



“Solution-Focused Risk Assessment”: Reversing the “Red Book” Relationship

SRA/RFF Conference on “New Ideas in Risk Regulation”
Washington, DC
June 22, 2009

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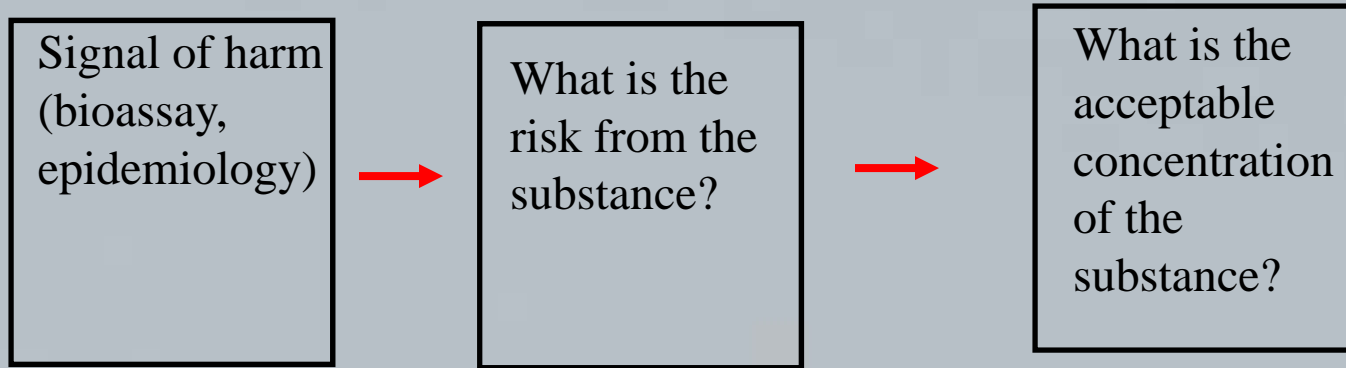
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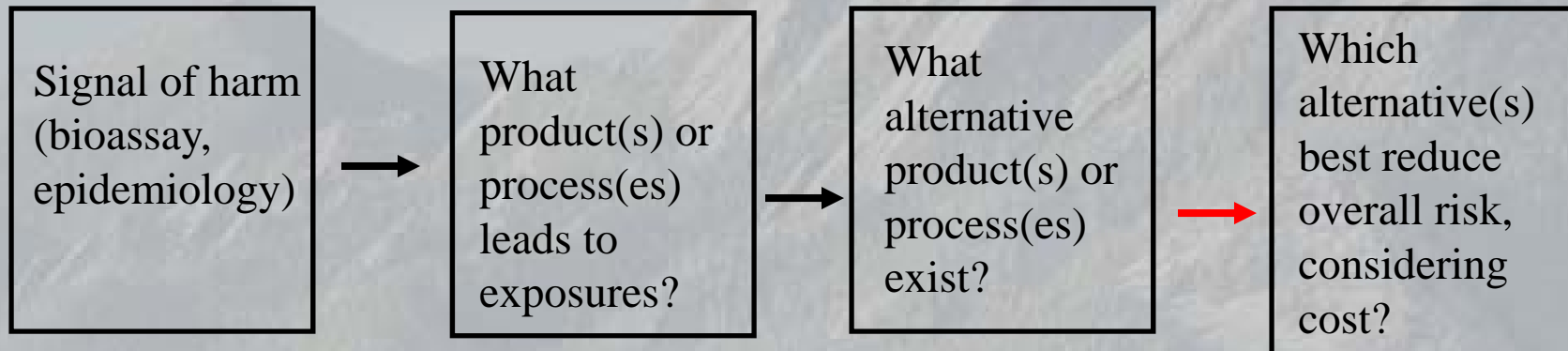
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[the “old” (current) way]



[a possible new way]



Main Assertions:

- We've gotten so far away from grounding risk assessment in a decision-making context that we increasingly refer to as “decisions” things that really are nothing more than *pronouncements* about risk. EPA “decides” that the NAAQS for ozone should be 75 ppb; OSHA “decides” that workplace air should contain less than 5 ug/m³ chromium(VI)—but these say merely that IF such levels were achieved, a certain acceptable amount of harm would persist. Worse yet, even if we assume perfect implementation and enforcement of controls [that may never have been defined in the “decision” process], **at best** these “decisions” will achieve *a defined amount of exposure reduction, but not necessarily ANY risk reduction*, because of risk-versus-risk effects!
- If we're going to decide rather than merely opine, the fundamental chicken-and-egg question is whether risk assessment questions should precede or should follow risk management questions.

