

Development, Sustainability & Culture

Lecture 3: Development from a socio-technical perspective

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Main questions of this course

- Under which conditions is a development project successful?
 - Focus on internship: How can my internship project become a success; i.e. result in a successful innovation?
- Under which conditions does a development project contribute to development?
 - Focus on internship: How can the internship project become a useful contribution to development?

Technology Dynamics

- Study of technological development from a social/societal perspective, with the aim to find enablers and barriers
- North-South: global context
- Focus on transitions & innovation systems

Contents

1. Transitions

2. Innovation Systems

3. Functions of Innovation Systems

4. National Innovation Systems

1. Transitions

Transition Together



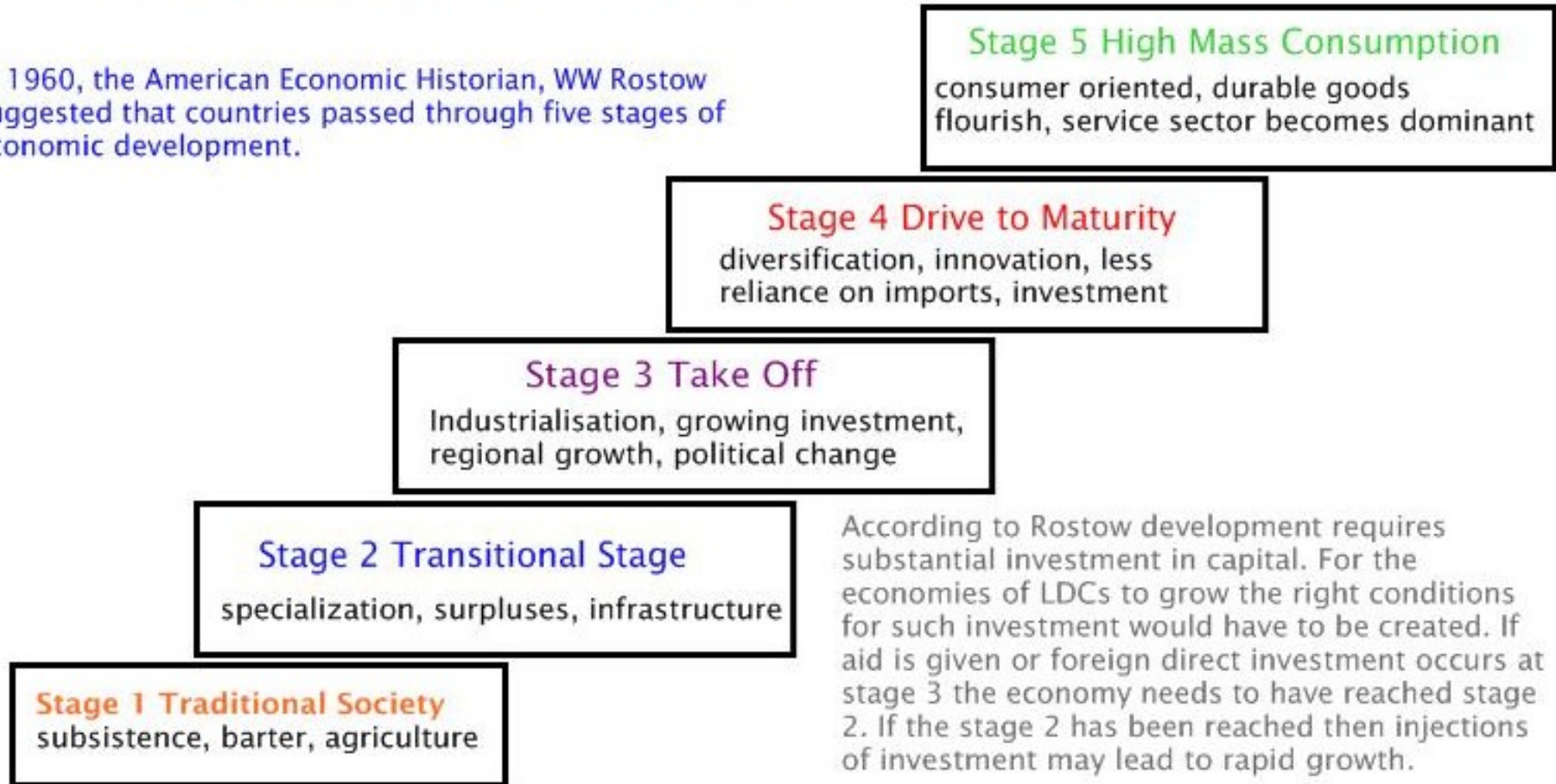
What is development?

- **Industrialization** processes all over the world following the Industrial Revolution in 18th century England
- **Self-sustained** process of economic growth and social change, ultimately based on human rights and the possibilities of nature, organization and technology
- Sustainable in terms of **ecological** possibilities and social **equity** effects, beside **economic** opportunities
- **Transition** from a stagnating economy and society to a growing welfare state

