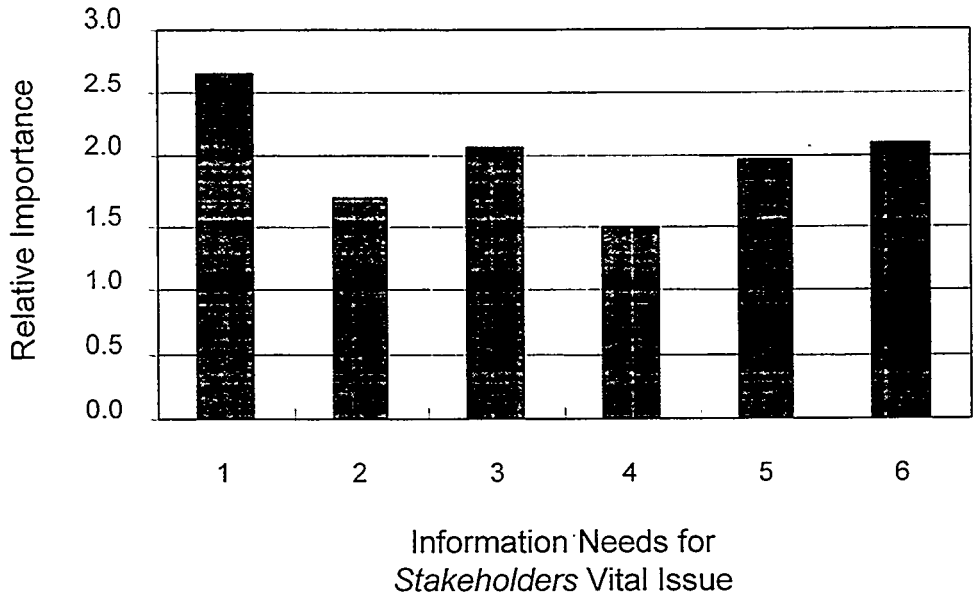

Figure 12. Relative importance of information needs for *Stakeholders* vital issue.

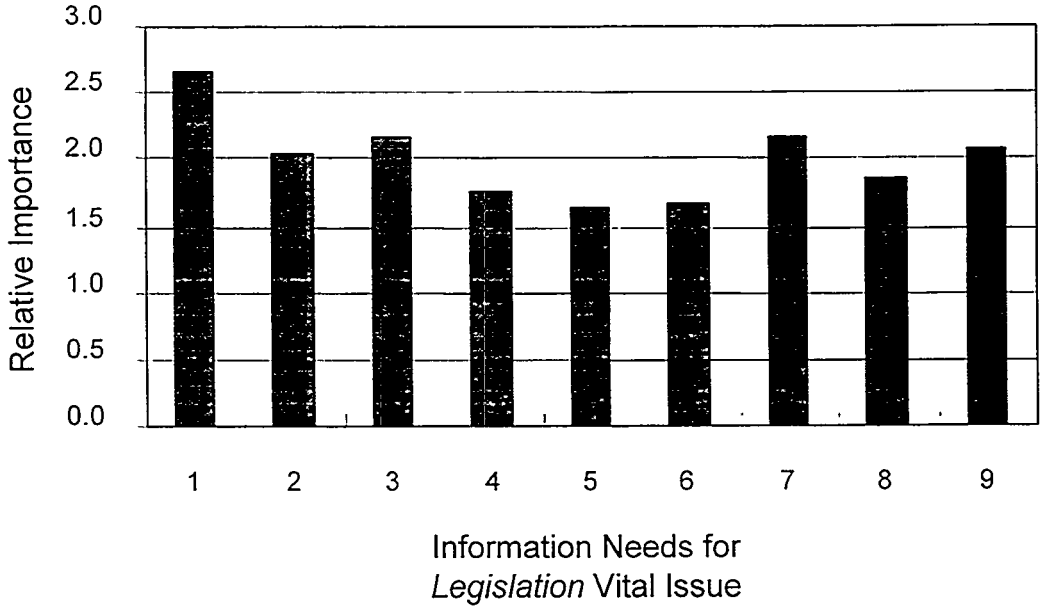

Figure 13. Relative importance of information needs for *Legislation* vital issue.

COMMENTARY

Summary

Three Vital Issues panel meetings were convened for the Senegal Water Resources Management Initiative, two in August and one in October 1997, to discuss water resource management in Senegal. Each panel was charged with tasks leading to the identification of information needed to manage Senegal's water resources. The meetings served as a first step in the development of an advanced state-of-the-art DSS that could be applied to the management of Senegal's water resources. The first panel developed a goal statement and selected and ranked criteria which were used by the second panel to identify and rank the issues that it considered vital to managing Senegal's water resources. The third Vital Issues panel identified and ranked a list of the information for each vital issue that it considered necessary to allow decision makers to address each of the issues.

The ordinal ranking of the relative importance of the vital issues in terms of both impact and benefit/cost is *Knowledge* > *Strategies* > *Legislation* > *Stakeholders.* The ordinal ranking of the level of agreement in terms of impact is *Legislation Strategies* > *Knowledge Stakeholders;* the ordinal ranking of the level of agreement in terms of feasibility is *Strategies* > *Legislation Stakeholders Knowledge.*

Conclusions

The Vital Issues process provided valuable information that can be used to develop a DSS that would help to manage Senegal's water resources. The process provided a format for both identifying and prioritizing vital issues and for identifying information needed to properly address those issues. The selection of panelists from the four basic institutional perspectives (government, industry, academe, and citizens' groups) ensured a high level of stakeholder involvement.

Recommendations

It is recommended that a DSS for managing Senegal's water resources be developed using the information obtained in the Vital Issues process implemented for the Senegal Water Resources Management Initiative and summarized in this report. It is also recommended that the

who represented the stakeholder communities by serving on the Vital Issues panels be included as team members during the development and implementation of the DSS.

APPENDIX A – Senegal Vital Issues Panel I Report

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Republic of Senegal
Ministry of Water Resources

United States of America
Sandia National Laboratories

MANAGING WATER RESOURCES IN SENEGAL

Senegal Vital Issues Panel I Report

August 11, 1997

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INTRODUCTION

This report summarizes the results of the first in a series of three Vital Issues panel meetings for the Senegalese Water Resources Initiative, a collaborative effort between Sandia National Laboratories (SNL) and Senegal to structure a state-of-the-art decision support system for managing Senegal's water resources. The Vital Issues process[1] was selected to help identify and prioritize the issues vital to the management of water resources in Senegal and to develop a preliminary list of information needs for managing the country's water resources that could be applied in the decision support system at both the policy-making and regulatory levels as well as in associated research and development projects.

The Senegalese Water Resources Initiative arose out of contacts developed by Mrs. Rokhaya Daba Fall, Technical Advisor to the Ministry of Agriculture in Senegal, who attended the international conference "The Science and Technology of Environmental Security in Drylands Workshop." The conference, which took place July 8–11, 1997, at SNL in Albuquerque, New Mexico, was sponsored by the United Nations Environment Programme (UNEP) and SNL. Dr. Dennis Engi, Manager of the Strategic Initiatives Department at SNL, who developed the Vital Issues process, personally organized this first panel of experts together with Mrs. R. D. Fall, who acted as facilitator at the meeting.

The meeting, designated Senegal Vital Issues Panel I, was held on Monday, August 11, 1997, in the Novotel in Dakar, Senegal. It was attended by various staff-level employees and decision-making authorities from the Office of the President of the Republic of Senegal and the Ministries of Water Resources, Agriculture, and the Environment and by representatives of the private sector and the civil works sector. The second Senegal Vital Issues panel, which will meet on August 20, 1997, will use the criteria developed by the first panel to identify and rank the issues vital to the management of water resources in Senegal. The third Vital Issues panel will identify and prioritize a preliminary list of information needed to address each vital issue.

The three Vital Issues panel meetings constitute the first phase of the Senegal Water Resources Initiative. Phase II of the Initiative will be devoted to the development of a proposal for the decision support system that will be submitted to Senegal's partner development banks. The third phase will consist of the marketing phase. Then, during Phase IV, the decision support system will be developed. The fifth and final phase will be the deployment and maintenance of the system.

[1] The Vital Issues process is a strategic planning tool for identifying and prioritizing a portfolio of 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. A combination of facilitated group discussion and quantitative ranking is used to provide input to strategic management decision making in the form of stakeholder-defined and -prioritized issues as well as information on potential barriers to the implementation of policies and programs.

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APPROACH

This initial Vital Issues panel was convened to carry out two essential tasks. The first was to develop a unifying goal statement for the Senegalese Water Resources Initiative. The second was to identify and rank criteria to be used by subsequent panels to identify and prioritize issues vital to the management of Senegal's water resources (Vital Issues Panel II) and to identify and prioritize the information needs (Vital Issues Panel III). The development of the goal statement and identification of the criteria took place during the morning session of the meeting, which involved quantitative dialogue and synthesis. The ranking of the criteria, which took place in the afternoon session, was, in contrast, quantitative and analytical.

The panelists used three *meta*criteria, listed below, to select and rank the criteria.

- *Necessary*...elimination of the criterion from the list would allow some important aspect of the goal to go unrecognized.
- *Operational*...the criterion can be used by the next panel to assess the relative importance of issues that are vital to the management of Senegal's water resources.
- *Sufficient*...the collection of criteria recognizes all important aspects related to the goal of managing Senegal's water resources.

