Technology Dynamics and Transition Management in China

EPA/ Harbin Institute of Technology

Prof. Mi Jianing
School of Management, Harbin Institute of Technology

Dr Wim Ravesteijn
Section Technology Dynamics and Sustainable Development, faculty of Technology, Policy and Management, Delft University of Technology

(photo from images.com.my)

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Global Warming

Harbin is probably the Chinese city that has been hit hardest by global warming

Edward Cody, Washington Post
China Digital Times, posted by Michael Zhao,
2007-02-25

(photo from images.com.my)

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Global Warming

Harbin: Ice sculptures, along with the economy, may be melting with rising temperatures.

The Ice festival here -- based on a local tradition of making ice lanterns and sculpting snow that reaches back almost 1,400 years to the Tang Dynasty -- has been undercut by climbing temperatures. Heads are falling from statues and intricately sculpted ice animals are turning into shapeless blobs.

For Harbin, a usually frigid city in northeast China about 400 miles east of the Russian border, the rise in temperatures is a direct threat to a tourist attraction bringing in 5 million visitors last year and injecting millions of dollars into the local economy through tickets, hotel stays, restaurant meals and taxi rides.

The China Meteorological Administration predicted recently that temperatures will likely continue to rise, by the year 2100 climbing by 7 to 10.8 degrees over the average temperatures between 1961 and 1990. By 2050, the meteorologists predict, the glaciers of China's far northwest mountains will shrink by 27 percent if curernt trends continue.

Water Problems

Global warming

Global warming aggravates water problems in China:

Flooding: East

Pollution: rivers al over the country

Droughts: West and North

Water Problems-River Pollution

Songhua River

China's Songhua River suffering near-daily chemical spills

Associated Press China Digital Times, posted by Zhou Li, 2006-09-11

Water Problems-River Pollution

Songhua River

When Beijing hosted the World Water Congress, the Associated Press about the Songhua River pollution (via China Environmental News Digest):

China's Songhua River, the site of a massive chemical spill last year that halted water supplies to tens of millions of people, has been hit by more than 130 water pollution accidents in the past 11 months, according to state media

Every few days, a chemical accident pollutes the Songhua, Pan Yue, deputy director of the State Environmental Protection Administration, was quoted as saying by the official Xinhua News Agency.

Pan blamed "irrational distribution of industrial enterprises" for the frequent accidents, the report said. No additional details were given about the scale or types of accidents.

Water problems-Flooding

Harbin

1998

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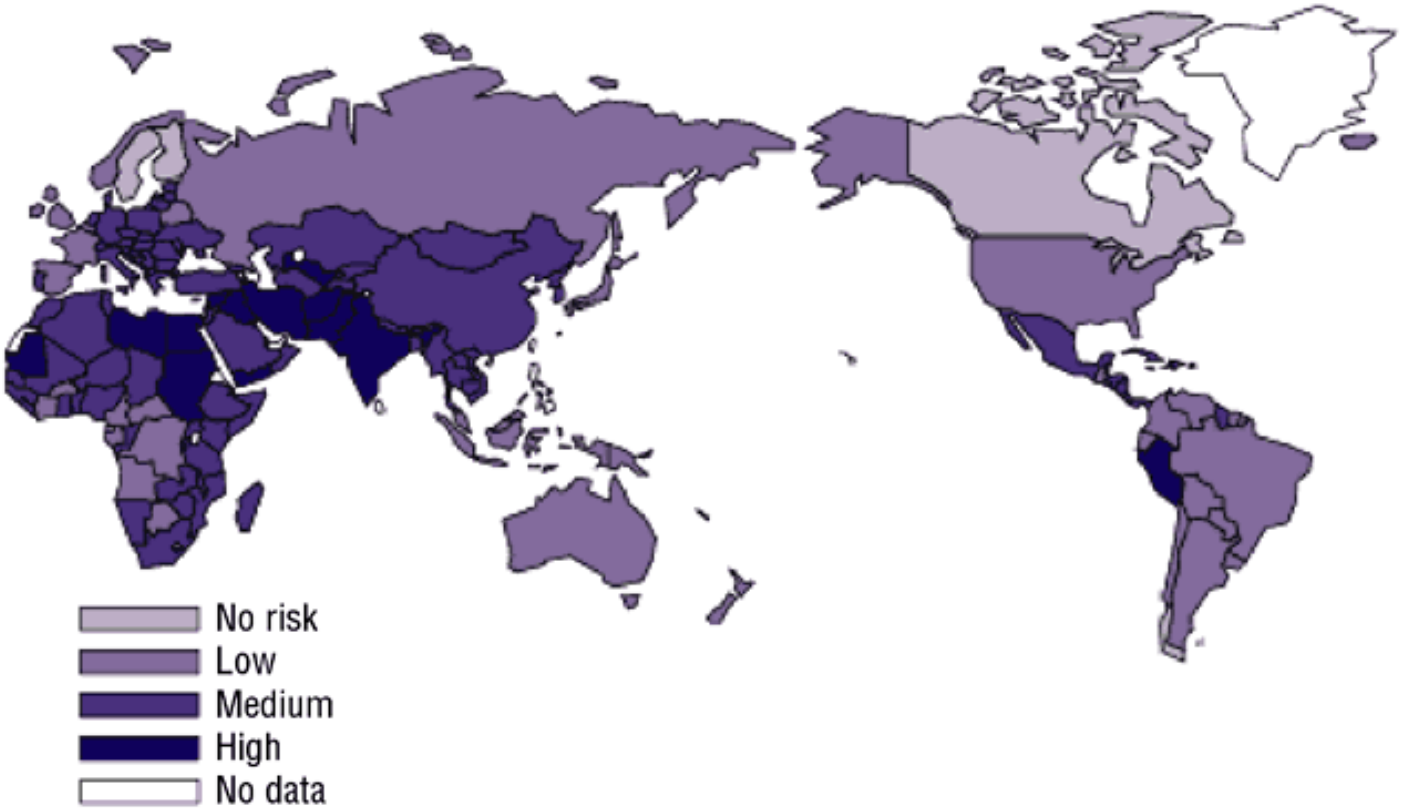
World Water Problems