Rostow's Model - the Stages of Economic Development

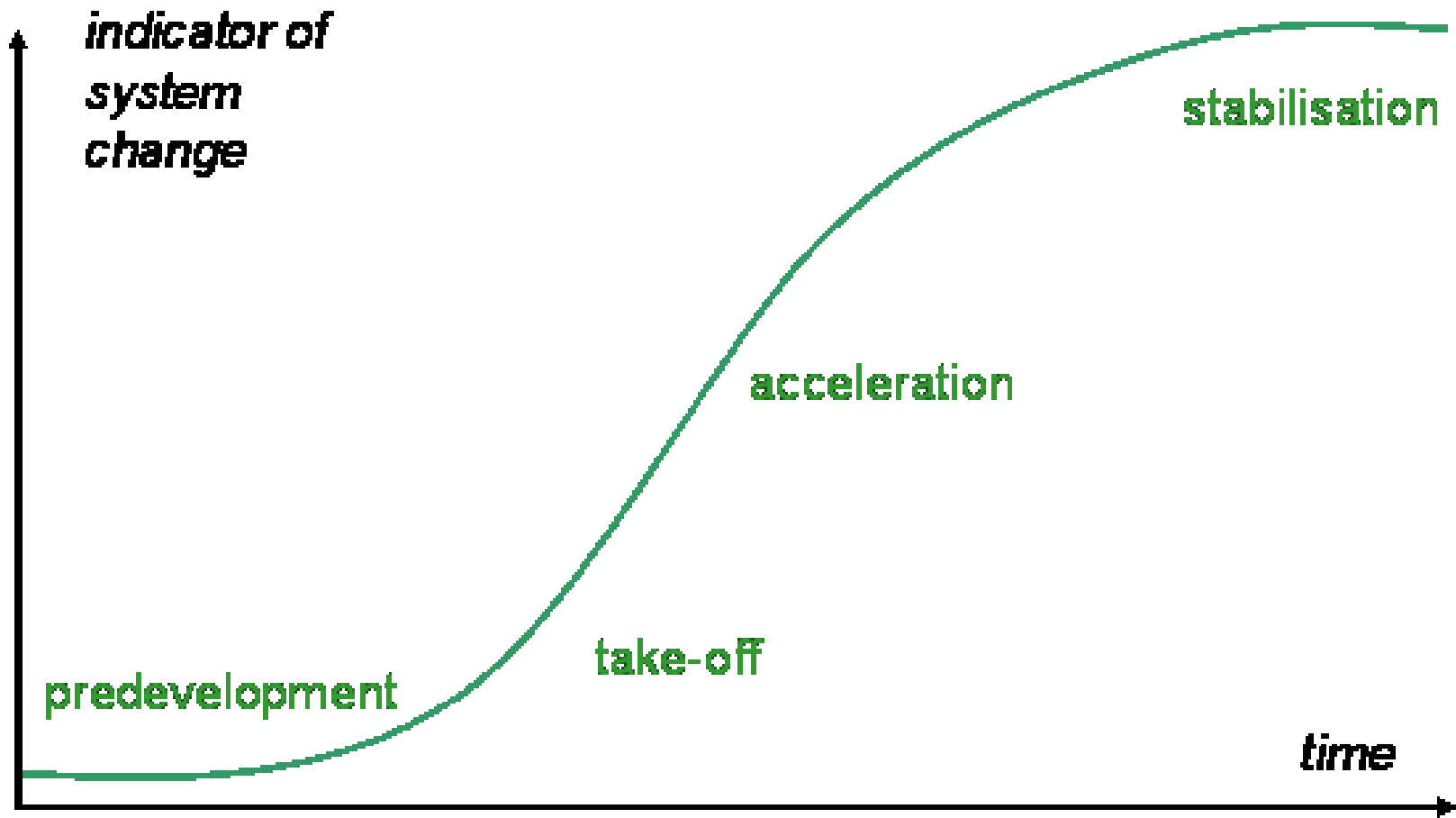
<http://www.bized.co.uk/virtual/dc/copper/theory/th9.htm>

In 1960, the American Economic Historian, WW Rostow suggested that countries passed through five stages of economic development.



According to Rostow development requires substantial investment in capital. For the economies of LDCs to grow the right conditions for such investment would have to be created. If aid is given or foreign direct investment occurs at stage 3 the economy needs to have reached stage 2. If the stage 2 has been reached then injections of investment may lead to rapid growth.

Transition



Green Revolution



Norman Borlaug: high yielding varieties developed in the 1960s, saved a billion people worldwide from starvation

Haber-Bosch process: artificial ammonia based fertilizer, developed in the early 20th century, increase in yields feeds 1/3 world population

Development as transition/s

Development is a transition from **a stagnant to a growth economy**, and includes besides a rise in income per capita:

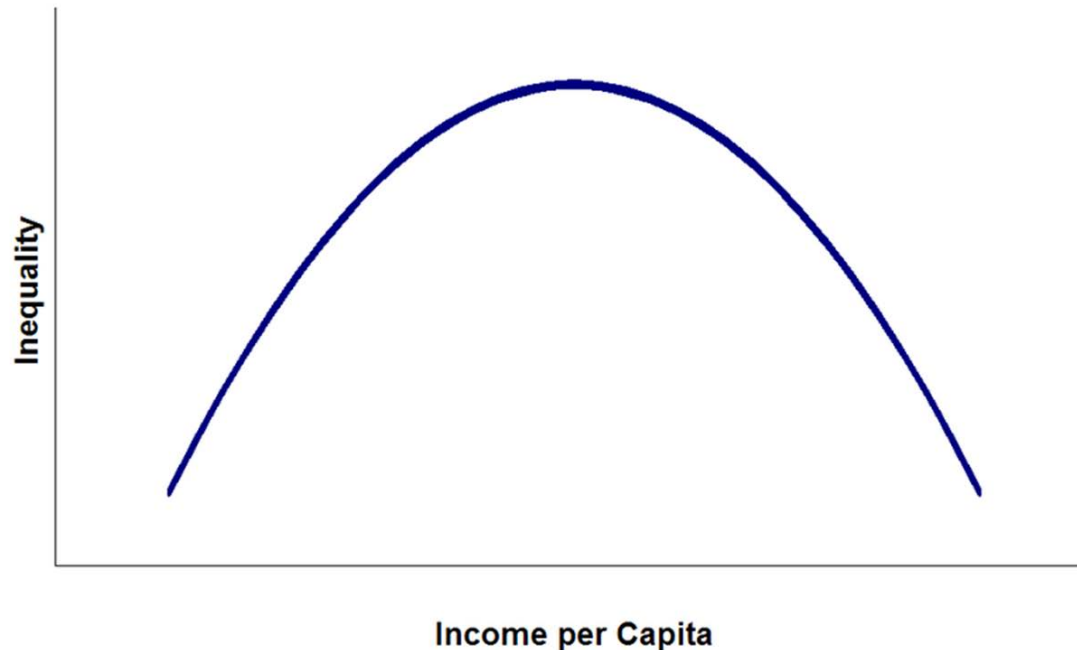
- Agricultural transition → Green revolution
- Industrialization → Industrial Revolution
- Social & cultural transformation, including **institutional reform**, in general from extractive to inclusive institutions to incentivize people, and the establishment of a Civil society
- Historically **Glorious & French** Revolutions preceded Industrial Revolution in Europe

