Future Challenges for Technology Management and Policies

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  - R&D Inefficiency
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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):

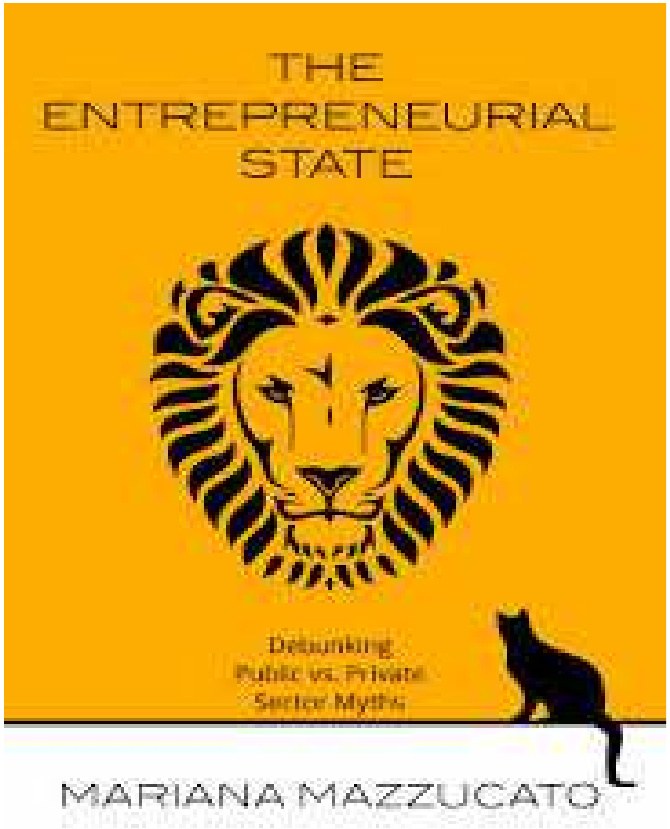
  - knowledge externalities
  - adoption externalities
  - incomplete information

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



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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)

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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

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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.

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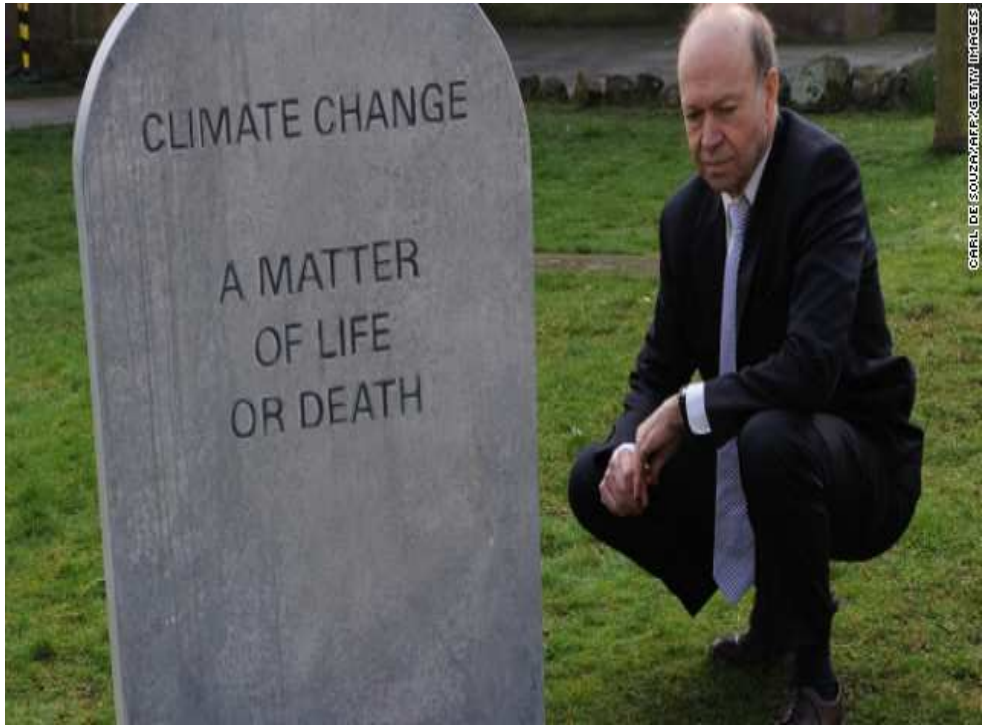
Technology Policies: specific

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.



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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.

