



Delft University of Technology

## Future Challenges for Technology Management and Policies

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# Future Challenges for Technology Management and Policies

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- Technology Policies: Reversed Engineering



# Technology Policies: general

- General aim of stimulating economic growth through production of new technological knowledge

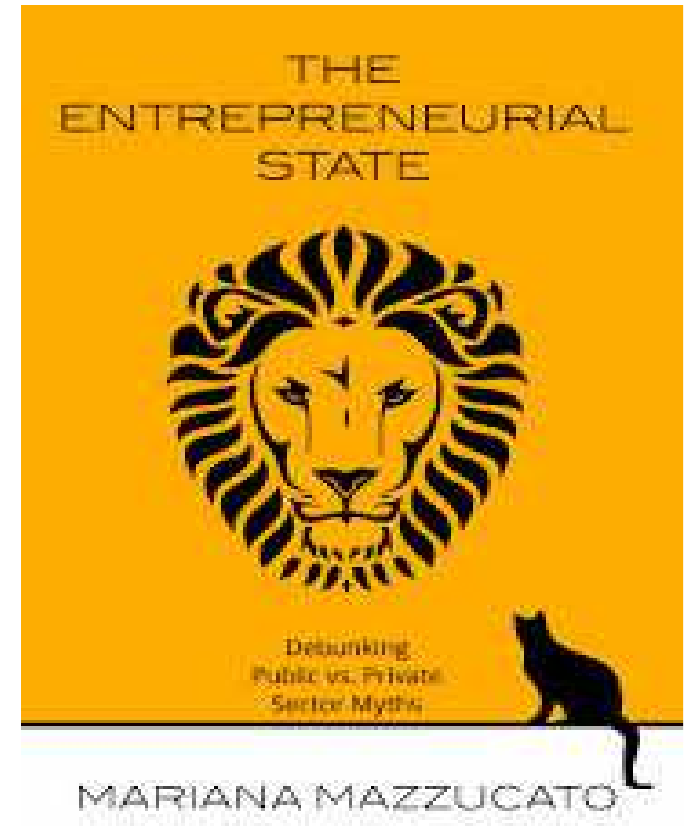
But technological knowledge is not an ordinary good

- Addressing market failures due to (Jaffe *et.al*, 2005):
  - knowledge externalities
  - adoption externalities
  - incomplete information



# Technology Policies: general

- Direct government intervention:
  - Manhattan Project on nuclear weapons
  - Apollo Project
- Indirect government intervention through incentives through taxes and subsidies to private enterprises



## Technology Policies: specific

- Combining Technology Policy with other specific policies (environmental, health policies).
- Stimulating positive (innovative technologies) and reducing negative externalities (climate change)

(Popp *et.al*, 2009; Diaz Arias and van Beers, 2013)

# Technology Policies: specific

## Directed Technological Change:



- Technological change due to price incentives: focus on price-induced technological change (innovations, patents, etc.) towards mainly sustainability (climate change) (Acemoglu *et.al*, 2012)
- Technological change taking into account a broad spectrum of values defined by society such as safety, risk, ethical and social values.
  - leads to a trade-off between values through value-sensitive design

## Technology Policies: specific

- Value-sensitive design aims at designing while taking into account societal acceptance and barriers against new technological change:
- Trade-off between different values: for example efficiency vs. privacy

Example: smart metering (privacy sensitive)

etc.





# Technology Policies: specific

Addressing responsible technological within the framework of socio-technical systems aimed at achieving European Union Grand Challenges:

1. Global warming;
2. Tightening supplies of energy;
3. Water and food;
4. Ageing societies;
5. Public health;
6. Pandemics and security.



# Technology Management: Future Challenges

- 1) increased inefficiency of technological innovation processes.
- 2) needs of marginalized and poor groups in the European Union.
- 3) the squeeze between increasing demand for public sector spending aimed at addressing the EU Grand Challenges through among others technology policies and public sector budget constraints.

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# Future Challenges: Inefficiency

Increasing inefficiency of R&D process valid for many sectors  
But strongest in pharmacy.

Big Pharma's R&D spending tripled between 1995 – 2009  
But number of new drugs launched dropped by 44 % since  
1997

Erooms' Law: concave relationship between R&D inputs and  
R&D outputs.