System dynamics

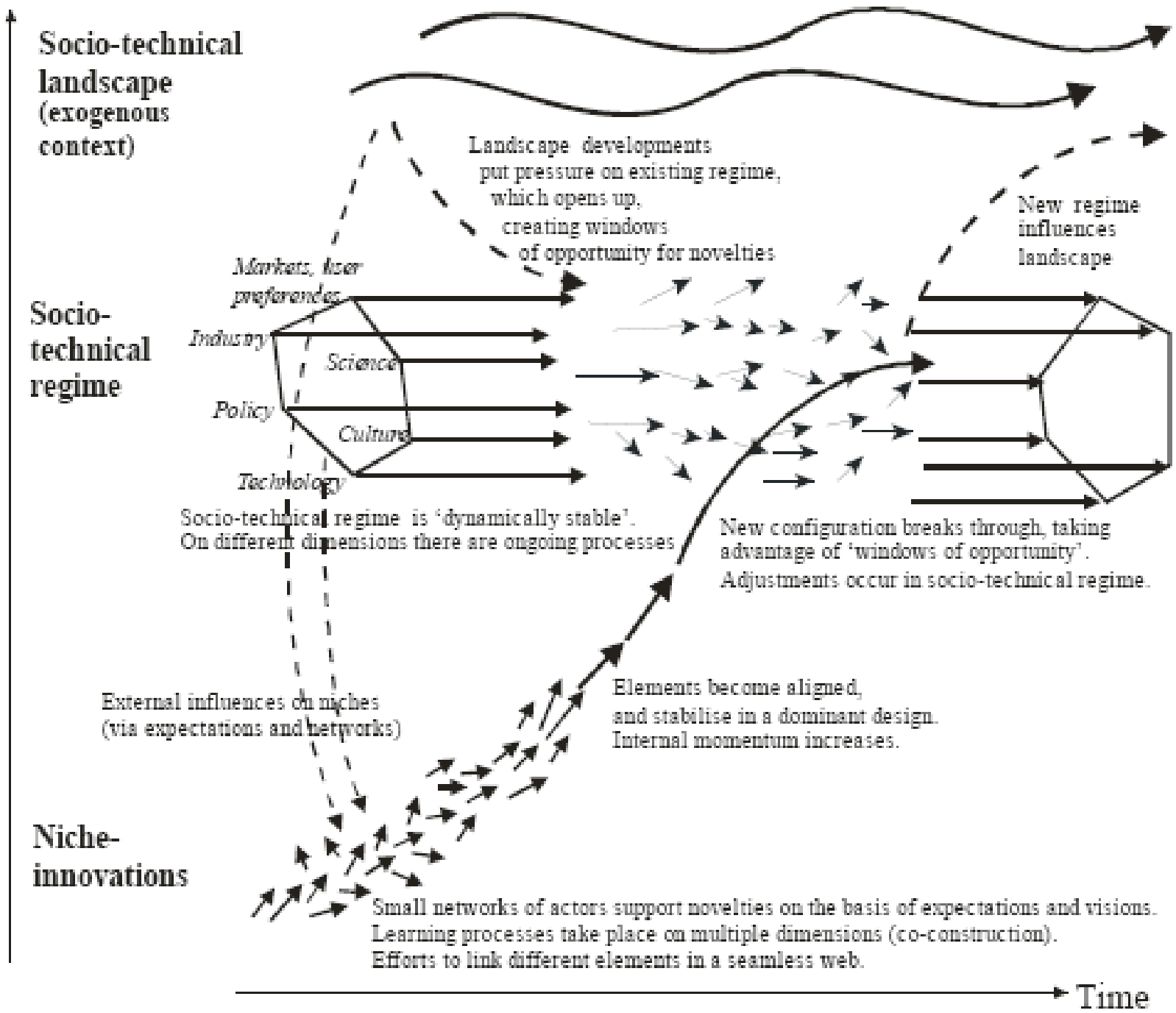
- **Kuznets curve** & economic “laws”, e.g. supply and demand
- Change in landscape → **niche innovation**
→ regime shift & systems change
- **Innovation systems**

