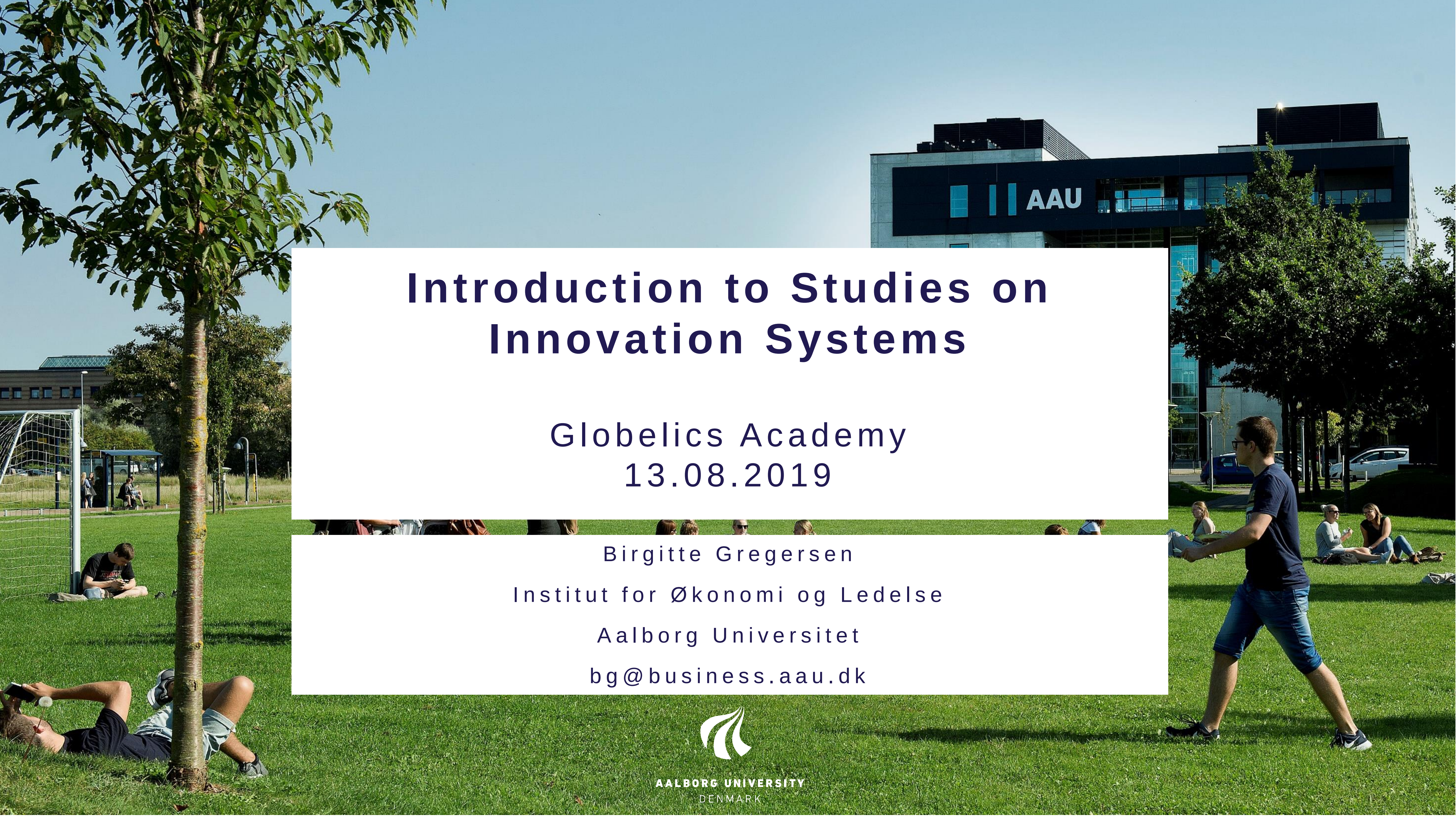

Introduction to Studies on Innovation Systems

Globelics Academy
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Birgitte Gregersen
Institut for Økonomi og Ledelse
Aalborg Universitet
bg@business.aau.dk

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Agenda

1. Findings from innovation studies (economics of innovation) – summing up
2. Systems of Innovation as analytical approach
    - What?
    - How?
    - Why?
3. Performance of IS? [if we have time]
4. Q&A

Innovation Systems - Relevance?

Knowledge perspective – “no firm is an island”

- Innovation is an interactive process (different actors).
    - Suppliers and customers (value chains), Universities and other knowledge institutions, Competitors, NGOs, ……..
- Institutions matters (norms, rules, trust,…)
- Context matters (technology, culture, history, country,……)

Development perspective – innovation system building as driver for development (also in relation to SDGs)

Innovation Systems - Relevance? (2)

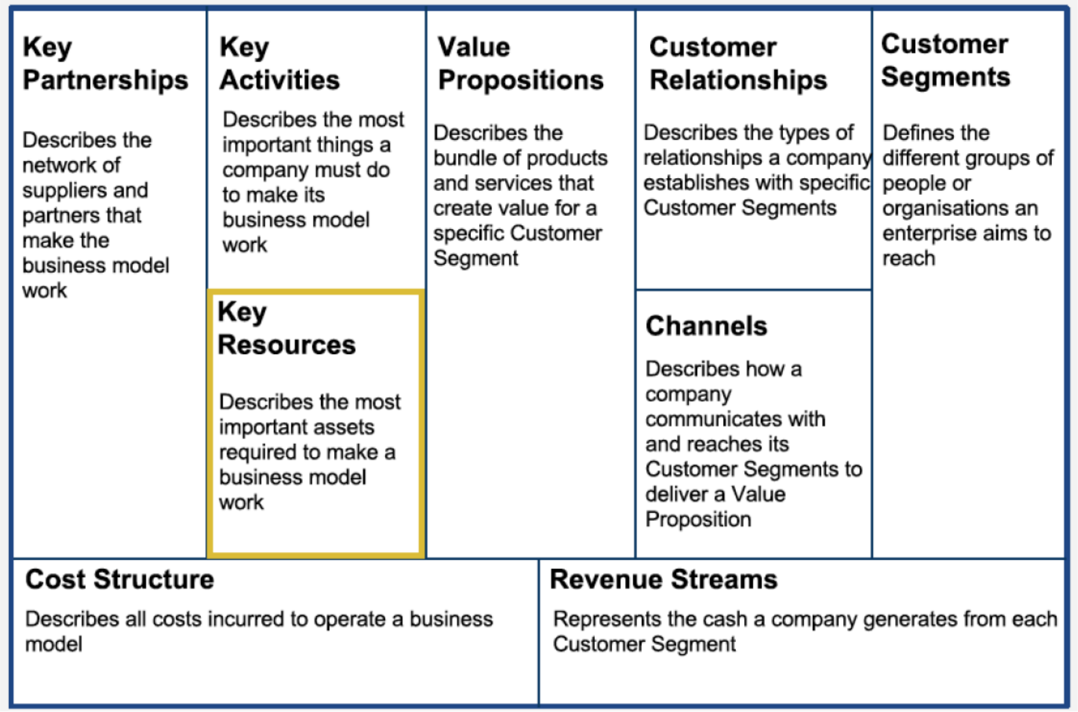
Micro (firm) perspective

- A system perspective can inform innovation management strategies
- Collaboration with whom, when and why? (Outsourcing, insourcing, national, global)

Macro perspective

- Policy implications

Business Model Canvas



Key Partnerships

Describes the network of suppliers and partners that make the business model work

Key Activities

Describes the most important things a company must do to make its business model work

Key Resources

Describes the most important assets required to make a business model work

Value Propositions

Describes the bundle of products and services that create value for a specific Customer Segment

Customer Relationships

Describes the types of relationships a company establishes with specific Customer Segments

Channels

Describes how a company communicates with and reaches its Customer Segments to deliver a Value Proposition

Customer Segments

Defines the different groups of people or organisations an enterprise aims to reach

Cost Structure

Describes all costs incurred to operate a business model

Revenue Streams

Represents the cash a company generates from each Customer Segment

www.businessmodelgeneration.com

1.Findings from innovation studies (economics of innovation) – summing up

What is Innovation studies about?