The world's water is finite, but the number of us is growing fast

World Water Problems

Water Shortage



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World Water Problems

Sea Level Rise

There will be increased flooding of low-lying areas when there are storm surges

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World Water Problems

Water Pollution

Waterborne chemical pollution entering rivers and streams cause tremendous destruction

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Water problems

Course Theme

Water stress (water scarcity, flooding, contamination) is a serious problem in today's world

Global warming is aggravating these problems

Could lead to local, national and international conflicts

The water domain clearly shows the interrelationship between technology and society

Water problems are socio-technical problems

Water problems

Three Gorges Dam

http://en.wikipedia.org/wiki/Image:200407-sandouping-sanxiadaba-4.med.jpg

Sun Yat-sen's idea in 'The International Development of China' 1919.

After the PRC was founded, several leaders were tempted to start the dam but considering their limited ability they started the Gezhouba Dam first.

With the approval of the National People's Congress on April 3rd 1992 the project was finally on the way to completion.

Construction began in 1994, structural work finished 9 months ahead of time on May 20th, 2006

Water problems

Three Gorges Dam- Drought in the Southwest of China?

Chinese leaders say it is climate change, not to the Three Gorges Dam and other vast hydro-engineering works that causes China's worst drought in fifty years.

Drought and shortage of drinking water in Sichuan province in southwest China has affected some 17 million people.

Drought has also affected the flow of the Mekong River, where Chinese authorities have diverted water to build the Manwan and Dachaoshan dams.

The drought in the Yangtze basin this summer have spurred speculations that the massive Three Gorges dam has upset the region’s ecological balance and is causing the decrease in rainfall.

Water problems

Three Gorges Dam- Drought in the Southwest of China?

Meanwhile, China's leaders are considering new huge, and controversial, water-diversion programs to transfer water from the south to the parched north and northwest.

Work is under way on tunnels for the “South-North Water Transfer Project.” The project’s Central route is to carry water from the Yangtze River up north to Beijing.

The Eastern route of the water transfer project is also under construction. Construction of the Western route—which is to tap into the Jinsha and other Tibetan plateau rivers and carry it to Qinghai province and other poor western areas—could start as early as 2010.

