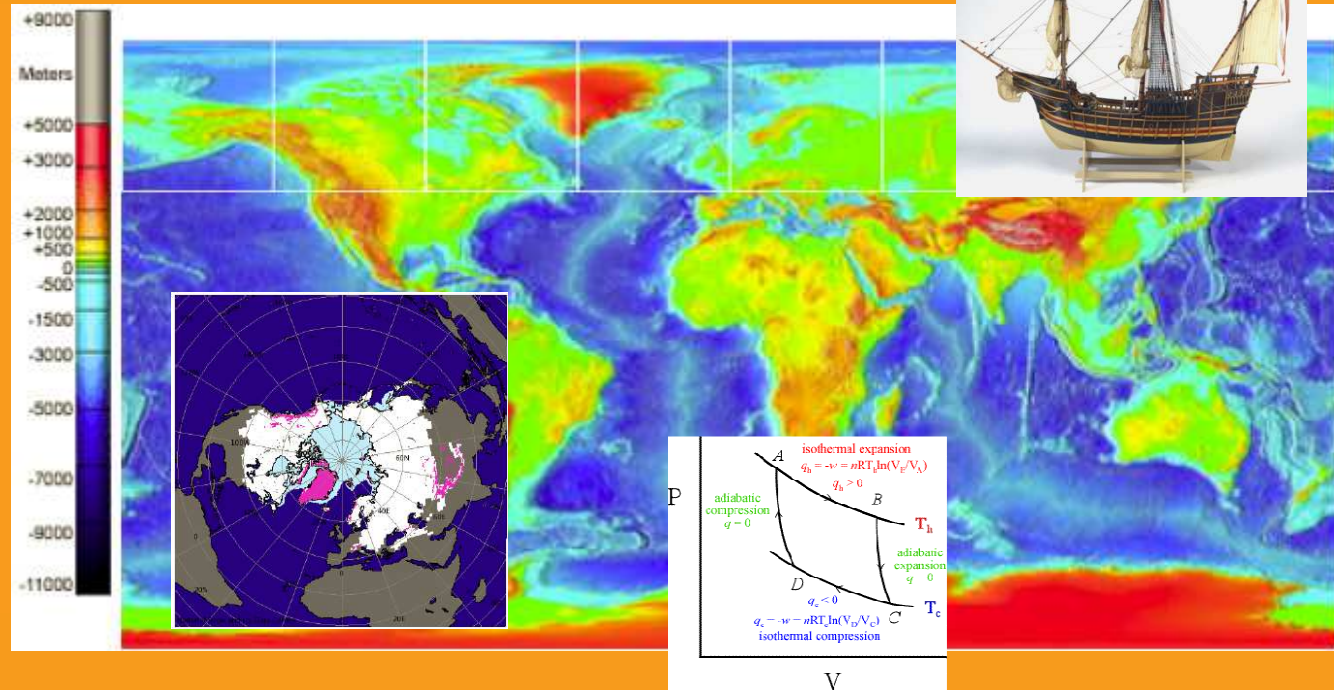


# The Ethics of Modeling



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# Speaker & Project

- PhD at Eindhoven University of Technology
- studied mathematics and philosophy;
- member of the 3TU Centre for Ethics and Technology;
- project belongs to the field of ethics of technology;
- the project is especially interesting because it touches the boundaries of philosophy of science, philosophy of technology and ethics.

## **HIV policy in Norway (Wenstøp & Magnus 2001)**

“The [Norwegian] Board of Health held a press conference in August 1996 where Norwegian citizens in general were warned against having unprotected intercourse with persons from sub-Saharan Africa.” (p. 67)

- stigmatization of an ethnic group;
- creation of general anxiety/racism;
- + prevention of future HIV infections.

## Multi-Criteria Decision Support for HIV Policy Decisions in 1989 (pp. 61-62)

- i. minimize new infections;
- ii. avoid invasion of privacy;
- iii. Overall Aim: Maximize socio-economic efficiency of a new anti-HIV program.
- iv. Relieve of personal anxiety,
- v. avoid life quality reduction of infected people;
- vi. avoid stigmatization of individuals;
- vii. avoid stigmatization of groups;
- viii. minimize monetary cost;
- ix. maximize the possibility for early treatment.

