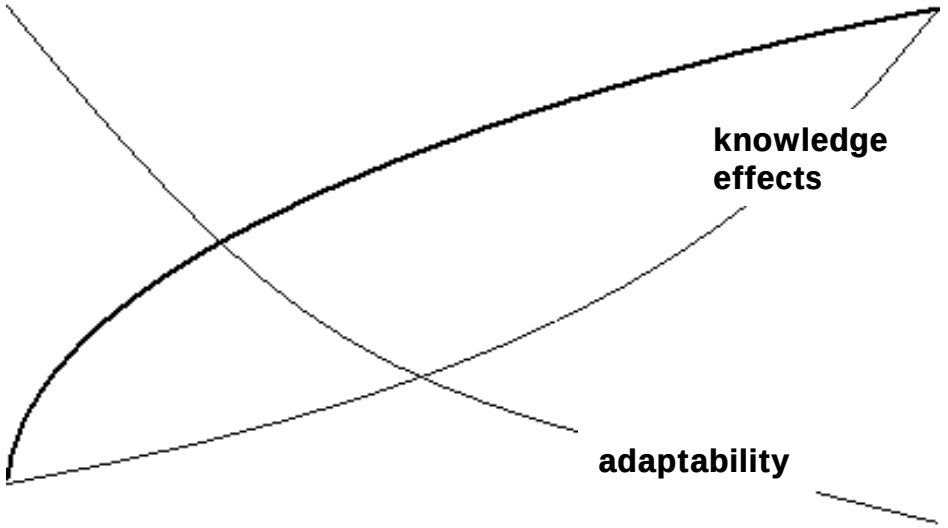
Technology Assessment & Measuring Sustainability

Changes due to New Technologies



Karel Mulder

January 8, 2010

TU Delft
Delft University of Technology

Changes due to New Technologies

What are the effects of new technologies?

How are they realized?

What can we do?