The criteria were ranked using a three-step process known as "point-counterpoint-score." Each criterion was assigned a "champion," whose job was to present the criterion and "sell" it to the other panelists. Another panelist was assigned the job of providing counterpoint or rebuttal to the champion's presentation in the form of constructive criticism. Each presenter had 10 to 15 minutes to defend his or her ideas. After the point and counterpoint were presented, each item was scored (one scoresheet per panelist) against all items previously presented using pairwise comparisons. The following comparison scale was used:

Comparison Scale

5 = Much more important

4 = More important

3 = Same (i.e., of equal importance)

2 = Less important

1 = Much less important

The results of the criteria comparison were used to calculate group-averaged relative weights for the ranked criteria. The scores for each row on each score sheet (one scoresheet per panelist) were summed and then divided by the number of criteria minus 1 to obtain the relative value for each criterion for that scoresheet. The resulting relative values were normalized, or divided by the sum of all the relative values, to obtain the relative weights for each criterion for each panelist. These individual panelist weights were then averaged over all panelists to obtain group-averaged relative weights for the ranked criteria.

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RESULTS

Opening Notes From the Meeting

Antoine Diokel Thiaw, Chief of Staff of the Ministry for Water Resources, gave the opening address, welcomed the participants, and expressed his satisfaction with the work of Mrs. Fall and Dr. Engi, which formed the basis for this effort and made it possible for Senegal to take advantage of the Sandia's work and advanced technologies. Mr. Thiaw then reiterated the hope expressed by the Minister for Water Resources that his department would be able to derive maximum benefit from Dr. Engi's experience as well as from the know-how of each of the participants, so that the work begun by Mrs. Astou Faye Fall, Director of Water Management Services in the Ministry of Water Resources, with the support of the United Nations Development Programme (UNDP), could be completed.

After each participant introduced himself or herself, giving his or her name and title, Dr. Engi explained the Vital Issues process using the work done in Puerto Rico as an example. Dr. Engi also expressed his appreciation for the skill and judgment used by the Ministry of Water Resources, who was responsible for selecting the panelists.

Goal Statement

The panelists developed a goal statement for the Senegalese Water Resources Initiative after much discussion. The panelists decided that the statement should contain all seven of the following key words necessary for proper control of the water:

- Improved knowledge of the water resources.
- Balance between sources and applications.
- Quality of water resources.
- Improved availability of resources.
- Quantification of resources.
- Protection of resources.
- Maintenance of dams.

It was also decided that the statement must contain the following concepts:

- Knowledge of the resource.
- Determination of the various applications/usages.
- Restrictions regarding usages.
- Generation of development plans.

After several hours of discussion, the panel derived the following goal statement for the Senegalese Water Resources Initiative:

> *"Control of water resources by the development of an efficient and sustainable management system."*

Criteria

The afternoon session of the Vital Issues Panel I meeting began with the selection of the criteria that will be used by Vital Issues Panel II to select and rank the vital issues. It was pointed out that in 90% of the previous programs that have used the Vital Issues process, the panelists identified the following core set of criteria:

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

Twelve initial criteria were identified by the panelists, as listed below:

1) Scope (dimension)/scale.
2) Frequency.
3) Economic and/or structural.
4) Duration.
5) Local/generalized.
6) Impact (secondary effects).
7) Feasibility.
8) Pertinence.
9) Applicability.
10) Sustainability/durability.
11) Replicability.
12) Cross-border questions (regionalization).

The panel applied the metacriteria to determine whether the criteria on the list were *necessary, functional,* and *sufficient.* Some duplication was found, and some additional criteria were added. The list was therefore reexamined and organized. The following criteria were adopted:

- Amplitude,
- Frequency,
- Duration, and

- Feasibility.

The panelists next participated in the point-counterpoint-score process. Notes from the discussions (translated from the French) that took place appear in the Attachment.

The four criteria were scored in the context of each of the metacriteria using pairwise comparisons. The resulting scores were used to develop panel-averaged criteria weights that are to be used by the second panel to assess the relative importance of the vital issues. Figure 1 presents the means and standard deviations (the triangles and the diamonds represent one standard deviation above and below the means, respectively) for the relative importance of the four ranked criteria. Figure 2 present the criteria weights (the normalized relative values).

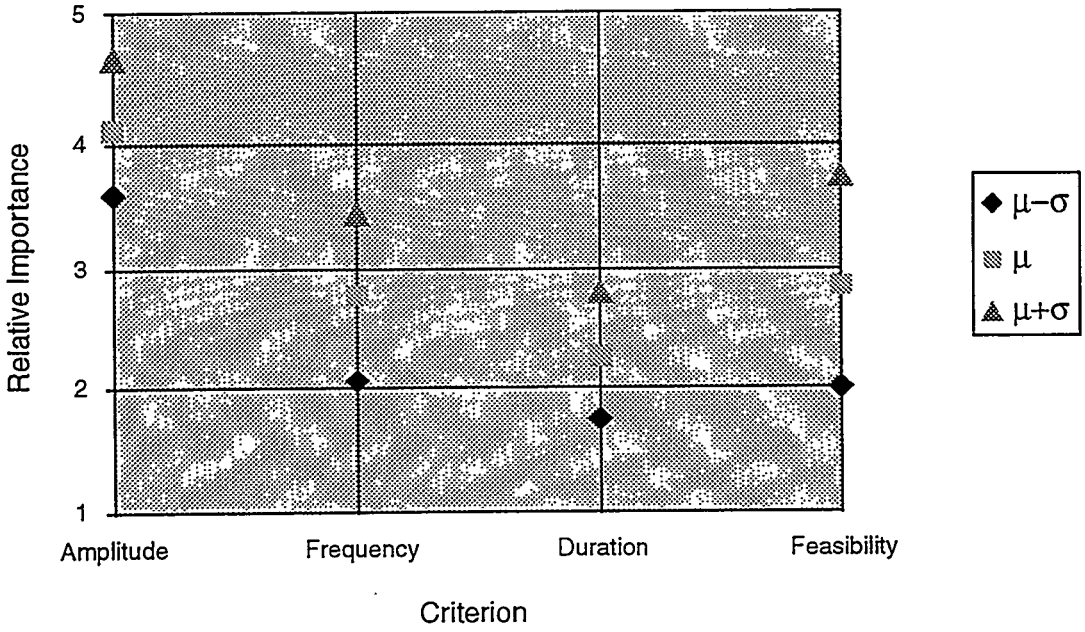

Figure 1: Relative importance of the criteria.

As shown in Figure 1, the ordinal ranking of the relative importance of the criteria is

Amplitude > Feasibility ≈ Frequency > Duration.

The ordinal ranking of the level of agreement in the relative importance of the criteria is

Amplitude ≈ Duration > Frequency > Feasibility.

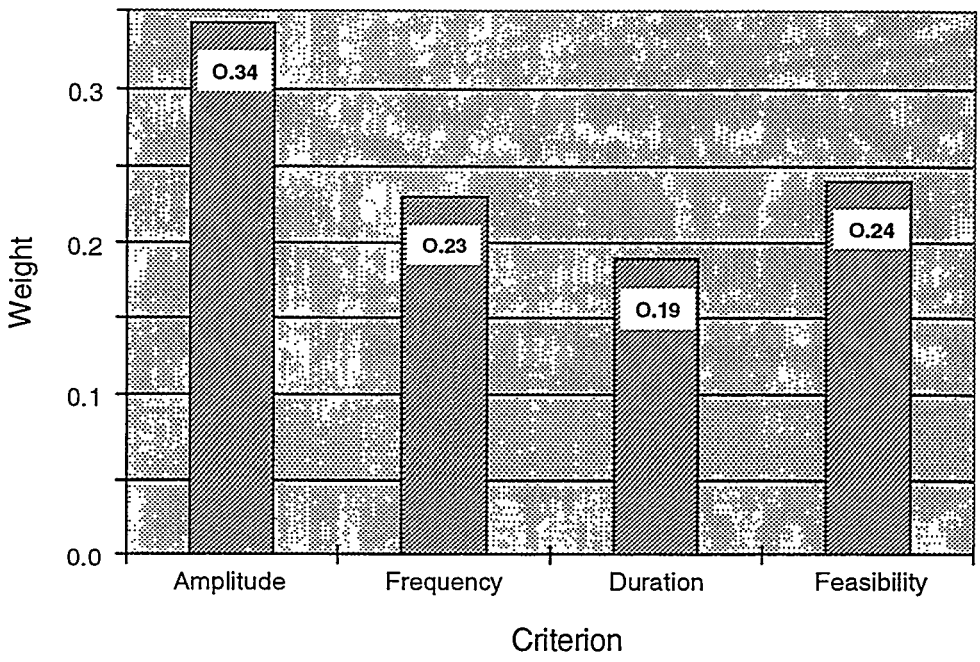

Figure 2. Criteria weights.

PANELISTS' SUGGESTIONS FOR IMPROVING THE PROCESS

The panelists made several comments and suggestions for improving the process in the form of constructive criticism. The criticism related to the overall evaluation of the meeting and was intended to improve the process for the second panel.

Generally, the panelists found the meeting to be of particular interest because it was, as one panelist stated, "stimulating in its form and content and because it was pragmatic, held in a very congenial environment, and each panelist had the opportunity to express an opinion on all of the topics discussed." The panelists felt that the most important questions had been covered. The results were felt to be on "a high level, positive, instructive, and very useful." The utilization of audiovisual equipment and transparencies was found to be "very instructive."