# Where Modeling Comes in...

Table 2  
 Trade-off results<sup>a</sup>

Criterion	Unit	Policy A	Policy B	Weight
Cases prevented	Persons	0	100	0.666
Rights invasion	1000 persons	0	12 000	0.014
Anxiety creation	1000 persons	2500	12 000	0.024
Anxiety reduction	1000 persons	600	0	0.027
Life-quality reduction	Person-years	3900	7200	0.031
Personal stigma	Persons	57	120	0.027
Group stigma	1000 persons	70	80	0.114
Costs	Mill. NOK	3000	5000	0.063
Early treatment	Persons	1000	0	0.034

<sup>a</sup> The value loss of shifting from policy A to policy B in any row except the first is compensated for by the value added of preventing 100 future cases of HIV (first row). Example: preventing 100 new cases compensates for the value loss of 12 million rights invasions. Further: preventing 100 new cases compensates for the value loss of increasing general anxiety by increasing the number of people that are screened from 2.5 million to 12 million, etc.

# Geographical Information Systems (GIS) (Jenkins & McCauley, 2006)



- GIS model topography;
- GIS distinguish different types of landscapes.
- Decision in geo-engineering are based on information provided by GIS.

# Problematic Assumptions in GIS

- **Assumption 1:** Water-streams are assumed to have fractal geometry.
- **Assumption 2:** Single depressional cells are assumed to be noisy data.
- **Problem:** Environmentally important wetlands are small depressional areas that do not follow a fractal pattern.

➡ *GIS ignore wetlands.*

# Moral Issues in Modeling

- Models discuss morally problematic issues.
  - Models influence and justify decisions in those matters.
  - These moral issues go beyond the traditional problems in modeling.
- ➔ An Ethics of Modeling is needed in order to cope with those moral issues.

*Further examples: Climate Models, Policy Modeling, Reference-Dose Models*



# Outline

- I. Examples of Moral Issues in Modeling
- II. Origins of Moral Issues in Modeling
  - a. Moral Perspectives: The three Origins
  - b. Examples for These Origins
- III. Moral Mid-Level Principles for Modeling
- IV. Application & Conclusions

# Conflicts in Ethics

- Consequentialism: Maximize *good* consequences (often happiness).
  - Deontological Ethics: Focus on good acts (often Kantianism).
  - Virtue Ethics: Pursuit of having a good character by pursuing virtuous behavior.
- ➔ All these perspectives provide different notions of what *morally good* means.
- ➔ All perspectives provide different insights of which aspects raise moral issues.

# Consequentialism

The consequences of an action are morally evaluated:

- An action is morally/wrong good iff it has morally good/bad consequences.


➔ *Applied to modeling:* The consequences of what we do with a model are morally evaluated.

➔ The consequences of the use of a model are morally relevant. The model itself remains a black-box to the moral evaluation


# The Scud Incidence (Blair et al., 1992)

On 25<sup>th</sup> February 1991, a patriot defense system failed to intercept a Scud rocket, 28 soldiers died.

- The Scud trajectory was modeled using increasing time starting from 0. Increasing time led to an increase of inaccuracy.
- The model was designed for short-time use and became useless after 20h.

 **Wrong usage:** At the moment of failure the patriot system worked for 100 consecutive hours.

# Deontological Ethics: Kantianism

- “[A]ct only in accordance with that maxim through which you can at the same time will that it become a universal law.” (Kant, 1998, p.31)
  - “[A]ct that you use humanity, whether in your own person or in the person of any other, always at the same time as an end, never merely as a means.” (Kant, 1998, p. 38)
-  Kant’s imperative restrict the purposes for which models should be used.

# The 1990's US Decennial Census (Fienberg, 1994)

- Problem with Census in 1990: minorities were undercounted.
- Two rival models were developed: one official with minor changes, one from independent statisticians with more accuracy on local scales
- Fienberg: Interest of a powerful minority turned down the more accurate model.




The purpose of the model was to deceive and thus plainly wrong.

# Virtue Ethics

- Striving for Eudemonia, the state of complete happiness.
  - “Happiness is an activity of soul in accordance with perfect virtue” (Aristotle, 1980, [1102a]).
  - Focus on character and character-development.
- ➔ Does the model discuss character traits or development?
- ➔ The target system is morally important.

## The Good Diet (Stehfest et al., 2009)

- Stehfest et al. forecasted the environmental impact of meat consumption (land use and CO2 emission).
- They compared current diet habits with alternative diets.
- Already a change to the medically recommended meat consumption would reduce environmental impact significantly.

 Eating meat once a week is more virtuous than eating meat on a daily basis.



