

Directions of Technological Change: Responsible Innovation

**Seminar on Responsible innovation: Emerging issues and practices.
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- Directions of technological change:
 - traditional views,
 - challenges
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Organisational Background

Department of Values Technology and Innovation (VTI):

1. Philosophy and Ethics of Innovation
2. Economics of Technology and Innovation
3. Safety and Security of Innovation

Research Program: responsible innovation

Leiden-Delft Erasmus (LDE) Centre for Frugal Innovations
in Africa

Direction of Technological change: traditional neoclassical view

Technological change is exogenous force but leads to temporary productivity changes in the economy

Robert Solow (1957) Technical Change and the Aggregate Production Function
The Review of Economics and Statistics, Vol.39, No. 3, 312-320.



Direction of technological change through direct government
Intervention (for example defense spending in USA):

- Manhattan Project on nuclear weapons
- Apollo Project

Direction of Technological change: traditional neoclassical view

Technological change due to price incentives to private profit-making firms. (Romer, 1990)

Paul Romer, 1990, Endogenous Technological Change, *The Journal of Political Economics*, 98, 5, part 2: S71 – S102.

Indirect government intervention through Incentives through taxes and subsidies to private enterprises

Aim: efficiency and economic growth

Direction of Technological change: traditional neoclassical view

Technological change due to price incentives: focus on price-induced technological change (innovations, patents, etc.) towards mainly sustainability (climate change).

Daron Acemoglu, Philippe Aghion, Leonardo Bursztyn, David Hemous, The Environment and Directed Technical Change, *American Economic Review*, vol. 102, no. 1, February 2012 (pp. 131-66)



Direction of Technological change: traditional neoclassical view

- Energy prices have a positive impact on energy efficiency innovation.
- Stringency/choice of environmental policies have a positive impact on renewable energy innovation.



Adriana Diaz Arias and Cees van Beers, 2013, Energy subsidies, structure of electricity prices and technological change of energy use, *Energy Economics*, 2013 .

Johnstone, N., I. Haščič and D. Popp. (2010). "Renewable Energy Policies and Technological Innovation: Evidence Based on Patent Counts." *Environmental and Resource Economics* 45(1): 133-155.

Popp, D., R. Newell and A. Jaffe (2010). "Energy, the Environment, and Technological Change." in: *Handbook of Economics of Innovation*, Elsevier Publishers

Direction of Technological change: challenges

20 Challenges for innovation studies



Ben Martin (2016) 20 challenges for innovation studies, *Science and Public Policy*, Volume 43, Issue 3, Pages 432–450,

Direction of Technological change: challenges

From innovation to economic productivity to innovation for sustainability

6. From innovation for economic growth to innovation for sustainable development
7. From risky innovation to socially **responsible innovation**
8. From innovation for wealth creation to innovation for well-being
9. From ‘winner takes all’ to ‘fairness for all’?



Direction of Technological change: responsible innovation view

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



Direction of Technological Change: responsible innovation view

- 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)