Panelist comments and suggested improvements included the following:

- Clearly define the terms beforehand so that the panelists can arrive at a common understanding. The English technical terms were not in all cases translated into French.
- Not enough time was allowed even though the entire proposed agenda was ultimately covered.
- The organization of the meeting should be revised. The preliminary explanation should be rearranged to achieve better balance.
- The documents distributed during the meeting should have been sent to the panelists before the meeting.
- Consideration should have been given to certain sectors not represented at the meeting, such as the National Health Service, the National Assembly, and the Ministry of Industry.

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VITAL ISSUES SUGGESTED FOR CONSIDERATION BY VITAL ISSUES PANEL II

The panelists identified the following vital issues, which they suggested for consideration by the second Vital Issues Panel:

1) Knowledge and management of water resources.

2) Protection and value of the water resources.

3) Improved management of runoff water.

4) Impact studies for questions relating to water resources.

5) Knowledge of the resource; establishment of a reliable management system.

6) Emphasis on much greater knowledge of the resource—the watershed and its replenishment—perimeter of protection of various resources.

7) Pollution of Guiers Lake, balance between requirements/availability, and water-borne diseases at the level of Guiers Lake and the Senegal River.

8) Identification of the entities involved in the field of water utilization.

9) Educational fields in water sciences and legislative and regulatory aspects.

10) How to identify conflicts between users in advance.

11) Cost of water that is acceptable to the majority—how to involve the beneficiary.

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ATTACHMENT A – POINT-COUNTERPOINT-SCORE DISCUSSIONS

Excerpts from the Meeting Minutes (Translated from the French)

CRITERION 1 – AMPLITUDE

For

The problems related to the water resources (knowledge of the resources) are of such a scope that all the projects carried out tend toward a strategy of water resource management. In Cap-Vert, for example, there is the problem of saline intrusion, as a result of which the President has issued a decree prohibiting the drilling of new wells.

Other quality management problems are of such scope that it would require an on-site visit and consultations to identify potential solutions (pollution).

The scope of the problems related to the water resources must be determined to identify the methods and resources that can be applied to solving the problem.

The scope of a problem can be defined by considering the following question: Can the means be found to solve this problem?

The management of water resources is a problem of balance, like managing a bank account. Ultimately, it is a problem of control. The scope of a problem is the ability to manage it.

Against

Is the problem of obtaining adequate knowledge of resources as important as you are leading us to believe? What is the current level of this knowledge, and what are the methods and resources being used to address this problem? The problems of quality and balance have also been mentioned, although not a great deal has been said about the scope of the problem.

In Senegal, the scope of the problem is at the level of saline intrusion and the drop in the water table due to low rainfall. If we add to that the problems of surface water (e.g., the increasing incursions of salt water into the Senegal River), the problem has been solved to some extent, but it remains a problem (e.g., in the Casamance River).

I do not see why the scope should constitute a criterion for the evaluation of the problem. Water is an essential element. The scope of the problem should be a basic point.

For

The water sources are located very inconveniently in relation to locations of demand. For example, the water supply comes from Guiers Lake. The Cayor Canal should ease this problem to some extent, but there are physical handicaps to be overcome. Nevertheless, the realization of the canal is essential, because Dakar needs an additional 100,000 m^3 of water. Therefore, the scope of the problem is an important criterion.

The scope of the problem is of capital importance. When we speak of water we speak in terms of entire watersheds. This is a problem that must be solved over the medium and long term.

There are two categories for water resources:

- mobility (depth);
- the major transfers that must be made both for underground water and for surface water.

We must also consider mobilization of equipment and costs.

There are 14,000 villages in Senegal. Therefore this problem has to be solved 14,000 times. That is the reason for the scope of the water supply problem. There is a dilemma between providing sufficient water for Dakar and the problem of a water supply in the villages. The scope of the problem will force someone to make a decision.

For

The scope of the water supply problem in Dakar has forced the decision-makers to consider the questions of desalinization and water treatment. Nevertheless, the decisions in favor of Guiers Lake and the Cayor Canal have taken priority over the other possibilities, due to the scope of the problem.

Therefore, we find that the scope of the problem is real.

Against

The importance of considering the scope of the problem has been overestimated. It is an imaginary problem. The water is there. All we have to do is manage it.

For

The notion of scope can be summarized as the geographical extent of a problem.

CRITERION 2 – FREQUENCY

For

If we don't worry about the frequency of an event, we risk having problems. From the point of view of the characteristics of the resource, the criterion of frequency is important. We have to know the frequency to identify the problem. If there is a recurrence, we have to find a solution. If the problem occurs only once every hundred or hundred and fifty years, we might be able to postpone addressing the solution.

On the other hand, if the problem occurs on an annual basis, the need to find a solution is urgent.

The frequency can be determined by dating the phenomenon (once a year, once a month, etc.).

The data relative to frequency must often be collected. We also have to consider observations made over a period of time. This type of frequency involves everyone, from the decision-making authority to the user. Beyond our own borders, the frequency also concerns international organizations.

These are some of the arguments for knowledge of frequency being necessary from the point of view of feasibility.

Against

The problem can also be examined from other angles.

In Senegal, we are currently in a state of uncertainty. We have to examine the situation from a negative perspective, because the problem of water management must be addressed on two levels: the population and the decision-makers.

The populations need to have water when and where they need it most. They are not concerned about frequency. On the sociological level, too, do we have to consider the problem in an altogether different context if we have to explain things like droughts and reduced rainfall in villages in backwoods Senegal?

The problem is therefore to acquire information in the area of frequency.

A knowledge of frequency can assist us in responding to disasters and problems. It makes us better managers. It is an important element of management information.

Nevertheless, the whole problem has to be considered in a new context, namely that we do not have enough water.

CRITERION 3 – DURATION

For

I think that the criterion of duration is more important than scope and frequency, because to get a proper handle on a problem, we have to have a frame of reference (duration) to facilitate finding a solution. The problem has to be considered in the context of time, i.e. the time it will take to solve the problem. If we think in terms of water management, it is important to evaluate water resources not only in terms of the amount of water, but also in terms of the length of time it will take to exploit this resource to determine the quantity of water to be removed by evaluating the time it will take to plan and implement an effective solution.

To solve a problem related to pollution, the duration of the problem is an important factor. When a river is toxic to the point of causing problems relating to survival, the length of time it takes to solve this problem is of major importance, and is proportional to the length of time this water will afflict the waterway. Although the scope and frequency of the problem may have been determined, it is more important to know the length of time that can be dedicated to solving the problem. On the level of resource management, it is also important to know the

quantity of resources available. It is also important to know the length of time a resource can be exploited to plan the level of consumption these quantities can support.

The aspect of time is of very great importance.

We should add that, just like the frequency, a thorough knowledge of duration is also important.

Against

In the matter of water resources, we know the time frame for Senegal. Since the 1973 drought, all our resources have been diminishing from year to year. Since then, we have been working out measures to reduce the impact of this phenomenon. We do not have any time scale, or any estimate of the drought cycle that is straining our water resources. Because there are factors we cannot control, it is apparent that we have no control over the long-term situation, and should instead concentrate on efficient management of the available resources.

For

A tool must be available to calculate the transit time in cases of pollution, hence the importance of the time period. In Senegal, we have nine months during which there is an increased possibility of brush fires, and therefore nine months to prepare an effective policy against brush fires. The notion of time is important and useful.

The flooding of the Senegal River can be considered in terms of time to initiate the planning of agricultural activities.

CRITERION 4 – FEASIBILITY

For

The feasibility aspect is important. Quite apart from political feasibility, it is essential because without it, nothing can be done. On the institutional level, the problem must be solved by enforcing the laws and regulations already in existence. Technical feasibility (reliability = notion of sustainability) must be accompanied by sociocultural feasibility (a return on the financial investment). Feasibility on the environmental level is also essential.

Against

I do not see any concrete information. What is the relationship between the institutional aspect and the technical realization of a project? Feasibility is a technical problem which must be solved in technical and financial terms. Where does technical feasibility rank in relation to political feasibility?

As soon as a problem is posed on the technical and natural level, why raise the problem to an institutional level when it is of a purely technical and scientific nature?

Feasibility is also limited by restrictions in terms of time and costs.

For

The problem of managing the water in the Senegal River is always a concern, and the political authorities involved will have to intervene to settle the matter. From the very outset, therefore, the project must be approached on an integrated basis to avoid unpleasant situations. The sociocultural aspects must also be included because the problems have a multi-sector diversity which requires intervention by several government departments.

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APPENDIX B – Senegal Vital Issues Panel II Report

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Republic of Senegal
Ministry of Water Resources

United States of America
Sandia National Laboratories

MANAGING WATER RESOURCES IN SENEGAL

Senegal Vital Issues Panel II Report

August 20, 1997

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INTRODUCTION

This report summarizes the results of the Vital Issues Panel II meeting for the Senegalese Water Resources Initiative, a collaborative effort between Sandia National Laboratories (SNL) and Senegal to structure a state-of-the-art decision support system for managing Senegal's water resources.

The meeting was the second in a series of three Vital Issues panel meetings, the first of which was held on August 11, 1997. At the first panel meeting, Vital Issues Panel I identified a goal statement for the Initiative and identified and ranked evaluation criteria for identifying and prioritizing issues vital to the management of water resources in Senegal. It also developed a set of strawman issues for consideration by Vital Issues Panel II. The second Senegal Vital Issues panel used the criteria developed by the first panel to identify and rank the vital issues. The third Vital Issues panel will identify and prioritize a preliminary list of information needed to address each of the vital issues.