You are more likely to choose the relatively best decision if you think your way from solutions to problems, rather than dissecting the problem until you are ready [or told that you must be ready!] to “find a solution to the well-understood problem.”

The earlier in the process you think about what *can* be done, the more likely you are to think of better ways to do it, solutions that cannot possibly occur to you after the problem has been defined in such a way as to exclude them.

Two Simple Examples of “SFRA 1.0”

- No lonely 20-year-old would draw two functions—an upward-sloping utility function over the physical beauty of a hypothetical date, and a downward-sloping one for the probability that a beautiful woman would go out with him—and “solve” the problem by finding the optimal level of attractiveness. One would hope he would consider beauty, receptivity, and other attributes of *women he actually knows* to decide which of them to ask out.
- There are many anthropogenic sources of dioxin (TCDD) and considerable uncertainty about the risk of TCDD as a function of exposure. A problem-centric approach (the approach we have taken over the past 25 years) would seek to understand the inherent properties of TCDD well enough to define acceptable levels in various environmental media. *By contrast, the first step in a solution-focused approach would be to ask what opportunities exist to reduce TCDD exposure.* One of these—arguably not nearly the most important, but not trivial either—is the contribution to ingestion exposure of TCDD by paper products used in food preparation, especially coffee filters and tea bags that contact hot water.

Other “Aha!” Ways To Recognize SFRA

- It reverses the original Red Book paradigm (in which risk management doesn't begin until risk assessment has “defined the problem”), to one in which a (preliminary) risk management step starts the process and *harnesses risk assessment to evaluate solutions*.
- It shifts the balance more towards design standards and away from pure performance standards—but more than that, it attempts to capture the best features of both.
- It combines risk assessment and more holistic decision frameworks such as life-cycle analysis, green design, and inherently safe production processes. It puts risk assessment to work comparing different ways of controlling hazards from the same “functional unit,” in LCA-speak.

Other Guises of SFRA (cont.)

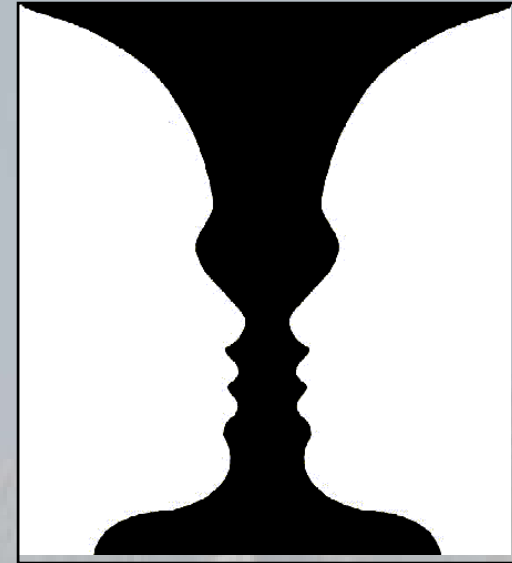
- It shifts attention away from continued angst over the performance of risk assessment, and instead picks up on advice (first?) offered by Bernie Goldstein in 1993: “It is time for risk assessors to stop being defensive. Because risk management is broke is no reason to fix risk assessment.”
- It changes risk-versus-risk assessment from a theoretical footnote (or a monkey wrench to justify turning our back on risks) to an integral feature of any analysis—from “what are *some* of the benefits from less exposure to one substance?” to “what are the *total* benefits of various actions designed primarily to reduce exposure to one substance?”
- It restores risk assessment to a central place in environmental policy, just in time to avoid alternative paradigms that do away with it altogether in the name of replacing “paralysis by analysis” with “who needs analysis?”

Disclaimers (Please don't object to a caricature of this idea)

- SFRA is not suited for every environmental problem—it will never displace the traditional problem-centered method entirely.
- It is aimed at the *regulatory* agencies—there's no reason for NIEHS, etc. to alter their problem-only mode of doing business. But the “P” in EPA should imply efforts that reduce risks, not ones that culminate with understanding but no action.
- *Thinking* about ambitious solutions (“SFRA 2.0”) does not imply the authority to actually implement the optimal solution. But EPA and the other agencies could be more useful even if they complete their work with a “we require these actions, which represents the limit of our authority—but in case you're interested, the following additional or other actions (ones we can only mention but not require) would do even more good.”

