Quantifying Values and Beliefs in Support of Political Decisions*

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Introduction

The Need

Most decisions made by local governments are based on the subjective evaluation of public values and beliefs. Public hearings are held where stakeholders and various interest groups lobby in support of, or in opposition to, the project. The decision-makers are not regulatory agency staff but elected officials. Political considerations control the decision, which is understandable because the technical issues are complex and the societal issues are strongly emotional. The result almost always takes a long time, costs the project proponent a lot of money, and leaves behind a lot of frustration and unhappiness. There are abundant examples that illustrate the point. They occur in all states, including Oregon (rock quarry and gravel pit) and Nevada (kitty litter clay). There are also public works (infrastructure) projects such as the former planning and engineering of a new bridge across the Columbia River connecting Oregon and Washington via Interstate 5. There is a common thread of much time and money with uncertain outcomes. In today's economy project proponents, government decision-makers, and the public deserve quicker decisions with lower costs. This can be done with a different approach to the process.

The Solution

A high quality decision requires two components. The first is a solid foundation for a political decision. This can be achieved with a quantified consensus of the relative importance weights of components in the economic, natural, and societal environments. The impact assessment term for this process is *scoping*. Every stakeholder and other interest group is encouraged to participate in identifying components of concern in each of the three environmental categories (e.g., jobs, traffic flow rates, tax revenues, wetlands, wildlife habitats, æsthetics, environmental justice, climate change) and sharing their values on the relative importance of each component. Broad participation with each individual's values and beliefs contributing equally to the results removes emotions from the decision-making process and lets the elected officials make a more technically sound and legally defensible choice.

The second component is appropriately using the relative importance weights and their insights for the decision. One robust approach to making an informed decision is to assume that the project will be approved based on a set of conditions and constraints described in a set of alternatives. If an alternative avoids, minimizes, or mitigates all concerns and undesired effects then it can be approved and the decision justified by objective data and comparisons.

High quality project approval decisions are achieved when existing and alternative future environmental conditions are objectively measured. This is easiest when all the most important components are determined from broad input during scoping.

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This white paper discusses the scoping process in detail. The process is completely compliant with federal, state, and other national environmental impact assessment statutes and regulations.

Scoping: Quantifying Values and Beliefs

Introduction

Every solid and enduring structure is built on a strong foundation. For an industrial or public works project that foundation is scoping. This foundation is easily accommodated by a consistent approach that can be applied everywhere while producing project-specific answers. The benefits of such consistency are many, including increased quality, shortened time, and greater incorporation of local values and beliefs.

Scoping Conduct Overview

Broad public participation is the means of strengthening both the assessment of alternative project approaches and the decision made from it. Participation by all stakeholders and other interested parties at scoping meetings should be strongly encouraged. The larger the pool of participants, the more comprehensive is the range of values provided as input to determine which components should be considered in the specific project's impact assessment. Because a computer analyzes the data, there is no practical limit to the number of participants contributing to the process. Evaluation time is not a factor.

In brief, there are two parts to establishing the evaluation's scope: identifying candidate components and rating each one as a quantitative consensus summary of all contributors. This process also broadly defines the concept of "environment." Many people associate the term with only the natural world, but we all live also in economic and societal environments. While individuals might assign higher value to one of these environments than to the others, these differences will vary enough there is no justification for not including all three. The assessment will be more robust because it includes all three environments, decisions are easier because you are not trying to directly compare totally different components.

The three environmental categories, *economic*, *natural*, and *societal*, are broad and incorporate components such as "jobs," "traffic," "noise," "air quality," "æsthetics," and "environmental justice." Details are added later in the scoping process. Because of practical considerations when determining relative importance, we strongly recommend a limit of eight components within each category.

Soliciting Components

The following components are those we use for our testing and demonstration model.