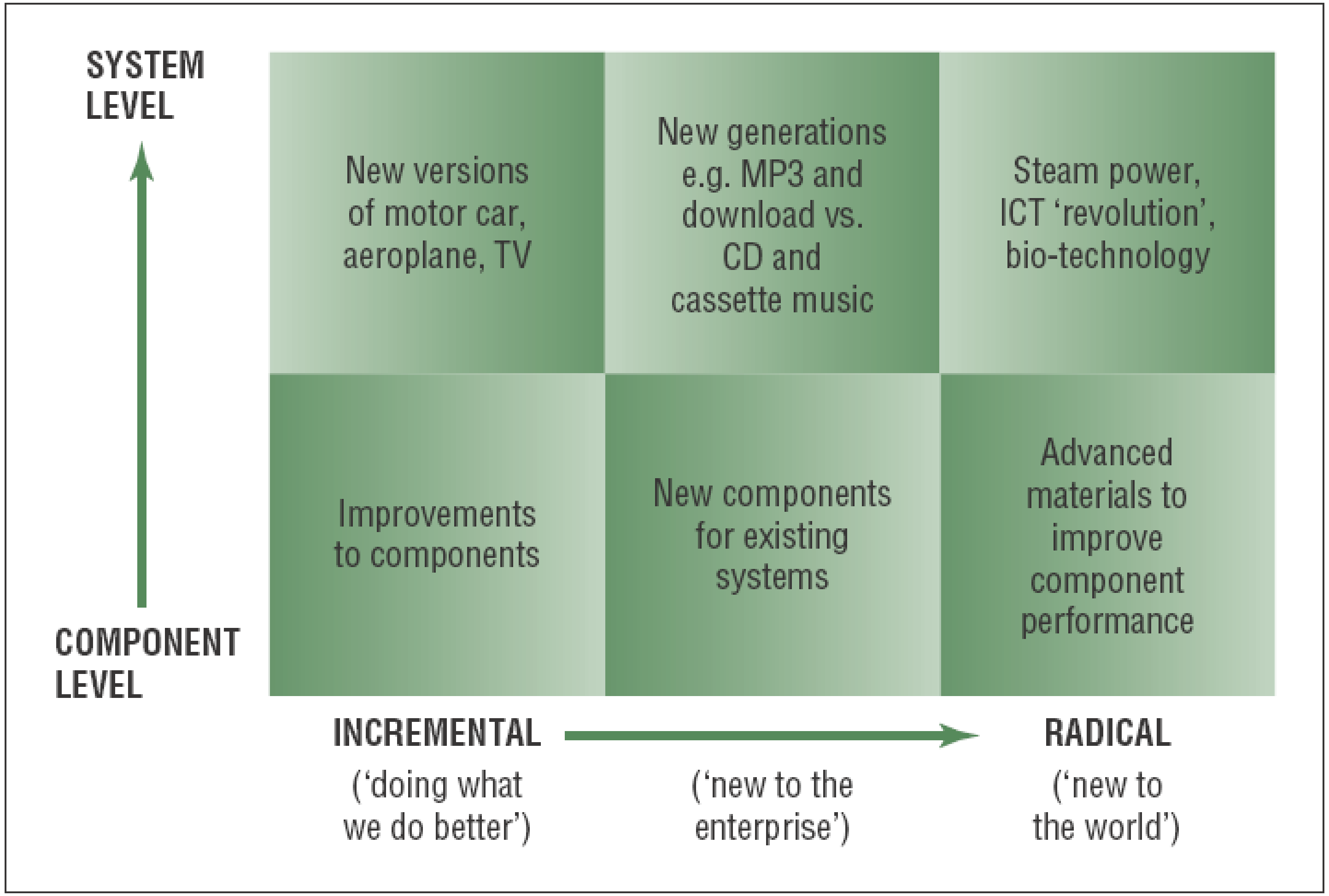
- What factors generate and influence innovation (sources, pace/rate, direction)
- How do innovation activities and processes happen (emergence and diffusion)
- How to identify an innovation (innovation output includes in the narrow sense new products, services and processes, but in the broad sense also diffusion and use of innovation)
- Management of knowledge and innovation
- Consequences of innovation (employment, growth, structural change, environment,..)
- Policy implications
- Measurement problems, indicators (R&D, Patents, CIS-data)
- Level of analysis (micro, meso, macro) (single unit - system)

Innovation studies – development

- 50s & 60s: The ”linear” model, science (R&D) as driving force, science policy, OECD starts to collect R&D statistics
- 70s & 80s: Chain-link model, Increasing focus on technology (assessment/ forecasting) as ”problem solver”, OECD and EC, technology policy
- 90s and beyond: innovation attracts attention, socio-economic aspects (EU), system perspective, innovation policy, Eurostat collects innovation statistics,
- Innovation studies develops as new cross-disciplinary field with centres/departments, journals and ”meeting places” (SPRU 1965, Research Policy 1971, Schumpeter Society 1986 (TIM 1987, DRUID 1995, Globelics 2002/3)
- From a small activity in a few countries to a global movement

How to define innovation?

1. ”When an enterprise produces a good or service or uses a method or input that is new to it, it makes a technical change. The first enterprise to make a given technical change is an innovator. Its action is innovation” (Schmookler, 1966)
2. New combinations including new production methods, new products, new markets and marketing methods, new forms of business organisation and new legal and regulatory conditions (Schumpeter, 1934)
3. Freeman & Perez’s taxonomy (1988)
   - incremental innovations
   - radical innovations
   - technological systems
   - techno-economic paradigms
4. Innovation is a process of turning opportunity into new ideas and of putting these into widely used practice (Tidd & Bessant, 2009, p.16)



	INCREMENTAL ('doing what we do better')	('new to the enterprise')	RADICAL ('new to the world')
SYSTEM LEVEL	New versions of motor car, aeroplane, TV	New generations e.g. MP3 and download vs. CD and cassette music	Steam power, ICT 'revolution', bio-technology
COMPONENT LEVEL	Improvements to components	New components for existing systems	Advanced materials to improve component performance

FIGURE 1.4: Dimensions of innovation

© 2009 John Wiley & Sons Ltd.
www.wileyeurope.com/college/tidd

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Economies as systems of learning, competence building and innovation (1)

[Mytelka & Smith (2002), Fagerberg (2013)]

1. Innovations are not like specific events, which can be localised in time and space but more like **cumulative processes over time**.

2. **Innovations are ubiquitous**. They are not only located in high-tech industries but happen in all sectors including so called low-tech and traditional sectors, which produce considerable numbers of new products and processes.

3. Firms use **many sources of innovation** like training, capital goods, consultants, customer contacts, design development besides R&D. The relative importance of the sources vary across sectors, but everywhere they interact and feed upon each other.

Economies as systems of learning, competence building and innovation (2)

[Mytelka & Smith (2002), Fagerberg (2013)]

4 Firms usually build learning capabilities and innovate with the help of **co-operation and collaboration** with other firms, organisations, research institutes, universities, technical service institutes, etc. Innovation is interactive and learning is a social process.

5 Innovation is **uncertain and often unpredictable**. Firms frequently make mistakes and innovation is often "by accident" rather than planned.

6 Territorial and **sectoral clusters and long-term relationships** between firms are important for learning and innovation capability.