More disclaimers

- SFRA is only about putting *relatively* more emphasis on solutions and relatively less on problems-in-a-vacuum—not about doing one and not the other. Instead, every activity of EPA/OSHA/FDA/CPSC/NHTSA/etc. should be viewed *simultaneously* as a challenge (problem) and an opportunity for change (solution). The trick is to be able to see both “foreground” and “background” simultaneously, and not to fixate on one and lose the ability to see the other:



- SFRA only helps to the extent that risks and costs are important—if the decision has to be made on other grounds (faith? a roll of the dice?), SFRA will be a waste of time—but then so will risk assessment.
- “The best solution is to do nothing” is always a permissible outcome of SFRA, if that is where the analysis takes it (all solutions increase net risk, or reduce risk at too great an economic cost).

Expected Advantages of SFRA

- *Produces results, not aspirations*—and does so more quickly. When the goal is to “understand the problem,” stopping points are elusive (more analysis almost always yields more understanding), whereas the natural time to move from analysis to action is when uncertainty has been reduced *enough* to make it unlikely that any other decision will overtake the one supported by the analysis to date.
- *Finally melds the best features of risk-based and technology-based standard-setting.* Technological mandates without risk assessment (e.g., the Clean Air Act for toxic air pollutants from 1990 to roughly 2004) produce results, but of unknown benefit (any “best technology” can be insufficient, or more costly than needed). Conversely, risk assessment without grounding in technology (e.g., CAA for toxics pre-1990 and again post-2004) can identify the optimal future, but can leave us helpless to get from here to there.
- *Provides the only sensible way to gauge the value of additional information.* Information has value only insofar as it lessens the probability and/or magnitude of *the costs of error*, with “error” defined as choosing incorrectly relative to another foregone choice. Without putting the decision options up front, the best one can do is to assume that the most valuable information is that which reduces the largest uncertainties, which is often not the case—and this assumption provides no guidance as to *when* to stop reducing uncertainty and decide.

Expected Advantages (cont.)

- *Gives stakeholders an opportunity to do what they most want and are best at—to comment from their special knowledge and preferences about decisions, rather than about science. Having a public forum to discuss fish consumption rates (or alternative modes of carcinogenic action) invites heat without light.*
- *Steers the process away from nonsensical “best estimates” and towards “best decisions.” It is tempting to handle model uncertainty by constructing a hybrid estimate of risk weighted by model likelihood (“10,000 will die if the mouse tumors are relevant to humans, but there’s a 40% chance they aren’t, so we’ll call the risk ‘6,000’”). Rather, we should average the costs and benefits of each decision under uncertainty.*
- *Highlights the pressing need to fix the broken part of quantitative environmental analysis—the estimation of regulatory costs and their uncertainty and interindividual variability. If we are going to consider cost (as I think we should, even when statutes forbid agencies from acting on this information), then we should get the costs right and be honest with respect to uncertainty and variability. Actions have costs—so do promises that some concentration or emissions level will be met—but the former can actually be analyzed, whereas the latter can only be concocted.*
- *Puts risk-risk tradeoffs front and center, but as impetuses (impeti?) for seeking solutions to multiple problems, not as excuses to do nothing.*

Misconceptions about SFRA

- Putting **decisions** in charge is not the same as putting **decision-makers** in charge. The “firewall” (the “conceptual separation”) never meant keeping the identity of solutions away from the risk assessors—it only meant protecting assessors from manipulation. Yes, in a corrupt SFRA process risk managers can order assessors to “evaluate these N choices, but make sure that Choice 3 comes out looking best.” But the current process can degenerate just as well (“evaluate this risk, but make sure to make it as high/low as you can.”) Flipping the Red Book process diagram around does not *per se* invite any more or less corruption than the current process—safeguards must be present either way.
- Evaluating choices is not the same as mandating “best available technology.” The point of analyzing risks and costs is that the “best” is sometimes not good enough, and sometimes is more than is needed. In addition, the choices need never be limited to technological fixes—labeling (right-to-know) might be the best decision, or marketable permits whose quantity and price are defined by risk and cost-of-control information.

Possible misconceptions (cont.)

