

# ENVIRONMENTAL DECISION-MAKING & RISK MANAGEMENT

APPLIED ECOSYSTEM SERVICES, INC.

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## Briefing

- Subjectivity causes increased risks to industry and regulators.
- Include everyone's values and beliefs to enhance your results.
- The value of being technically sound and legally defensible.

## Environmental Subjectivity

Subjectivity in environmental laws frustrates industry, regulators, planners, and developers alike. Development and permitting criteria often include terms such as "no significant impacts," "ensure sustainability," and "consistent with local values and cultural traditions." Because the meaning of these terms varies by individual and group, decision-makers often hesitate to act because they do not want to be appealed or challenged.

It does not matter whether the applicable laws and regulations are at the local, county, state, or national levels. There are more than 200 countries with their versions of these requirements; all have the same subjective basis and can be successfully addressed by the same robust approach.

Subjective decisions can always be challenged as arbitrary and capri-

cious. This issue of our newsletter explores where subjectivity occurs and how we quantify that subjectivity. Your results are of very high quality, technically sound, legally defensible, timely, and cost effective.

We have developed a tool, the *FuzzyEI-Assessor*<sup>TM</sup>, that allows us to quantify subjectivity. It uses robust mathematics and logic to compute with words, approximating the reasoning process of a human expert. This newsletter issue introduces you to how we convert subjective feelings to objective data in several key phases of environmental assessment and planning. One big advantage is that this breakthrough requires no laws or regulations to be changed.

To learn whether this approach can benefit you, call us or send an e-mail to the address on page 4.

## Beliefs And Values

The scoping phase allows stakeholders to express their values and beliefs. This is when subjectivity first appears, and it dominates the process. Ignoring opinions of groups--particularly those with an anti-project agenda--provides an opening for later appeal or challenge. Quantifying the full range of values and beliefs expressed by stakeholders reduces risks of future problems. Equally important, these contributed opinions of what is important form the foundation for everything that follows. What components are important to stakeholders is the appropriate

scope of the assessment.

The *FuzzyEI-Assessor*<sup>TM</sup> process classifies "environment" into three categories: natural, economic, and social concerns that are specific to the location of the proposed project. In addition, those participating in the scoping process identify their general position with regard to the project: supportive, neutral, or opposing. This anonymous self-characterization is very important because it ensures that every individual opinion has equal weight and validity. Groups holding a certain position about the project cannot influence the decision-making process by the

presence of overwhelming numbers.

Components to be assessed are broad terms such as "water quality" and "economic growth." The specific aspects of these components will be identified later. After eight candidate components have been identified in each category, participants rate each pair of components relative to each other, using a scale of 1-9. This preference "voting" is done individually by marking a form. As with a political election, the privacy of the secret ballots encourages thoughtful and candid expression of values and beliefs.

(cont.page 2)

The forms are scanned, and the average value of each pair-wise comparison is calculated by category. The average value for each position (supporting, neutral, opposing) is calculated first.

The eight components represent everything important in each category. The results of the pair-wise comparisons are the relative importances of each component as expressed by everyone who participated. The resulting list of relative importance weights are consensus values. Each individual and each position group contributed equally to the results. This procedure is technically sound and legally defensible; and much better than the

traditional approaches.

These relative importance weights are used to calculate the overall "goodness" of the existing environmental conditions and each proposed alternative future conditions. The *FuzzyEI-Assessor*<sup>TM</sup> quantifies the condition of the environments relative to measured values for each component. This is another improvement over how environmental impact assessments have traditionally been conducted.

You may wonder how this helps you, as the project manager, the sponsoring company, or regulatory agency. The benefit is that the *FuzzyEI-Assessor*<sup>TM</sup> provides you with a more meaningful, definitive,

and quantitative rationale of what is included in the assessment. Thus, you will not waste time developing scenarios, collecting data, or analyzing components that are of minor importance to stakeholders. You probably are doing this in a current project, or you have done so in the past. Your efficiency in completing the assessment will increase and you will spend less time and money on things that really do not count for very much. Moreover, since this robust and thoroughly documented process allows you to focus in on the important things, you will probably spend less time in court.

