Technology Dynamics and Transition Management in China

Technology Forecasting

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http://inventorspot.com/files/images/Flying%20car--taylor%20aeroca r%20restored.img_assist_custom.jpg

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Transition in Living

Water flat ideal for student housing

Floating house with drive-in for pleasure yacht

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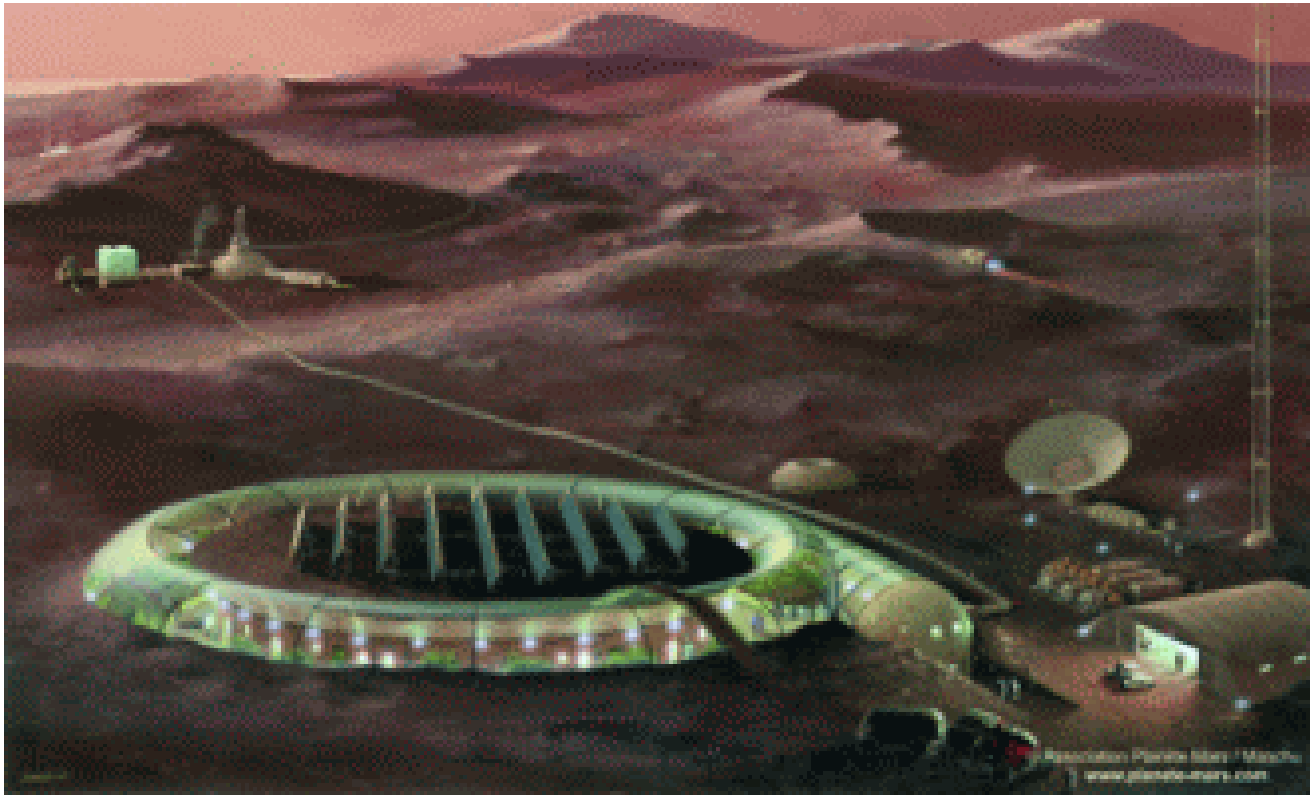
Red Colony



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Why Forecasting?

