Experimenting with Nuclear Waste

Technology as a social experiment

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Disposal as social experiment

- Developing repositories has been often seen as a technical challenge: first technical *solution*, then social *acceptance*
  - even after the *participatory turn* (Bergmans et al 2015)
- Technocratic approaches err and they have led to controversies, because they neglect socio-ethical issues
  - E.g. technical and social uncertainties, intricate justice issues and reversibility
- Nuclear waste disposal should be considered as a social experiment in order to help address societal and ethical issues

Structure of the presentation

- What is a social experiment?
  - Why is nuclear waste disposal a social experiment?
- Responsible *experimentation* with nuclear waste disposal
  - What/how can we learn?
  - How can we design for reversiblility?
  - Justice (procedural and spatial/temporal distributive)
- Multinational nuclear waste disposal as a social experiment
  - Experimentalist governance

Part 1: Social experimentation

Scientific experiments

- Epistemic aim is often to test hypothesis or to find causal relations
- Control of independent variables and possible intervening factors is often crucial to achieve that epistemic aim
- E.g. controlled randomized trials in medicine

Design experiment

- Experimental introduction of a ‘design’ in society to try it out
- Aim is to improve the design along the way while implementing it
- Learning takes place but not primarily about causal relations
- E.g. early introduction of new not yet fully finished software technology for the purpose of debugging and optimization

Social experiments with new technology

- Often, they are 'not called by name': de facto experiment
- Often, we don't have the liberty of turning them into a scientific experiment (with an epistemic aim)
  - Too many and unacceptable risks involved
- Social experiments with technology resemble more a design experiments with limited room for learning

“Unavoidable experimental state”

[W]e are in an unavoidably experimental state. Yet this is usually deleted from public view and public negotiation. If citizens are routinely being enrolled without negotiation as experimental subjects, in experiments which are not called by name, then some serious ethical and social issues would have to be addressed.

(EU expert group on science and governance 2007)

Part II: Responsible experimentation with nuclear waste

Responsible experimentation

- Differences with standard experiments:
  - More and other people involved (users and bystanders)
  - Less controllable environment (closed versus open system)
  - Often not conceived as experiments (de facto experiment)

Disposal as experimental technology

- Only little experience with nuclear waste disposal
  - Times scales of (possible) effects: 10,000 to 1,000,000 years
- It will most likely remain *experimental* and a technology in development for another 100 years
  - No operational (commercial) waste disposal places yet
  - Building and operating repositories will take decades
  - E.g. the official Dutch policy is to dispose of in 2120
- Some kind of experiment is unavoidable
  - How to do it (more) responsibly?
  - How to organize implementation as a design experiment?

Learning

- Physical learning
  - Long-term implementation project and the need for monitoring
- Institutional learning
  - Regulatory experiments: e.g. multinational disposal
  - Institutional memory
- Moral learning
  - How safe is safe enough?
  - How to ensure long-term safety?
  - How to deal with the interests of different future generations?
- How to design the experiment so that we can learn optimally while avoiding (large-scale) harm?

Reversibility

- Now often understood only as (technical) retrievability, but it is broader
- Looking through the lens of experimentation
  - How to stop the experiment
  - How to undo undesirable consequences

Stopping the experiment

- Completely stopping might not be possible
- But we can leave open the option to experiment with another technology for nuclear waste storage
- Avoid lock-in
- Keep open other options than deep geological disposal
  - Even if we now have reasons to believe that it may be the safest option in the long run

Undo consequences

- Four strategies for undoing consequences
  - Remediation
  - (Re)construction
  - Containment
  - Compensation
- In the long run, there may be irreversible consequences that cannot be undone: think of compensation in time!

J. P. Bergen. 2015. "Reversible Experiments: Putting Geological Disposal to the Test," *Science and Engineering Ethics*, vol. 22, no. 3, pp. 707–733.

Justice: procedural and distributive

1) Spatial procedural justice
   - Participation

2) Spatial distributive justice
   - Acceptable levels of risks
   - Compensation

3) Temporal distributive justice
   - Intergenerational justice
   - Balancing the interests of different future generations

Participation

- Experiments on human subjects require informed consent
  - Informed consent might be too strict to apply to collective (technological) risks
- At a minimum, we can expect that
  - Experimental subjects are informed
  - Risks are approved by democratically legitimized bodies
  - Experimental subjects can influence the setup, carrying out and stopping of the experiment
- The Swedish nuclear waste disposal is *de facto* a social experiment

Acceptable risks

- What level of risk should be acceptable in not only a legal/regulatory question
  - There is an undeniable normative level
  - Ethics of risk (and criteria for risk acceptability)
- When establishing that there are certain (acceptable) risks distributed unequally, this could be remedied differently
  - How to compensate, whom to compensate and when to compensate

Intergenerational justice

- Often used as a phrase to establish there are intricate questions that we cannot deal with
- However, it has practical relevance for short-term and long-term regulatory purposes
- Early disposal with long monitory period has different intergenerational implications than late disposal
- How to establish long-term radiation protection standard for containment
  - E.g. EPA standards for the Yucca Mountain Repository

Part III: Multinational nuclear waste disposal as a social experiment

Multinational repositories

- In principle, nuclear waste disposal is a national responsibility
  - But multinational collaborations are becoming increasingly relevant (both front-end and back-end of the fuel cycle)
- Dual track policy (EU Waste Directive 2011) allows for *experimenting* with European repositories
  - Experimentalist governance: a regulatory experiment
  - Perhaps also as a moral experiment (how to do it fairly in the short and long run?)

What *experimentation* adds

- For establishing multinational disposal there is a strong emphasis on social acceptance
- Social acceptance is a necessary but NOT sufficient criterion
- Social experimentation framework helps us
  - Approach the problem as a continuous regulatory experiment
  - Address social and technical issues in conjunction
  - Address the intricate justice issues at hand (procedural international justice as well as intergenerational justice)

Taebi, B. 2012. Multinational nuclear waste repositories and their complex issues of justice. *Ethics, Policy & Environment* 15 (1): 57-62.

Conclusions

- Deliberately organizing nuclear waste disposal as a social experiments emphasize that project with major risk/impact
  1) Need to be evaluated from early stages of development
  2) And they need to be continuously evaluated

- More specifically, it could help us
  - Improve learning from the start
  - Recognize and communicate uncertainties, also to the public
  - Avoid lock-in into geological disposal as the only option
  - Allow regulatory experiments, also with multinational repositories
  - Address justice issues explicitly and from the start

Thank you for your attention

Comments are greatly appreciated

now or later:

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http://belfercenter.ksg.harvard.edu/experts/3095/behnam_taebi.html