Economies as systems of learning, competence building and innovation (3)

[Mytelka & Smith (2002), Fagerberg (2013)]

7 **Innovation is systemic** and can not be adequately understood at the level of the individual firm. It depends on interactions and feed-backs within the organisational and institutional set-up of the economy.

8 **Sectoral differences.** In some sectors and for some firms there are strong links to the science system and the knowledge infrastructure and there are important interactions between science and technology. In others not.

9 The possibilities for learning and innovation vary across the sectors of the economy and often follow **trajectories formed by path-dependency**.

Innovation studies – New perspective on economic theory

- New perspectives on markets: organised markets and product innovations
- New perspectives on relations: Competition, co-operation, co-production, innovation
- New perspectives on firms: learning organisations
- New perspective on Government and role of the public sector: role of demand and policy

Introduction to the analytical foundations – a simplified comparison

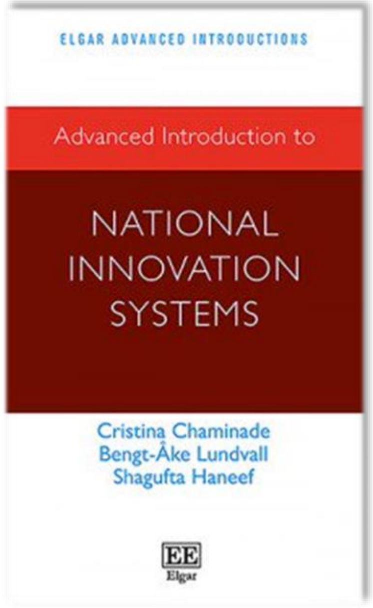
“Neoclassic textbook approach”	Evolutionary approach
Static equilibrium	Dynamic processes
Ahistoric	Path dependency & open ended
Exogeneous technology	Endogeneous technology
Process innovations	Product and process innovations
Single units analysis (mainly)	System perspective
Optimality	Multiple “solutions”
Representative agents	Heterogeneous actors/diversity
Price factors dominates	Non-price factors
Institutions are neglected	Institutions are crucial
Profit maximisation	Satisfying (bounded rationality)
Allocation	Innovation

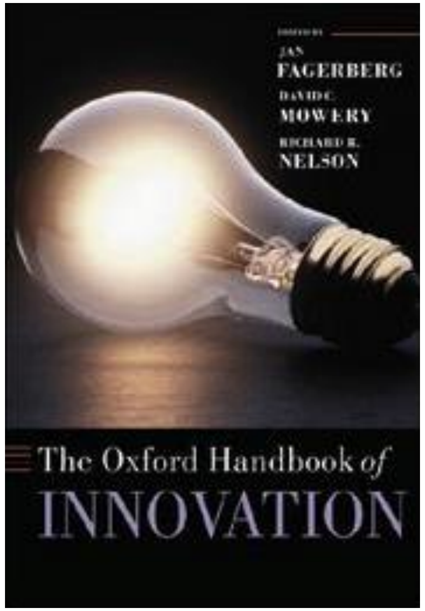
Further literature studies and material

Key Journals:

- Research Policy
- Industrial and Corporate Change
- Journal of Evolutionary Economics
- International Journal of Industrial Organization
- Journal of Economic Behaviour
- Journal of Industrial Economics
- Regional Studies
- Industry and Innovation
- Innovation and Development

- DRUID working papers, conferences (www.druid.dk) (AAU)
- GLOBELICS, conferences, working papers (www.globelics.org)


ELGAR ADVANCED INTRODUCTIONS
Advanced Introduction to
NATIONAL INNOVATION SYSTEMS
Cristina Chaminade
Bengt-Åke Lundvall
Shagufta Haneef
EE Elgar


JAN FAGERBERG
DAVID C. MOWERY
RICHARD R. NELSON
The Oxford Handbook of
INNOVATION

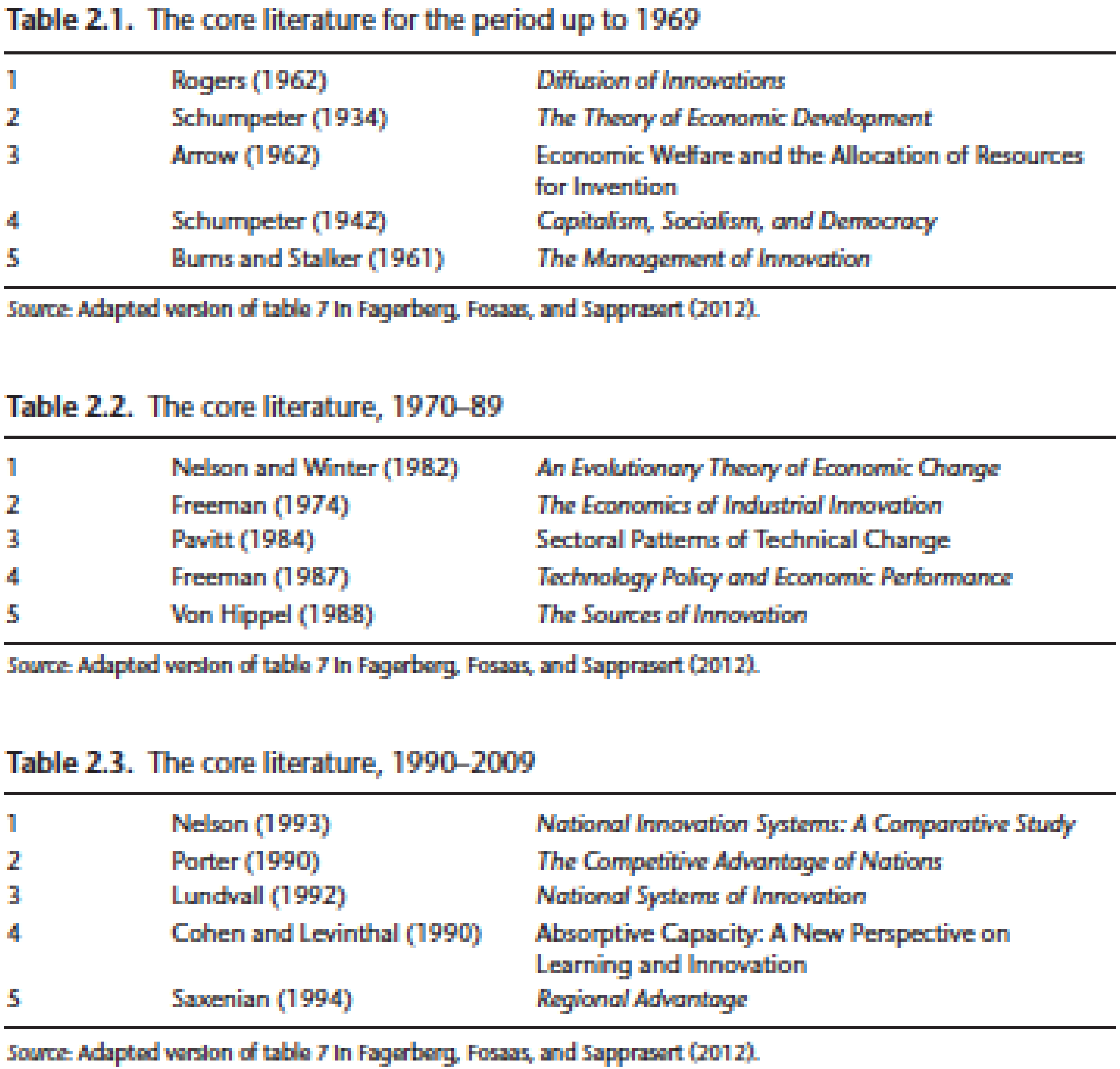


Table 2.1. The core literature for the period up to 1969

1	Rogers (1962)	*Diffusion of Innovations*
2	Schumpeter (1934)	*The Theory of Economic Development*
3	Arrow (1962)	Economic Welfare and the Allocation of Resources for Invention
4	Schumpeter (1942)	*Capitalism, Socialism, and Democracy*
5	Burns and Stalker (1961)	*The Management of Innovation*

Source: Adapted version of table 7 in Fagerberg, Fosaas, and Sapprasert (2012).