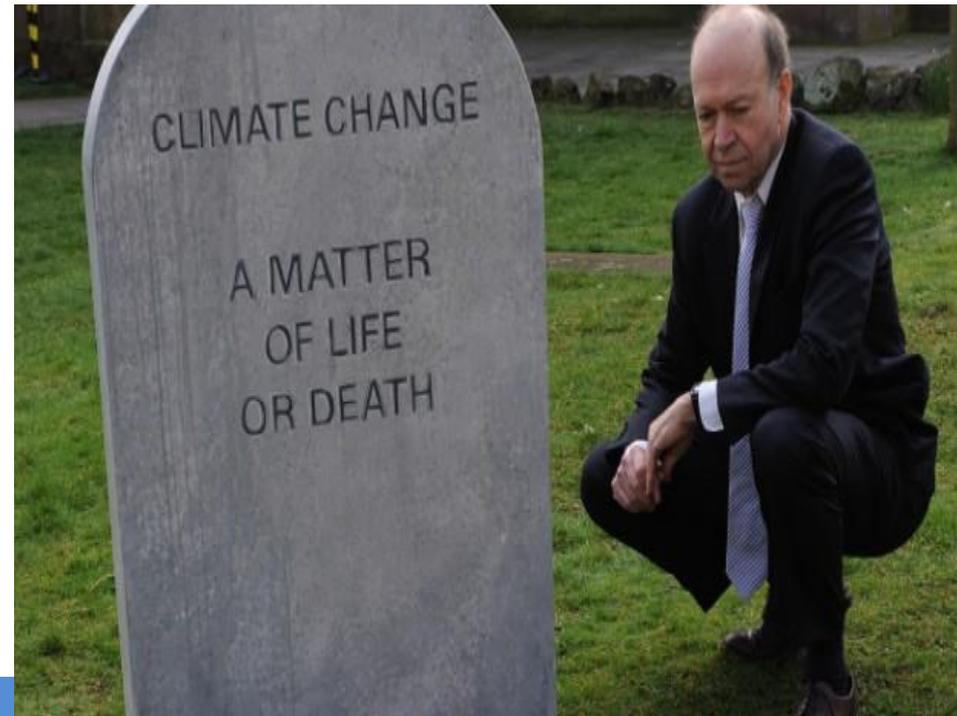
etc.



Direction of Technological change: responsible innovation view

Addressing responsible technologies 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.

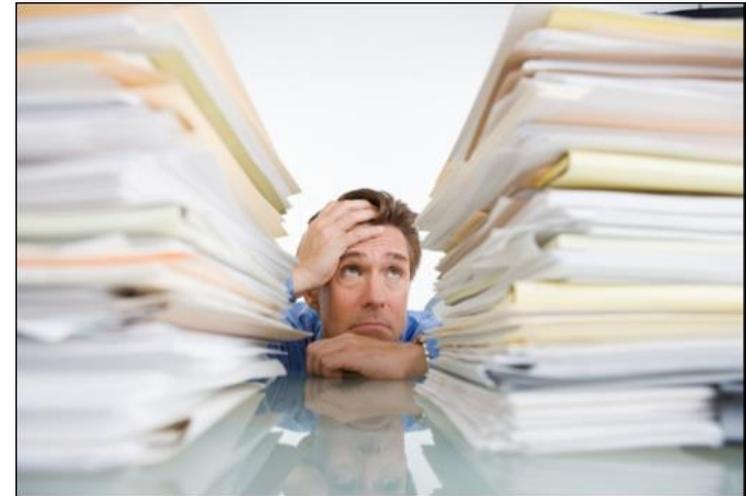


Relevant Trends

1) increased inefficiency of technological innovation processes.

2) needs of marginalized and poor groups in the European Union and beyond.

3) Technological developments now and to come



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Relevant Trends

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: over-engineering
- Lacks flexibility required to deal with fast changing technological and economic external environments
- Elitist and insular: knowledge is power

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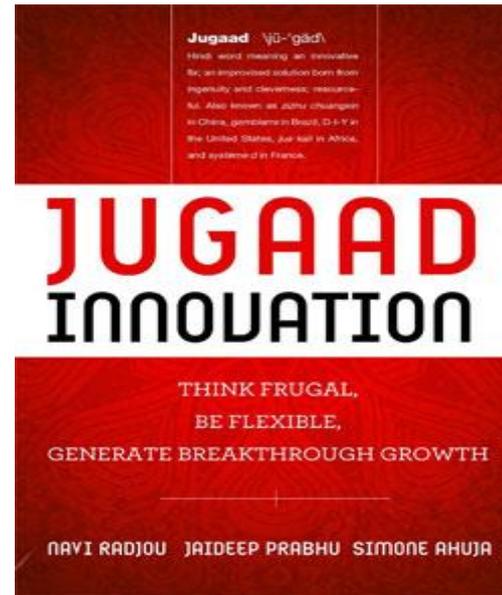
Relevant Trends

Why?

