

Organizations Matter: Monitoring and Long-Term Governance

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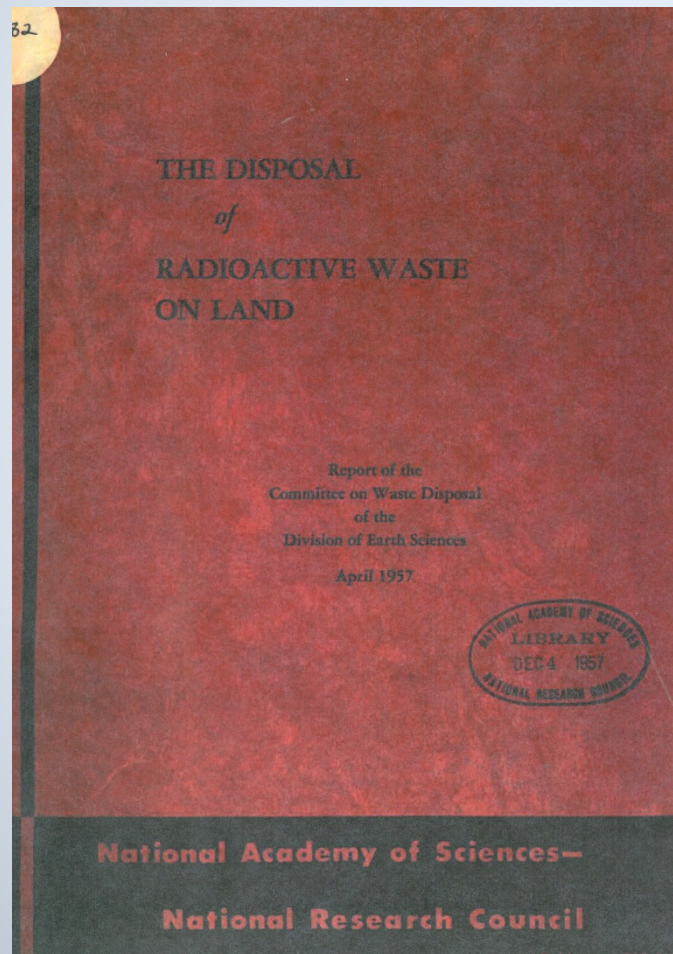
“The biggest problem in dealing with radioactive waste is that people are involved.”

Edward Teller 1975

Argument That Will Be Advanced

- By not reflecting on the organizational issues associated with developing of a deep-mined, geologic repository, early discussions about waste management left the impression that the activities to be undertaken will be virtually **self-implementing**.
 - ✓ Once identified and specified, the activities will naturally occur.
 - ✓ Questions of execution are decidedly secondary to technical questions.
- When it comes to the act of monitoring and its ramifications, that impression has softened, but organizational issues are rarely explored even today.
- Organizational behavior is critical to monitoring because it controls how two questions are addressed.
 - ✓ How is the reliability and validity of new information evaluated, especially if it is opaque and ambiguous?
 - ✓ Under what circumstances are courses altered, especially when change can be controversial?
- Failure to give serious consideration to organizational design and behavior can undermine the governance of radioactive waste management.