Table 2.2. The core literature, 1970–89

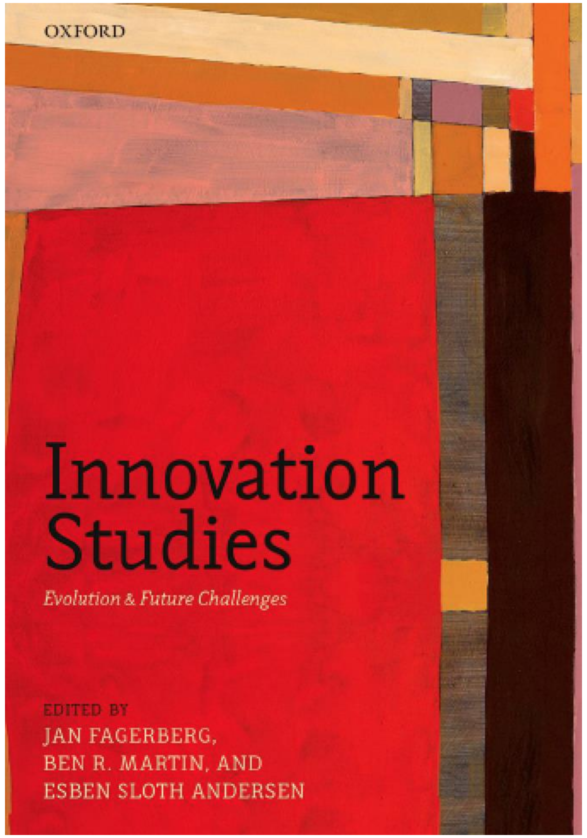
1	Nelson and Winter (1982)	*An Evolutionary Theory of Economic Change*
2	Freeman (1974)	*The Economics of Industrial Innovation*
3	Pavitt (1984)	Sectoral Patterns of Technical Change
4	Freeman (1987)	*Technology Policy and Economic Performance*
5	Von Hippel (1988)	*The Sources of Innovation*

Source: Adapted version of table 7 in Fagerberg, Fosaas, and Sapprasert (2012).

Table 2.3. The core literature, 1990–2009

1	Nelson (1993)	*National Innovation Systems: A Comparative Study*
2	Porter (1990)	*The Competitive Advantage of Nations*
3	Lundvall (1992)	*National Systems of Innovation*
4	Cohen and Levinthal (1990)	Absorptive Capacity: A New Perspective on Learning and Innovation
5	Saxenian (1994)	*Regional Advantage*

Source: Adapted version of table 7 in Fagerberg, Fosaas, and Sapprasert (2012).



Source: Lundvall 2013: ”Innovation Studies: A Personal Interpretation of ‘The State of the Art’ in Fagerberg, Martin & Andersen (2013): *Innovation Studies – Evolution & Future Challenges*, OUP, p. 35.

2. System of Innovation as analytical approach

What? How? Why?

National systems of innovation

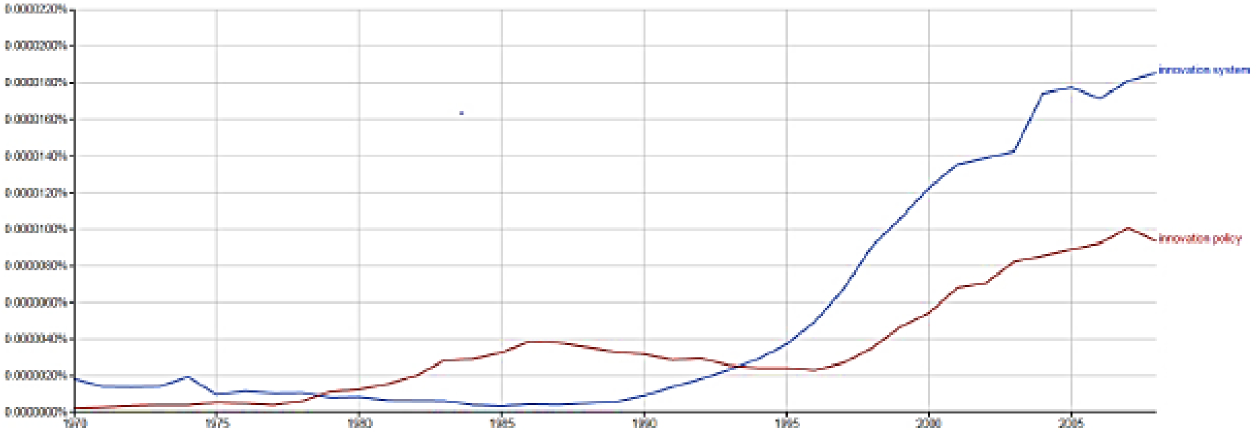
1. The concept appears first time in 1982 (Freeman working paper for OECD). First published in booklet on user-producer interaction 1985 (Lundvall), Freeman book on Japan 1987, Dosi et al 1988, Lundvall et al 1992, Nelson et al 1993,………..
2. OECD uses it 1992 in the TEP-report and the Finnish Prime minister in 1990.
3. Today the ‘system of innovation’ concept is all over the place (Google gives more than 9 million hits).
4. US, Japan, China, OECD, EU etc. use it to frame innovation policy. But also many hits for countries in Latin America and emerging in Africa

WHY?

Why has the (N)SI-concept become so popular?

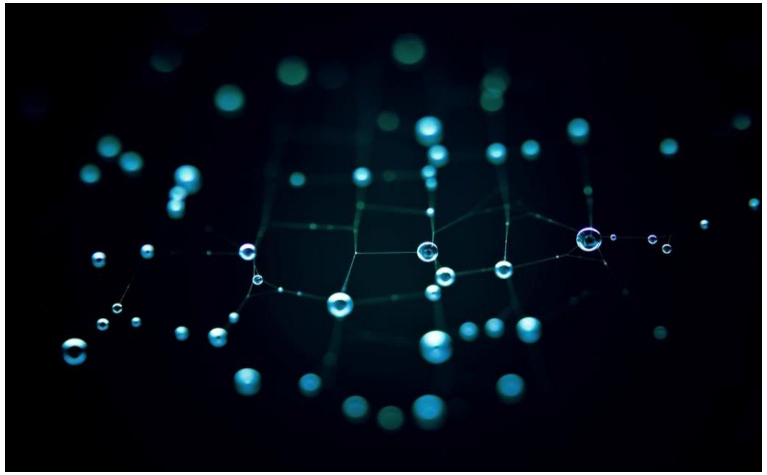
- Dialectic concept – innovation is often seen as outcome of the individual’s creativity while the ‘(national) system’ is a macro-structuralist concept.
- The concept helps to correct a widely spread misinterpretation of innovation as a linear process. (science – technology – productivity)
- Timing – comes forward in a period where it becomes clear that rich countries cannot compete through low costs.
- A useful framework for national mobilization for economic growth both in rich and poor countries.