Changing complexity of the external environment due to:

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

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Relevant Trends

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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Relevant Trends

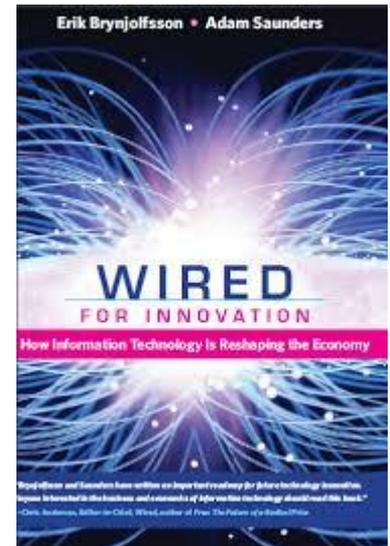
Interconnectivity

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

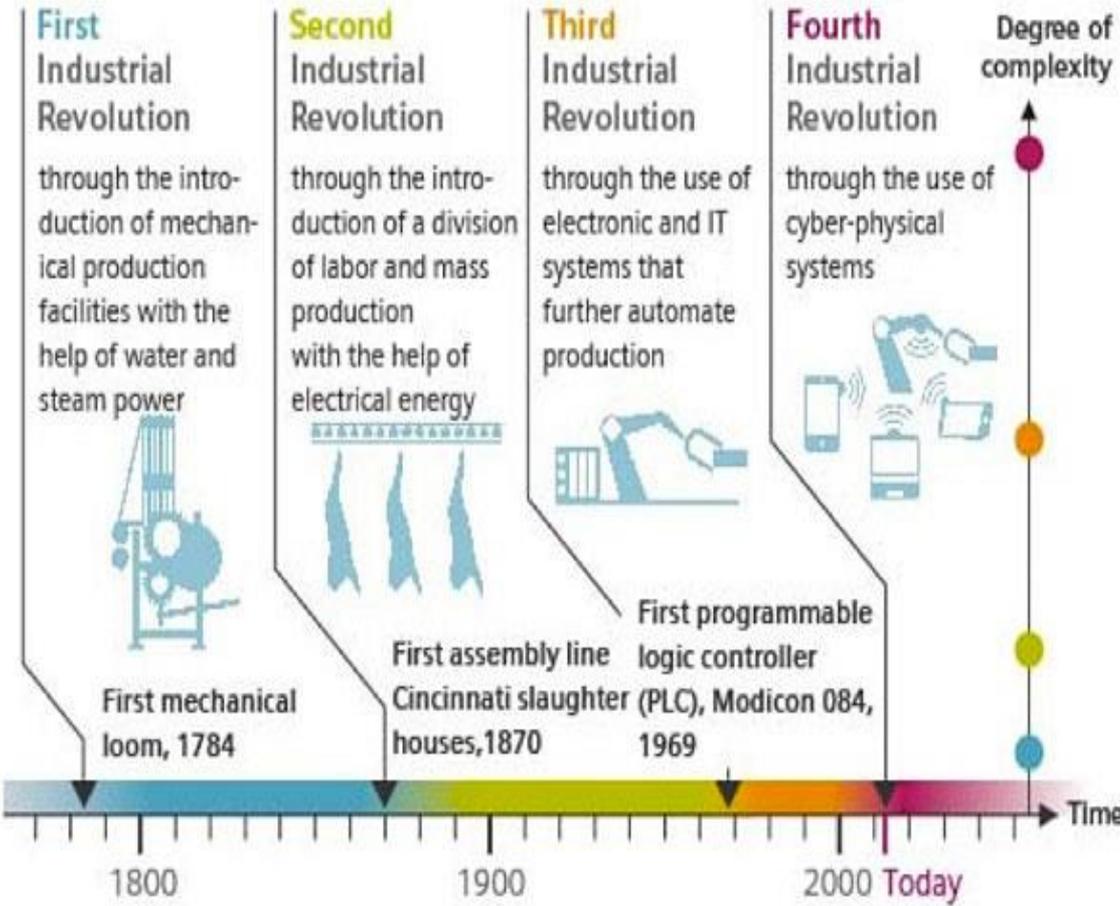
Velocity

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

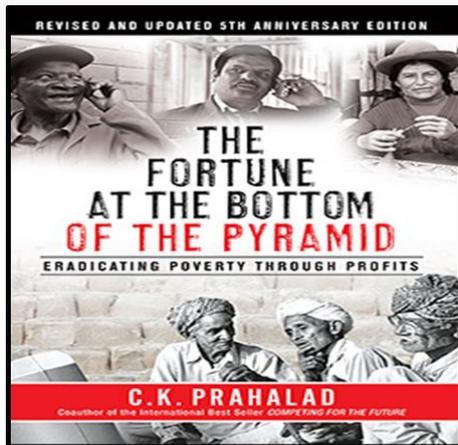
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Relevant Trends: General Purpose Technologies