How You View a Problem Determines What You See

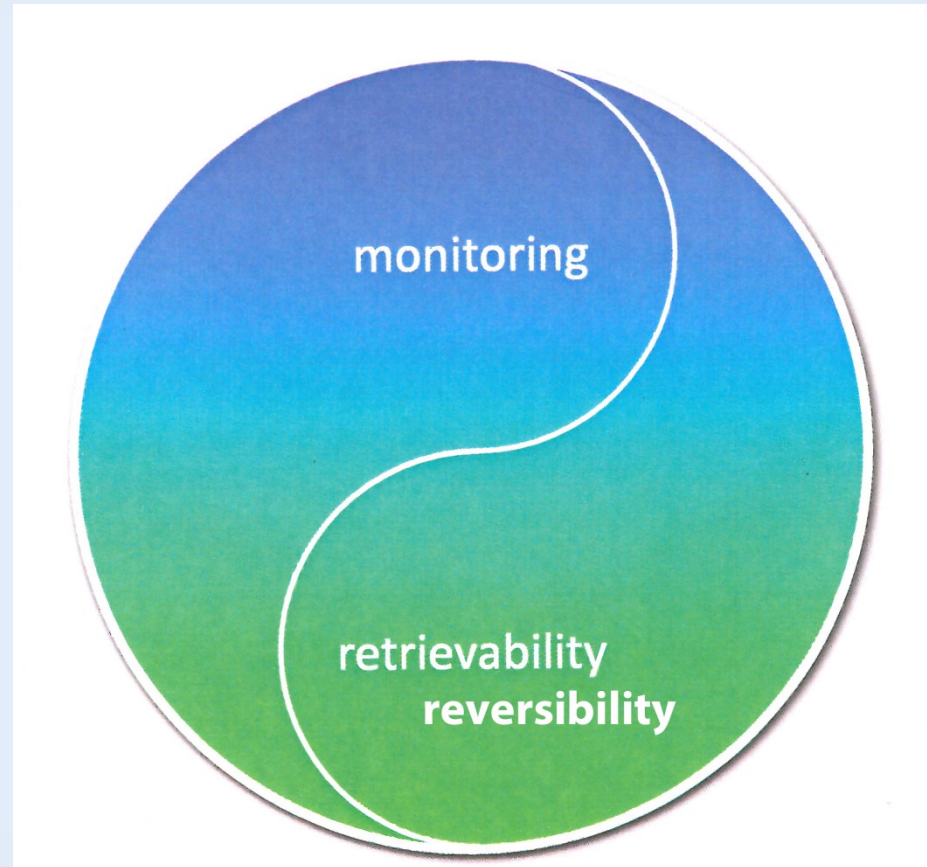


- Rejected “perpetual” tank storage of HLW and advanced the idea of a deep-mined geologic repository
- Failed to appreciate what it would take to develop a repository
 - ✓ Fostered a sense of technological optimism, which prompted a belief in a “technical fix”
 - ✓ Did not foresee the organizational challenges that were likely to arise

Waste management activities are not self-implementing. They place significant demands on the organizations involved.