Antoaneta Bezlova, “Environment-China: Gov't Denies Droughts Caused by Big Dams,” Inter Press Service, 30 August 2006. Submitted by Michael Renner on September 23, 2006 **Worldwatch Institute**

Water problems

China South-North Water Transfer project (SNWT)

http://icivilengineer.com/Big_Project_Watch/China_River_Diversion/

http://www.usembassy-china.org.cn/sandt/SNWT-East-Route.htm

http://www.nsbd.mwr.gov.cn/nsbd/news/j20011120.htm

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Water problems

Western Route Project (WRP)

Move some 53 trillion gallons of water --- roughly equivalent to 40 percent of Lake Erie --- annually from Tibet to northern China to turn deserts and parched lands into fields and forests.

http://www.progress.org/2006/water29.htm

http://www.nsbd.gov.cn/zx/english/wrp.htm

Water problems

Grand Canal: eastern route

http://www.chinaheritagequarterly.org/editorial.php?issue=009

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Water problems

In this course

Yellow River basin (WFD and SNWT, three routes)

Yangtze Kiang basin (Three Gorges Dam) / Chongqing area (droughts)

Water problems in the Harbin area, esp. pollution

Water problems

Solving Problems: The problem solving cycle

engineering.dartmouth.edu

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Water problems

Conceptual and theoretical frameworks

Analysis: Technology dynamics

Solution: Transition Management

Water problems

Problems and Solutions in the Netherlands

The Dutch have always struggled with water problems

- Water problems caused by global warming, climate change and human intervention
- Rise of level, increasing peak discharges in the rivers, increasing peaks in rainfall and the declining bottom: all enlarging flood chances

How to solve these problems?

How did they confront these problems up to now?

- ‘North Sea Wall’ gives some backgrounds and answers!

Water problems

Technology Dynamics: concepts

Technology

(knowledge of) artefacts, complex artefacts, technical systems

Society

Actors: users, producers, authorities, managers etc.

Institutions: regulations, laws

Values (culture): ‘freedom, equality and brotherhood’, dry feat, reliable drinking water supply, safety as to floods, sustainability, justice

Technology and society

Technology + relevant actors (organizations for production, operation, maintenance, repair and innovation) + institutions: *sociotechnical systems*

Technology + engineering knowledge & values: *technological regimes*

Water problems

Theories on the relation between technology and society

Various theories – theoretical viewpoints – for:

1. analyzing technology development in relation to societal transformation
2. steering technology development and societal transformation

Technology push

Market/society pull

Co-evolution of technology and society

Water problems

Technology Dynamics: theoretical point of view

Basic idea: technological innovation is a

(quasi-)evolutionary process of variation and selection

Variation in the form of technological alternatives

Selection through actors

→ Technology development is a socio-technical process

Technology Dynamics

Quasi-evolutionary

Biological evolution: variation (through mutations) and selection (through environmental conditions) are not (directly) related

Socio-technical evolution: variation and selection are *connected*: selecting actors **influence** technology development and technology development **influences** the choice people make → co-evolution

Technology and society are linked through agency, socio-technical system building and technological regimes

Technology Dynamics

Agency

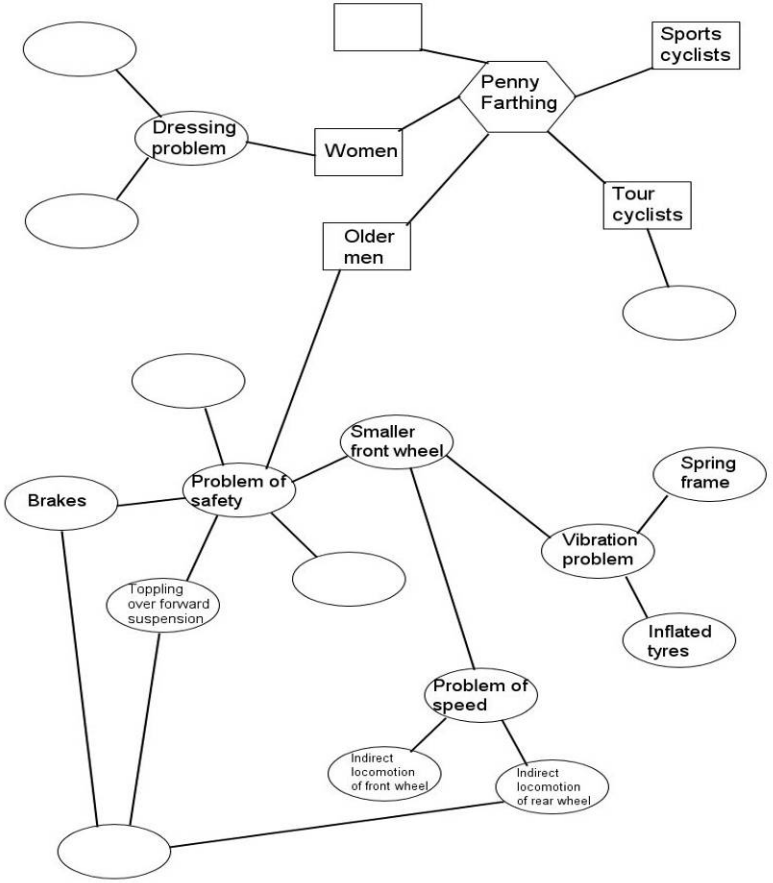
Actor (social actors): an **organized social unity** engaged in a socio-technical problem which has influence in the construction of the solution, e.g. entrepreneurs, government agencies, educational institutes