To gain insight into technology development, in order to be able to influence it

Control dilemma:

- influence possibilities greatest in the beginning
- entrenchment or lock-in: technology development has gained momentum

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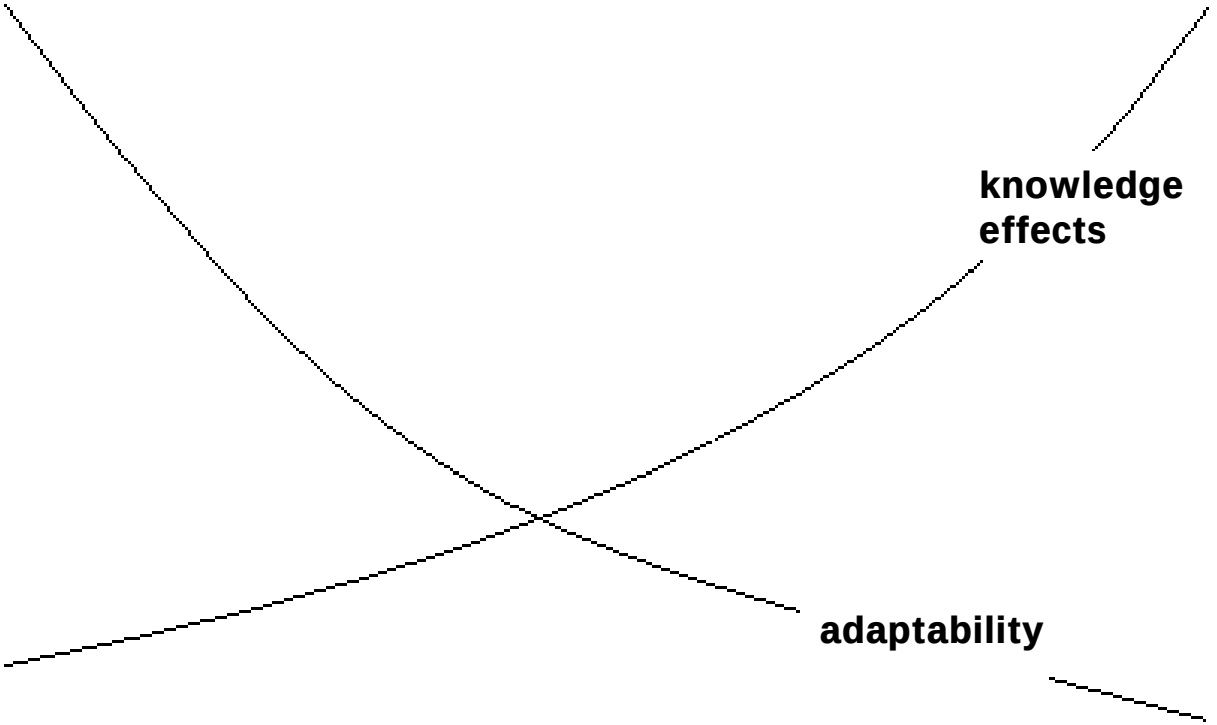
Collingridge dilemma. E.g leaded fuel



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Forecasting Possible?

Fundamental problem: non-linearity (discontinuity)

Problem of induction (black swans)

Historical empirical correlations are insufficient if there is no clear causal relationship (mechanism)

Uncertainty (patterns of change are complex)

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Flying car

http://inventorspot.com/files/images/Flying%20car--taylor%20aeroca r%20restored.img_assist_custom.jpg

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Failed Forecasts

Misjudgment of:

- speed of technological change (1950s expected flying cars)
- expert assessment of technologies (superiority of synthetics, 1970)
- citizens opinions (nuclear power)
- public policy (glass recycling: economically and environmentally unattractive)

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Failed Forecasts

Value of forecasting is limited (too short-term & well-defined systems)

Not equipped for uncertainty

Forecasting methods are useful within modern interactive TA, as they can improve quality of arguments

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Predicting = influencing

Self-fulfilling prophecies, e.g. rumour that bank becomes insolvent → run of customers → bankruptcy / inevitability of war

Self-destroying prophecies, e.g. the 1972 “predictions” of the Club of Rome that some raw materials would be exhausted in the 1980s and 1990s