NAS 1957

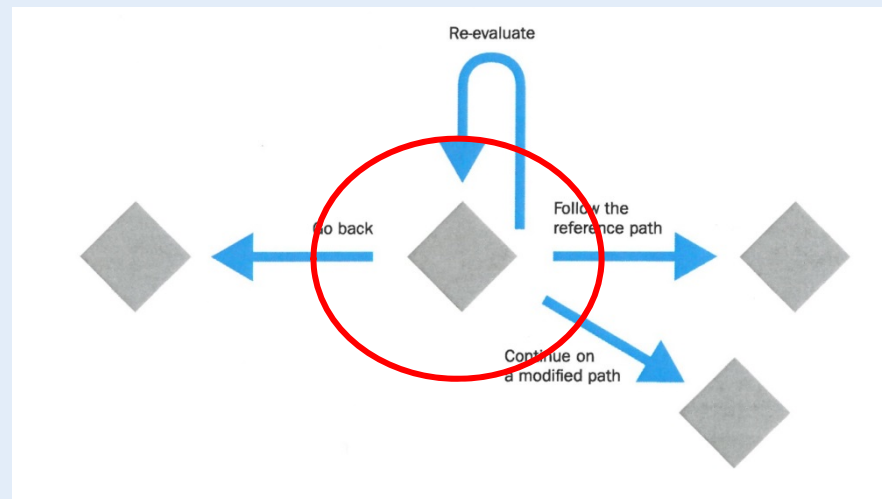
Yin and Yang



Adapted from Poley and Schröder 2016

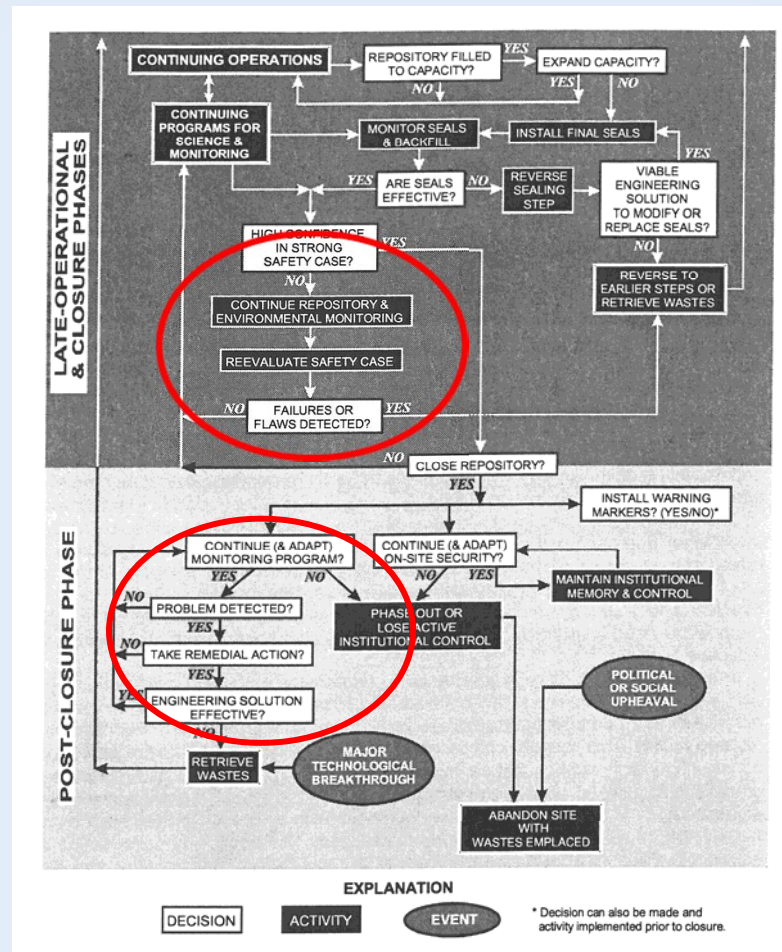
Stepwise Repository Development (I)

“Stepwise implementation of plans for geological disposal leaves open the possibility of adaptation, in the light of scientific progress and social acceptability, over several decades, and does not exclude the possibility that other options could be developed at a later stage.”



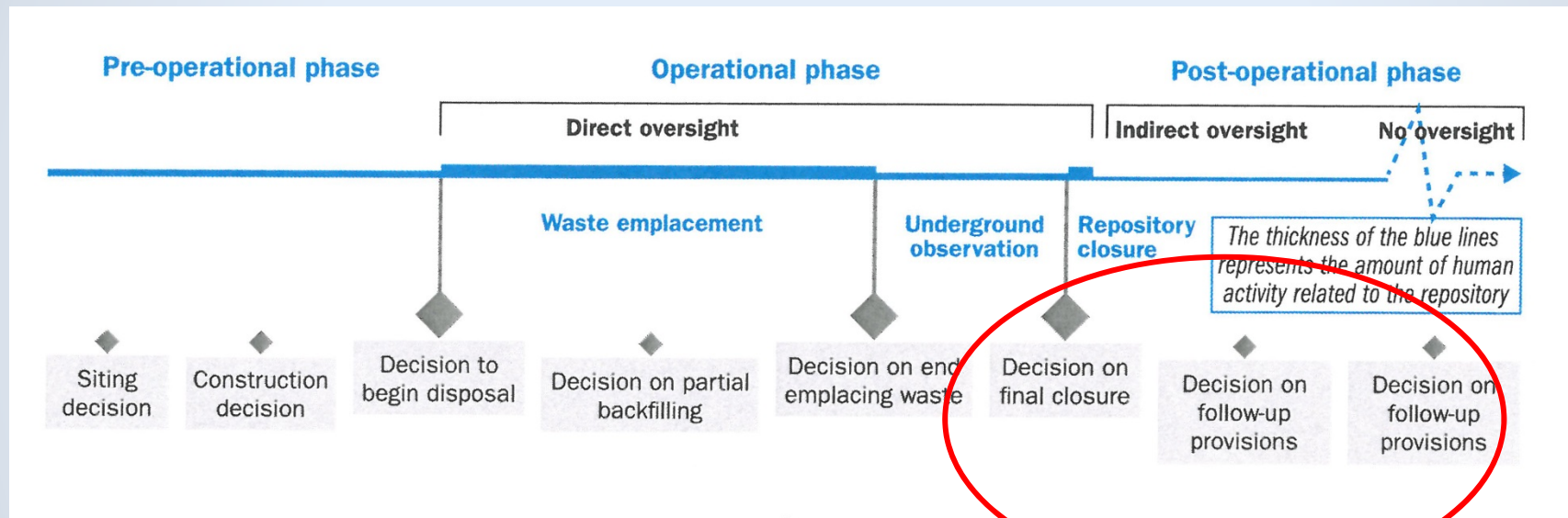
NEA 1995, 2012

Stepwise Repository Development (II)