Actors have problems, interests and values; they select technology, but also co-construct technology → 'social constructivism'

Actors *perceive* problems and solutions, they 'assign meanings', they suggest solutions and thus co-construct technology

Technology Dynamics

Actors, Problems and Solutions (bike)



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Technology Dynamics

Restraints: systems and regimes

Socio-technical system: technology and the actors directly involved form a system (hardware)

actors within the system and actors making part of the system environment; both groups have influence and should be considered

Example: river basin = multi-purpose and multi-actor situation

(farming, industry, shipping, drinking water); not directly involved: citizen groups

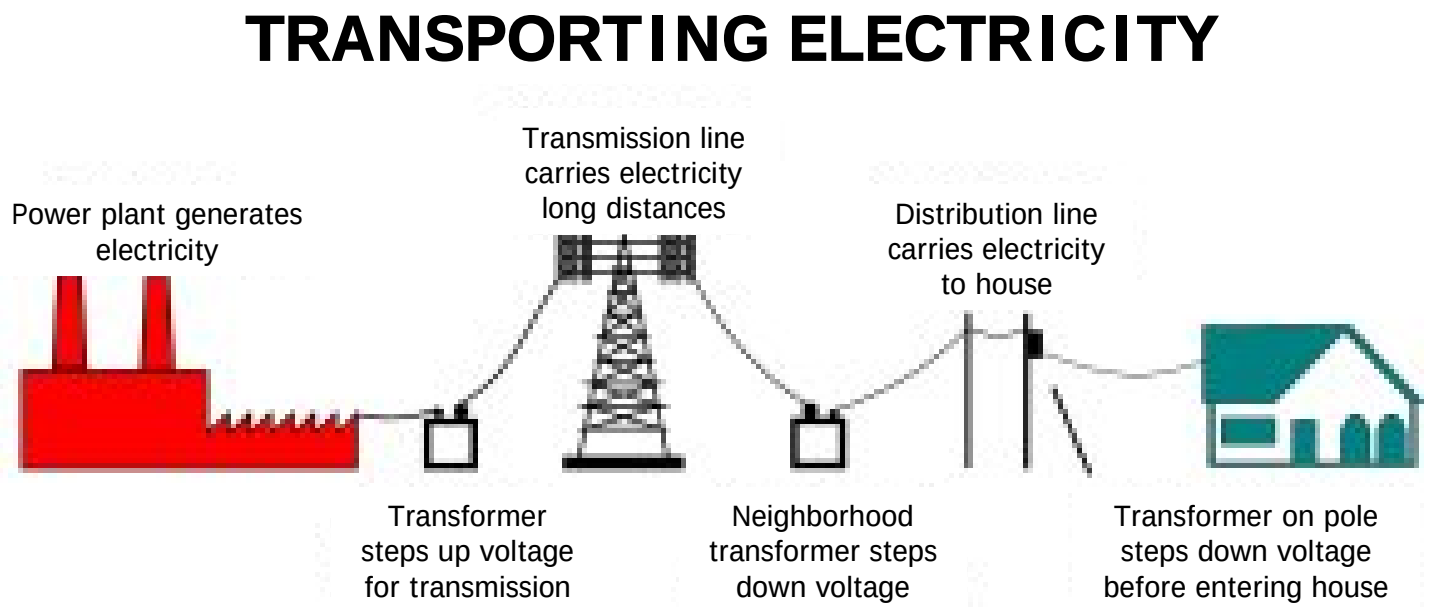
Technological regime: rule-set engineers use for identifying, analyzing and solving socio-technical problems; some rules are technical, others reflect society (software)

Example: ‘dry feet’ regime vs ‘room for the water regime’