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Basic working definition frugal innovations

Products, services and system (re)designed and re)engineered specifically to target customers who live and work in resource-constrained environments (values on both input and output side).



Key characteristics

- Value sensitive (responsible)
- Basic functionality/simplicity
- Good enough quality/user value
- Affordability
- Combining low and high end technology (sophistication)

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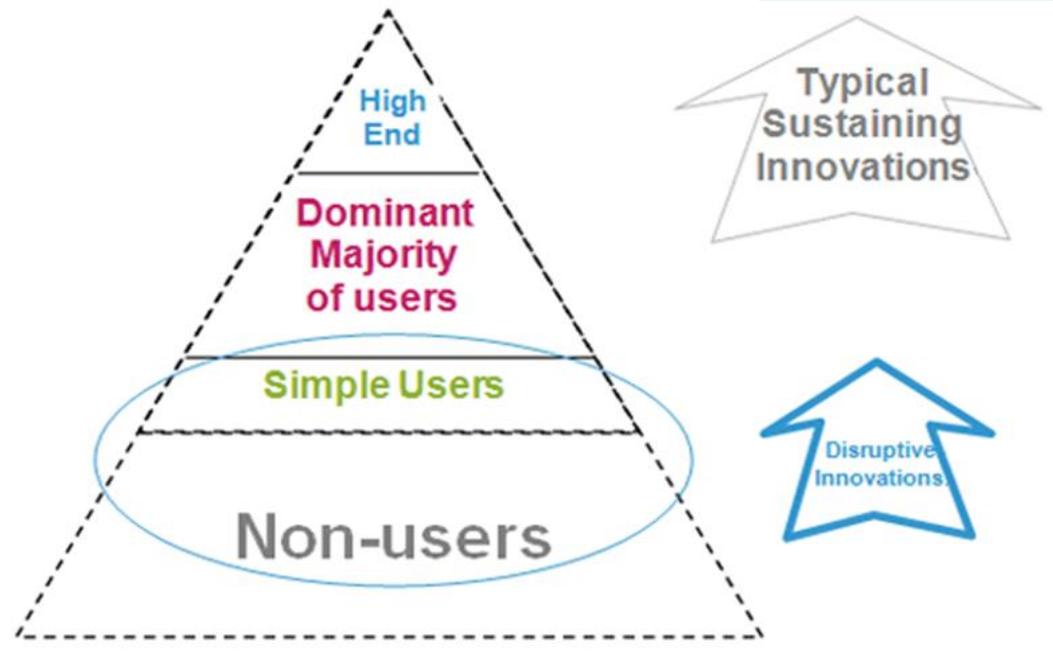
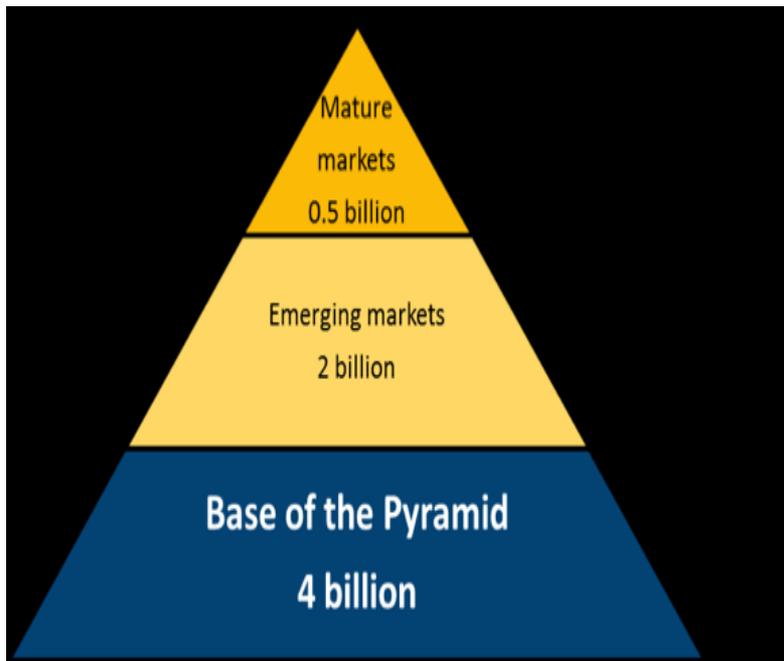
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Most challenging for technology strategy of Western firms is:

- 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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Reversed Innovation



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



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Mini-grid solar energy or water provision

Delivering Electricity Through Mini-grids

Mini-grids are electrical generation and distribution systems of less than 10 megawatts (MW) that serve customers through local distribution networks.

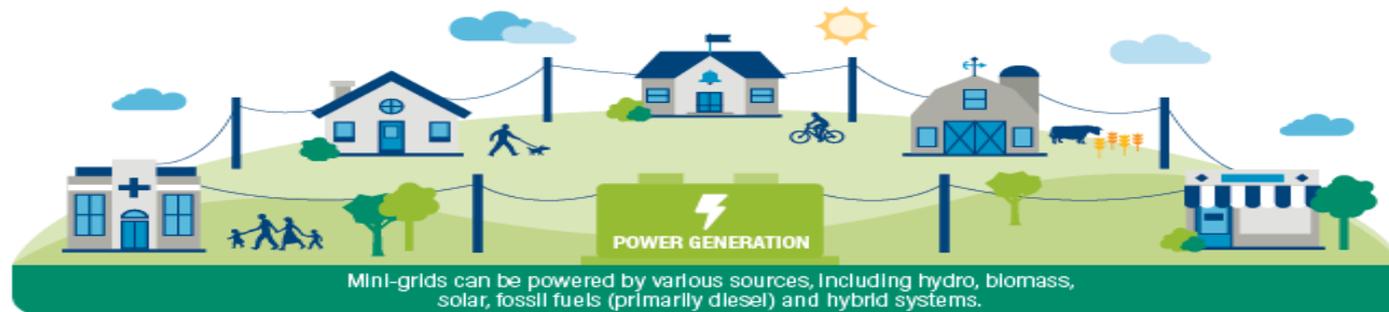
HEALTH CLINICS
Village health centers use refrigerators to store medical supplies

HOUSEHOLDS
Electricity for meeting household needs

SCHOOLS
Children have longer hours for study and more computer lessons

AGRICULTURE
Farmers process fruits and vegetables and press sunflower seeds into oil

SMALL BUSINESSES
Barbers, butchers and restaurant operators extend business hours



#energyaccess
wri.org/tanzania-mini-grids

 WORLD RESOURCES INSTITUTE

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Frugal Innovations as Responsible Innovation System

Philips Africa: Community Life Centers (CLCs)

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TAHMO

The **Trans-African Hydro-Meteorological Observatory** is a hydro-meteorological measurement stations to be implemented in sub-Saharan Africa.

Effects: data use for

- Micro-insurances
- Weather forecasting/climate change
- On-farm decision-making



Rachel Howell, Cees van Beers & Neelke Doorn, 2018, Value capture and value creation: The role of information technology in business models for frugal innovations in Africa, *Technological Forecasting and Social Change*, 131(C), 227-239.