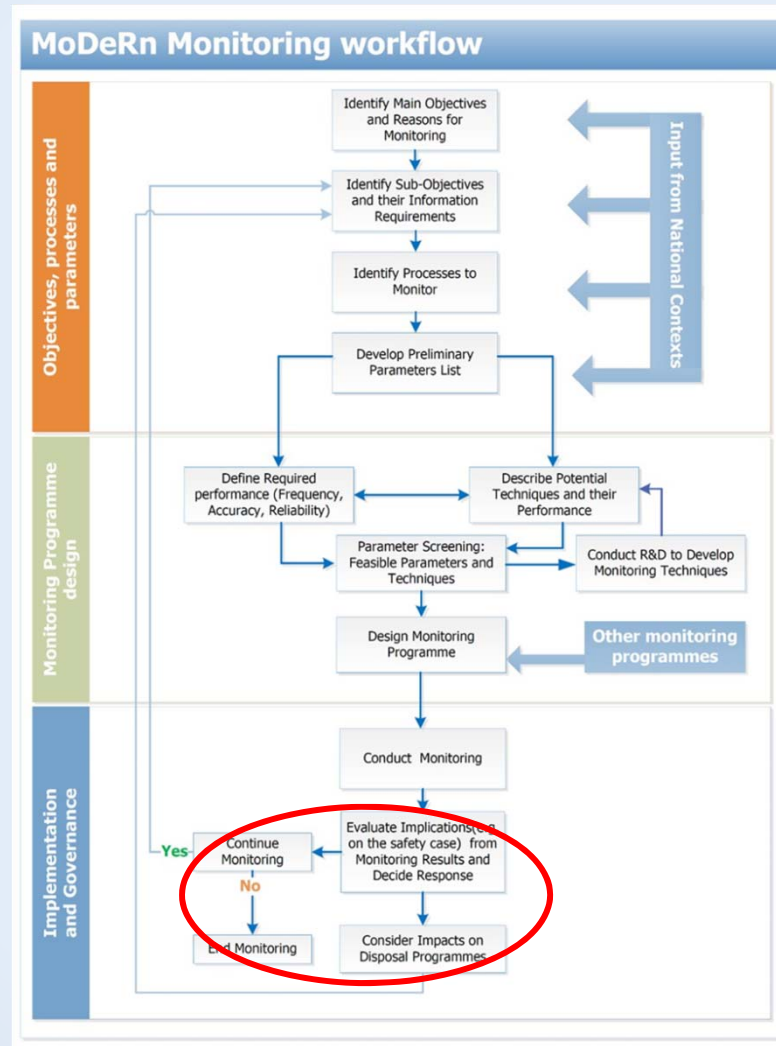
NAS 2003

Reversibility and Retrievability



NEA 2012

Monitoring



MoDeRn 2014

Empirical Analysis and Prescriptions

- Given the role that monitoring plays in driving decisions about reversibility and retrievability, it is surprising how little attention is paid to understanding how organizations choose.
 - ✓ Few relevant cases?
 - ✓ Missing expertise?
 - ✓ Residual power of the belief regarding self-implementation?
- To the extent that it is considered at all, organizational behavior is only addressed prescriptively.
 - ✓ Flexible
 - ✓ Open and transparent
 - ✓ Self-critical
- Two questions go to the heart of the matter.
 - ✓ How do organizations evaluate the reliability and validity of new information, especially if it is opaque and ambiguous?
 - ✓ How do organizations alter course, especially when change can be controversial?
- A number of theories and constructs used in the social sciences can suggest some answers.