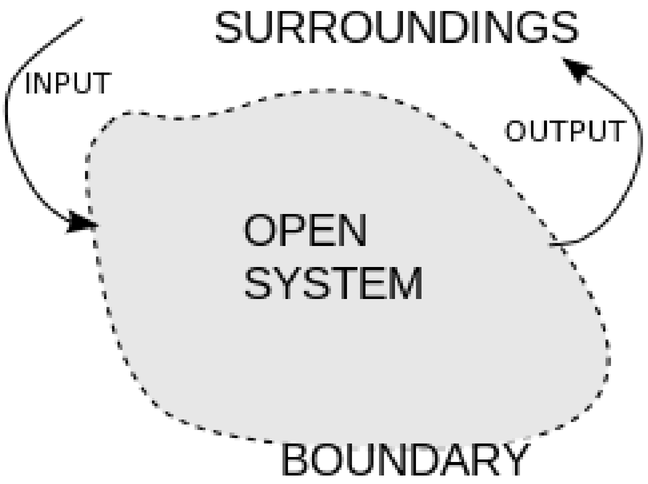
Figure 1. The frequency of the terms “Innovation Policy” and “Innovation System” according to Google



Source: https://books.google.com/ngrams

You are here




SURROUNDINGS

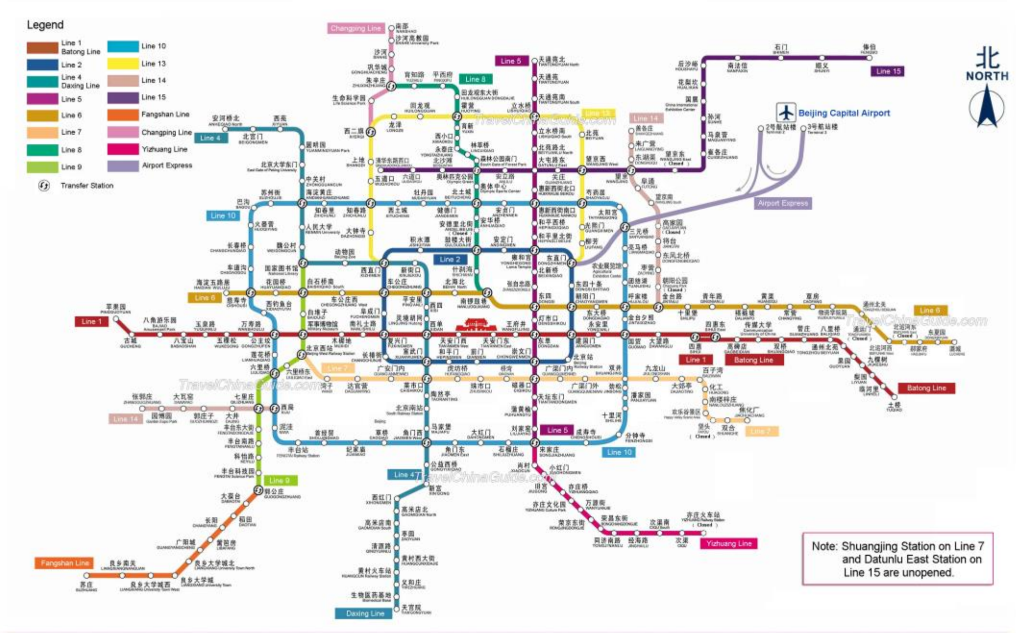
INPUT

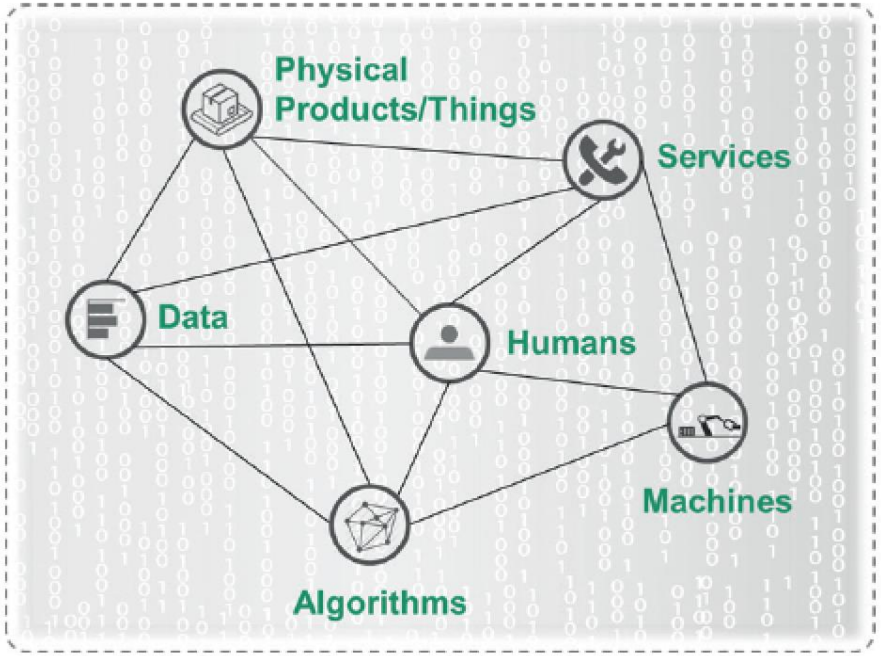
OUTPUT

OPEN SYSTEM

BOUNDARY

Beijing Subway Map (Cilck to Enlarge)


Legend
Line 1 Batong Line
Line 2
Line 4 Daxing Line
Line 5
Line 6
Line 7
Line 8
Line 9
Line 10
Line 13
Line 14
Line 15
Fangshan Line
Changping Line
Yizhuang Line
Airport Express
Transfer Station
北 NORTH
Beijing Capital Airport
Note: Shuangjing Station on Line 7 and Datunlu East Station on Line 15 are unopened.


Physical Products/Things

Services

Data

Humans

Machines

Algorithms

Defining a System

System theory (engineering):

A system is *a set of interrelated components working toward a common objective. Systems are made up of components, relationships, and attributes.* (from Carlsson et al. (2002), p. 234)

Defining a Systems of Innovation

SI= “all important economic, social, political, organizational, institutional, and other factors that influence the development, diffusion, and use of innovations.” (Edquist, 2005)

“…an open, evolving and complex system that encompasses relationships within and between organisations, institutions and socioeconomic structures which determine the rate and direction of innovation and competence-building emanating from processes of science-based and experience-based learning” (Lundvall et al. 2009)

Systems of Innovation

There are two ways, a *narrow* and a *broad* one, to look upon innovation systems.

In the *narrow* perspective innovations are generated in and distributed from a specific sector of the economy and are supported by specific institutions. (IS rooted in the R&D-system)

According to the *broader* view, innovations also follow as by-products of ordinary economic activities like procurement, production, and marketing in almost all parts of the economy.

Different types of Systems of Innovation

1. Territorial point of departure (geographical proximity), local, regional, national, continental, (and global?):
    - National Systems of Innovation (Lundvall, Nelson, Edquist,...)
    - Regional Innovation Systems - From Marshal to Porter’s clusters to RIS (Phil Cooke/Asheim/...., Economic Geography)
2. Point of departure in a specific technology: Technological Systems of Innovation (Carlsson & Stankiewitz, Jacobsen)
3. Point of departure in a specific sector: Sectoral Systems of Innovation (Malerba,...)
4. Combinations of 1, 2, and 3 (“multiple layers”)