- NB: refers to “self-sustained character” of development

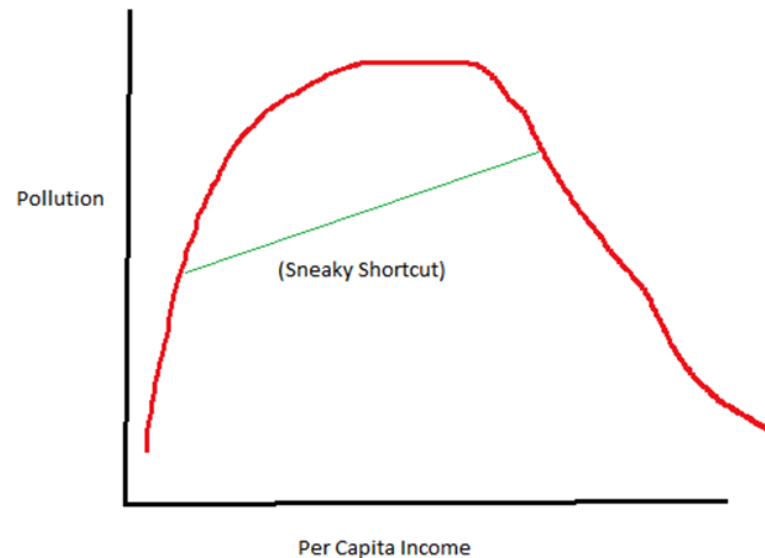
Kuznets curve: Economic development & inequality



In the long-term, rising living standards contribute to **decreasing inequality**; however, first stages of development see increasing inequality!



Innovation, transition & leapfrogging



- Development countries are inclined and forced to adopt sustainable pathways of change and transformation earlier than developed countries!
- **Leapfrogging**: from traditional to advanced technology, without intermediate stage(s)
- E.g. cell phones in Africa and China's "Resource-Efficient and Environment-Friendly (REEF) Society"

- NB: **Challenge for engineers!**

2. Innovation Systems



Dynamics of development



Innovation systems are the motor of development

Relevant aspects of development on the basis of historical evidence

Agency/entrepreneurship

Natural aspects/raw materials

Capital/welfare

Labour

Specialization

Trade

Administration/governance

Institutions

Cities

Infrastructure

Science & technology

Culture/work hard

Education

	Sachs
Agency	
Natural aspects	<ul style="list-style-type: none"> -Geographically favourable agricultural resources -Geographically favourable position (for transport, trade and defence) -Coal [and other natural resources]
Capital/welfare	Income from agriculture
Labour	Agricultural productivity
Specialization	
Trade	With EU and US
Administration	Sovereign country
Institutions	<ul style="list-style-type: none"> -Freedom, esp. Parliament and property rights -Open society with room for personal initiative and social mobility
Cities	
Infrastructure	Cheap transport (island, navigable waterways)
Science & technology	<ul style="list-style-type: none"> -Scientific centre since Newtons Principia Mathematica (1687) -Steam-engine
Culture	
Education	Schooling

	Sachs	Easterly	Collier	Acemoglu & Robinson
Agency		Entrepreneurship		Broad coalition
Natural aspects				
Capital/welfare	Money			
Labour				
Specialization				
Trade				
Administration			-Political stability -Good governance	Centralization
Institutions			-Economic security	Inclusive institutions
Cities				
Infrastructure				
Science & technology				
Culture				
Education				

Innovation systems

- Involve “all” aspects
- A set of **actors and factors**, of technical and social elements producing new knowledge as well as new technologies and industries
- Make innovation activities successful (FIS) and contribute to development (NIS)

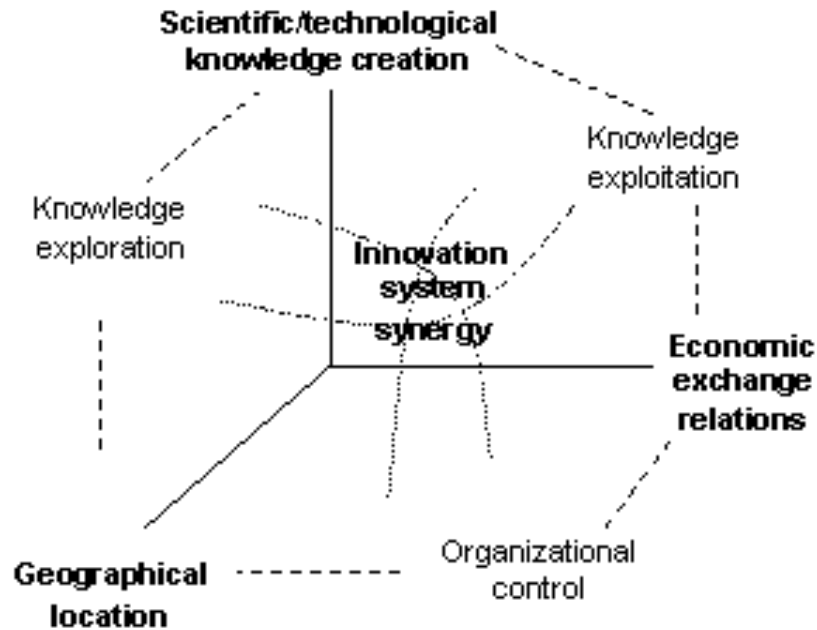
Knowledge & institutions

- Narrow sense: actors & factors/ institutions directly involved in innovation, e.g. entrepreneurs & **knowledge** centres → FIS
- Broad sense: all relevant actors & **institutions** including labour and social relations, all kinds of organizations, practices etc. → NIS