Evaluating Reliability and Validity: Enduring Uncertainties

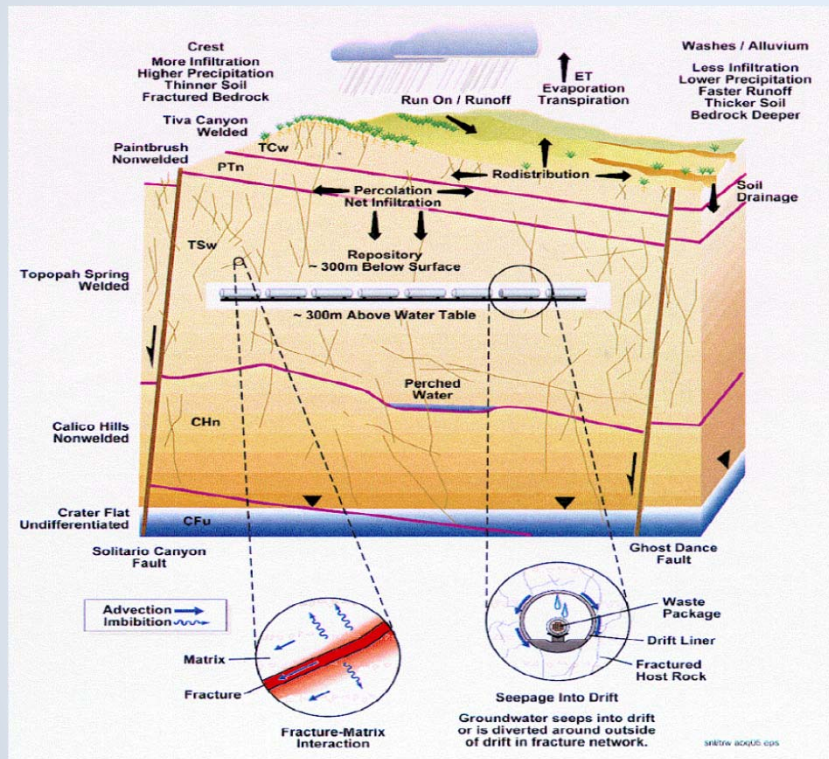
- Key parameters of the safety case have to be identified to specify what information should be collected. The possibility of a mismatch cannot be discounted.
- Monitoring occurs under harsh environmental conditions that can degrade instrumentation. Common-mode failures can defeat efforts to design redundant detectors.
- Measurements take place behind safety-relevant natural and engineered barriers. Uninterruptable power supplies and wireless transmission of data are prerequisites for monitoring.

Whether the right conditions are being measured and whether they are being measured reliably are questions that continuously must be asked.

Evaluating Reliability and Validity: Subjective Resolution of Uncertainty

- Heuristics and biases (cognitive errors)
 - ✓ Anchoring
 - ✓ Availability
 - ✓ Representativeness
 - ✓ Confirmation
- Bureaucratic pressures and imperatives
- Social construction of knowledge

Evaluating Reliability and Validity: Percolation Flux at Yucca Mountain



Year	Judgment about Percolation Flux
1983	4 mm/year
1984	0.1 mm/year
1986	0.4 mm/year
1991	0.1 mm/year
1995	0.04 mm/year
1998	8 mm/year