# Summary of Moral Perspectives

Case	Consequences of the Use	Purpose of the Use	Target System
Scud interception	<b>failure to prevent death of 28 soldiers</b>	prediction of missile trajectories for intercepting them	trajectories of Scud rockets
GIS landscape modeling	<b>neglected or destroyed wetlands</b>	mapping of topography and water streams	landscapes
1990's US decennial census	<b>probably disadvantageous for minorities</b>	<b>biasing results in favor of a minority</b>	number and type of US inhabitants
forecasting the effects of human meat consumption on climate change	description of the expected climate effects of different diets	explore the consequences of diet changes	<b>human way of living respectively effects on climate change</b>

# Should these issues be addressed within modeling?

- Modelers “will be acting in an ethical manner if they apply the general accepted best practice of their profession.” (Walker, 2009, p. 1051)
- However, normal problems arise externally; moral problems arise while modeling.

*Treating moral problems as normal modeling problems means ignoring them.*

# Outline

- I. Examples of Moral Issues in Modeling
- II. Origins of Moral Issues in Modeling
- III. Moral Mid-Level Principles for Modeling
  - a. What are Moral Mid-Level Principles?
  - b. The principles in detail
- IV. Application & Conclusions

# Moral Mid-Level Principles

- Moral mid-level principles avoid the traditional conflict of moral theories.
  - ➔ Mid-Level principles base on professional norms and experiences.
- Traditional ethical codes or moral theories are very prescriptive and general.
  - ➔ Mid-level principles are prima-facie and assume balancing and specification.

# What Does 'Mid-Level' Mean?

**Moral Theory** holds in all cases and situations.

**Mid-Level Principles** hold usually in certain contexts.

**Obligations** hold in particular situations.

# Four Moral Mid-Level Principles

- **Transparency:** State assumptions clearly, make the design of a model understandable, explicate its possible applications, and explain its restrictions.
- **Integrity:** Modelers and the modeling practice should follow professional standards.
- **Comprehensiveness:** Consider all moral issues connected to the problem at hand.
- **Evaluation:** Give a detailed analysis of all effects for each moral issue.

# Transparency – Literature

- Participants “agree on some aspects of ethical conduct, such as ... to make
- Clear to the model users what the model responsibility and its limitations are.”
- “Whether via a particular model or its created, what problems they address, and how they are implemented should be made available to stakeholders of the research activity.” (Drake et al., 2009, p.10)

# Transparency

- **Transparency:** State assumptions clearly, make the design of a model understandable, explicate its possible applications, and explain its restrictions.
  - + relevant for rational decisions;
  - + respect for interests of stakeholders;
  - + precondition for maximizing benefits.