The Vital Issues Panel II meeting was held on Wednesday, August 20, 1997, in the Novotel in Dakar, Senegal. The meeting was led by Mrs. Rokhaya Daba Fall, Technical Advisor to the Ministry of Agriculture, who was assisted by Dr. Dennis Engi of SNL.

The panel consisted of high-level representatives of the Office of the President of the Republic, the Ministries of Agriculture, Water Resources, and the Environment, Cheikh Anta Diop University (UCAD), SONES, l'Organisation de Mise en Valeur du Fleuve Sénégal (OMVS) (Organisation for the Management of the Senegal River), and the civil engineering companies via the Association des Producteurs pour le Conseil Rural (APCR) and the Fédération des Organisation Non Gouvernemental du Sénégal (FONG), as well as engineering companies.

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APPROACH

The second Vital Issues Panel in the Senegalese Water Resources Initiative identified and ranked issues vital to the management of Senegal's water resources using the goal statement and criteria developed by Vital Issues Panel I. The goal statement developed by the first Vital Issues Panel was:

"Control of water resources by the development of an efficient and sustainable management system."

The criteria and the criteria weights (generated from the ranking performed by the first vital issues panel) are listed below:

Amplitude (0.34)

Frequency (0.23)

Duration (0.19)

Feasibility (0.24)

Vital Issues Panel II also reviewed a set of strawman issues proposed by the first Vital Issues Panel as a starting point for discussion. The strawman issues are listed below.

1) Knowledge and management of water resources.

2) Protection and value of the water resources.

3) Improved management of runoff water.

4) Impact studies for questions relating to water resources.

5) Knowledge of the resource; establishment of a reliable management system.

6) Emphasis on much greater knowledge of the resource—the watershed and its replenishment—perimeter of protection of various resources.

7) Pollution of Guiers Lake, balance between requirements/availability, waterborne diseases at the level of Guiers Lake and the Senegal River.

8) Identification of the entities involved in the field of water utilization.

9) Educational fields in water sciences and legislative and regulatory aspects.

10) How to identify conflicts between users in advance.

11) Cost of water that is acceptable to the majority—how to involve the beneficiary.

The panelists were directed to reduce the proposed list to six and to review the issues in light of the following three *meta*criteria:

- *Necessary*...elimination of the criterion from the list would allow some important aspect of the goal to go unrecognized.
- *Operational*...the criterion can be used by the next panel to assess the relative importance of issues that are vital to the management of Senegal's water resources.
- *Sufficient*...the collection of criteria recognizes all important aspects related to the goal of managing Senegal's water resources.

After the panel selected the vital issues, the issues were ranked using a three step process known as point-counterpoint-score. Each issue was assigned a "champion" whose job it was to present the criterion and "sell" it to the other panelists in the context of each of the criteria and the criteria weights developed by Vital Issues Panel I. Another panelist provided counterpoint or rebuttal to the champion's presentation in the form of constructive criticism. After the point and counterpoint were presented, each item was scored against all items previously presented in the context of each criterion using pairwise comparisons (one scoresheet for each criterion for a total of four scoresheets per panelist). The following comparison scale was used:

Comparison Scale

5 = Much more important

4 = More important

3 = Same (i.e., of equal importance)

2 = Less important

1 = Much less important

The numerical results of the comparisons were used with the criteria weights to generate a group-averaged criteria-weighted relative ranking of all of the vital issues (means).[1] The extent of the panelists' disagreement with regard to the rankings (standard deviations) was also calculated.

The relative importance of the vital issues in the context of a composite of the three criteria *amplitude, frequency,* and *duration* (a composite ranking characterizing the impact of the issues) and in the context of the criterion *feasibility* (characterizing the benefit/cost of addressing the issue) was calculated. The composite ranking was generated by using criteria weights for the three criteria *amplitude, frequency,* and *duration* (these criteria weights were calculated by dividing each of the relative values by their sum). The single criterion ranking for *feasibility* was generated by averaging the scores for the four issues for the *feasibility* criterion over all the panelists. The mean relative values and standard deviations for the composite ranking and for *feasibility* were plotted graphically to produce two one-dimensional rankings of the vital issues, one for the composite and one for *feasibility.* A two-dimensional ranking was also plotted to show the assessed value of each vital issue in the context of the composite criterion versus the assessed value of each vital issue in the context of the single *feasibility* criterion.

[1] To calculate the rankings of the vital issues, the relative values were first calculated for all the vital issues on all the scoresheets for each panelist. This was done by summing the scores for each row on each scoresheet and dividing by the number of items minus 1. All the resulting relative values for a given criterion were then multiplied by their corresponding criteria weights. The resulting values provided a criteria-weighted ranking of the items for each panelist. These weighted values were then averaged for each vital issue across all the panelists to obtain a group-averaged criteria-weighted ranking for each vital issue.

RESULTS

The Chief of Staff of the Ministry of Water Resources, Mr. Antoine Diokel Thiaw, gave the opening address. Mrs. Fall then presented a summary of the activities for the Initiative and the results from the first Vital Issues Panel.

The panelists reviewed the strawman issues proposed by the first panel and amended the list to include the following 23 proposed issues:

1) Knowledge and control of natural resources.
2) Quality, conservation, and protection.
3) Availability and management strategy.
4) Identification and involvement of entities and their roles.
5) Legislation and regulations.
6) Education, training, and awareness.
7) Scarcity of water resources.
8) Water resource policy and management.
9) Availability of water resources.
10) Valuation of water resources.
11) Value and costs of water resources.
12) Economy of water resources.
13) Geographic distribution of water resources (transfer).
14) Recycling used water.
15) Availability and accessibility (time, space, cost, value).
16) Efficiency of the utilization systems.
17) Policies to increase water resources.
18) Water and the environment.
19) Human actions and their effects on the resource.
20) Climatic changes and their effect on water resources.
21) International dimension of water resource management.
22) National coordination for improved utilization of water resources.
23) Appropriate treatment technologies for wastewater.

After reviewing the issues on the basis of the metacriteria (necessary, operational, and sufficient), the panelists narrowed the list to four issues that it considered vital to the management of Senegal's water resources. These are listed below.

1) Insufficient ***knowledge*** about the quantity and quality of Senegal's water resources.
2) Ineffective ***strategies*** for managing Senegal's water resources.

3) Inadequate involvement of important Senegalese water resource ***stakeholders.***

4) Ineffective implementation of integrated, cohesive ***legislation*** for managing Senegal's water resources.

The panelists next participated in the point-counterpoint-score process. Notes from the discussions (translated from the French) that took place appear in the Attachment.

The results of the pairwise comparisons performed on the four issues using the four criteria developed by Vital Issues Panel I appear in Figures 1 through 3. The composite ranking for the vital issues in the context of the composite criterion (one-dimensional perspective) and the ranking for the *feasibility* criterion (one-dimensional perspective) appear in Figures 1 and 2, respectively. The two-dimensional perspective, showing the integrated ranking of the composite relative value for each issue versus the relative value in the context of *feasibility,* is presented in Figure 3.

Figures 1 and 2 show the means and standard deviations (the triangles and the diamonds represent one standard deviation above and below the means, respectively) for the relative importance of the vital issues for these two rankings.

In Figure 3, the mean relative values for each vital issue for the composite ranking and for *feasibility* are plotted along the *x* and *y* axes, respectively. The center-points of the elliptical areas on the graph are the plotted means for the panel's assessment of the issues. The ellipses represent the range of the panelists' disagreement (one standard deviation above and below the mean) regarding the relative importance. The vital issues that have the highest values along both axes are the most desirable to address. Those with the lowest values along both axes are the least desirable.

As shown in the figures, the ordinal results for the relative importance of the vital issues for both the composite ranking and for *feasibility* are *Knowledge > Strategies > Legislation > Stakeholders.* The ordinal results for the level of agreement on the relative importance of the vital issues are *Legislation ≈ Strategies > Knowledge ≈ Stakeholders;* the ordinal results for the level of agreement for the *feasibility* criterion are *Strategies > Legislation ≈ Stakeholders ≈ Knowledge.*

The standard deviations provide useful information. For example, when choosing between two issues, a decision maker may wish to address the vital issues with a lower rank but less disagreement, judging that it may have a greater chance of successful resolution than the one with a higher rank but greater disagreement. A vital issues with a lower rank and less disagreement may also be preferable to a decision maker who is risk-averse. For example, note that in the figures, *Knowledge* has a wider range of disagreement along both axes than *Strategies.*

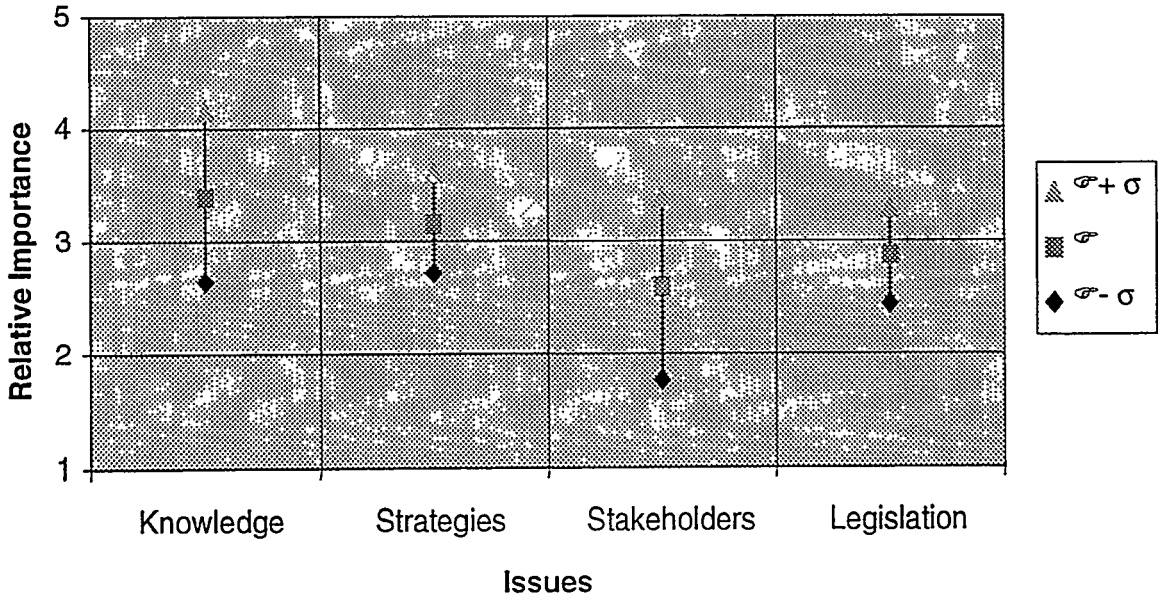

Figure 1. Composite ranking of the vital issues in the context of the compostite criterion (characterizing the impact of the issues).