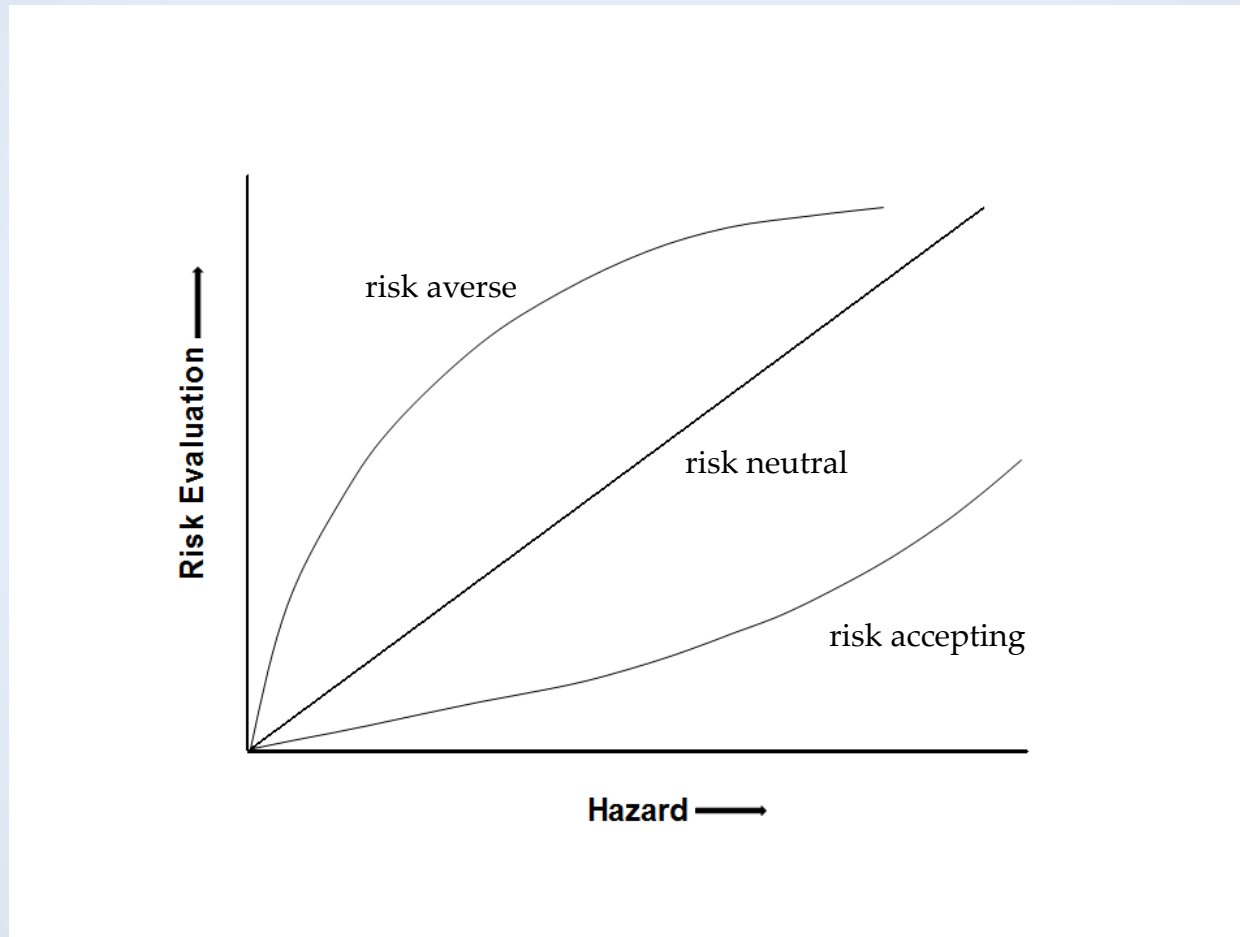
Metlay 2000

Evaluating Reliability and Validity: Chlorine-36 Experiments

- 1996: *Initial experiment*, conducted by Los Alamos National Laboratory (LANL), found elevated chlorine-36 levels along fractures at the repository horizon
- 1999: *Replication experiment #1*, conducted by US Geological Survey (USGS) and Lawrence Livermore National Laboratory (LLNL), failed to find elevated chlorine-36. Methodological differences appeared to explain the contradictory findings.
- 2001: *Replication experiment #2*, conducted by LANL, USGS, and LLNL, using identical methods and split samples, confirmed each organizations' earlier findings. Attempts to reconcile the differences were unsuccessful.
- 2003: *Replication experiment #3*, conducted by the University of Nevada, Las Vegas, was shut down due to laboratory contamination.

DOE subsequently abandoned further attempts at understanding and subjectively resolved the uncertainty by taking a “conservative” modelling approach.

Altering Course: Risk Profiles



Altering Course: Why Risk Profiles May Differ

- Properties of the risk
 - ✓ Controllability
 - ✓ Dread
 - ✓ Voluntary or imposed
 - ✓ Natural or man-made
- Who generates the risk
 - ✓ Trustworthy
 - ✓ Credible
 - ✓ Competent

Risk perceptions strongly influence how alternative courses of action are valued.