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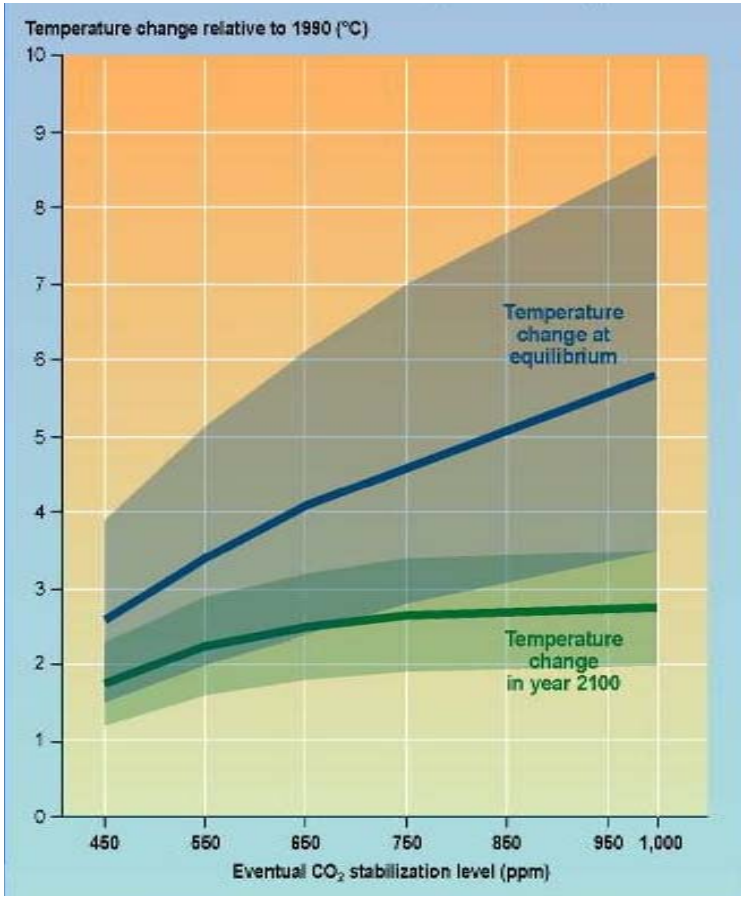
Predicting= influencing

There is a wide band of uncertainty in the amount of warming that would result from any stabilized concentration of greenhouse gases



International Panel on Climate Change
IPCC, WMO, UNEP

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Types of Future Studies

Likely futures

Weather forecasting, market forecasting, economic forecasts, sometimes Delphi studies

Possible futures

Shell-type scenarios, IPCC-scenarios, Meadows

Also: design scenarios

Normative / Desirable futures

Backcasting, policy scenarios, future visions

However: avoid blueprint thinking

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A Simple Approach for TA

0. Defining problem and research questions
   E.g. for whom, problem vs technology oriented

1. Exploring/foresighting (technology) developments

2. Technology impact assessment

3. Normative judgement

4. Generating improvement options

Source: Smit & van Oost 1999

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Step 1: Exploring / foresighting

a. Monitoring / trend watching
b. Literature, desk study, expert & stakeholder interviews
c. Scenario's (Shell type, normative, likely)
d. Delphi & cross-impact
e. Analogies
f. Trend extrapolation (qual. / quant.)
g. Technological map, socio-technical maps

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Monitoring (a)

Study of

- professional journals
- patents/patent trends
- meetings
- web searches
- annual reports/media

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Expert Judgment (b)

WHEN

- If there is no qualitative information about what a technology might do (e.g. Nano-technology)
- If there are no reference points for extrapolation

BUT EXPERTS

Are always biased

- Positive in regard to technology in general
- Positive in regard to the area of expertise (nuclear fusion, self selection)

The social structure of disciplines prohibits open communication regarding the future (interdependencies, prejudices, publication priorities)

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Hydrogen as aircraft fuel?

Bulky, higher air resistance, expansion of airfields;

New risks because of fuel

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Impact of stimulating algae in the ocean?

Algae extract CO2 from the air and are stimulated by spreading an iron solution in the oceans

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Scenarios (c)

In sketching the various possible and consistent futures in a complex situation, come up with:

Credible stories that stimulate the creativeness of people in thinking of future threats and opportunities

Robust options and cheap precautions

Different types

- Context / strategic (Shell-type)
- Normative / Vision / Policy / Design (system changes)
- Socio-technical

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Shell global (context) scenarios 1

For 1995-2020

TINA (1995): There is no Alternative (globalization, liberalization, technology dominant)

Embrace or resist? Two embracing scenarios:

→ **Just do it** (US-type capitalism, individualization)

→**Da Wo – 'Big Me'** (civil society, community oriented)

For 1998-2020; based on Just do it:

- TINA above (The New Game)

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Shell global (context) scenarios 2

2001-2020 People and Connections

Add a social dimension to the economic and the political: “Which people and connections will be most powerful and influential in shaping the future?”