TECHNOLOGY ASSESSMENT

Changes due to New Technologies

Policy and Technology

New technologies can create new problems

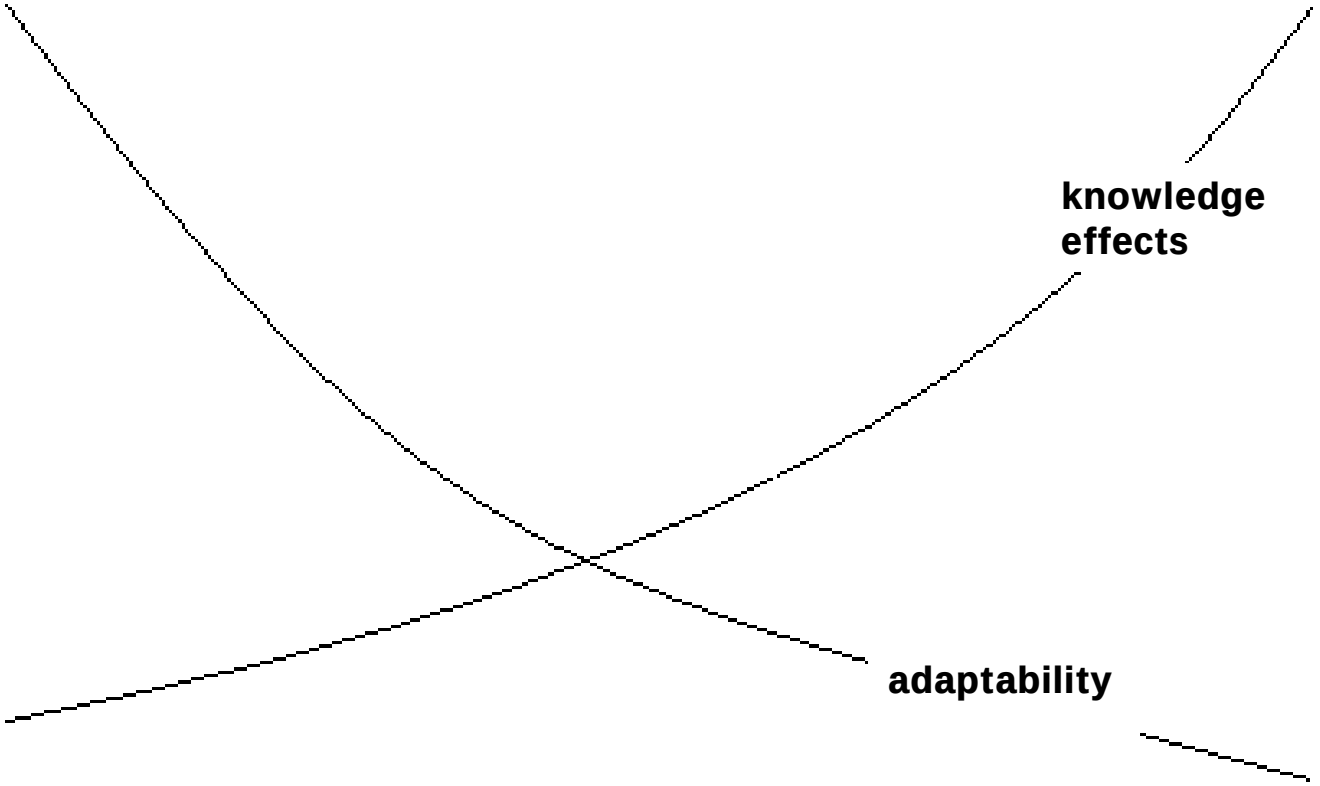
e.g. cloning

These new problems are not foreseen since people use technologies in unpredictable manners

e.g. hackers

Changes due to New Technologies

Collingridge dilemma



TU Delft

Changes due to New Technologies

Collingridge dilemma, (trilemma)