# Transparency (Sundqvist et al. 2004)

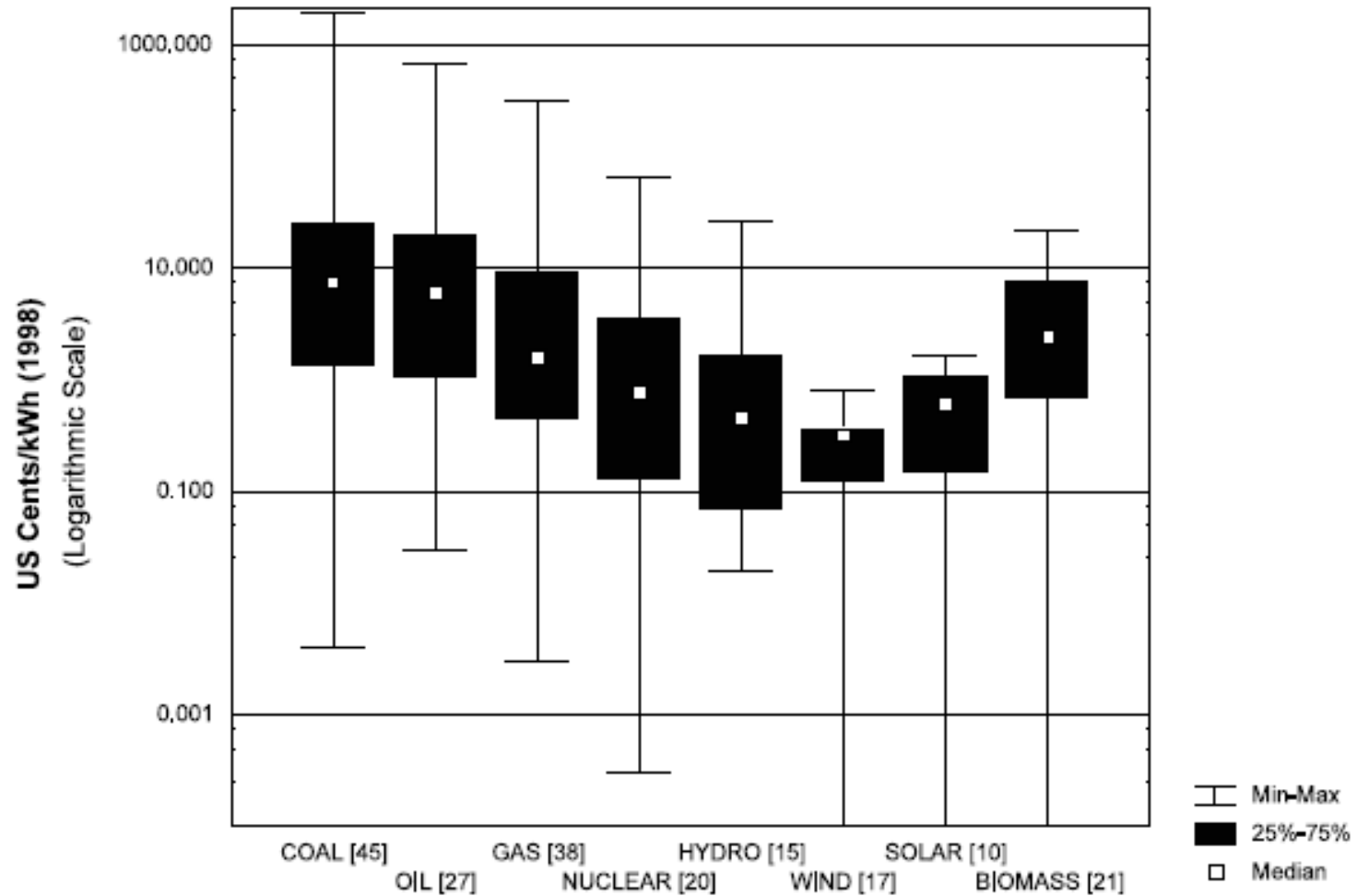


Fig. 1. Range of external cost estimates in power generation. Sources: Sundqvist (2002) and Sundqvist and Söderholm (2002).

# Integrity – Literature

- Modelers “will be acting in an ethical manner if they apply the general accepted best practice of their profession.” (Walker, 2009, p. 1051)
- Brans (2002): The Oath of Prometheus
- Several professional codes, e.g. IEEE members agree “to accept responsibility in making engineering decisions consistent with safety, health, and welfare of the public”. (Gass, 2009, pp. 1047 )

# Integrity

- **Integrity:** Modelers and the modeling practice should follow professional and scientific standards.
  - + Epistemic and ethical legitimacy;
  - + Give orientation about right or wrong;
  - + Support role-responsibility of a modeler.

# Integrity: US Decennial Census

- The official decision was made by statisticians, i.e. the Bureau of the Census.
- “If we know that Blacks and Hispanics are undercounted relative to Whites, resulting in harmful consequences, and we know that, on average, adjustments can be made that will move us **closer to the truth** then should not the statistician feel **compelled** ethically, to use statistical models to correct this inequality?” (p. 131)

# Comprehensiveness – Literature

- “The main issues are not primarily the technicalities or heuristics. The definition of the human context, the identification of stakeholders and their moral values, the systematic analysis of all connections and entanglement with society impose in-depth recurrent analysis” (Kunisch et al., 2009, p.1101)
- “Value’s 2004 as a non-technical principle”: (Alford, 1994, p.104) this principle suggests, for example, taking into account not only the point of view of the ‘client’, ... but also the point of view of all ‘stakeholders’”.

# Comprehensiveness

- **Comprehensiveness:** Consider all moral issues connected to the problem at hand.
  - + decreases likelihood of one-sided decisions;
  - + consequentialism, discourse ethics: incorporation of more interests;
  - + elucidates about all effects of an action.