- Settling for less-than-perfect knowledge about risk (“enough to choose confidently”) is not the dumbing-down of risk assessment. Quite the contrary—it will take a *smarter* brand of risk assessment to answer questions about benefits that RfDs and MOEs can’t illuminate.
- Evaluating choices is not the same as rose-colored glasses that assume there is always a risk-free choice. It is possible (and advocated by some, e.g., Mary O’Brien) to evaluate choices through only the lens of prevention—but her parable (“why compare the risks of swimming across an icy river when there is a bridge I can walk across?”) presupposes a free lunch where there may not always be one. *When there is no “bridge,” and when staying put is risky too, the choice of where and how to cross cries out for analysis.*
- Mindlessly “solving” non-problems is not the same as setting sensible, *solution-based* priorities—but there is also virtue in solving some small problems cheaply.

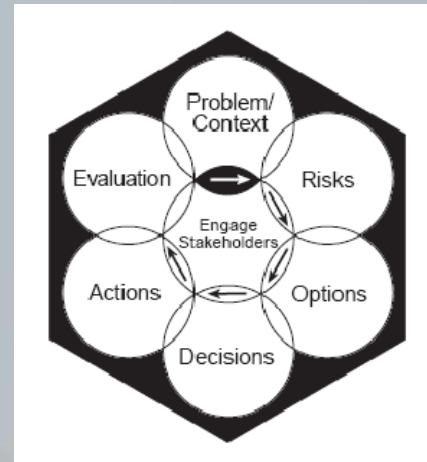
Debts to Other Ideas

- Pioneers of decision-theoretic approach to environmental problems (Ralph Keeney, William Clemen, etc.)
- Cumulative risk assessment at EPA (Mike Callahan, Ken Sexton, etc.)
- Life-cycle analysis champions (e.g., SETAC)
- Technology options analysis (but herein with risk assessment embraced rather than marginalized)—Nick Ashford
- “Solving for Pattern”—Wendell Berry (“To define an agricultural problem as if it were solely a problem of agriculture—or solely a problem of production or technology or economics—is simply to misunderstand the problem, either inadvertently or deliberately... The whole problem must be solved, not just some handily identifiable and simplifiable aspect of it.”)
- “TRIZ” (*Teoriya Resheniya Izobretatelskikh Zadatch*)—Russian (1946)
“theory of solving inventors’ problems”—see <http://www.triz-journal.com/archives/1997/02/a/index.html> for an example of “the ideal final result” for improving the lawnmower (grass engineered to stop growing when it reaches a 3” height) (with thanks to Mike Callahan for presenting it)
- Bjorn Lomborg—“Copenhagen Consensus” ranks solutions rather than problems; popularized via “How to Spend \$50 Billion to Make the World a Better Place” (next slide)

	SOLUTION	CHALLENGE
1	Micronutrient supplements for children (vitamin A and zinc)	Malnutrition
2	The Doha development agenda	Trade
3	Micronutrient fortification (iron and salt iodization)	Malnutrition
4	Expanded immunization coverage for children	Diseases
5	Biofortification	Malnutrition
6	Deworming and other nutrition programs at school	Malnutrition & Education
7	Lowering the price of schooling	Education
8	Increase and improve girls' schooling	Women
9	Community-based nutrition promotion	Malnutrition
10	Provide support for women's reproductive role	Women
11	Heart attack acute management	Diseases
12	Malaria prevention and treatment	Diseases
13	Tuberculosis case finding and treatment	Diseases
14	R&D in low-carbon energy technologies	Global Warming
15	Bio-sand filters for household water treatment	Water
16	Rural water supply	Water
17	Conditional cash transfers	Education
18	Peace-keeping in post-conflict situations	Conflicts
19	HIV combination prevention	Diseases
20	Total sanitation campaign	Water
21	Improving surgical capacity at district hospital level	Diseases
22	Microfinance	Women
23	Improved stove intervention	Air Pollution
24	Large, multipurpose dam in Africa	Water
25	Inspection and maintenance of diesel vehicles	Air Pollution
26	Low sulfur diesel for urban road vehicles	Air Pollution
27	Diesel vehicle particulate control technology	Air Pollution
28	Tobacco tax	Diseases
29	R&D and mitigation	Global Warming
30	Mitigation only	Global Warming

Small Steps (Lip Service?) to SFRA:

- PCCRAM—“In some cases, examining the options may help refine a risk analysis”



• Ecological Risk Assessment’s “Problem Formulation (PF)/Planning & Scoping (P&S)”—these improve on the Red Book by vowing to “address the needs of the decision-maker.” HOWEVER, these stop well short of evaluating solutions, because they concentrate on the (welcome) expansion of the definition of the true problem at hand. PF (by its very name and by its practice) is more about designing the *risk assessment itself* than about designing the optimal solution; P&S is about bringing decision-makers and stakeholders to the table, and ensuring that they consider multiple stressors, but does not imply scoping the solutions.

