RISK ANALYSIS AS A TOOL FOR MAKING BENEFIT/COST WORK IN AN ENVIRONMENT OF CONFLICT

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WHAT CAN RISK ANALYSIS DO?

- Quantify risk and uncertainty in evaluating and comparing alternative strategies;
- Involve stakeholders and experts in finding consensus; and
- Facilitate the quantification of issues that traditionally have only been addressed qualitatively.

MITIGATING CONFLICT WITH RISK ANALYSIS

- Choice conflict.
  -Project and program prioritization
  -Allocation of limited resources
- Financial conflict.
  -Financial viability of major public investments
  -Financing
- Procurement conflict.
  -Products
  -Contracts/risk sharing

RISK ANALYSIS—A FOUR STEP PROCESS

1. Identify the structure and logic of the forecasting problem—*tangible, intangible.*
2. Quantify forecasting assumptions—*probability, objective, subjective.*
3. Facilitate scrutiny and consensus—*management, stakeholders*
4. Decisions—*strategic planning, resource allocation, timing*

THE FUTURE OF FORECASTING: RISK ANALYSIS AS A PHILOSOPHY OF TRANSPORTATION PLANNING

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Decision-support efforts for infrastructure development take place in an arena where the exposure of risk can be more constructive than the search for certainty. Forecasting in all fields today means accommodating a paradox of planning in an informed society, namely that the quest for certainty can foster indecision, whereas the exposure of doubt can promote resolution and action.

Risk Analysis as a Philosophy of Decision

Risk analysis includes a family of forecasting techniques and planning processes used to (a) examine risk and uncertainty in alternative courses of action and (b) achieve public consensus. The forecasting techniques seek to distinguish the probable from the improbable implications of infrastructure investments, including their transportation, social and economic, environmental, and fiscal consequences. The planning processes capitalize on contemporary methods of group dynamics to promote consensus, find win-win community-government compromise, and ensure timely action on sound investments.

Why Conventional Decision-Support Remedies Fail

Conventional forecasting methods often fuel mistrust by appealing to counterintuitive or mechanical notions of uncertainty. Four examples stand out.

- *What if.* The what-if questions are rarely the kind that impart any genuine insight. Consider the common practice of developing best- and worst-case or high and low scenarios. The flaw is the failure to identify the probability of the alternative outcomes.
- *Doomsday or Utopia.* Another flaw is the belief that all forecasting assumptions (income growth, mode choice elasticities, values of time, and so on) will deviate from expectations in the same direction to manufacture the high and low or best- and worst-case outcomes. In reality the likelihood that all forecast assumptions will err simultaneously in the same direction is as remote as everything turning out exactly as expected.
- *Insensitive Sensitivity.* In another standard procedure known as sensitivity analysis, forecast assumptions are varied one at a time and the resulting changes in projected outcomes are reported accordingly. A problem here is that assumptions and judgments are typically varied by arbitrary amounts instead of by reference to reasoned analysis of potential error. Any measured shifts in the bottom line are thus impossible to interpret meaningfully.
- *Risks Prowl in Packs.* The most fundamental problem is that in the real world assumptions do not veer from expected outcomes one at a time. It is the

prospective result of simultaneous variation in all assumptions that mirrors reality and provides true perspective on the effects of any planning action.

How Risk Analysis Succeeds

Three factors underpin a sound risk analysis process: organizing the planning process for flexibility and consensus, blending the subjective beliefs of stakeholders with the scientific knowledge of experts, and accounting for simultaneously occurring risks.

Organizing for Flexibility and Consensus

Although the public participation literature has long proclaimed the importance of openness and flexibility in the transportation planning process, until now the principle has not been extended to the technical domain, such as the choice of demand forecasting models, estimation of statistical relationships, application of economic assumptions, calibration of engineering algorithms, and so on. In an educated and informed society this is the level at which the seeds of perpetual conflict are sown. To address this problem, the structure of risk analysis unlocks three doors to the technical and scientific aspects of planning.

- Choice and use of planning models,
- Choice and use of technical assumptions, and
- Exposition of results for decision and action.

