ENVIRONMENTAL REGULATION AND PROBABILISTIC RISK ASSESSMENT

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We Athenians, in our own persons, take our decisions on policy and submit them to proper discussions; for we do not think that there is an incompatibility between words and deeds; the worst thing is to rush into action before the consequences have been properly debated. And this is another point where we differ from other people. We are capable at the same time of taking risks and of estimating them beforehand. Others are brave out of ignorance; and, when they stop to think, they begin to fear. But the man who can most truly be accounted brave is he who best knows the meaning of what is sweet in life and what is terrible, and then goes out undeterred to meet what is to come.

Funeral Oration Delivered by Pericles circa 430 B.C. Thucydides, History of the Peloponnesian War,
I. Introduction.

Four related questions are addressed:

• what is a probabilistic risk assessment (PRA);
• what kinds of problems does one encounter in performing one;
• how might one be used, in general; and
• what problems are encountered when one is used in environmental regulatory programs.
II. What is a PRA?

A. A probabilistic risk assessment is a comprehensive, structured and logical analysis aimed at identifying, assessing and ultimately quantifying the risks in complex technological or natural systems. Often the PRA concept is described as a “triplet” comprising three fundamental questions. What can go wrong? How likely is it? What are the consequences?

B. Performing a PRA is explained using a simple example (being late for work), employing event trees and fault trees.
Event Tree

Get up late  
Car starts?  
Train/ subway available?  
Colleague available?  
Road clear?  
Late again!

Yes

Y  No
N  Yes

No

Y  No
N

Yes

Y  No
N

Yes

Y  No
N

Yes

Y
N

Yes
III. PRA Problems.

A. Selection of the “bad event” or “bad consequence” to be evaluated and the selection of initiating events.
B. Problems with “worst case” analyses.
C. Data uncertainty.
D. Model uncertainty.
E. Special problems with event screening (excluding low frequency events or failures from the analysis).
IV. General PRA Uses.

A. Using “bottom line” PRA risk numbers and PRA uncertainty.

B. Suggesting the existence of previously undiscovered vulnerabilities or that features of the system that have received little attention are in fact major contributors to overall risk.

C. Use in “risk informed” decision making.
V. PRA Uses in a Legal Framework for Regulating Health, Safety or Environmental Hazards.

A. Different regulatory frameworks distinguished:
   (1) Pure risk framework (including zero risk).
   (2) Utility based framework (including cost-benefit analyses).
   (3) Technology based framework (requiring “best available” or “best practical” technology).
   (4) Hybrid (combined) framework.
   (5) A requirement that pollution be prevented, reduced, and controlled suggests the application of a hybrid framework, with judgment to be exercised regarding which kinds of pollution risk are to be managed in a zero risk framework (or near equivalent) and which kinds of pollution risk are to be addressed in a utility based or technology based framework.
V. PRA Uses in a Legal Framework for Regulating Health, Safety or Environmental Hazards.

B. A PRA may in theory be used in all frameworks except (3) special problems with using a PRA in a zero risk framework (accomplishing zero overall risk is usually impossible).

C. Special problems with using a PRA in other frameworks.
   (1) Expense
   (2) Availability of expertise
   (3) Uncertainty
   (4) Transparency in decision making and need for confidentiality.
Advantages of a PRA in Regulatory Programs.

A. Eliminating regulatory myths and bureaucratic inertia.
B. Focusing regulatory oversight on significant risks.
C. Knowing where to require redundancy and diversity, based on areas of significant risk and uncertainty.
D. Focusing research.
E. Budget justification.
VI. Conclusion.

Ignorance about the risk in complex engineering or natural systems is not bliss and a properly conducted PRA will tell you things about risk you really should know. However, careful PRA planning and execution are essential. Moreover, using a PRA in a regulatory setting required good judgment based on knowledge of how a PRA is conducted and its limitations.
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