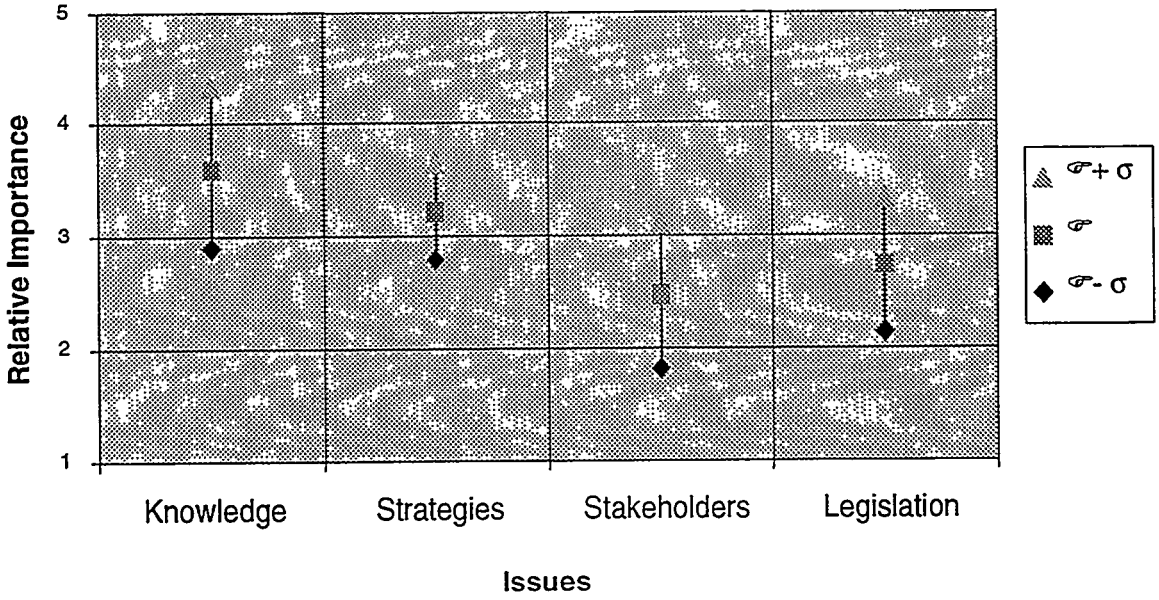

Figure 2. Relative importance of the vital issues in the context of the *feasibility* criterion (characterizing the benefit/cost of addressing the issues).

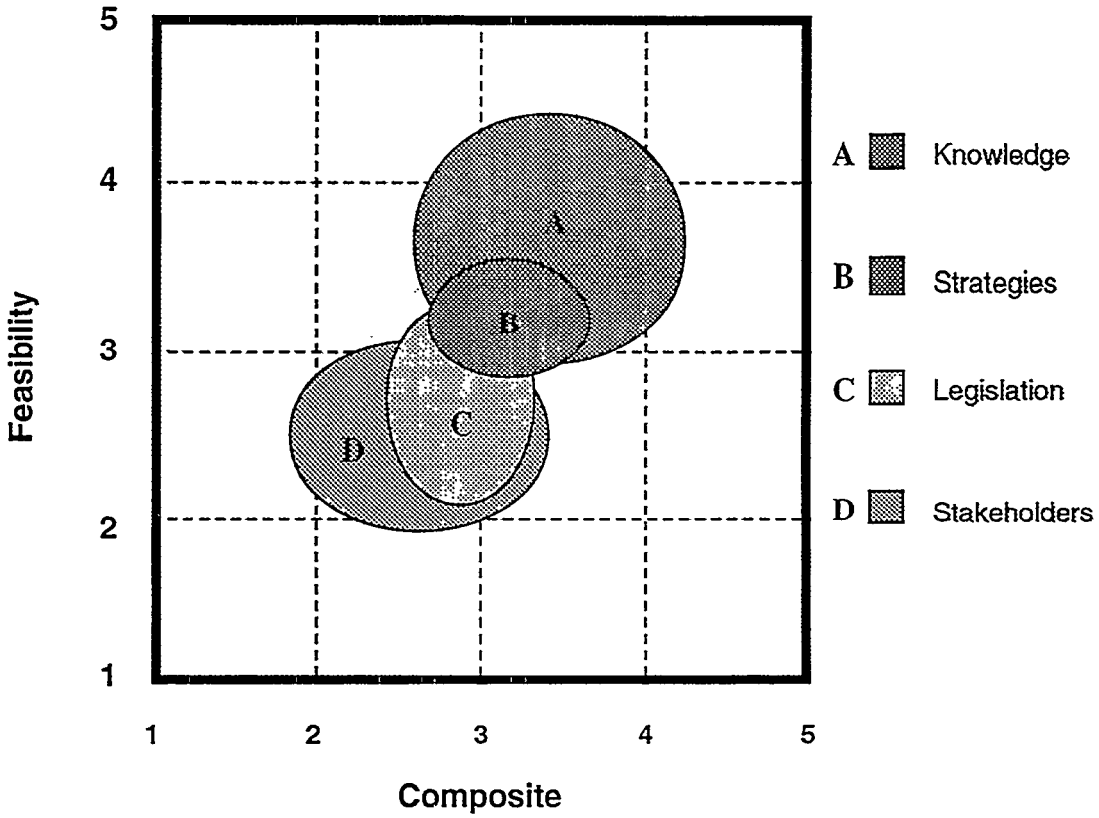

Figure 3. Integrated ranking of the issues vital to the management of Senegal's water resources.

STRAWMAN INFORMATION NEEDS FOR EACH VITAL ISSUE SUGGESTED FOR CONSIDERATION BY VITAL ISSUES PANEL III

The panelists identified the following information needs for each vital issue for consideration by Vital Issues Panel III:

Knowledge

1) Identification of the types of pollution of water resources.
2) Potential availability and growth.
3) Statistical level of the water table.
4) Methods for mobilizing and distributing water resources.
5) Water resource situation (quantitative and qualitative).
6) Lateral limits of the deep water table.
7) Value (real cost) of water.
8) Legislative texts.
9) Water and illnesses.
10) Degree of eutrophication of Guiers Lake.
11) The optimum monitoring mechanism.
12) Tendencies of the evolution of the resource by period.
13) Level of exploitation of the aquifers.
14) Replenishment rate of the various aquifers in Senegal.

Strategies

1) Current strategies.
2) Institutional framework and mechanism for policy development.
3) Water resource mobilization strategies.
4) Resource monitoring strategy.
5) Strategic priorities.
6) Feasibility or adequacy of water management strategies with current growth trends in Dakar.
7) Strategies for recovery of waste water.
8) Level of resource requirements.
9) Rainwater capture strategies.
10) Rainwater storage strategies.
11) Strategies to improve human resources in the current context (no new hiring).
12) Strategies to maintain operations in hydraulic projects in the context of privatization.

13) Mechanisms to articulate strategies with other sectoral planning strategies.

Stakeholders

1) Identification of the parties involved.
2) Level of involvement of stakeholders in the construction of earthen dams.
3) Identification of the faculties and capabilities of the various parties involved.
4) Domain of actions of the stakeholders.
5) Criteria for identifying stakeholders.
6) International context: sharing of the water resources.
7) Dissemination of information and increasing the awareness of the parties involved.
8) Conservation of water resources for future generations.
9) Level of responsibility of the stakeholders.
10) Mechanism and context for the operation of partnership.

Legislation

1) Existence and application of laws and regulations.
2) Harmonization of sectoral legislation in the field of water resource management.
3) Customary rights.
4) Follow-up in applying the law.
5) Finality and procedures for laws and regulations.
6) Potential conflict in inventory.

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ATTACHMENT – POINT-COUNTERPOINT-SCORE DISCUSSIONS

Excerpts from the Meeting Minutes (Translated from the French)

Knowledge

ARGUMENTS FOR

Pressing insufficiencies have been identified in the area of water management in Senegal. During a recent meeting on the River Valley, lenders questioned the responsible government officials on the subject of the allocation of water and evaporation. The responses were unsatisfactory. That is a serious matter, because we have been an independent country for 37 years and we would have been able to answer this question if our knowledge in this specific area had been sufficient.