Technology Dynamics

Socio Technical Systems

kohm.org



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Technology Dynamics

Technology Dynamics: technological regimes

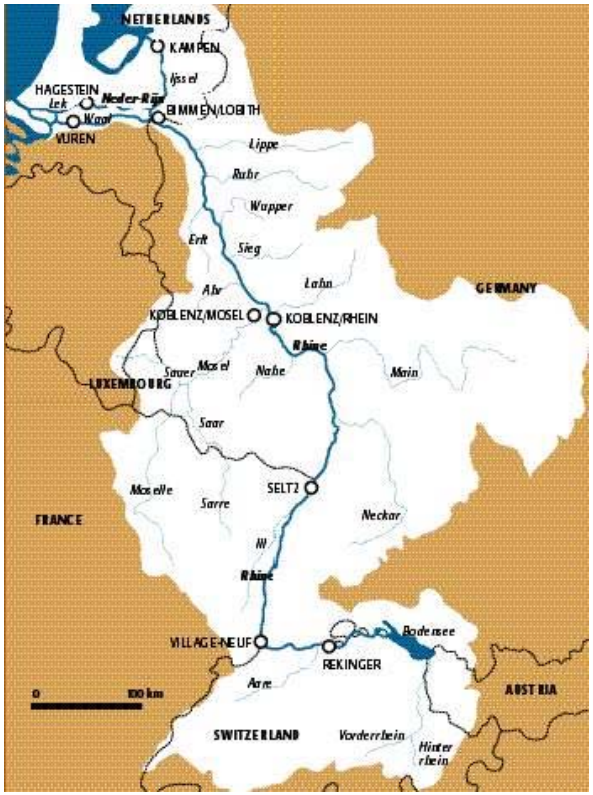
Water boards

National water agency

European water management

‘Dry feet’

‘Room for the water’



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Technology development

Technology change per se

system growth governed and conditioned by *technological regime*

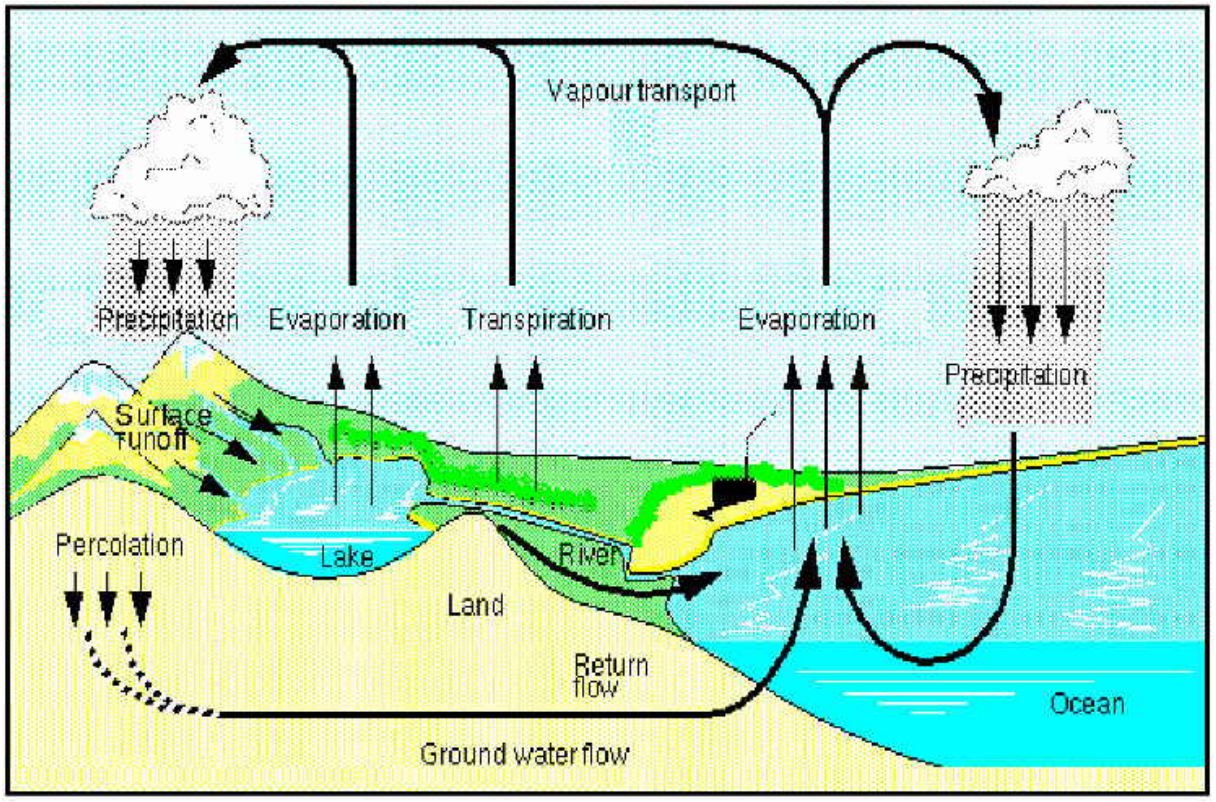
system innovation made possible by *regime shift*, including involved social values