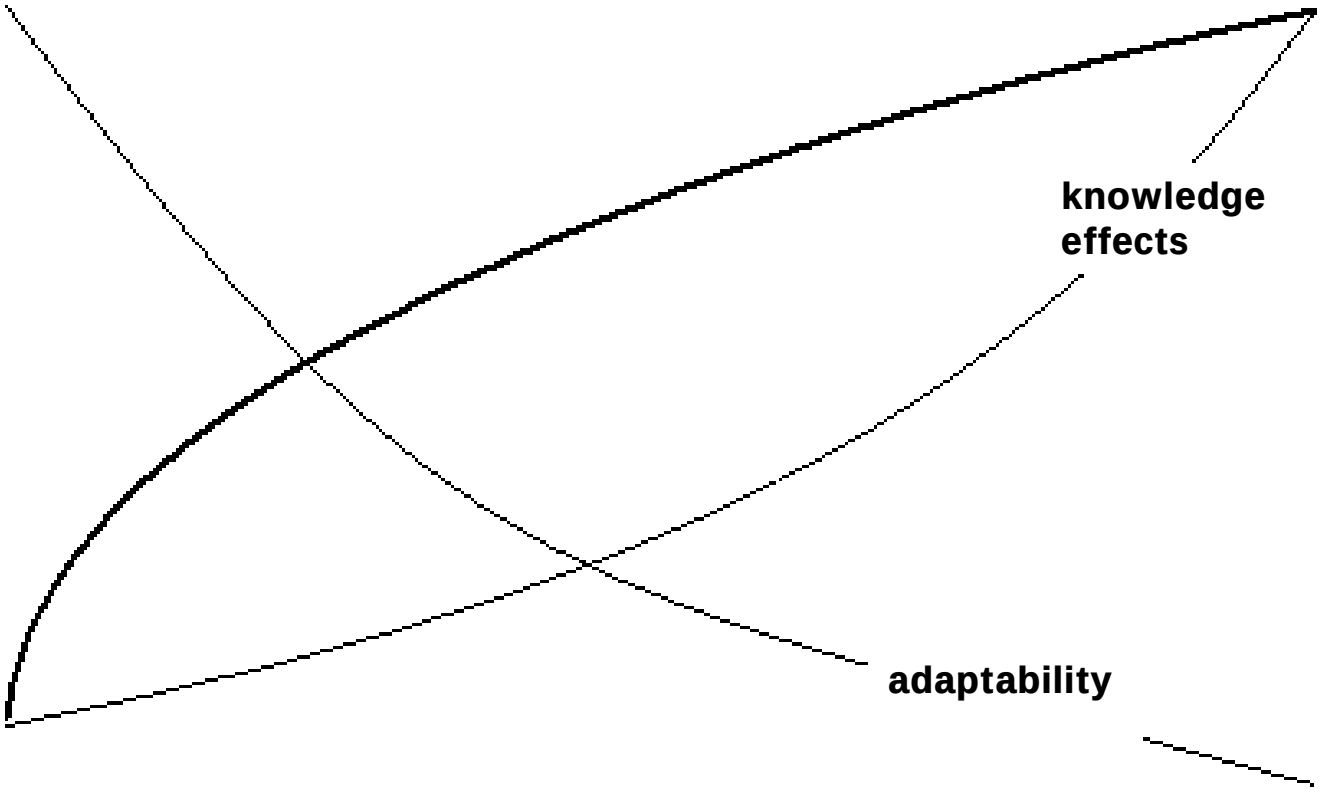
Lead

Trilemma?

Flexibility?

Changes due to New Technologies

Control dilemma with forecasting of impacts



Changes due to New Technologies

DDT

Paul Hermann Muller

- Invented DDT in 1939 (insecticide useful to control insect borne diseases)

Won the 1948 Nobel Prize in Medicine

Silent Spring, 1963, Rachel Carson

- Dealt with the effects of chemicals such as DDT in the environment.
- This lead to the banning of DDT in the 70's and 80's in western countries

http://sandwalk.blogspot.com/2007/03/nobel-laureate-paul-hermann-mller.html

Changes due to New Technologies

Wadden area, Netherlands

Canal in Wadden-area

Was never constructed due to political and environmental reasons

TU Delft

Changes due to New Technologies

Where do things go wrong?

Technology ‘did not work’ as was expected

Technology didn’t fully ‘work’

Technology did other things as well

Social demands for a product are not assessed correctly, or change

Usually all relevant requirements are discovered in practice: Rachel Carson’s Silent Spring

http://en.wikipedia.org/wiki/Rachel_carson

Changes due to New Technologies

Second order effects

Behavior changes due to new technology:

- Traffic is attracted to new roads/connections
- Cultural changes as a result of television

Third and higher order effects again lead to change

The Pill → changing sexual behavior → sexually transmitted diseases → ??

Changes due to New Technologies

1950's

Technological optimism

- Nuclear energy would be 'too cheap to meter'
- Natural gas would be exhausted
- Flying cars

Technology is a positive sum game

http://i3.iofferphoto.com/img/1158562800/_i/14188158/1.jpg

http://novaminds.net/images/science_images/skycar.jpg

TU Delft

Changes due to New Technologies

Late 1960's

Technology and its consequences are decisive for the environment

Society (governments) should be able to make found judgments

Technology assessment as a neutral, factual analysis of technological effects as an input in the decision-making process.

Changes due to New Technologies

1960's

Charles Lindberg

- Loved both technology and nature

- Pioneered in looking for a balance between technological achievements and nature

  → technological assessment

http://archives.delaware.gov/100/airlandandsea/A%20Meeting%20of%20Innovators.shtml

TU Delft

Changes due to New Technologies

Technology Assessment Defined

Technology Assessment is:

> the **systematic** identification, **analysis** and **evaluation** of the **potential secondary consequences** (whether beneficial or detrimental) of
>
> technology in terms of its **impacts** on **social, cultural, political, economic** and **environmental** systems and processes.

Changes due to New Technologies

Technology Assessment Defined

Technology Assessment is:

> an attempt to establish an **early warning system** to detect, control, and direct technological changes and developments so as to **maximize** the **public good** while **minimizing** the **public risk**

Changes due to New Technologies

Early 1970's

1972, USA, Office of Technology Assessment

Technology Assessment is intended to be a neutral, factual input into the decision-making process.