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Polycentric innovation model to make frugal responsible with focus on inclusiveness:

Innovations by combining the strengths of Multinational enterprises: DSM, Phillips, Unilever, Tata with local entrepreneurs in global value chains):

- Small and medium entrepreneurs
- Hubs: Start up (**local**) entrepreneurs



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Frugal Innovations through polycentric approach

Advantages Local Entrepreneurship in Polycentric business models

1. Distribution channel rolling out innovations to local communities, particularly relevant in remote areas.
2. Important sources on local user values
But and hence important as (co-) innovators providing new ideas and values in innovation process.

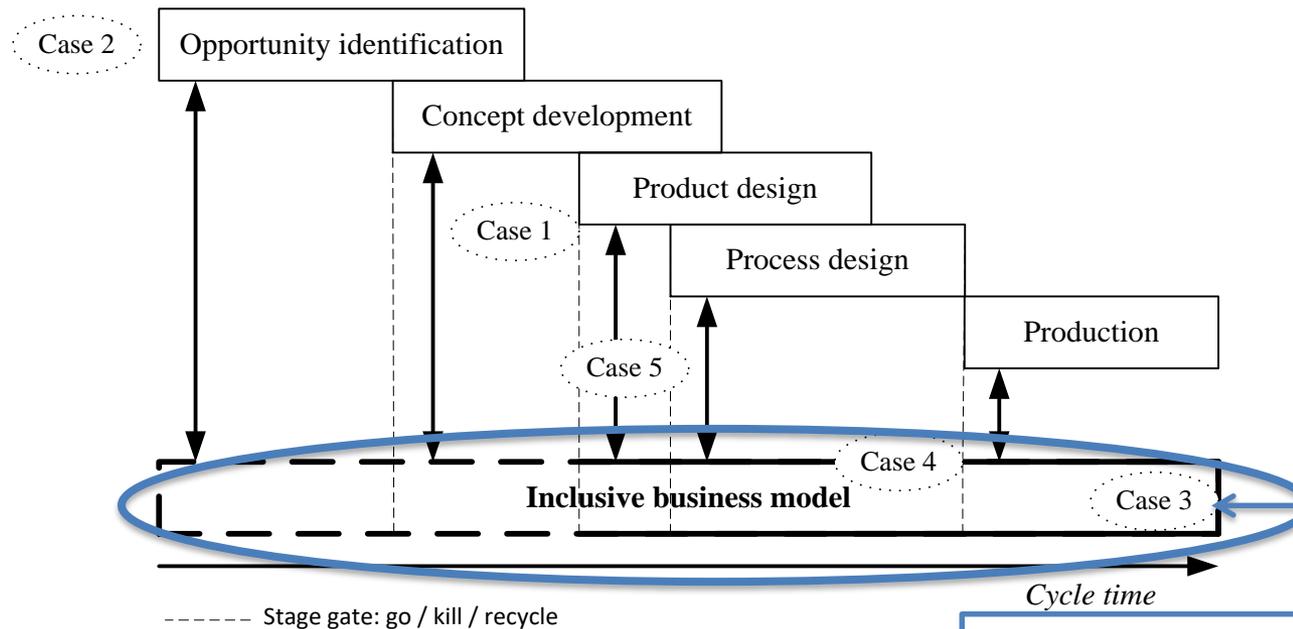


Some Conclusions

- Responsible innovation has logical place in innovation discourse
- Societal demands and technological supply opportunities define this logical place
- Increased attention for frugal innovations due to technological opportunities
- Frugal Innovation only relevant as a form of responsible innovation in developing but also developed countries as remedy against:
 - overengineering
 - exclusion of low-income groups in developing countries and the EU from innovations.