These various types are complements rather than substitutes

New kids on the block: Innovation eco-systems, entrepreneurial eco-systems, ……

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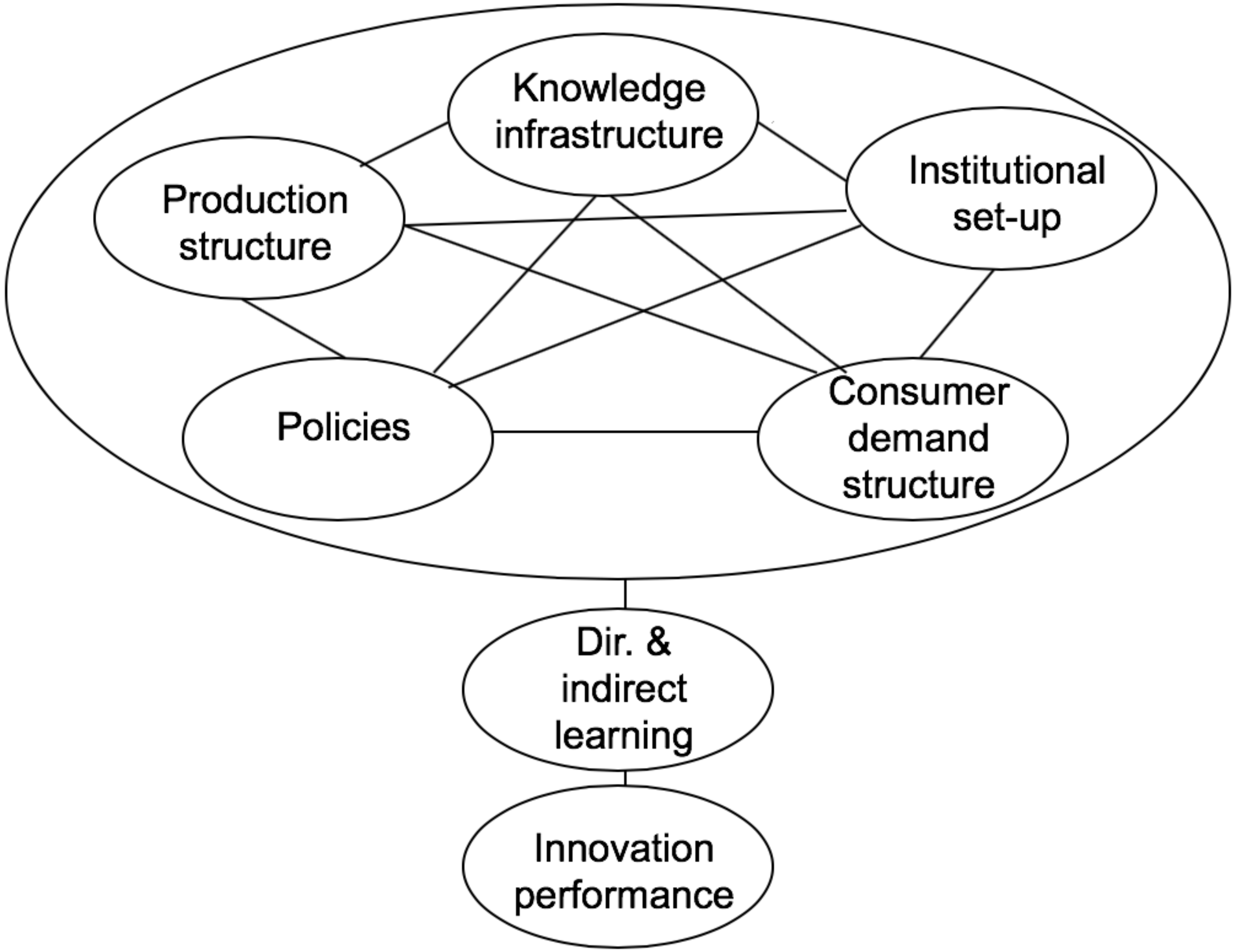
(Why) are NSIs still relevant?

Despite increasing globalisation (and international institutional coordination) nation states still constitute relevant environments for interactive learning and innovation:

1. The policy argument
    - Regulation of institutions related to the process of technical innovation and structural change
    - Providing of infrastructure ("traditional" and knowledge infrastructure)
    - The nation as an expression of a "common culture" supported by the political power of the state

2. The "diversity" argument: (Significant differences in the production structure / specialisation, institutions, policies, knowledge infrastructure, demand structure)

(National) Innovation system - Main factors affecting learning



Knowledge infrastructure

Production structure

Institutional set-up

Policies

Consumer demand structure

Dir. & indirect learning

Innovation performance

Gregersen, B. and Johnson, B. (1997), ‘Learning Economies, Innovation Systems and European Integration’, *Regional Studies*, Vol. 31 (5)

Common characteristics of SI:

- The structure of production and knowledge depend on each other and change rather slowly
- Important aspects of knowledge are localized
- Focus on interaction and institutions
- Synergy and diversity matters
- All activities are not of equal importance
- Dynamic system (a SI is always in motion and is always inducing change [no state of equilibrium])
- SIs are open systems
- Co-evolution

The Constitution of Innovation systems

- Constitution of Innovation System
  - Elements (Agents/actors, sub-systems,….)
  - Relationships (Interaction, ownership,….)
  - Processes (Learning and Knowledge)
  - Activities/functions (R&D, entrepreneurship,……)

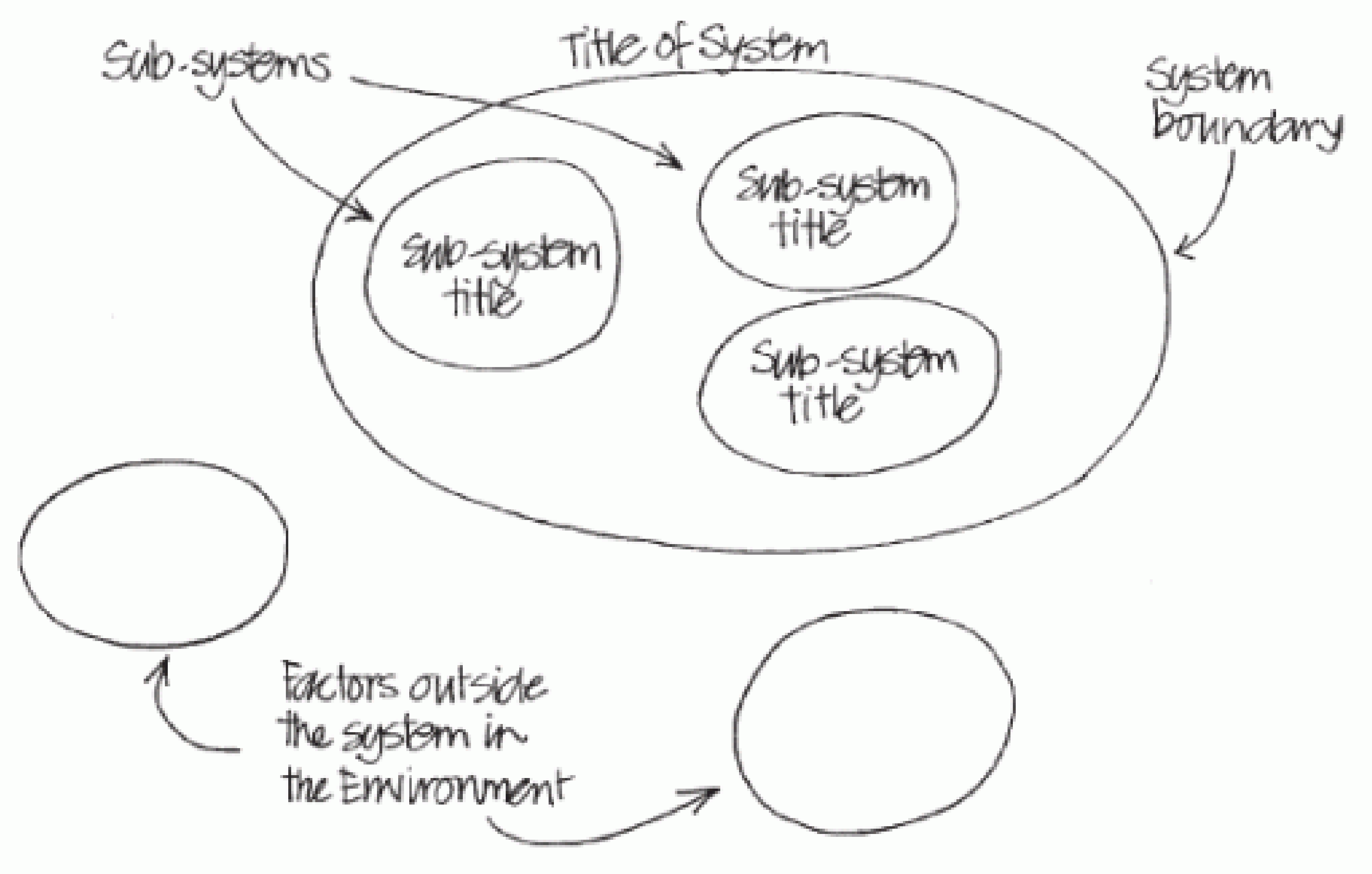
- Innovation systems differ in terms of
  - Specialisation - what they do
  - Mode of innovation - how they innovate

- Context matters!