## Significance

Whether project-related changes on the existing natural, economic, or societal environments are significant is the underlying reason for conducting an environmental impact assessment. We provide an approach to defining significance that is technically sound and legally defensible.

Impact significance is the aggregate of eight factors: its nature (positive, negative, neutral; direct or indirect), aerial extent, magnitude, duration (temporary, permanent; intermittent or continuous), reversibil-

ity, ability to be mitigated, occurrence timing, likelihood of occurrence, and the scale over which it occurs (local, regional, national, global).

With the input of agency staff, consultants, and the public each of the eight parts of significance is a fuzzy set describing the domain in which values will be found. The interaction of the parts is an overall measure of impact significance.

There is no a priori assumption that all impacts are negative.

**Significance has 8 parts. Each contributes to the meaning.**

## Environmental Condition Index

Ecosystems are highly complex combinations of components. We do not know all interactions, and many functions are difficult to see. In spite of all this, there are many legitimate needs for a method that captures complexity and variability in a single number useful for spatial and temporal comparisons.

Environmental impact assessments are one such need. How can a decision-maker compare proposed alternative future and existing environment without a technically sound and legally defensible measure of each? Plus, what to include in the characterization of a

complex environment must also be considered.

The *FuzzyEI-Assessor*<sup>TM</sup> solves these two problems with a method useful every-scribus@nashi.altmuehlnet.dewhere. What to include was determined during scoping, when beliefs and values were ranked by consensus into relative importance weights. For each component, there is defined a range of values from "not good" to "very good." For each measured value in the existing and alternative environments a degree of goodness is associated. The goodness is weighted by the component's im-

portance, and the individual results are summed to produce an overall Environmental Condition Index (ECI). This number is directly comparable from place to place, time to time, and among alternatives and the existing conditions. The weights of each component and the domain of goodness reflect local stakeholder values.

Components you included in past assessments may not have been important to stakeholders. That opened avenues for avoidable delays and legal actions.

## Alternatives

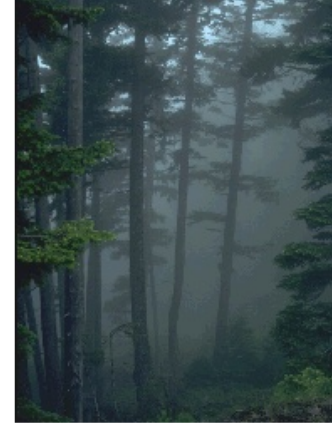
Alternative analysis is another phase of the assessment process where subjectivity and contention can appear. No matter how alternatives are described, the implications of the changes can be difficult to identify and defend. The *FuzzyEI-Assessor*<sup>TM</sup> helps reduce this risk by defining changes using words, not just numbers. For example, a new road might require the fill of 20 hectares of wetlands. This is expressed in terms such as a "small," "moderate," or "large" amount of wetlands relative to what is there now.

A common basis for appeal is that the No Action alternative (what happens if the project does not occur) is mentioned but not analyzed. Because natural ecosystems are constantly changing, albeit at very slow rates in some places, this

does not reflect reality. There is no reason not to analyze the No Action Alternative along with all the others.

Using the *FuzzyEI-Assessor*<sup>TM</sup> approximate reasoning computer model lets the assessment professionals consider as many different alternative futures as desired. The application uses the same components and logic to analyze alternatives as it does for the existing conditions. Because this is a quantitative approach, it is much quicker than speculating using "best professional judgment." And the results are technically sound and legally defensible.

Because assessment analysis is done quickly, various changes can be applied to analyze sensitivity of the model and environment.