Learning & social capacities

- Freeman 2002: “**social capability** for technical change”
- Varblane et al. 2007: “increase the learning capacity of the whole society” → **interactive learning**, innovation diffusion management, managerial & organizational competences
- *Industrial Development Report* 2005: **capacity building** through learning and innovation systems
- *Least Developed Countries Report* 2007: increasing **absorptive** capacity for foreign technologies of domestic firms and knowledge systems

Interlinkages & interaction



Linkages between system elements produce system dynamics and development

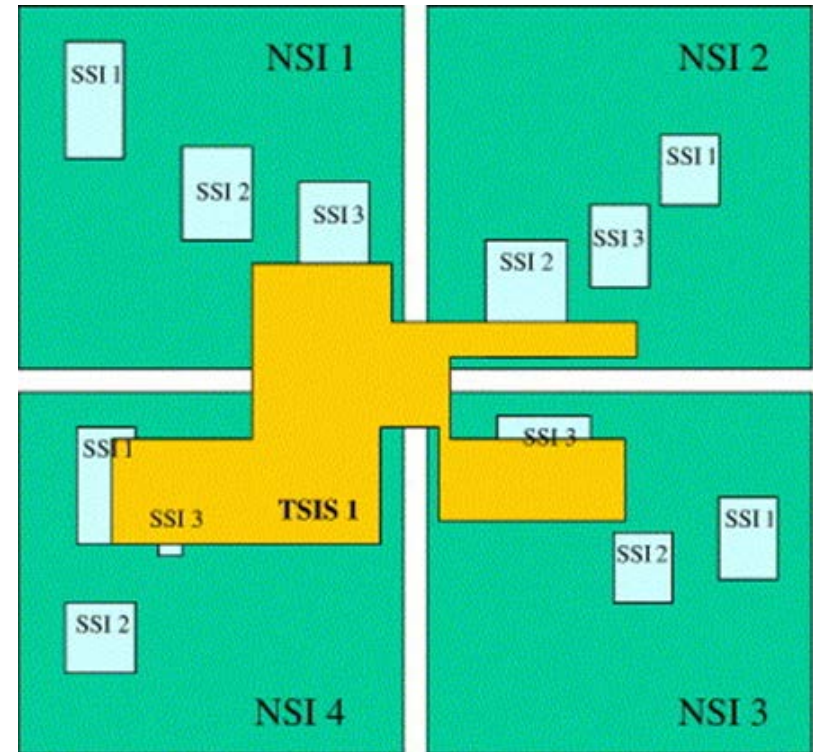
Types of innovation systems

Geographical:

- Sub-national innovation systems, e.g. “sustainable village” & export production zones in China
- **National innovation systems, e.g. 18th century England and late 19th century USA**
- International innovation systems e.g. Europe, multinationals & universities

Specific:

- Sectoral innovation systems, e.g. construction sector
- **Technological innovation systems, e.g. RETs**



3. Functions of Innovation Systems



Functions of innovation systems

Functions

1. Entrepreneurial activities
2. Knowledge development
3. Knowledge diffusion through networks
4. Guidance of the search
5. Market formation
6. Resources mobilization
7. Creation of legitimacy / counteract resistance to change

Functions of innovation systems - Examples

1. Entrepreneurial activities?
'Turn potential in business'

1. **Entrepreneurial activities**
2. Knowledge development
3. Knowledge diffusion through networks
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Functions of innovation systems - Examples

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Functions of innovation systems - Examples

2. Knowledge development

'Learning by searching, by doing, R&D'

1. Entrepreneurial activities
2. **Knowledge development**
3. Knowledge diffusion through networks
4. Guidance of the search
5. Market formation
6. Resources mobilization
7. Creation of legitimacy / counteract resistance to change

Functions of innovation systems - Examples

2. Knowledge development

'Learning by searching, by doing, R&D'



KNAW

1. Entrepreneurial activities
2. **Knowledge development**
3. Knowledge diffusion through networks
4. Guidance of the search
5. Market formation
6. Resources mobilization
7. Creation of legitimacy / counteract resistance to change

TNO innovation
for life

Functions of innovation systems - Examples

3. Knowledge diffusion through networks
'Learning by using, by interacting'

1. Entrepreneurial activities
2. Knowledge development
- 3. Knowledge diffusion through networks**
4. Guidance of the search
5. Market formation
6. Resources mobilization
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Functions of innovation systems - Examples