Business Class: efficiency & individualization, the world as a business

Prism: different types of development exist, different regional development paths

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Globalization scenarios

- Westernization / William McNeill: World Web History
- Economic and political liberalization / Kenich Ohmae: The End of the Nation State & Francis Fukuyama: The End of History
- Partial globalization, westernization and/ or libralization / Benjamin Barber: consumentism vs neotribalism, McWorld vs Jihad
- No globalization / Samuel Huntington: clashing civilizations of China, the Arabic world, Christian orthodoxy and the West

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Uniform

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Or Pluriform





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Delphi Method (d)

Delphi

- survey among experts in several rounds
- anonymous feed back of arguments & estimates
- revision of judgments
- consensus in 3-4 rounds

Criticism

- group bias remains
- strategic behavior by mutual contact
- only for experts within a discipline

Experiences

- used since 1959
- good results not just forecasting: it is also intervention in a discipline

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External Propulsion of Vehicles

External propulsion systems form part of the infrastructure, e.g. through magnetism or compressed air

50 experts (global, 50% return, variation)

- 14 technologies
- 4 technologies were promising
- many experts changed their view during Delphi process

Conclusion: economic and technical feasibility low

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Extrapolations

Based on hypotheses such as

- Linear growth
- S-curve
- Fisher-Prey, Gompertz diffusion models

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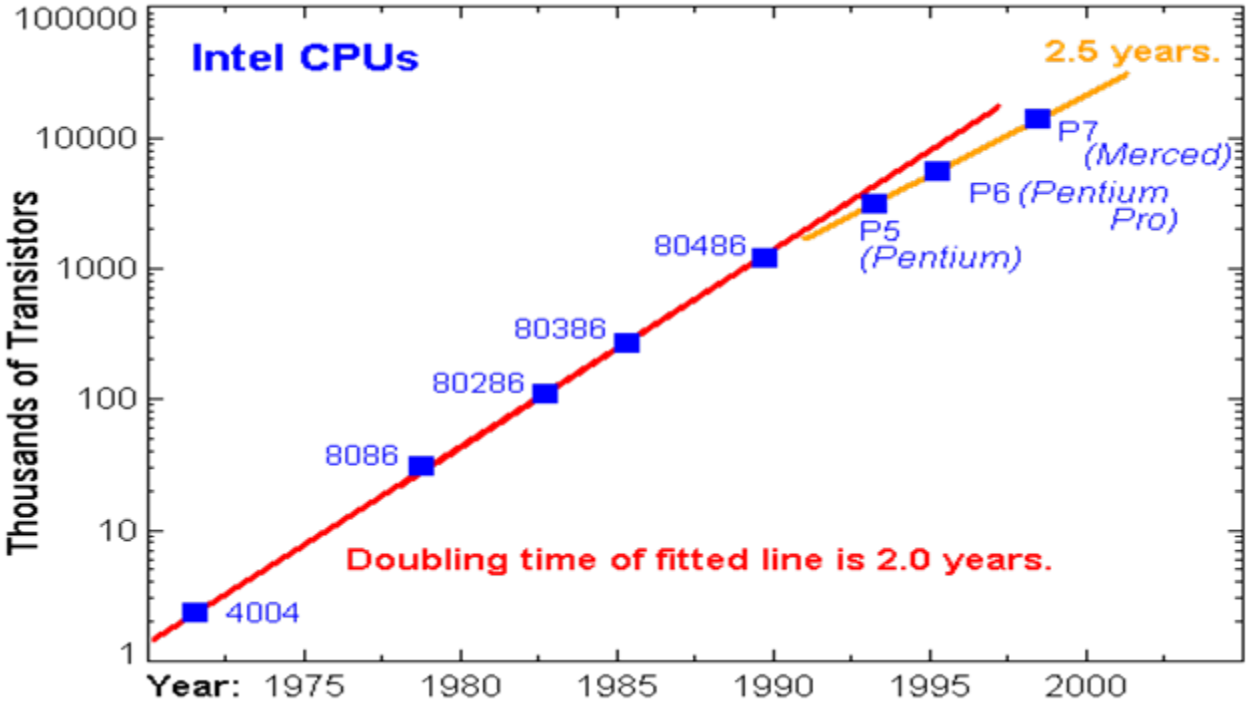
Moore's Law