## Decision-Making

Every major development has multiple objectives and multiple constraints. Objectives are what the project is desired to achieve or produce. Of course, this can vary with the perspective of the individual or group. A hydroelectric dam project, for example, can have objectives of electrical power generation, flood control, navigation improvements, recreation, fish and wildlife habitats, and agricultural irrigation. These are quite difficult to balance in a reasonable way as well as being objectively documented and supported. By treating each objective as a component of a project alternative, the cumulative environmental condition index allows an objective assessment of relative value among the alternatives and the baseline



conditions. A mine, timber sale, terrestrial power plant, pipeline, or resort development may have a single developmental objective, but spatial positioning of elements as well as developmental and operational timing issues can also be important considerations.

Constraints are limiting factors that need to be considered. Reproductive seasons and locations for fish and wildlife may constrain when and how the project is developed and operated. Slope stability in humid areas or ground water supplies in semi-arid areas may also impose constraints on the project. These constraints can be incorporated into the alternatives and accounted for in the calculations of the environmental condition indices.

Using the objective outputs of the *FuzzyEI-Assessor*<sup>TM</sup> allows the decision-maker to evaluate all important objectives and constraints using a common scale, with results that are directly comparable among themselves. This means that decisions can be reached more quickly and with greater confidence than can be accomplished using the traditional approach of discussion, thinking, and hoping that the choice will stand up to scrutiny, appeal, or legal challenge.

If you have faced the uncomfortable task of defending a decision from the accusation that it was arbitrary and capricious, you will immediately appreciate the added value of a decision based on robust mathematics and logic.

## What Do I Do Now?

The summary of benefits provided by incorporating our expertise and knowledge into your environmental impact assessment or planning efforts does not fully explain everything you might need to make an informed decision whether this approach is right for you. You have several options, and each one will add to what you have learned by reading this issue of our newsletter.

We encourage you to call us or send an e-mail message (the details are at the bottom of this page). Also, please visit our Web site: <http://www.appl-ecosys.com/>. We are always ready to answer your questions and discuss whether this approach, and our *FuzzyEI-Assessor*<sup>TM</sup> approximate reasoning model will give you the support - you want to create a technically sound and legally defensible product that fulfills your needs.

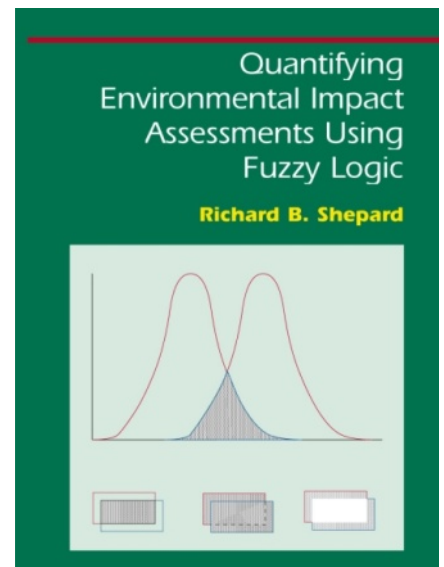
At decision levels of cities and counties, it is usually elected officials who make project decisions,

and they tend to lack the technical backgrounds and experience of agency staff professionals at the state and national levels. These non-technical decision-makers will benefit greatly from the clarity and detail provided by our modern approach. It allows them to make a decision on the basis of measurement and societal values expressed by stakeholders who participated in the scoping and review processes.

Our role in helping you to achieve your goals and objectives is that of technical specialists, experts in quantifying subjectivity and facilitating planning and impact assessment decisions that serve the combined interests of industry, government, and society as a whole. We do not displace the established relationships you have with trusted prime contractors and expert consultants in other relevant technical subjects.

Contact us now for more information. We may be able to help you

with an existing project, and our conversation can help you better plan a future project. For those of you in the private sector, we will help you discover how much you can reduce your environmental risks and associated expenses. For those of you in the public sector, we can discuss how you can gain greater confidence that you are making the correct decision and reducing your risk of legal exposure by incorporating our approach in your efforts.



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