Interactions and relationships

- Innovation is an outcome of interaction among different agents/organisations:
    - Suppliers and customers (value chains)
    - Universities an other knowledge institutions
    - Competitors
    - NGOs, ……..
    - Informal interaction and formal R&D-alliance
- Innovation is a combination of diverse elements of knowledge
- Relationships among diverse agents/organisations determine the direction and the rate of innovation.
- Relationships are systemic and localised (economic, geographical, organisational, cultural space)

Key analytical questions


Sub-systems
Title of System
System boundary
Sub-system title
Sub-system title
Sub-system title
Factors outside the system in the Environment

- Which are the *elements* of a SI?
- Which are the *links/relationships* in a SI?
- How to draw the *boundaries* of a SI?
- Which are the *'activities' and processes?*
- What do we mean by *performance* of a SI?

Group work or DIY (30 minutes)

Make an illustration of your understanding of a welfare technology innovation system and prepare a presentation

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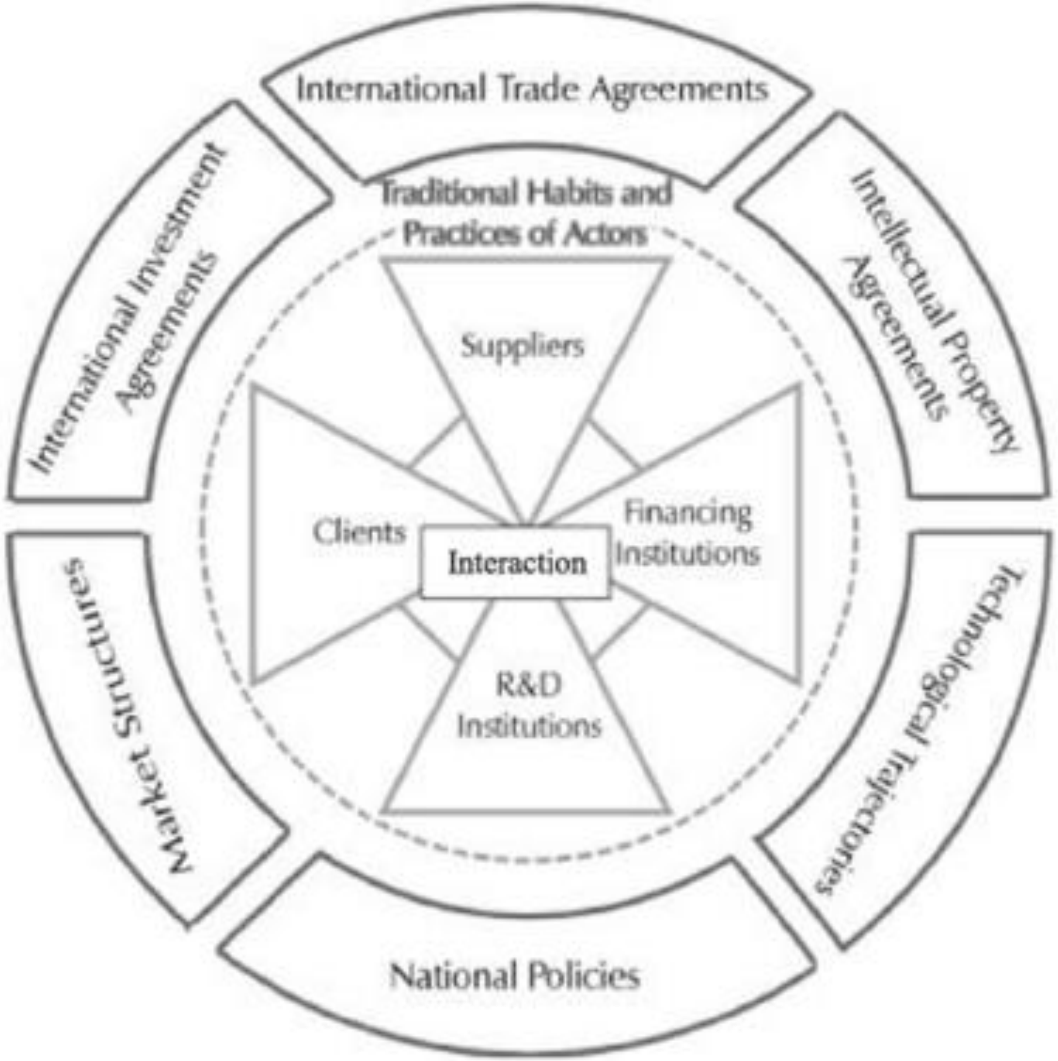
one example among many

2


International Trade Agreements
Intellectual Property Agreements
Technological Trajectories
National Policies
Market Structures
International Investment Agreements
Traditional Habits and Practices of Actors
Suppliers
Clients
Interaction
Financing Institutions
R&D Institutions

Source: Mytelka (2008)

- https://www.google.dk/search?q=%22innovation+system%22&client=firefox-b&dcr=0&tbm=isch&tbo=u&source=univ&sa=X&ved=0ahUKEwiZpObkrrTWAhXGfRoKHYD6A8QQsAQIMA&biw=1182&bih=636

Innovation System research 1.0 – setting the scene, from micro level to system level

1960s – beginning of the 80s
- Linear model
- Firms and industries (Schumpeter Mark I and Mark II)
- Nelson & Winther 1982, evolutionary theory of economic development

1980s – 1990s
- Innovation rooted in the production structure (specialisation, home market as test bed)
- Localised knowledge, proximity
- Importance of institutions
- Linkages and interaction between users and producers
- Active role of the state, policy implications