At the level of runoff, we are wasting an enormous quantity of resources. We know nothing about the rate of evaporation. We need an enormous amount of information on rivers and streams. This is a problem that is occurring with increasing frequency. The water shortages in Dakar and the floods in Saint-Louis resulted from insufficient knowledge of water resources. ORSTOM (Organisation Scientifique et Technique d'Outre Mer) (now called the Association des Producteurs pour le Conseil Rural (APCR)), on the other hand, has done remarkable work in this area.

In spite of all the financial and human resources that have been devoted to finding solutions, we must realize that feasibility has not yet been achieved.

Wells are being drilled all over the place without any idea of the tolerance threshold of the watershed. Wells are also being drilled in improper locations, which results in health problems and major cost overruns on account of a lack of knowledge of the water table. We know nothing about the pollution of the river water, for example. We have no parameters or reliable studies.

The data exist, but there is a problem of getting the data to the users. Information has to circulate. There is no follow-up on projects. The resources have to be increased and monitored while developing internal expertise.

ARGUMENTS AGAINST

With regard to the scope of the problem, it should be noted that a great many studies have been conducted on all the types of water. There is a database and a system of geographic information. All that is required is to improve the results to be able to use them on a practical level. During the meeting with the lenders on the River Valley, the technicians were never consulted. The Water Resources Management Department was not involved. Anyone who had anything to do with this affair should have been supported by information from the water management community. In that regard, all that has to be done is to improve the existing facilities.

For the River Valley, the problem is one of a lack of knowledge. The Senegalese government is responsible for the work performed for it by ORSTOM. Some of the data need to be revised and put into practice, as a function of the time available. This is a long-term task and requires the skills of multidisciplinary and multisector teams.

With regard to feasibility, it should be noted that less than 1% of the operating budget is devoted to studies and their implementation. The money is being used for other things. From now on, we have to provide appropriations for project studies to avoid errors.

On the level of water quality, some admirable things have been accomplished. Part of the problem is a lack of appreciation. There is no problem of scope because reference is being made to only one part of Senegal. We can obtain information concerning water resources for any part of Senegal we want. Since 1977, there has been a network to monitor underground and surface water. The General Plan of l'Organisation de Mise en Valuer de Fleuve Gambia (OMVG) (Organisation for the Management of the Gambia River) is based on the information available at the level of Senegal.

There is a lack of effective interaction between the various parties involved. The principal consequence is that information does not circulate. There is no analytical laboratory.

Strategies

ARGUMENTS FOR

There have been strategies in place since the early 1970s, following repeated cycles of drought. All the states of the Conseil Inter Etats de Lutte Contre la Secheresse (CILSS) (Interstates Consul to Combat Drought) have developed strategies. There have been all sorts of projects and decision-making bodies. There is disagreement over whether to build large dams or small dams. The Saint-Louis floods reminded us that two dams were constructed without taking certain realities into account. A great deal of time is wasted on the level of studies, and effort is dispersed. There has been an uncontrolled drop in water levels in villages.

Some dams have had damaging effects on the ecosystem (e.g., the problems with the Guide Dam in Casamance).

In Dakar, we find that the problem of forecasting the demand for water and prospecting for the appropriate resources has still not been solved. This situation has been going on for several decades. We have to think in the long term. The work must be continuous.

Dakar produces an estimated 100,000 m^3 of wastewater. This water could be treated and reused, which would help to make up the shortage in the capital. That would buy time to define alternative solutions to solve Dakar's water supply problem. The institutional framework must be strengthened to cut out all the red tape at the ministerial level.

The water treatment stations must be constructed at the level of the municipal and metropolitan areas that use the water.

ARGUMENTS AGAINST

Strategies must be reviewed in the light of the conceptual errors that have been noted. We have to determine what it was about the particular concept that did not work. The term "efficiency" is inappropriate. The water treatment centers exist, as do the technologies. But how applicable is such a project given the scope of the problem in Dakar?

Stakeholders

ARGUMENTS FOR

Numerous conflicts arise at the level of the distribution of resources. There is no demarcation at the level of the various users. Efforts must be made to permit all the parties involved to get down to essentials. This need is ever more pressing because the demand for water is steadily increasing on account of the growth in the population and the added demand that entails.

The question is of major importance, because on the project level, the local populations are never involved, which brings up the problem of the long-term success of the projects. On the level of frequency, we find that this problem occurs over and over again. The local populations have no direct involvement.

The solution to this problem requires open and sustainable cooperation on the level of all the participants on one hand, and an in-depth knowledge of the overall situation on the other hand.

ARGUMENTS AGAINST

What do we mean by "involvement"? As far as we are aware, the local populations have always been involved. It is really a question of returning their true role to them. Involvement? Participation? We should be talking about involvement. The government creates coordination teams, but that takes time. All policies must have support from the ground up if we are to prevent failures. Local expertise should be encouraged.

Everyone knows that the participants are not sufficiently involved, but that does not mean that we should therefore just give up and go home. We need to establish a team to deal with the problem. The government must not surrender its sovereignty to the ONG and other participants in the development projects. The government needs an intermediary. We need to strengthen the organizational and institutional capabilities of these intermediaries. To do that, we need to determine the level of participation and involvement of each participant. The rights and obligations must be shared.

Most of the participants are not involved most of the time. That can be verified in the case of the Well Drilling Management Committees.

The plethora of water projects scattered throughout the country proves that the base has been taken into consideration. Nevertheless, a great many projects have also been realized without sufficient prior study because of powerful lobbying efforts. This situation means that some of the projects constructed simply do not work (equipment failures, poor location).

Legislation

ARGUMENTS FOR

There is a lack of integration among the various legislative entities. All the laws and regulations that have an effect on water must be harmonized. The codes and regulations that have been allowed to lapse should be revived.

ARGUMENTS AGAINST

The Water Code exists. There is also a Health Code, an Environment Code, etc. The government has tried to harmonize these various codes to involve all the participants so that they can defend their interests. A start toward cooperation has been made with the establishment of the Environment Code, which has involved all of the parties involved in water management. The law implementing the Water Code applies to this situation. Application decrees are required. Of course, the application decrees have been delayed, which makes the application of the code difficult. The ministerial departments are preparing the regulations, but it will be up to the authorities who make the political decisions to promulgate these decrees.

The texts of these decrees have been wrapped up in red tape for the past three years. The courts and legal system are involved, and the processes involving those departments need to be streamlined. A great many of the texts have to be updated. The politicians should take charge so that all the texts are harmonized and so that they have a real impact on the realities of the situation, because that is what the populations are concerned about.

APPENDIX C – Senegal Vital Issues Panel III Report

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Republic of Senegal
Ministry of Water Resources

United States of America
Sandia National Laboratories

MANAGING WATER RESOURCES IN SENEGAL

Senegal Vital Issues Panel III Report

October 15, 1997

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INTRODUCTION

This report summarizes the results of the Vital Issues Panel III meeting for the Senegalese Water Resources Initiative, a collaborative effort between Sandia National Laboratories (SNL) and Senegal to structure a state-of-the-art decision support system for managing Senegal's water resources. The Senegalese Water Resources Initiative arose out of ideas developed by Mrs. Rokhaya Dava Fall, Technical Advisor to the Ministry of Agriculture in Senegal, who attended the international conference "The Science and Technology of Environmental Security of Drylands Workshop," held on July 8–11, 1997, in Albuquerque, New Mexico. The conference was cosponsored by the United Nations Environment Program and SNL.

The meeting was the third in a series of three Vital Issues panel meetings, the first and second of which were held on August 11 and 20, 1997. At the first panel meeting, Vital Issues Panel I identified a goal statement for the Initiative and identified and ranked evaluation criteria for identifying and prioritizing issues vital to the management of water resources in Senegal. The second Senegal Vital Issues panel used the criteria developed by the first panel to identify and rank the vital issues. The third Vital Issues panel was tasked with identifying and prioritizing a preliminary list of information needs for each vital issue that can be used to make the appropriate decisions for water resources management in Senegal.

The information obtained in the three Vital Issues panel meetings will be used in combination with state-of-the-art technology developed by Sandia to assist Senegal with its water resource management. Approximately three months will be dedicated to the startup and implementation of an advanced information system (SIC) that can be applied to Senegal's water resources management (initial results expected in the short term). Long-term investments (10 years) are expected to follow in a second phase that will require financial contributions, environmental impact considerations, and health and shared-border resource studies.

The Vital Issues Panel III meeting was held on Wednesday, October 15, 1997, in the Novotel in Dakar, Senegal. The meeting was chaired by Professor Cheikh Bécaye Gaye of the Geology Department of Cheikh Anta Diop University (UCAD). Professor Gaye was assisted by Dr. Dennis Engi of SNL, who developed the Vital Issues process.

The meeting was attended by representatives of the Ministries of Agriculture, Hydraulics, and Environment as well as representatives of UCAD, SONES, and research bureaus. The panel was composed of decision-makers, model designers, and data providers to ensure that the information needs would be useful in decision making, able to be modeled, and capable of being investigated.

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APPROACH

The third Vital Issues panel reviewed the results of the first and second Senegal Vital Issues panel meetings. Included in these results was 1) a goal statement for the Senegal Vital Issues Water Resources Initiative, 2) evaluation criteria, and 3) a set of issues considered vital to management of Senegal's water resources. (For more information on the results of the first two panels, see the Vital Issues Panel I and II reports).

Vital Issues Panel III was tasked with identifying and prioritizing information needs for addressing each vital issue identified by the second Vital Issues panel. The four issues are listed below.