Reserve slides below

Planned Research: product development cycle with value sensitive design



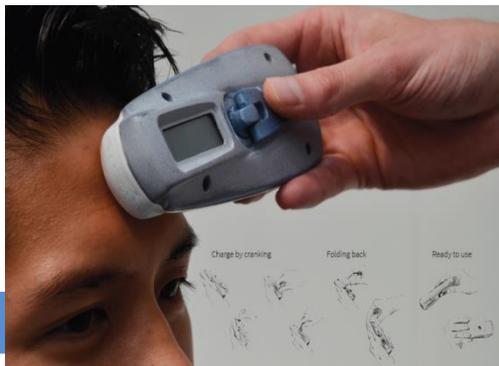
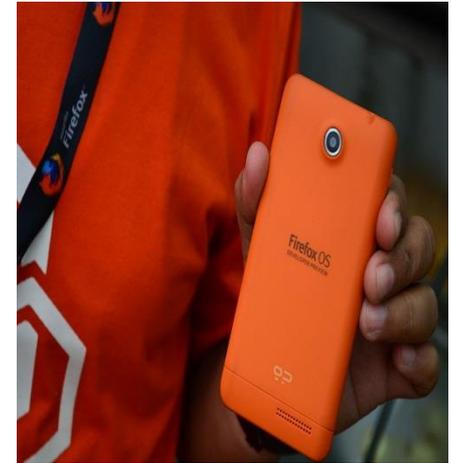
Direction of Technological Change: responsible innovation view



SUSTAINABLE DEVELOPMENT GOALS



Examples



Frugal Innovations through polycentric approach

Start ups (local) entrepreneurs

- Innovation, Tech and Business Hubs are widely spread across (regions of) Africa
- Large Digital Dividend
- High failure rate



Source: www.africahubs.crowdmap.com



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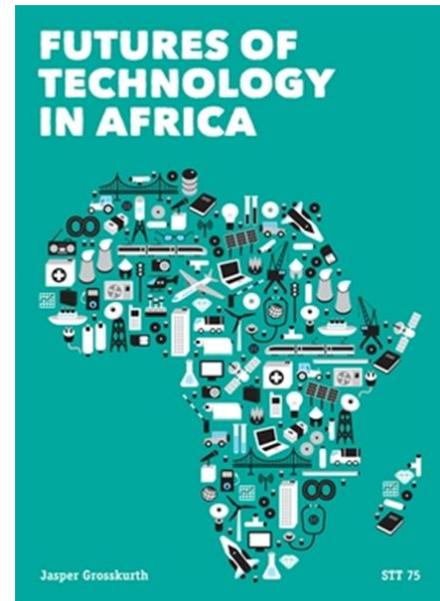
Relevant Trends

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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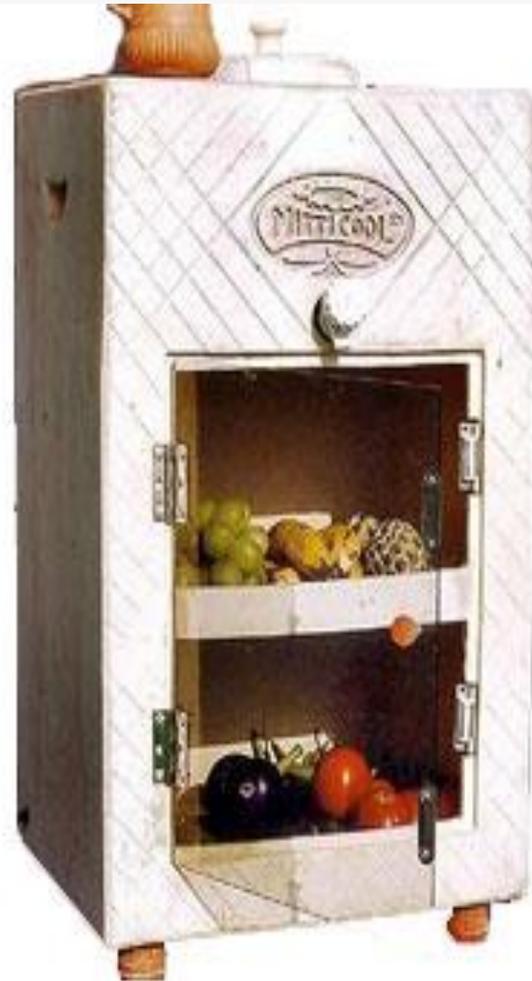
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