Altering Course: Two Narratives about Asse II

- Technical calculations: Based on public health and safety, occupational risk, and economic cost considerations, retrieving the waste cannot be justified.
- Ethical considerations: Even if the technical analyses were defensible, concerns for future generations compel the retrieval of the waste.
- The two narratives reflect opposing views on how trade-offs among options *should* be made.
- BfS conclusion: “According to the present state of knowledge, the safety case required by the Atomic Energy Act can only be ensured if the radioactive waste is retrieved.”
- *Lex Asse*: Retrieval has been determined as the decommissioning option to be pursued as long as it does not pose a radiological and safety-related risk for workers and the population.

Conflicting Organizational Requirements???

- To answer the first question — reliability and validity of new information — the “monitoring” organization needs to be **independent**.
 - ✓ The “monitoring” organization may be “inside” or “outside” of the implementing body.
 - ✓ The task here is fundamentally “scientific” (Is the hypothesis supported?) colored by politics and values.
- To answer the second question — should the course be altered — the “monitoring” organization needs to be **interdependent**.
 - ✓ The task here is fundamentally “political” and “value-driven.”
 - ✓ Power must be exercised to alter the *status quo*.

Balancing the independence required for “error detection” with the interdependence required for “error rectification” can be quite challenging.

Contingency Theory (Decision Strategies)

		Uncertainty	
		Low	High
Value Conflict	Low	Programmed	Incremental/ Trial and Error/ Stepwise/ Adaptive
	High	Bargaining/ Political	Charismatic/ Inspirational??

Are the conditions under which monitoring might take place consistent with the decision strategy embraced?

Metlay and Sarewitz 2014

Is Monitoring Promising?

- Promising: An expectation that something will or not be done
 - ✓ Unkept political promise
 - ✓ Promising help
- Promising: An indication of future excellence, success, or achievement
 - ✓ A scientist shows promise
 - ✓ A promising young man

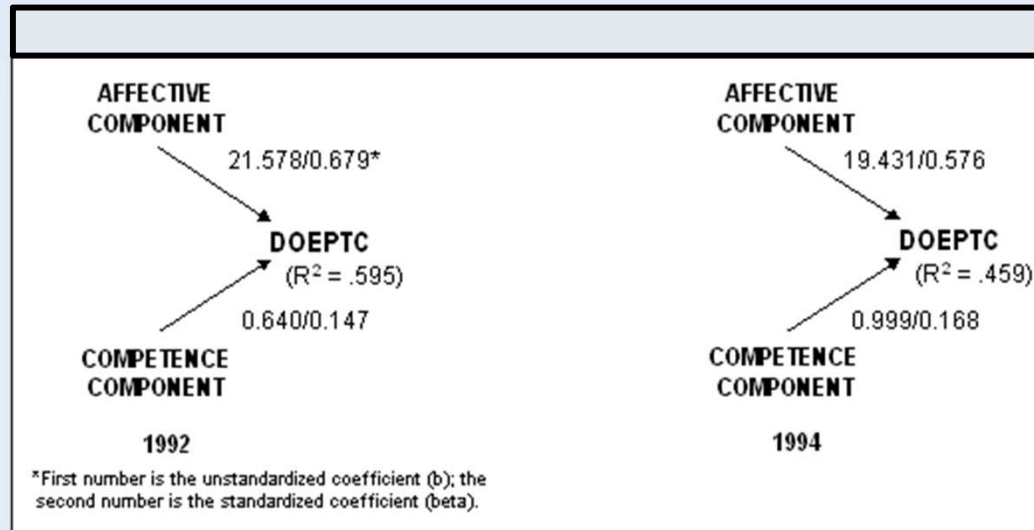
Random House Dictionary 1987

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BACK-UP SLIDES

What Is Institutional Trust and Confidence?



Affective component: fairness, openness, integrity, caring
Competence component: necessary skills, first class staff

Metlay 1999

Advice to Two DOE Secretaries

- Interactions with external parties
 - ✓ Early and consistent engagement
 - ✓ Faithful implementation of agreements
 - ✓ Consistent and respectful efforts to reach out to interested parties
- Internal operations and programmatic choices
 - ✓ Meet schedules dictated by a project's intrinsic technical requirements
 - ✓ Reward honest self-assessment
 - ✓ Develop tough internal processes that may include stakeholders for reviewing operations and discovering potential and actual errors

*The recommendations represent a **recipe** not a **menu** from which DOE could choose something from Column A and something from column B.*

SEAB 1993; SEAB 2000