The number of transistors on an integrated circuit (chip) doubles every 24 months (1965)



http://www.physics.udel.edu/~watson/scen103/intel-new.gif

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Moore's Law

Based on extrapolation it is clear that current technology will grow less fast within 5 years as physical limits will be reached (quantum effects)

Further growth can only be achieved by switching to another basic technology (regime switch)

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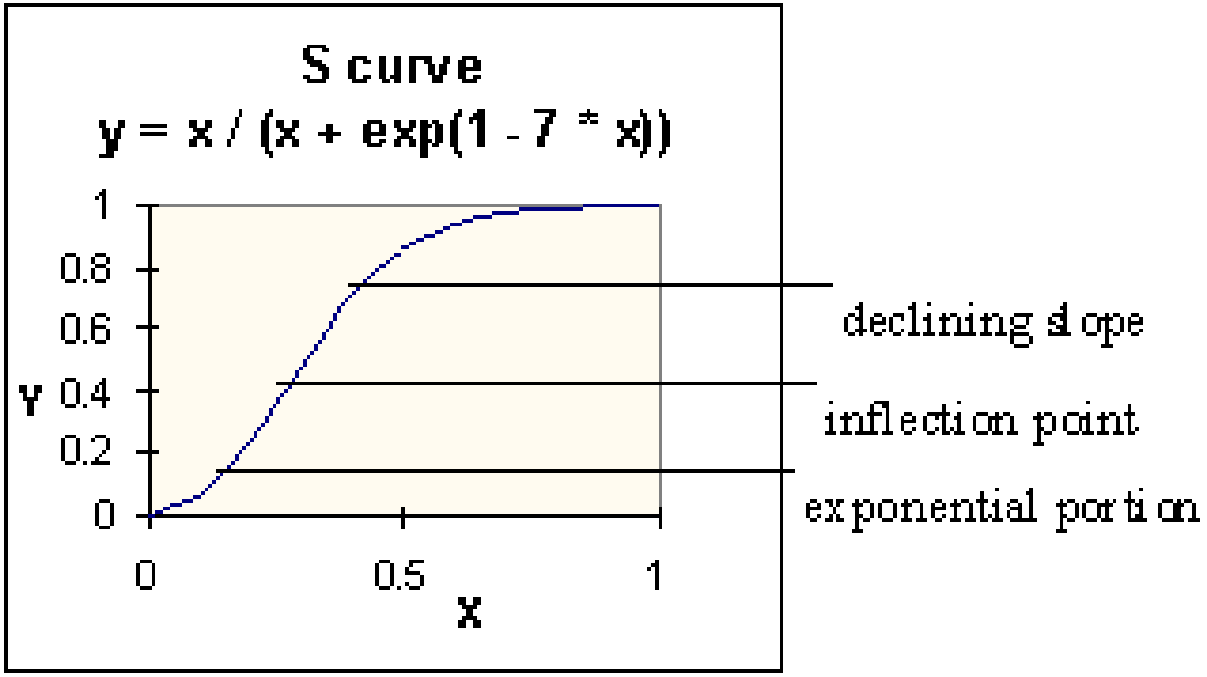
S-curve