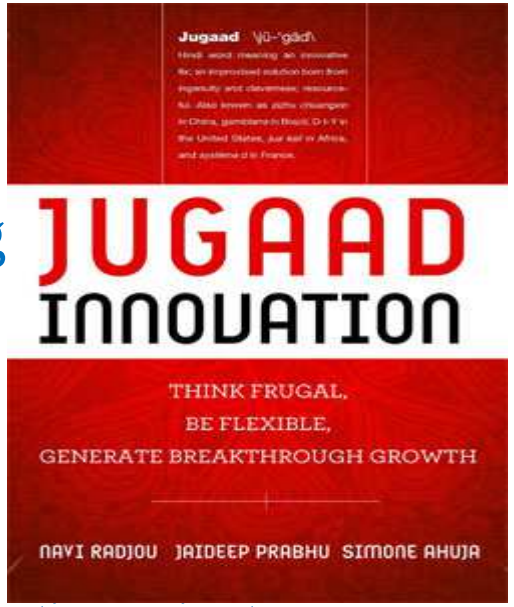
Future Challenges: Inefficiency

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.

Future Challenges: inefficiency



Standardization and routinization of R&D leading to bureaucratic R&D departments are result of Technology Management in 20th 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

Future Challenges: changing environment

Why?

Increased complexity of the external environment due to:

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

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

Future Challenges: changing environment

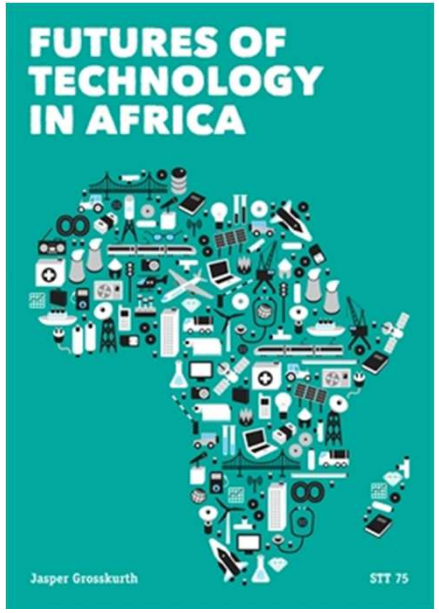
Interconnectivity

- 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

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

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

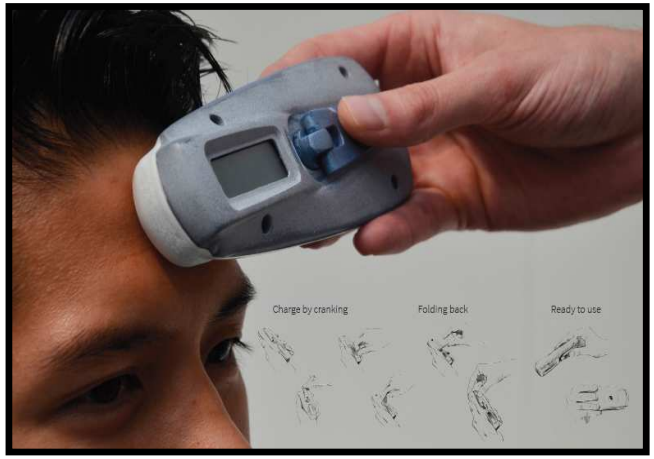
Future Challenges: Frugal and Reversed Innovations

1. Frugal Innovations: new functionality at low costs

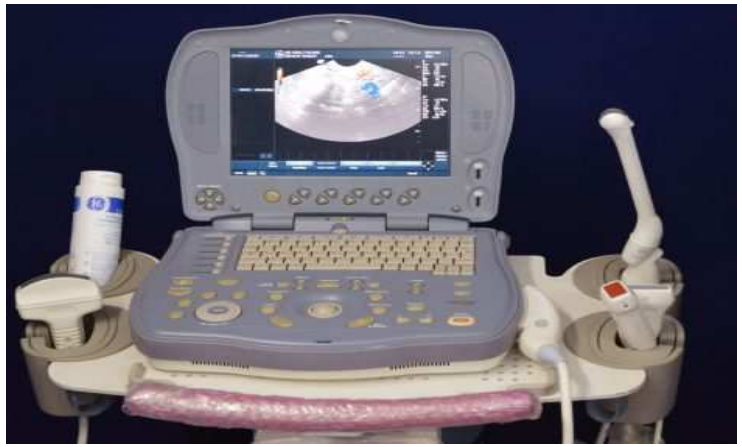
2. Reverse Innovations: selling low-cost innovations originally developed for emerging markets in developed markets

Future Challenges: Frugal and Reversed Innovations

Frugal Innovation



Reversed Innovation



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.

Future Challenges: Frugal and Reversed Innovations

Philips Africa: Community Life Centers (CLCs)

January 13, 2017

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