Economic:

- Jobs
- Infrastructure
- Housing
- Tax base
- Traffic volume
- Roads
- Sustainability
- Medical care

Natural:

- Endangered Species
- Habitats

- Wetlands
- Hydrology
- Air quality
- Water quality
- Slope stability
- Ground water

Societal:

- Aesthetics
- Noise
- Recreation
- Quality of life
- Health effects
- Environmental justice
- Cultural heritage
- Urban growth

Determining Importance

Preparing to compare values

Our quantitative approach goes well beyond identifying which components in each of the three environmental categories are valued by the scoping participants. Calculating relative weights of importance of each component provides three important benefits:

1. Demonstration that *all* important components are included for assessment; those deemed unimportant will not consume time and other resources.
2. Demonstration that no individual or interest group has been excluded from the process (except by their choice), and that each individual's expression of values and beliefs has been equally analyzed.
3. There is a solid basis for objectively characterizing the existing and alternative environments based on the importance of components.

A three-step process accomplishes the determination of each component's relative importance weight.

First, generate all 28 pairs of the 8 candidate components. For the natural environment these pairs are:

- Air quality/Water quality
- Air quality/Slope stability
- Air quality/Habitats
- Air quality/Wetlands
- Air quality/ESA species
- Air quality/Ground water
- Air quality/Hydrology
- Water quality/Slope stability
- Water quality/Habitats
- Water quality/ESA species
- Water quality/Wetlands
- Water quality/Ground water
- Water quality/Hydrology
- Slope stability/Habitats
- Slope stability/ESA species
- Slope stability/wetlands
- Slope stability/Ground water
- Slope stability/Hydrology
- Habitats/ESA species
- Habitats/Wetlands
- Habitats/Ground water
- Habitats/Hydrology

Table 1: Numeric values of relative importance of a component in a pair-wise comparison.

Value	Definition
1	Equal importance
3	Weak importance of one over another
5	Strong importance of one over another
7	Demonstrated importance of one over another
9	Absolute importance of one over another
2, 4, 6, 8	Intermediate values between two definitions

- ESA species/Wetlands
- ESA species/Ground water
- ESA species/Hydrology
- Wetlands/Ground water
- Wetlands/Hydrology
- Ground water/Hydrology

Component pairs are also created for the economic and societal components. Asking each participant to think about the relative importance of 84 component pairs is the practical limit of attention that still produces sufficient results for a comprehensive assessment.

Expressing preferences

Determining the relative importance of each component within a category depends on the pair-wise comparison of each component with every other component. Doing this requires thought by everyone participating, but the process is fundamentally no different than that which we use when we decide on which make and model car to buy, make choices from menu items in a restaurant, and make all the many decisions we do on a daily basis.

The comparison scale (Table 1) was developed in the early 1970s by Dr. Thomas L. Saaty, a mathematical economist at the University of Pittsburgh. He developed this scale to use for planning, resource allocations, and priority setting by governments. He applied it world-wide in political, economic, and societal policy decision-making. The 40-plus year history of this scale justifies its use in comparing each pair of components within each of the three categories.

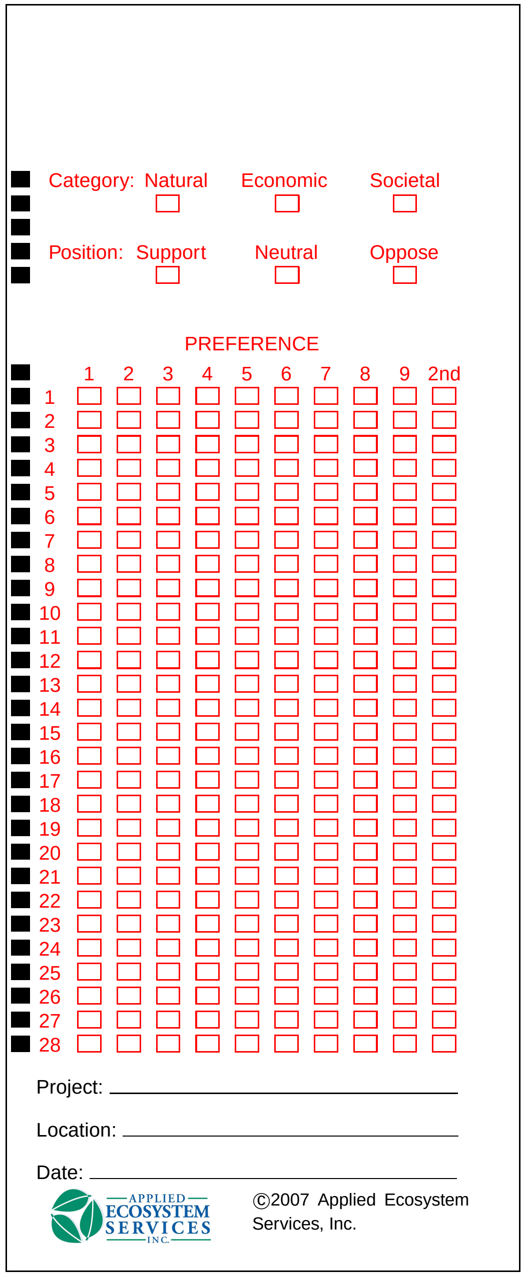
Preferences are recorded on a form (Figure 1), one form for each category. There are several benefits to using these forms when participants express their preferences:

- The process is anonymous. While we write a sequential number on each form so it can be associated with a database record for audit purposes, there is no individual who can be associated with any form.
- Having each participant self-select his position on the project (supporter, neutral, opponent) demonstrates that no group has been systematically excluded from participating and, of equal importance, that each vote is equal to every other vote. No one can "game" the system to drive to a pre-determined conclusion.
- The results are a quantitative measure of consensus, with each participant contributing to the outcome. The votes can be collected over multiple meetings on different days at different locations to ensure the broadest public participation in the process.

Calculating relative importance weights

This part of the process is modified from Dr. Thomas Saaty's *The Analytical Hierarchy Process for Multi-Criteria Decision-Making*[1]. For each category, the votes on pair-wise preferences are collected into a

[1] 1990. RWS Publications, ISBN: 0-9620317-2-0.


Category: Natural Economic Societal

Position: Support Neutral Oppose

PREFERENCE

	1	2	3	4	5	6	7	8	9	2nd
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Project: __________

Location: __________

Date: __________

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Figure 1: The Optical Mark Recording form used to express preferences for one of each pair of candidate components.

Table 2: The societal components arranged as a symmetrical table showing average preferences for each component pair.

	Aesthetics	Noise	Recreate	Quality	Health	Env. Justice	Cultural	Urban
Aesthetics	1.00	2.26	3.07	2.29	2.31	3.54	4.02	3.11
Noise	0.44	1.00	2.97	2.83	2.08	2.62	2.00	3.03
Recreation	0.33	0.44	1.00	2.93	3.29	3.25	2.95	3.34
Life Quality	0.43	0.28	0.25	1.00	2.72	3.39	2.31	2.63
Health	0.32	0.34	0.35	0.48	1.00	2.57	3.10	3.32
Env. Justice	0.38	0.50	0.33	0.34	0.30	1.00	2.28	2.67
Cultural Heritage	0.31	0.34	0.30	0.37	0.30	0.43	1.00	2.65
Urban Growth	0.38	0.39	0.32	0.30	0.44	0.37	0.38	1.00