3. Knowledge diffusion through networks 'Learning by using, by interacting'



1. Entrepreneurial activities
2. Knowledge development
- 3. Knowledge diffusion through networks**
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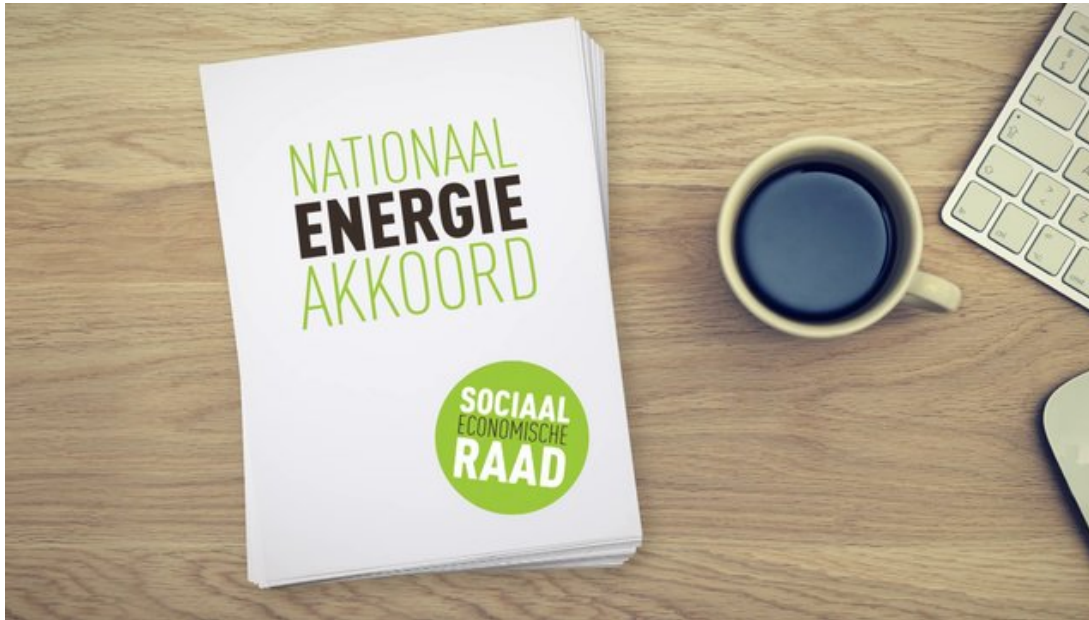
Functions of innovation systems - Examples

4. Guidance of the search 'Selection on basis of preferences'

1. Entrepreneurial activities
2. Knowledge development
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- 4. Guidance of the search**
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Functions of innovation systems - Examples

4. Guidance of the search 'Selection on basis of preferences'



1. Entrepreneurial activities
2. Knowledge development
3. Knowledge diffusion through networks
4. **Guidance of the search**
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Functions of innovation systems - Examples

5. Market formation

'Creation of protected space'

1. Entrepreneurial activities
2. Knowledge development
3. Knowledge diffusion through networks
4. Guidance of the search
5. **Market formation**
6. Resources mobilization
7. Creation of legitimacy / counteract resistance to change

Functions of innovation systems - Examples

5. Market formation

'Creation of protected space'



1. Entrepreneurial activities
2. Knowledge development
3. Knowledge diffusion through networks
4. Guidance of the search
5. **Market formation**
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Functions of innovation systems - Examples

6. Resources mobilization 'Funds and human capital'

1. Entrepreneurial activities
2. Knowledge development
3. Knowledge diffusion through networks
4. Guidance of the search
5. Market formation
- 6. Resources mobilization**
7. Creation of legitimacy / counteract resistance to change

Functions of innovation systems - Examples

6. Resources mobilization 'Funds and human capital'



1. Entrepreneurial activities
2. Knowledge development
3. Knowledge diffusion through networks
4. Guidance of the search
5. Market formation
6. **Resources mobilization**
7. Creation of legitimacy / counteract resistance to change

Functions of innovation systems - Examples

7. Creation of legitimacy/counteract
resistance to change

'Accepted by regime or regime shift,
creative destruction, advocacy coalitions'

1. Entrepreneurial activities
2. Knowledge development
3. Knowledge diffusion through networks
4. Guidance of the search
5. Market formation
6. Resources mobilization
7. **Creation of legitimacy /
counteract resistance to
change**

Functions of innovation systems - Examples

7. Creation of legitimacy/counteract resistance to change

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V.S.



V.S.



V.S.



1. Entrepreneurial activities
2. Knowledge development
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7. **Creation of legitimacy / counteract resistance to change**

Functions of innovation systems

Functions

1. Entrepreneurial activities
2. Knowledge development
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Indicators

1. N of new entrants, diversification activities, experiments with new technology
2. R&D projects, patents, investment in R&D, learning curves
3. N workshop & conferences, network size & intensity
4. Targets by government & industry, debate in scientific journals (n articles + or -)
5. N of niche markets, tax regimes, environmental standards
6. Interviews with core actors
7. Interest groups & lobby actions

Innovation systems in developing countries: technology transfer

Functions

1. Entrepreneurial activities
2. *Creation of adaptive capacity*
3. Knowledge diffusion through networks
4. *Demand articulation*
5. Market formation
6. Resources mobilization
7. Creation of legitimacy / counteract resistance to change
8. *Infrastructure networks*

Indicators / improvement

1. Facilitating private sector action
2. Human, organizational institutional: training, planning national policy, new institutions
3. Participation & networking, connecting local agencies to international, incl NGOs
4. Matching demand & supply through information exchange
5. Marketing & government support
6. Low investments, high risks; financial reforms & credit
7. Acceptance & compliance
8. Roads, mobile phones etc.

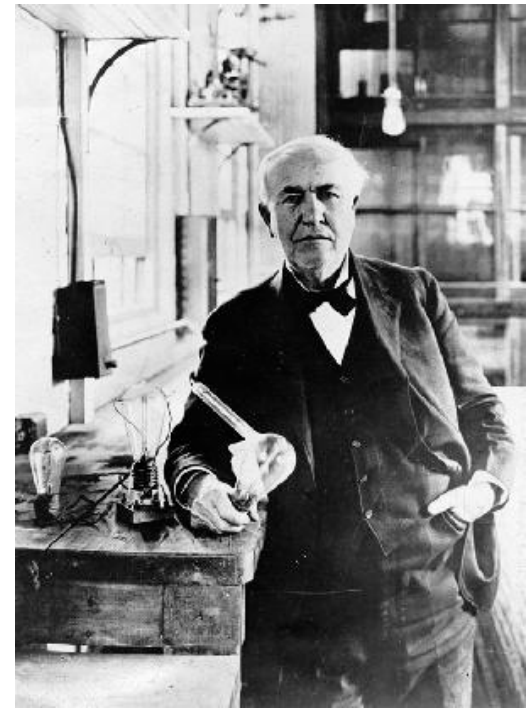
4. National Innovation Systems



2nd Industrial Revolution

Thomas Edison (1847-1931)