1) Insufficient ***knowledge*** about the quantity and quality of Senegal's water resources.
2) Ineffective ***strategies*** for managing Senegal's water resources.
3) Inadequate involvement of important Senegalese water resources ***stakeholders***.
4) Ineffective implementation of integrated, cohesive ***legislation*** for managing Senegal's water resources.

The panelists next scored the information needs using the following comparison scale:

Comparison Scale

3 = More important

2 = Same (i.e., of equal importance)

1 = Less important

The numerical results of the comparison were used to generate a group-averaged relative ranking of the information needs for each vital issue (means). The extent of the panelists' disagreement with regard to the rankings (standard deviations) was also calculated for each information need. The reciprocal of the coefficient of variation (μ/σ) was then calculated for each information need to generate a ranking for each set of information needs that reflects both the relative importance and the extent of the panelists' agreement as to the ranking.

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RESULTS

The panelists identified the following information needs for each of the four issues identified by the second Vital Issues panel.

Knowledge

Findings: Insufficient knowledge of water resources in Senegal, both qualitative and quantitative.

The knowledge required is varied, such as:

1) Typology of water resource pollution (types of pollution, sources, standards).
2) Available potential and evolution (quantitative studies to be performed on groundwater and surface water, incoming and outgoing water balance, basic quantification, static level of water table, location of water resources, water value).
3) Typology of the primary uses of water.

Strategies

Findings: Lack of efficiency and/or applicability of water resource management strategies.

1) Critical inventory of current strategies.
2) Institutional framework and policy drafting mechanism.
3) Mobilization and use of potable water resources.
4) Dakar Region water supply.
5) Resource follow-up.
6) Assessment of wastewater.
7) Alignment of needs/resources.
8) Strengthening capacity.
9) Operation and maintenance of hydraulic works.
10) Integration of strategies in global planning.
11) Preservation of water resource.

Stakeholders

Findings: Insufficient implication of the primary stakeholders in the domain of water resource usage.

1) Identification of actors (government, decision-makers, private sector, users, scientists, financial backers or development cooperation organizations, local cooperatives).
2) Implication of the actors in the design, implementation, and management of hydraulic infrastructures.
3) Identification of skills and capabilities of the various actors.
4) International context: shared basin.
5) Information, awareness and reinforcement of the capabilities of the actors.

Legislation

Findings: Shortcomings in the application of legislation and regulations regarding water.

1) Inventory of statutory laws and their application.
2) Degree of applicability.
3) Alignment of sectoral legislation regarding water management.
4) Customary laws.
5) Popularization of statutory laws.
6) Drafting of statutory laws.
7) Water authority.
8) Inventory and prevention of potential conflicts.
9) Ultimate purpose of legislative enactments.

The results of the pairwise comparisons performed on the information needs for each vital issue are presented in Figures 1 through 8. The relative value rankings for the vital issues appear in Figures 1 through 4. Figures 5 through 8 are plots of the reciprocal of the coefficient of variation (μ/σ) for each information need for each vital issue. Note that the rankings are not the same in the two sets of figures because the second set (Figures 5–8) reflect *both* relative value and agreement. The top ranking information needs in Figures 1–4 have higher relative values than the other information needs; those in Figures 5–8 have both higher relative values and greater agreement. Note that, for all of the issues, the highest ranking information need is the same in terms of both relative importance and μ/σ.

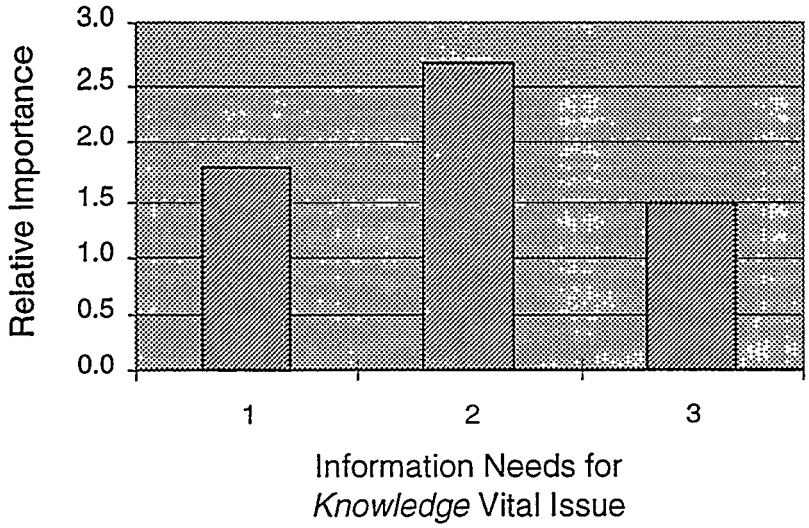

Figure 1. Relative importance of information needs for *Knowledge* vital issue.

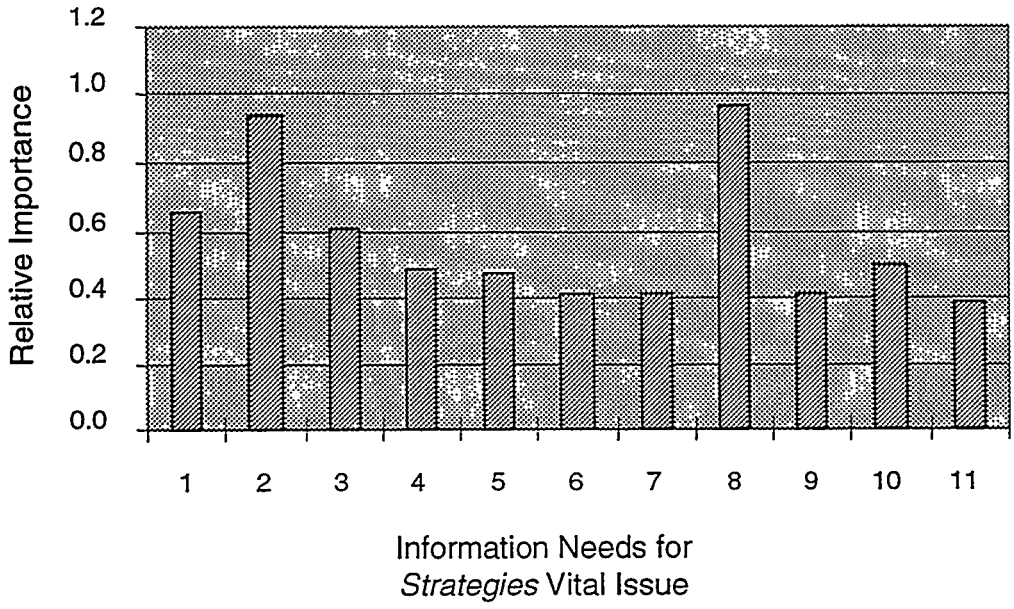

Figure 2. Relative importance of information needs for *Strategies* vital issue.

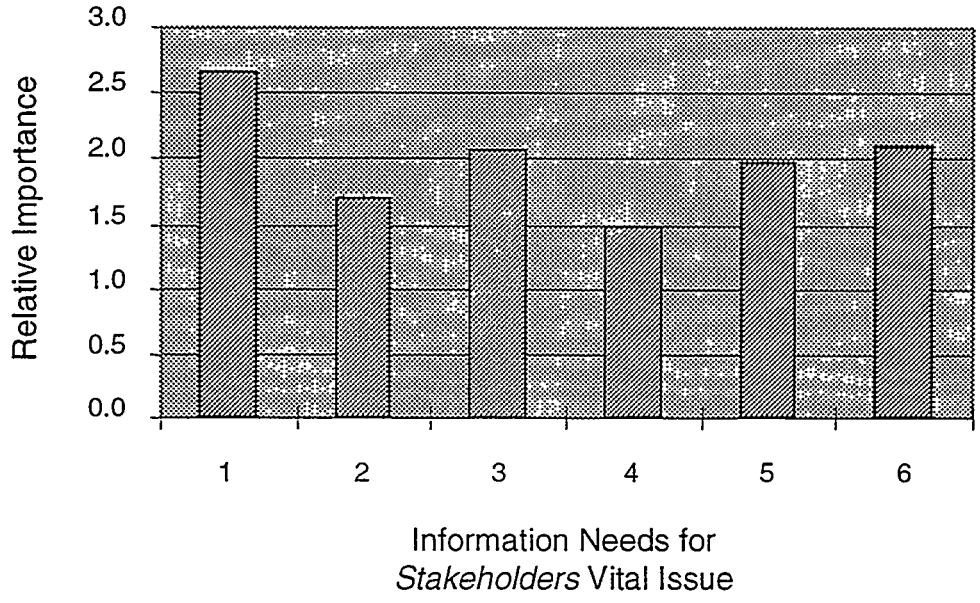

Figure 3. Relative importance of information needs for *Stakeholders* vital issue.