To provide members of congress with an objective and authoritative analysis of complex scientific and technical issues

Europe did not follow immediately due to other political traditions

http://en.wikipedia.org/wiki/Image:OTA_seal.png

TU Delft

Changes due to New Technologies

Criticism

Marcuse/Wynne:

- Little democracy
- Repressive tolerance
- Unpredictable

Changes due to New Technologies

Problems with classical Technology Assessment

Classical technology assessment:

Is deterministic

Objective claims can not be proven

'After the fact'- problems are identified when they are already there

It is not productive to correct on hindsight

Does not contribute to neutral, factual decision-making for technological or scientific issues.

Changes due to New Technologies

Strategic Technology Assessment

A process to analyze technological developments and discuss the consequences

The goal of technology analysis is to provide those involved with information to formulate strategic policy, and to define areas of further study.

But:

- This is not neutral
- Goal is to implement results

Changes due to New Technologies

Constructive Technology Assessment

Presuming that:

Technology can be directed

Improve interaction between technology developers and those implementing technology

Interactive technology assessment, public debate

Changes due to New Technologies

Classical vs. Modern Technology Assessment

Differences between classical and modern Technology Assessment are exaggerated

Public and political formulation of opinions is now most important but:

- Political lobby and ‘media coverage’ were already relevant for the Office of Technology Assessment back in 1972

Public debate must be based on facts. This creates the need for classical technology assessment, that today is less pretentious

Changes due to New Technologies

1980's

In the 80's Europe followed with several institutes for Technology Assessment:

Rathenau
TAB
STOA
POST
IPTS

http://www.jrc.es/
http://www.europarl.europa.eu/stoa/default_en.htm

TU Delft

Changes due to New Technologies

Measuring Sustainability

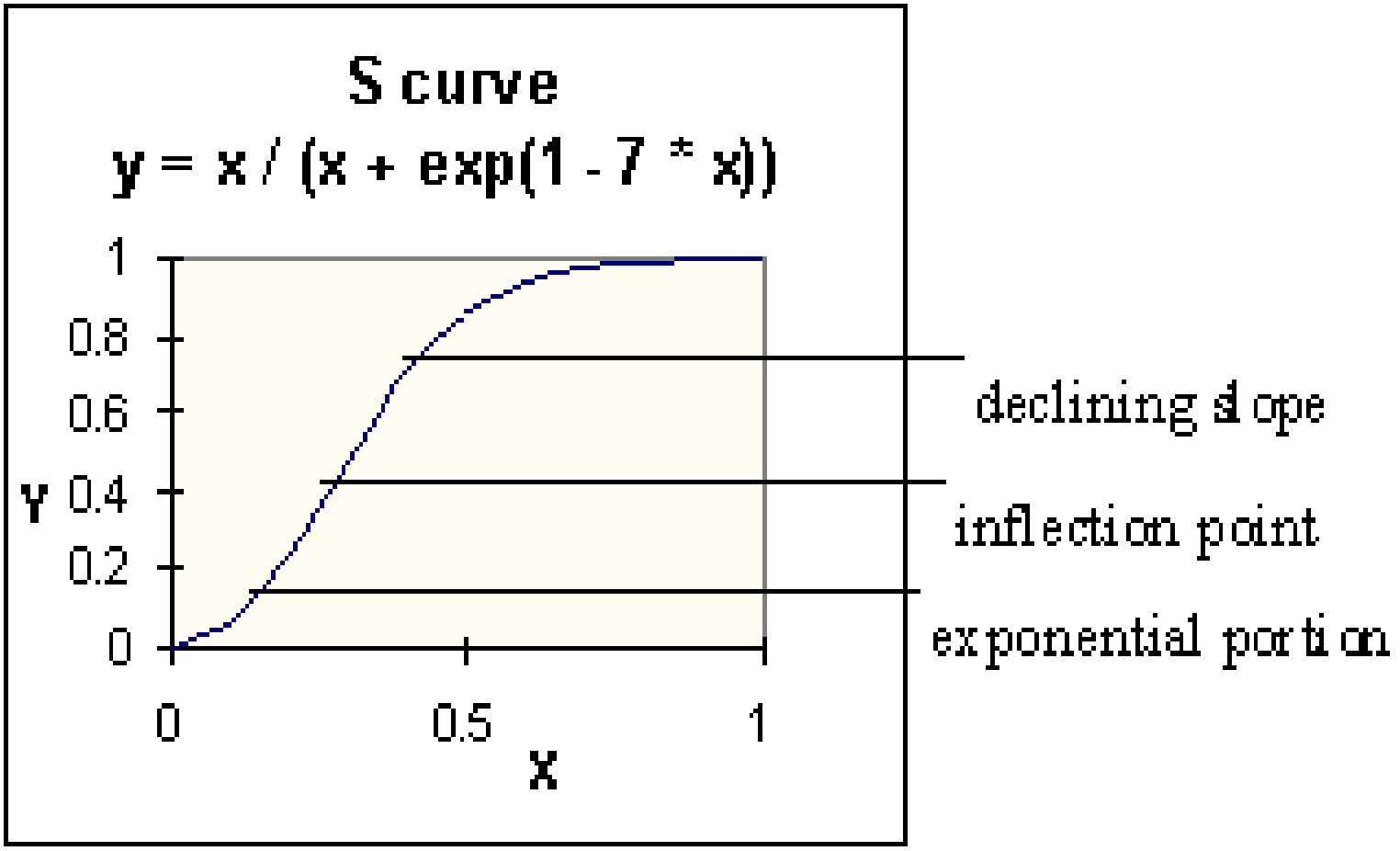
Ecological Footprint

http://www.footprintnetwork.org/

TU Delft

	Ecological footprint per capita (Ha)		Ecological footprint per capita (Ha)
Germany	5,3	Bangladesh	0,5
Australia	9,0	Brazil	3,1
Austria	4,1	Chile	2,5
Belgium	5,0	China	1,2
Canada	7,7	Colombia	2,0
Spain	3,8	Egypt	1,2
U.S.A	10,3	Ethiopia	0,8
France	4,1	India	0,8
Great Britain	5,2	México	2,6
Netherlands	**5,3**	Nigeria	1,5
Italia	4,2	Pakistan	0,8
Japan	4,3	Peru	1,6
Portugal	3,8	Thailand	2,8
Russia	6,0	Turkey	2,1
Sweden	5,9	Venezuela	3,8
Mean World Ecological Footprint	**2.8**		
Available Bio capacity	**1.7**		

TU Delft


S curve
y = x / (x + exp(1 - 7 * x))
1
0.8
0.6
0.4
0.2
0
y
0
0.5
1
x
declining slope
inflection point
exponential portion

Changes due to New Technologies

Forecasting Methods

Forecasting methods are certainly useful in modern, interactive technology assessment.

These methods are however usually labor-intensive

Changes due to New Technologies

Forecasting Methods

Expert methods:

If there are no reference points for extrapolation

http://www.flug-revue.rotor.com/FRheft/FRH9809/FR9809K1.JPG

Hydrogen as aircraft fuel?

Nanotechnology

Changes due to New Technologies

Forecasting Methods

Models, analogies and extrapolation when technology needs to be adopted by society

Changes due to New Technologies

Expert Methods and Bias

Positive bias technology in general

e.g in IEEE research

Positive bias in area of own expertise

e.g in nuclear fusion, self-selection

Social structure within disciplines prevents open communication:

dependencies, interests/benefits, biases, delphi method

Changes due to New Technologies

Delphi Method

Delphi:

- Survey among experts in several rounds
- Anonymous feed back of arguments & estimates
- Revision of judgments
- Consensus in 3-4 rounds

Wikipedia: Pythia1.jpg

Changes due to New Technologies

Delphi Method

Used since 1959

Good results,

Not just forecasting: it is also intervention in a discipline

But, criticism:

- Group bias remains
- Strategic behavior by mutual contact
- Only for experts within a discipline

TU Delft