The first stage of risk analysis involves identification of the result variables (such as traffic demand estimates, the social rate of return, and environmental costs), their suspected causal factors, and the nature of the relationships that link them. Because these elements are common to all forecasting efforts, existing models are easily accommodated and incorporated into a risk analysis process.

In the second stage of risk analysis, the structure and logic diagrams serve to facilitate panel sessions organized to elicit expert and stakeholder beliefs about the effects of causal factors, their uncertainty, and the nature of the relationships that link them to results. For each causal variable and interrelationship identified in the model, panelists provide ranges, or probability distributions, that characterize uncertainty about them. To those unfamiliar with probability and statistics, this task may sound onerous. However new techniques and software programs are designed specifically to make the application of probability analysis accessible and user friendly.

The third stage of risk analysis involves the generation of results for use in decision making by entering the probability values developed in the second stage in the model formulated in the first stage. Technically the result of a risk analysis is a quantitative statement of the probability that an investment will yield a desirable outcome and of the risk that it will not. Computer simulation is used to generate thousands of possible results by allowing all causal factors and relationships to vary simultaneously according to their estimated probability distributions. The frequency with which various outcomes occur and recur forms a probability distribution, or risk analysis, or a project's economic, social, transportation, and environmental consequences.

Philosophically the presentation of a risk analysis differs markedly from traditional modes of forecasting. In particular there is no presumption of a best or most accurate forecast. Instead the whole range of conceivable outcomes is arrayed, together with the estimated probability of each occurring.

Risk analysis changes the way analytic work is portrayed as a basis for consideration by decision makers. It is not characterized as the work of professional analysts, but instead as a broadly based consensus rooted in the community at large. Gone is the presumption that it is for analysts to establish what level of risk a decision maker ought to tolerate. Gone in particular is the convention of presenting the central-case forecast—the outcome with a 50 percent likelihood of being wrong in either direction—as the best quantitative measure for decisions.

Blending Objective and Subjective Data

Each factor identified in a structure and logic forecasting model is assigned a numerical range of possible outcomes, and all possible outcomes within the range are assigned a probability of actually occurring. The result is a probability distribution for each factor. Combining these probability distributions reveals the probable, less probable, and improbable effects of a project, including demand, congestion, social and economic impacts, and environmental consequences.

Where do the judgments about probability come from? The starting point is empirical data gathered in the second stage from which initial risk markers are deduced.

Although the procedure described will be recognized as the standard objective approach to probability, it is only the beginning of an effective risk analysis process. Of equal importance is the subjective approach, which holds that the probability of an event is the degree of belief sustained by an informed person or group of stakeholders that it will occur. The use of subjective probability in risk analysis blends the subjective beliefs of stakeholders with the objective, scientific knowledge of experts.

Infrastructure proposals invoke at every juncture subjective convictions, and it is thus not surprising that the subjective approach to probability in risk analysis has proven itself an appealing and effective consensus-building tool.

In practice, the blending process begins with the assembly of an appropriate panel of subject-matter experts and stakeholder representatives.

A key attribute of the risk analysis process is that stakeholders are never drawn into a debate about who is right and who is wrong. Extreme views may be assigned lower probabilities, but this is wholly different from impugning an individual's view as being unworthy of consideration. Special interest groups will often present technical arguments that differ sharply from the mainstream but are not provably incorrect. Yet in dismissing one view while accepting another, traditional forecasting approaches foster polarization and encourage divisive and unproductive debate. Risk analysis, on the other hand, embraces virtually any reasoned view, albeit with different degrees of probability. Experience demonstrates that the process results in consensus not because of clever group manipulation, but because of its authenticity in dealing with the realities of uncertainty in engineering, environmental science, and economic theories.

Conclusion

Most people believe that the only sure thing about a forecast is that it will be wrong. So it goes in decision support for infrastructure planning. Shifting the debate from "your crystal ball versus mine"—an argument innately unwinnable and endlessly debatable—to matters of the probable and possible allows the debate to shift from unproductive technical controversy to policy, compromise, and action. Risk analysis facilitates that shift.