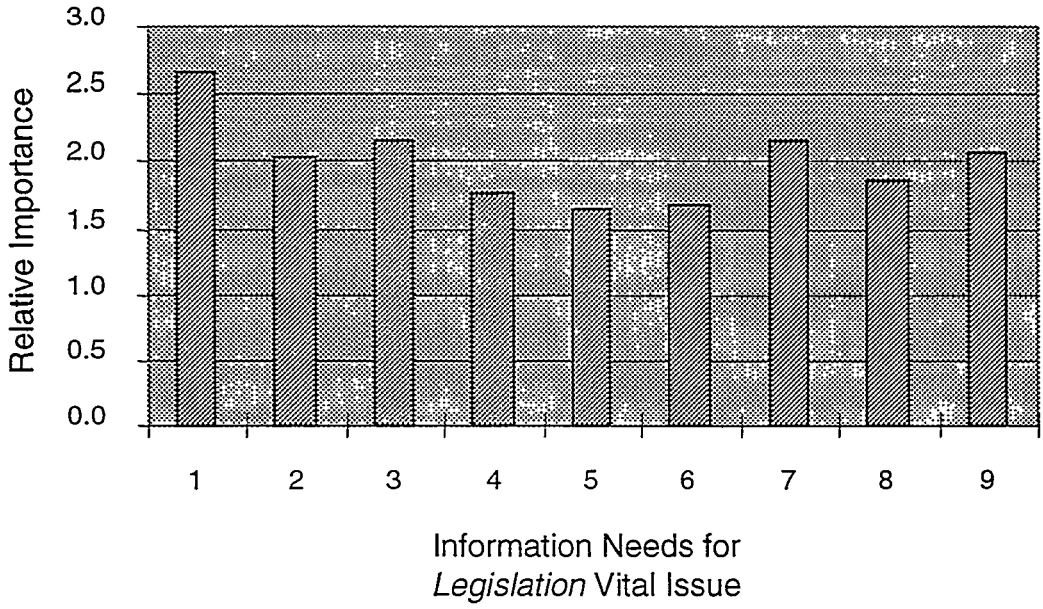

Figure 4. Relative importance of information needs for *Legislation* vital issue.

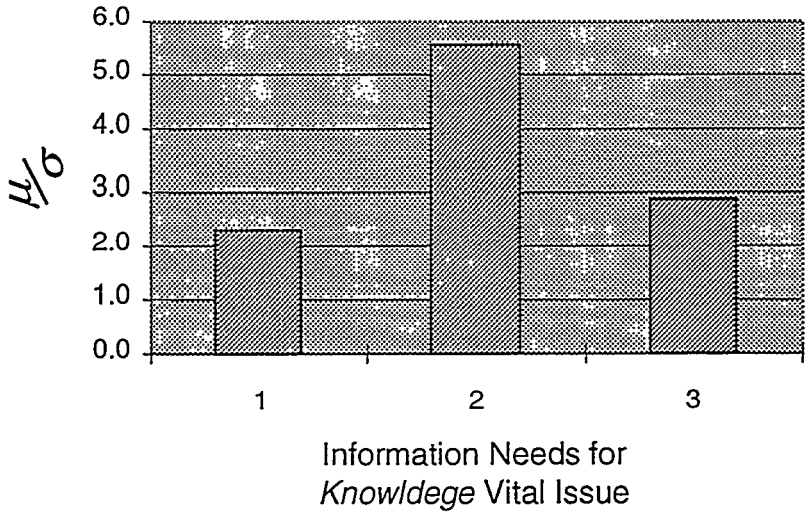

Figure 5. Ranking of information needs for *Knowledge* Vital Issue by the reciprocal of the coefficient of variation.

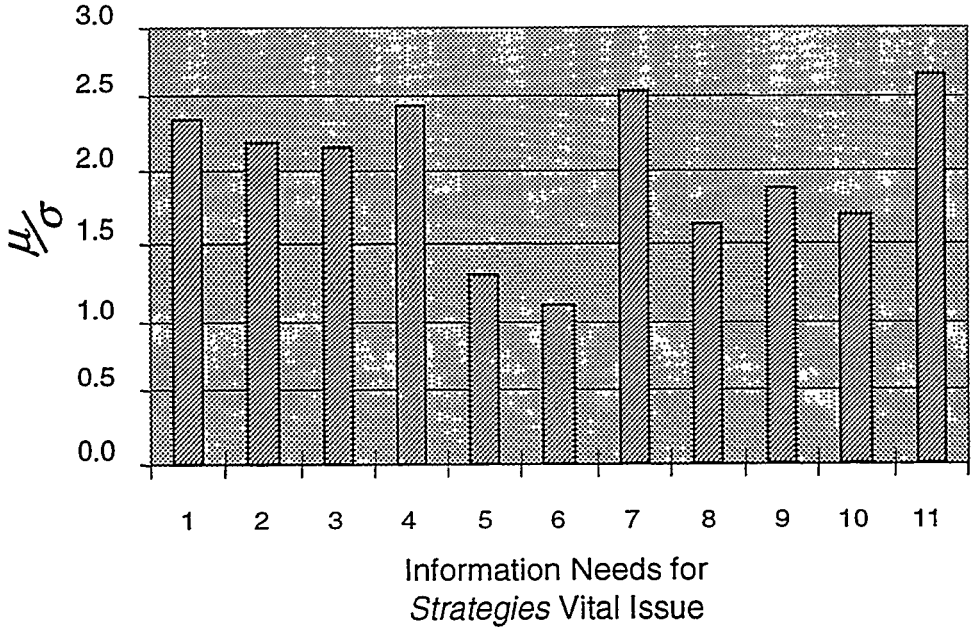

Figure 6. Ranking of information needs for *Strategies* Vital Issue by the reciprocal of the coefficient of variation.

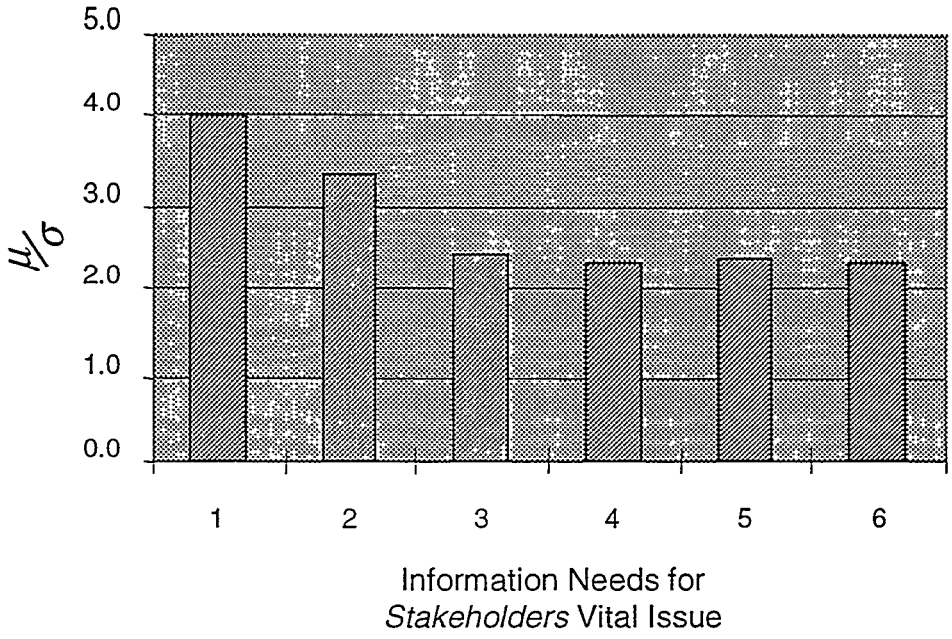

Figure 7. Ranking of information needs for *Stakeholders* Vital Issue by the reciprocal of the coefficient of variation.

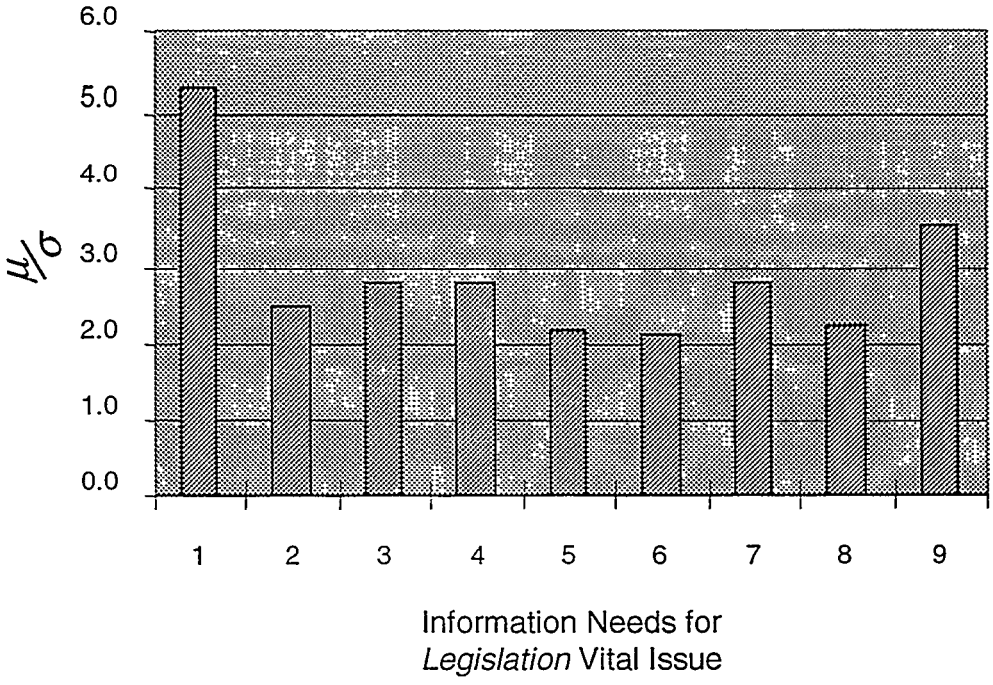

Figure 8. Ranking of information needs for *Stakeholders* Vital Issue by the reciprocal of the coefficient of variation.

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