Development of technology and society

technological variation, performed by engineering activity: *incremental or far-reaching* innovations

social selection (acceptability), performed by social agency: technical possibilities fitting in with the main stream of social development are easy to accept; possibilities outside the mainstream are harder to implement

Sustainable Development



http://www.euwfd.com/assets/images/autogen/a_Image-050202.jpg

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Sustainable Development

Focus on far-reaching solutions

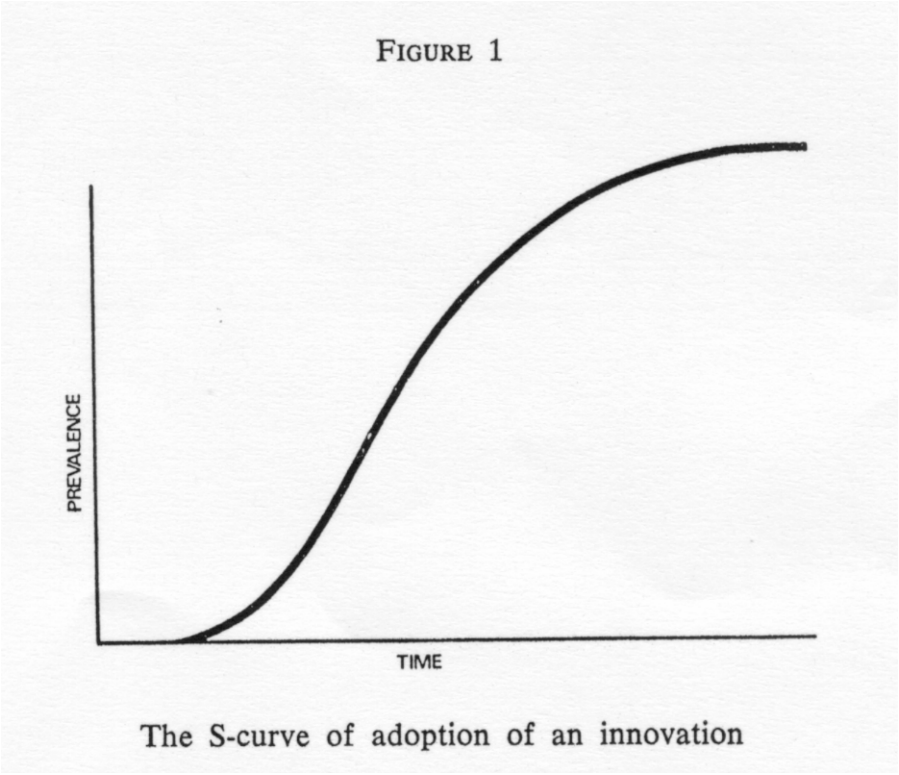
Sustainable development requires solutions that are:

- Technically feasible, robust
- Safe technology, risk analysis should be positive
- Economically viable, cost-benefit analysis should be positive
- Ecologically sound, in harmony with nature
- Socially responsible, socially acceptable and morally equitable

Sustainable development requires innovative policies or transition management, based on co-evolution of technology and society

Sustainable Development

Transitions



www.unodc.org

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Sustainable Development

Transition Management: Technology and Society Innovation Cycle

	Society demand	**Technology push**
High co-ordination	3. Coordinated answer to problems / product idea Tool: problem solution cycle	4. Technological answer / product Tool: design process
Co-evolution	2. 'Conscious actors' put problems of the agenda / articulation Tool: expert consultation	5. Responsible engineers involve relevant actors / adaptation product Tool: SCOT
Low co-ordination	1. Social problems call for change / market question Tool: sociological analysis	6. Implementation and adoption / marketing and commercial success Tool: diffusion theories

Sustainable Development

Two different solution possibilities

Structural or non-structural, buildings or management

Small-scale vs large-scale; local, regional or national; delta, river basin, interbasin

Government vs business

Technology transfer vs endogenous development

Assignment

Choose and specify a water problem

Identify at least two alternative solutions

Analyze problem and solutions in terms of social actors and sustainability

Devise integrated solutions

Weigh the pros and cons of these solutions and make feedback to original problem

Come up with a final advice for a relevant agency

Devise implementation strategies for the proposed solutions in terms of transition management

Assignment

In groups of 5 students, writing and presenting a report

On the basis of technology dynamics and transition management

And on the basis of the course literature as well as additional sources

Collective reports are expected to have 6 pages, incl. one page references. During the end presentation each student presents one page.