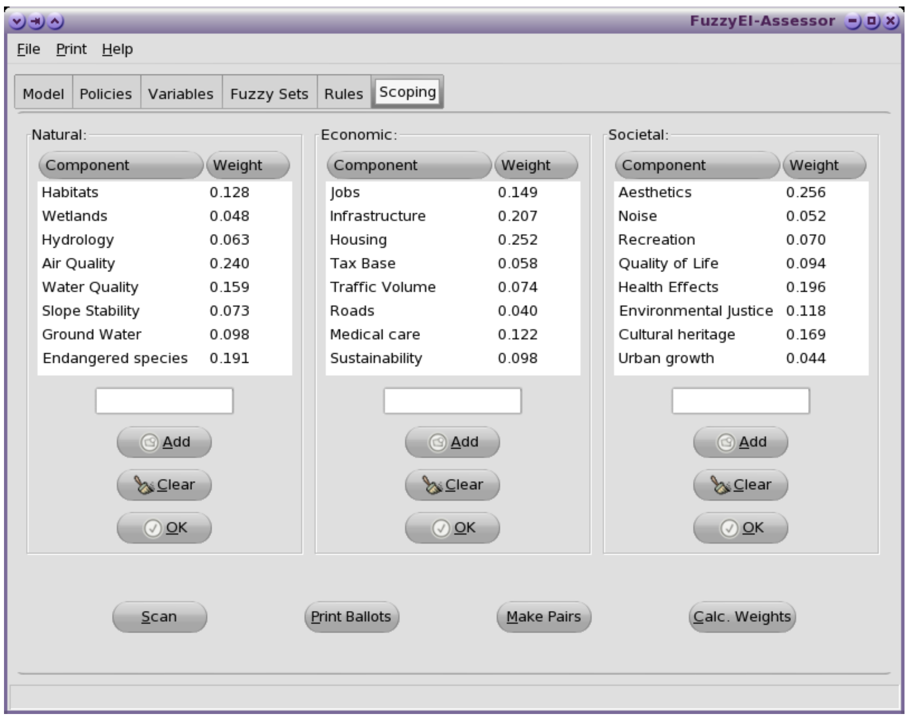

Figure 2: The relative weight of each component in the three categories for the demo model.

symmetrical table. Table 2 shows the symmetrical matrix for the societal factors in the demo model. The original votes were created by a random number generator based on 60 participants in the scoping process. There were 13 project supporters, 14 neutral, and 33 opponents. The individual votes ranged from 1–9, but after they are averaged the extremes have low influence and most of the components are fairly close. This does not mean that they have nearly equal importance to the 60 participants.

In the mathematics of linear algebra, symmetrical matrices can be characterized by a single number called the *Eigenvalue*. The principal Eigenvalue characterizes the entire matrix. Associated with the Eigenvalue is an Eigenvector which, when normalized, represents the relative weight of importance of each component as a consensus of all participants. For the demonstration model, the importance weight of each component in the three categories is shown in Figure 2.

Quantitative Decision Support

It is very important to understand the most important aspect of this approach: no computer model makes any decision. The regulatory decision-makers do. However the decision process is implemented, for example our proprietary model, it is a decision-support system, not a decision-making system. Decision-makers retain total control over the process and the decision.

This quantitative paradigm does provide meaningful benefits over the traditional scoping process. For example, with this method existing conditions and alternative future conditions are quantified using the same criteria, the results reflect local values, most important components, and consensus rules. In addition, technical experts and the public determined the project-specific dynamics so the process is fully inclusive in gathering the information needed for decisions. In brief, the complete process is technically sound, legally defensible, timely, and cost effective.

Summary

This white paper resents a new paradigm for complex project decision-making that:

- Includes all stakeholders, governments, environmental NGOs, tribes, other interest groups, and the general public.
- Fully complies with NEPA, SEPA, CEQA, and other states' environmental laws.
- Is technically sound and legally defensible because decisions are based on quantitative, objective data and not subjective feelings.
- Requires NO changes in current statutes or regulations.

Applying this new paradigm provides an objective basis for high quality decisions and the ability to do more with fewer resources and lower budgets. Decisions are based on: an objective measure of each alternative's impact significance, the comparison of each alternative future condition to the existing condition, and the assurance that all components most important to everyone participating in assessment scoping have been included.

Risks are managed by minimizing or eliminating use of inappropriate decision tools, making a poor decision, making a decision based on insufficient information, conducting an assessment that did not include all relevant components, and having the decision appealed or challenged in court.

Conclusions

1. A local land use planning and resource allocation decision is not a zero-sum game. There is no winner and no loser. Political decision-making involves trade-offs which, when well done, are a pragmatic balance.

2. The natural, economic, and social environments are highly dynamic and adaptable. Every decision changes the current state of all three environmental categories, and they also change from natural, internals shifts. But, this displacement from what appears to be a stable position is normal, and another local stable state will be established until the next disturbance.

3. Political decision-making is not expected to be perfect; there is no single, right answer. As a society we manage risks by using appropriate data and robust analyses that support a technically sound and legally defensible decision.