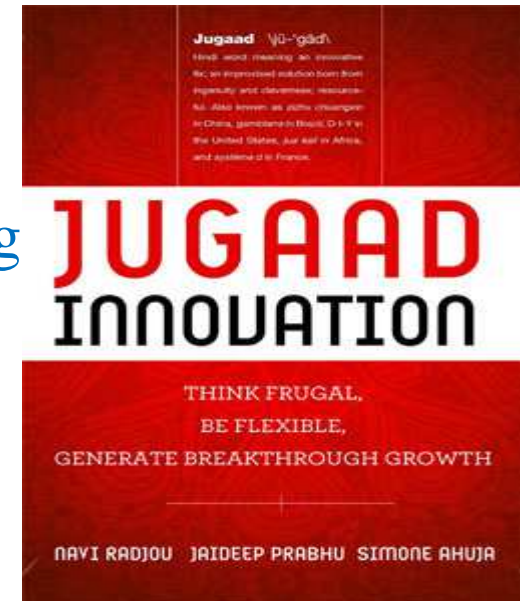
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# Future Challenges: inefficiency

Standardization and routinization of R&D leading to bureaucratic R&D departments are result of Technology Management in 20<sup>th</sup> century (Radjou *et.al* , 2012).

- Too expensive and resource consuming: overengineering
- Lacks flexibility required to deal with fast changing technological and economic external environments
- Elitist and insular: knowledge is power



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# Future Challenges: changing environment

Why?

Increased complexity of the external environment due to:

1. Scarcity
2. Diversity
3. Interconnectivity
4. Velocity
5. Globalization

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# Future Challenges: changing environment

## Scarcity

- Declining incomes of middle classes in USA and Europe
- Increasing scarcity of natural resources: oil, water

## Diversity

- Changing values: responsible innovation
- Less homogeneous markets: less scale economies

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# Future Challenges: changing environment

## Interconnectivity

- due to technology not necessary to work in big firms for R&D and technology commercialization

## Velocity

- Shorter product life cycles provoking corporations to launch new products faster and faster to keep consumers satisfied

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# Future Challenges: changing environment

## Globalization:

- Emerging markets (China, India, Nigeria etc.) lead to more scarcity, diversity, interconnectivity and velocity due to Rising middle class (opposite to declining middle class in USA and Europe)



- Emerging markets increase competition for Western firms particularly for consumers in emerging economies: frugal innovations important

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# Future Challenges: Frugal Innovations

Recent phenomenon: frugal innovations in order to supply Base-of-Pyramid and emerging middle class in emerging markets such as Brazil, China and India)

## Frugal innovations

re-designing products without luxury attributes in order to supply the Base-of-Pyramid as well as rising lower middle classes (between \$2,- and \$ 10,- a day) in emerging markets

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# Future Challenges: Frugal and Reversed Innovations

1. Frugal Innovations: new functionality at low costs
2. Reverse Innovations: selling low-cost innovations originally developed for emerging markets in developed markets

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# Future Challenges: Frugal and Reversed Innovations

## Frugal Innovation



## Reversed Innovation



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# Future Challenges: Frugal and Reversed Innovations

Most challenging for technology strategy of Western firms is:

- Frugal innovations: adapting to characteristics BoP
- Reverse innovations: risk of disrupting yourself

Immelt, J., Govindarajan, V. and C. Trimble, 2009, How GE is disrupting itself, *Harvard Business Review*, 87(10): 56 – 65.

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# Future Challenges: Frugal and Reversed Innovations

## Philips Africa: Community Life Centers (CLCs)



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# Re-engineering and technology policies

Several program on bottom up innovations aimed at providing solutions for making health care, energy and education affordable and accessible:

1. Social innovation and civic participation program (SICP, USA)
2. System D program (France)
3. Training programs in entrepreneurship schools (School of Engineering at Santa Clara University; Leiden, Delft Erasmus Centre for Frugal Innovations, in Africa; Cambridge Inclusive Design Program (UK))

# Re-engineering and technology policies

## Some issues:

- How to change standard technology policies aimed at premium price products, services of systems of big firms to stimulate frugal innovations
  - study in-progress for the EU on stock taking of all issues and policy advice ( to be delivered in November 2016).
- How to deal with issues around security, privacy and existing technology policies in EU and USA focused on standard technology development