Halfway groups present their problem analysis and the solutions they want to explore.

Structure of Course Content

Socio-technical problems

Technology dynamics forms the *framework*

Actor perceptions and sustainability form *perspectives*

Expectations

The course offers you *a learning path for which you are responsible yourself*

We expect YOU to form working groups, to deal with a *specific problem* and to write and present a report

From US you can expect a list of *general problems* out of which you can make a choice, conceptual and theoretical frameworks to work with, basic information, answers to your questions and other help you need

Type of problem

Point of departure: we live in a *risk society*

Paradox: science and technology cause social problems, e.g. pollution, safety problems, big differences between rich and poor, which should be solved with science and technology

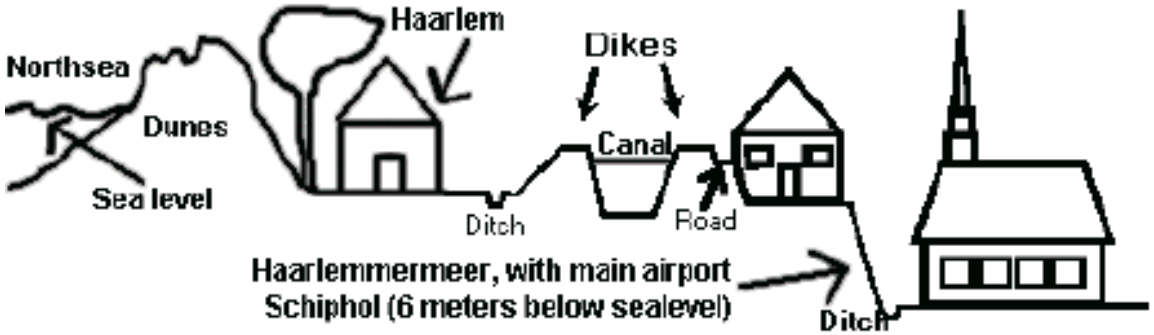
Example: the Dutch water control situation. Expert water interference has led to problems which could only be solved through the experts

Problems are *socio-technical*: they have a technological aspect and a social aspect and both are intermixed.

Example: the danger of flooding has to do with dikes, but also with people living in dangerous zones

Example

The Netherlands



Almost 50% of the Netherlands lies beneath sea level

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Example

The Netherlands

What is the problem? Which causes can be distinguished?

People potentially suffering

Dutch water history success story?

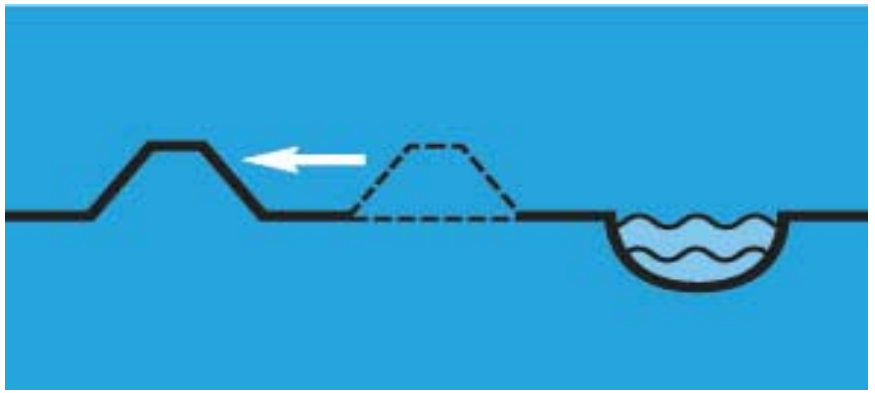
Problem analysis determines solution possibilities