# Comprehensiveness: GIS

- High epistemic accuracy;
- Insufficient environmental comprehensiveness;

(Jenkins & McCauley 2006)



## Evaluation – Literature

- Mason (1994, p.184) sees it as one of the obligations of the modeler “to insure that actions the client takes based on the model have the desired effect.”
- Gallo (2004) ‘sharing and cooperation principle’: modelers should share openly their insights.
- Wenstøp & Magnus (2001), Wenstøp (2005), Le Menestrel & Van Wassenhove (2004), Brans (2004)



# Evaluation

- **Evaluation:** Give a detailed analysis of all effects for each moral issue.
  - + assessment of severity;
  - + ratio of benefits and disadvantages;

# Evaluation (Taebi & Kadak, 2010)

IMPACTS	ALTERNATIVES							
	Current Practice		Direct Storage		Transmuter		LWR-FR (Breeder)	
	Gen 1	Gen 2-n	Gen 1	Gen 2-n	Gen 1	Gen 2-n	Gen 1	Gen 2-n
<b>Environmental Friendliness/Public Safety</b>								
Mining, milling, enrichment, fuel fabrication	High		High		Medium		Low	
Transport of spent and recycled fuel	Low		Medium		High		High	
Reactor operation and decommissioning period	Low	Low	Low	Low	High	High	High	High
Spent fuel storage	High	High	Low	Low	High	High	High	High
Final disposal of spent fuel and other waste	Indifferent	High	Indifferent	High	Indifferent	Low	Indifferent	High
Reprocessing – applying fast reactors	x		x		Indifferent		Indifferent	
<b>Security</b>								
Uranium enrichment	High		High		Medium		Low	
Reactor operation and decommissioning period	Low	Low	Low	Low	High	High	High	High
Spent fuel storage	Medium	Medium	Low	Low	Low	Low	High	High
Final disposal of spent fuel and other waste	Medium	Medium	Medium	Medium	Low	Low	High	High
Reprocessing – applying fast reactors	x		x		Medium		High	
<b>Resource Durability</b>								
Consuming uranium	High		High		Medium		Low	
Energy production with uranium (benefit)	Low	Low	Low	Low	Medium	Medium	High	High
Retrievable stored/ disposed of spent fuel (benefit)	High	High	High	High	Medium	Medium	Low	Low
<b>Economic Viability</b>								
Safety measures costs until the end of retrieval	Indifferent	Indifferent	Indifferent	Indifferent	Indifferent	Indifferent	Indifferent	Indifferent
Building reprocessing plants and fast reactors	x		x		medium		High	
<b>Technological Applicability</b>								
Geological disposal	Indifferent		Indifferent		Indifferent		Indifferent	
Applying reprocessing and fuel fabrication	x		x		High		High	
Applying fast reactors	x		x		High		High	

# Four Moral Mid-Level Principles

- **Transparency:** State assumptions clearly, make the design of a model understandable, explicate its possible applications, and explain its restrictions.
- **Integrity:** Modelers and the modeling practice should follow professional standards.
- **Comprehensiveness:** Consider all moral issues connected to the problem at hand.
- **Evaluation:** Give a detailed analysis of all effects for each moral issue.

# Outline

- I. Examples of Moral Issues in Modeling
- II. Origins of Moral Issues in Modeling
- III. Moral Mid-Level Principles for Modeling
- IV. Application & Conclusions
  - a. How to use Moral Mid-Level Principles
  - b. Conclusions

# Specification (Transparency)

The studies presented in Sundqvist et al. (2004) differ in

- employed methodology;
- what is regarded as an external cost;
- how 'fuel cycle' is defined;
- which external cost are relevant;
- input parameters;
- relevant preferences of stakeholders;
- which technologies the model focuses on;
- assumed circumstances;
- implicit trade-offs between different effects;
- how uncertainties are coped with.

# Specification

- *Integrity*: Modelers should conduct scientifically accurate research.
- *Comprehensiveness*: Modelers should assess all (external) costs of the stakeholders.
- *Evaluation*: Modelers should precisely estimate these external costs.

## Balancing (Taket, 1994)

“Out of a desire to make my report for [the clients] as accessible as possible, I did not include a discussion of the methods used (cognitive mapping). This decision was based on my judgment (grounded in my own experience) that understanding cognitive mapping requires some exposure to the use of the technique, beyond a simple written explanation. ... however, as I have not produced any other [technical] report, I have not followed the ORSA guidelines ...”

# Balancing Rules

**(Beauchamp & Childress, 2008, p.23)**

- Good reasons can be offered to act on the overriding norm.
- The moral objective has a realistic prospect of achievement.
- No preferable alternative are available.
- The lowest level of infringement has been selected.
- Any negative effects have been minimized.
- All affected parties have been treated impartially.



# Conclusions

- There are (at least) three origins of moral issues in modeling:
  - i. the consequences of the use of models;
  - ii. the purpose of using a model;
  - iii. the issues discussed by the target system.

# Conclusions

- Four moral mid-level principles were derived:
  - i. Transparency
  - ii. Integrity
  - iii. Comprehensiveness
  - iv. Evaluation

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**Thank You!**