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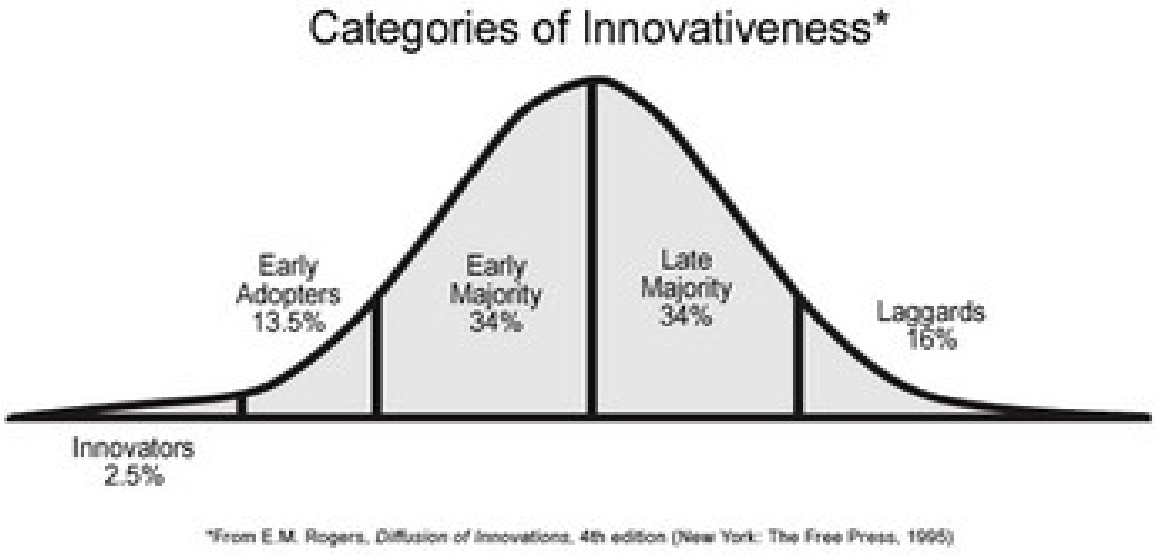
Rogers' Innovation theory



http://www.dangerouslyirrelevant.org/Rogers01_small.jpg

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Java Water Plan

Historical and engineering tendencies towards higher levels of integration and organization:

- Main works
- Systems
- Interbasin transfer
- Integrated River Basin Management
- Van Blommestein: one all-embracing water system for the whole of Java

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Java Water Plan

Continuous development shows system innovation

However, a succession of technological regimes was involved

- Main works by exploitation regime
- Systems and interbasin works by colonial development regime (agricultural)
- IRBM & Java Water Plan by post-colonial development regime (multi-purpose, multi-actor)

Regime shifts were required, showing discontinuity

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System innovation and regime shifts in the Netherlands

Scale enlargement

- Water boards: polders
- National water agency: big rivers
- European water management: complete basins

Dry feet → Room for the water,
e.g. de-poldering

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Social-technical map (g)

Stakeholders and their views and interests: developers, users, regulators, others

The state and dynamics of the technologies involved

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Step 2: Impact assessment

Which impacts are relevant for whom?

- safety health environment in production and products
- external risks & safety (chemistry, Schiphol, fire works, floodings)
- environment (environmental impact)
- labour conditions
- social-economic effects
- risks in relation to armed conflict and terrorism
- social, ethical, cultural impacts

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Step 2: Impact assessment: quantitative methods

Risk assessment (chemical factory, airports, floodings)

Life Cycle Assessment, Env. Impact Assessment

Cost benefit analysis

Citizen Value assessment

Scenario-analysis

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Step 2: Impact assessment: qualititative methods

Checklist

Impact & effect trees

Social map (several types of categories)
companies, government, research, ngo's, public
T-developers, T-users, T-regulators, miscellaneous

Round-table, workshops, interviews

Literature, analogies

Step 2: Exercise

Construct an impact tree of ZOAB (Very Open Asphalt Concrete) containing 2 branches of 3 effects each

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Step 3: Normative Judgement

Make your own framework, possible criteria:

- Type of decision making & participation, equity, equal access, privacy, future generations, value changes, concern with minorities and their opinions

Ask the stakeholders or citizens

- Interviews, workshops, surveys
- N.B.: this can also be part of impact assessment!

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Control dilemma: new design criteria & barriers

New design criteria

- Correctability of decisions
- Control of systems
- Flexibility
- Insensitivity to errors

Barriers

- Entrenchment
- Competition
- Positive feedback
- Lead time
- Scale

Group Assignment

Make a new technology assessment of your solutions, using the insight from this lecture