An Example of “SFRA 2.0”

Question Analytic Exercise(s) Pronouncement Response by Foam Assemblers Response by Airplane Painters

(EPA) What is the RSD(10^{-6})?	Potency	No more than 25 ppb in outdoor air	<ul style="list-style-type: none"> • nothing? • Close windows? • Switch to n-propyl bromide? 	<ul style="list-style-type: none"> • nothing? • Close windows? • Still dispose of paint/MC slop
(OSHA) What is the RSD(10^{-3})?	Potency	No more than 25 ppm in indoor air	<ul style="list-style-type: none"> • non-comply? • open windows • switch to n-PB 	<ul style="list-style-type: none"> • non-comply? • Open windows • Strip less often (accidents)?
What is BAT for foam sector?	Efficiency	Require thermal oxidation	<ul style="list-style-type: none"> • incur large costs? • move overseas? 	N/A
What is BAT for plane sector?	Efficiency	Require steel shot	N/A	<ul style="list-style-type: none"> • comply (accidents?) • move overseas?

Example of Different Paradigms

Question	Analytic Exercise(s)	Pronouncement	Response by Foam Assemblers	Response by Airplane Painters
How can we produce foam cushions at min [risk plus cost]?	Risk, Efficiency, Cost, Distribution	Require carbon adsorption	<ul style="list-style-type: none"> • comply? • not? 	<ul style="list-style-type: none"> • N/A
How can we repaint planes at min [risk plus cost]?	Risk, Efficiency, Cost, Distribution	Require walnut shells	<ul style="list-style-type: none"> • N/A 	<ul style="list-style-type: none"> • comply? • not? • dispose of paint
How can we provide air travel at min [risk plus cost]?	Risk, Efficiency, Cost, Distribution	Ban (tax) painted planes	N/A	<ul style="list-style-type: none"> • Metal with stickers • Less fuel used*

* An unpainted 747 weighs 500 lbs. less than a painted one; American Airlines saves 7 million gallons of jet fuel per year by eliminating paint (about 0.5% of its total fuel consumption)

Two other analogies:

- A medical analogy—“my pants are too tight” is a problem statement that leads to a measurement and the advice to buy size 38 pants instead. But viewed as an *opportunity for change*, the symptom of tight pants might lead to a decision analysis of liposuction versus gastric stapling versus amphetamines versus diet/exercise.
- (adapted from “Pipe Dreams,” NY Times op-ed Oct 3, 2007) The “problem” of reaching acceptable levels of risk for hundreds of contaminants in public water supplies leads to MCLs; the opportunity of “how do we provide houses with safe water, some of which will be used for drinking and some for washing clothes?” might lead instead to “ 10^{-4} water” coming into the house, after which only the drinking water is further purified via point-of-use devices to reach “ 10^{-6} ” or less risk—ingestion risks can be further reduced while overall cost and energy use might go way down.

Serious Concerns (other speakers)

- Statutes don't permit such expansive thinking, so it is a waste of time and resources.
- Analyzing solution options is even more complicated and resource-intensive than analyzing risks.
- Dose-response and exposure information is often in the public domain, whereas information about the efficiency and cost of technologies is often closely-held by the regulated community, which raises the specter of strategic manipulation or withholding of information in order to preordain desired solutions.
- Design standards are by definition more expensive to comply with than performance standards (but I advocate design standards with an option to achieve equivalent performance).

Conclusions (1)

- At best, a traditional risk assessment can tell us *what to fear*; a solution-focused risk assessment can help tell us what to do.
- At best, a traditional risk assessment can aspire to *do less harm*; a solution-focused risk assessment can aspire to *do more good*.
- Arguably, risk assessment is under fire, and must adapt or be supplanted. We assessors can be at the periphery in a regime based on the precautionary principle, or we can be at the center of a regime based on the scientific and economic analysis of decision choices.

- Seeing risks as opportunities for change, rather than as problems to dial downwards, requires a level of interagency cooperation (and OIRA coordination) not seen in our lifetimes.
- While evaluating choices is better than not evaluating choices, evaluating them at the middle or the end of the process is far inferior to evaluating them at the beginning. Risk assessors need to insist on being empowered to evaluate solutions as they begin and as they refine their work. The adage “if all you have is a hammer, everything starts to look like a nail” is out of sequence: the real dilemma is that once you decide that you are here to “assess the size of a nail,” the only choice left is what color hammer to use and how hard to swing it.