- inventor-entrepreneur
- builder of electricity system
- “invention of invention” through research laboratory



Late 19th Century USA: “Most productive society in world history” (Hughes)

- Inventors **learned** from one another, watching each other’s design and trying to improve them
- Secret was: how to **translate** barriers (“reverse salients”) into solvable critical problems, e.g. battle of the systems (AC vs DC)
- **System-builders** learned, communicated, competed and cooperated in constructing technological, social and economic networks

Characteristics of the British national innovation system during 18–19th century

Strong links between scientists and entrepreneurs

Science has become a national institution, encouraged by the state and popularised by local clubs

Strong local investment by *landlords* in transport infrastructure (canals and roads, later railways)

Partnership form of organisation enables inventors to raise capital and collaborate with entrepreneurs (e.g. Arkwright/Strutt or Watt/Boulton)

Profits from trade and services available through national and local capital markets to invest in *factory* production and in infrastructure

Economic policy strongly influenced by classical economics and in the interests of industrialisation

Strong efforts to protect national technology and delay catching up by competitors

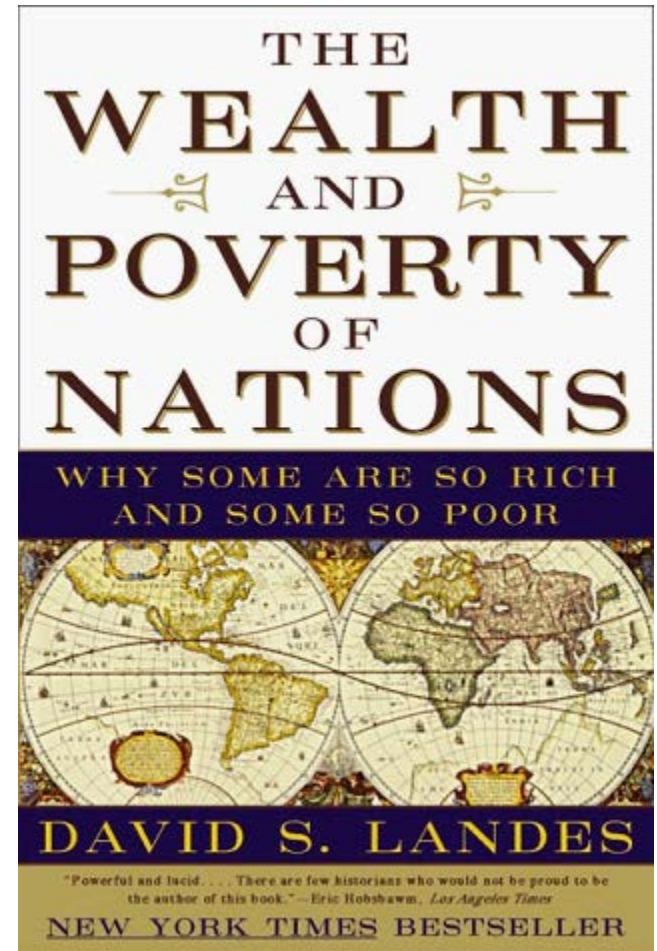
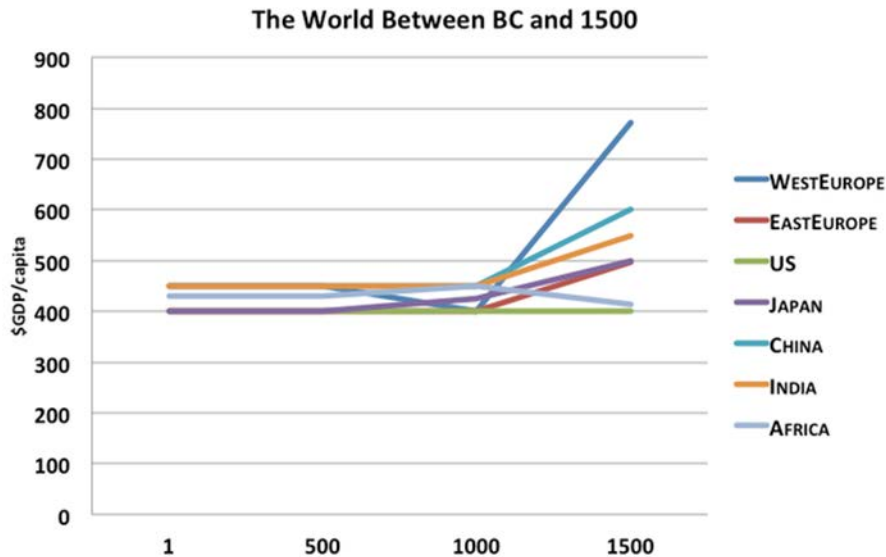
British productivity per person about twice as high as European average by 1850

Consulting engineers develop and diffuse best practice technology in waterwheels, canals, machine-making and railways

Part-time training, night school, and apprenticeship training for new factory technicians and engineers

Gradual extension of primary, secondary and tertiary education

David Landes' Modernity hypothesis



In the year 1000, Europe was marginal; in the year 1500 it was ready for world dominance, because of

the commercial, technological and industrial revolution of the Middle Ages

Ideal society for growth and development

Political and social institutions

Private property

Moderate and efficient administration

Protection of personal liberties

Fair administration

Garanteed contract right

Shared feeling of national unity, common identity and loyalty, equality of civil status, collective synergy