Example

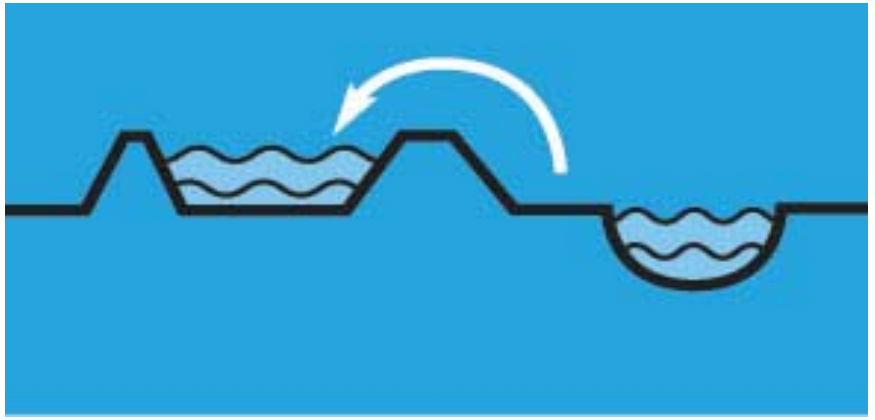
The Netherlands

Two solutions:

Repositioning the dike



Constructing a retention reservoir



Examples

Two solutions: examples from Delft course

New Orleans (Katrina): nature's way vs terps

Ethiopia water scarcity: irrigation and drainage vs virtual water trade

Bangladesh arsenic in drinking water: deep tube wells vs integrated water system

Danube pollution: polluter pays principle vs beneficiary pays principle

The Netherlands: heightening vs repositioning the dikes

Working Instructions

General

Think in terms of *actors, socio-technical systems and technological regimes*

When it comes to social actors: realize that their *perceptions* of problems, situations, solutions can be different

Think in terms of *sustainability*

Working Instructions

6 Steps to deal with Socio-Technical Problems: Step 1

Specify and define the problem

Which **sustainability aspects** can be identified?

Working Instructions

6 Steps to deal with Socio-Technical Problems: Step 2

Which **actors** are involved?

What is the **problem context** in terms of socio-technical systems and technological regimes?

Technology Dynamics Model

Concepts	**Analysis**
- Actors	Farmers, communities, drinking water companies, industrial firms etc.
- Socio-technical systems analysis	Water control system geared to draining water as soon as possible to the sea
- Technological regime analysis	Dry feet vs room for the water regime

Working Instructions

6 Steps to deal with Socio-Technical Problems: Step 3

Make an inventory of **technological possibilities** to solve the problem

choose 1 incremental/conservative and 1 radical innovation

Solution 1	**Solution 2**
Make polders adapted for water storing	Increase the storing capacities of rivers

Working Instructions

6 Steps to deal with Socio-Technical Problems: Step 4

Make an **actor / perception analysis** of the two solutions: which social actors are involved, what are their interests, values and views?

Make an analysis of the alternatives in terms of **socio-technical systems and technological regimes**: chances and restrictions

Analysis of the solutions with technology dynamics model

Concepts	**Solution 1: polders**	**Solution 2: rivers**
-Actors	E.g. farmers	E.g. inhabitants of newly-built house owners
-Socio-technical systems	Existing water regime geared to drainage in sea	System change toward storing
-Technological regimes	Dry feet regime	Regime change toward room for the water

Working Instructions

6 Steps to deal with Socio-Technical Problems: Step 5

Evaluate the solutions in terms of the actors involved and the criteria of sustainability

Give an **expert advice** on the optimum solution, considering both expert sustainability views and actor views and considering the implementation chances of the solution

Perspectives	Solution 1: polders	Solution 2: rivers
-Actor perceptions	E.g. farmers in polders, pollution?	E.g. house owners
-Sustainability	Who profits, who pays? (People and environment)	Who profits, who pays? (People and environment)
Advice	?	?

Working Instructions

6 Steps to deal with Socio-Technical Problems: Step 6

Indicate how these solutions could be implemented

Phases	**Solution 1: polders**	**Solution 2: rivers**
Phase 1	Preparation	Preparation
Phase 2	Execution	Execution
Phase 3	Evaluation	Evaluation

Assessment

Students are assessed on the basis of their final project reports and the presentations of these reports.

Reports are assessed **collectively** and count for 75% (lectures can differentiate individual scores).

Presentations are assessed **individually** and count for 25%.

Final marks are determined collectively by the lectures, in which each expert especially considers the way his topic has been dealt with, and will be individually assigned.

Assessment

Criteria

Criteria for the (group) report are:

- (clear) specification and delineation of a socio-technical problem
- (complete) application of the theoretical model in analyzing the problem and working out (two) alternative solutions
- originality of the chosen solutions
- use of the various perspectives
- quantity and quality of the used sources
- integration of the various perspectives in the solutions considered
- weighing the pros and cons of the solutions, in view of the original problem and including the creation of new problems
- quality of the final solution choice

Criteria for the (individual) presentations:

- clearness and comprehensiveness
- dealing with questions and defense of positions