Stable government

Fair society

Core of a perfect efficient & effective development machine

Use, fabricate and innovate means of production

Opportunities for individual and collective entrepreneurship

Distribution of jobs and mobility based on achievements and merites

People enjoy the fruits of their own labour

Capability to transfer knowledge and know-how through education and practical training

Consequences

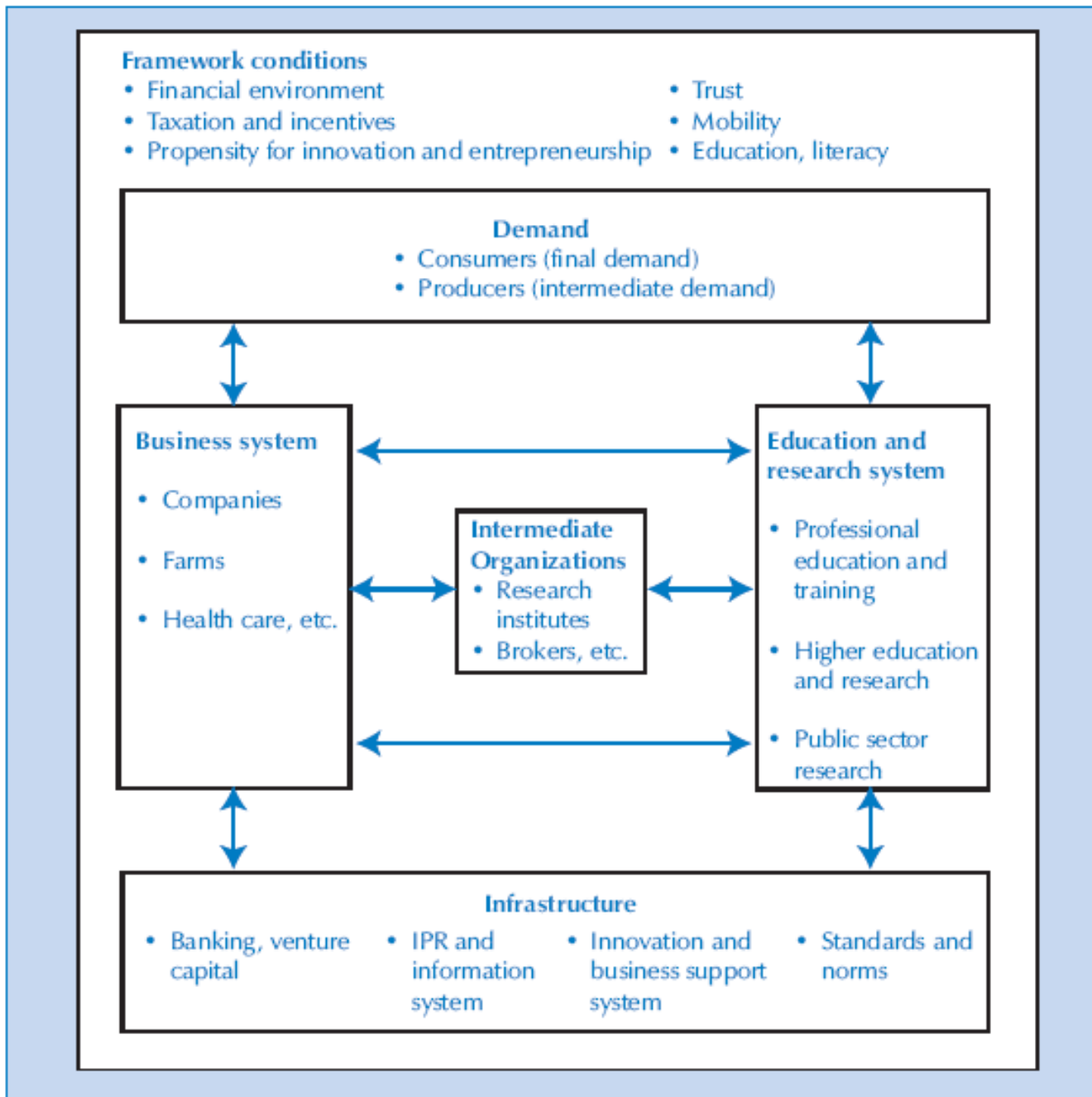
Preference for scientific, effective rationality

No discrimination
Mobility
No fair sharing because of talents
More even distribution of income than in case of privileges and favouritism; big middle class;
Homogeneous clothing and loose manners

Society with respect for new and old, youth and experience, change and risk as well as security

Source: Landes 1998

Chart 7. Major components of a national innovation system



Source: The Least Developed Countries Report, 2007

Clues for answers

Under which conditions is a development project successful?

- Focus on internship: How can my internship project become a success; i.e. result in a successful innovation?
- Functions of Innovation systems approach (TIS/SIS)

Under which conditions does a development project contribute to development?

- Focus on internship: How can the internship project become a useful contribution to development?
- National Innovation Systems (NIS) (production)
- Inclusive institutional & cultural context for inclusive development (distribution)

How to improve living standards? (All the important aspects for answering the main questions)

- Hard work
- Stimulating human capabilities (better future, supra family etc.)
- Cheap money
- Entrepreneurship
- Good circumstances (political stability, good governance and economic security)
- Societal institutions (market; parliament; credit facilities; law & regulation; private property, contract & patent rights etc.)
- Learning: knowledge and experience and capabilities