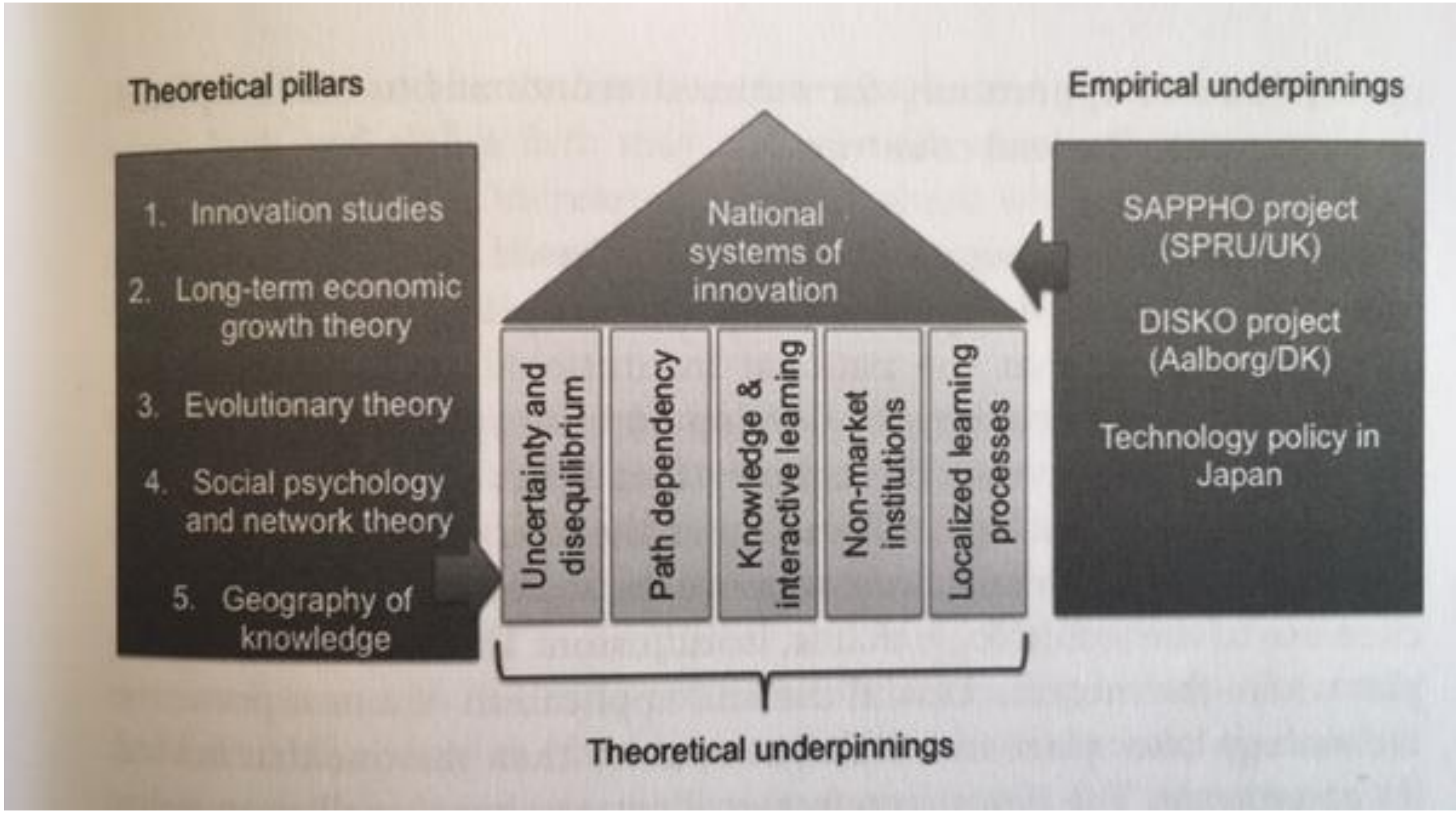
National, regional, sectorial, technological systems
- empirical studies (mainly in the North)
- narrow and broad definition of IS (STI/DUI modes of innovation)
- mainly the "usual suspects": firms, universities, research institutions, government agencies

Innovation System research 2.0 – increasing focus on contributions from the South and from Transition Economies

1990 - now

- *Building* innovation systems, creating interactive learning spaces
- Bringing in ‘new’ actors: NGOs, farmers, small family businesses, intermediaries, State Owned Companies,…
- Formal/informal sector
- Sustainability (social, economic, environmental)
- Importance of macro-economic conditions
- Indicator work and a variety of analytical frameworks
- Enhanced and rich knowledge of ISs in the North and the South
- More disciplines (economics, innovation, management, development, geography, sociology, political science, history,…)

Theoretical and empirical foundations of the (national) innovation system concept


Theoretical pillars
1. Innovation studies
2. Long-term economic growth theory
3. Evolutionary theory
4. Social psychology and network theory
5. Geography of knowledge
National systems of innovation
Uncertainty and disequilibrium
Path dependency
Knowledge & interactive learning
Non-market institutions
Localized learning processes
Theoretical underpinnings
Empirical underpinnings
SAPPHO project (SPRU/UK)
DISKO project (Aalborg/DK)
Technology policy in Japan

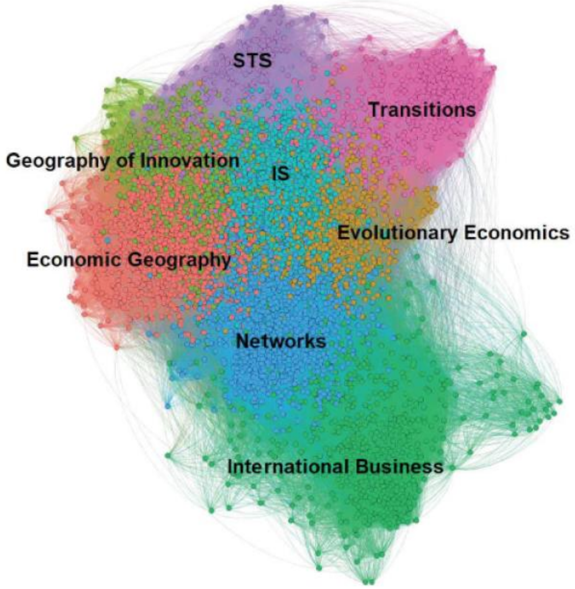
Chaminade et al. (2018), p. 31

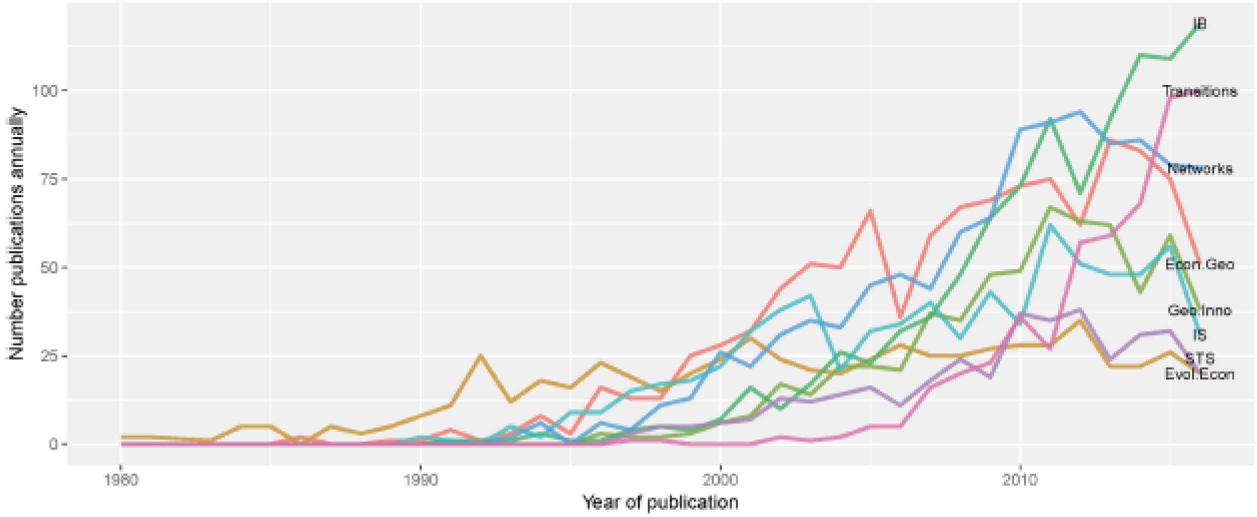
Innovation (system) studies 3.0 – common challenges in our current contexts

- Sustainability, energy supply, climate changes, water supply
- Increasing inequalities in many respects (income, health, education, gender, ethnicity, age, employment, …..)
- Distribution of costs and benefits
- Inclusive innovation
- Global value chains and learning, role of MNC
- IPR
- Labour market issues, wage dumping, working conditions, migration
- Financial systems
- Public sector services, health care, education,…
- Urbanization
- Changing role of universities and other knowledge institutions

Innovation (system) studies 4.0 – analytical challenges

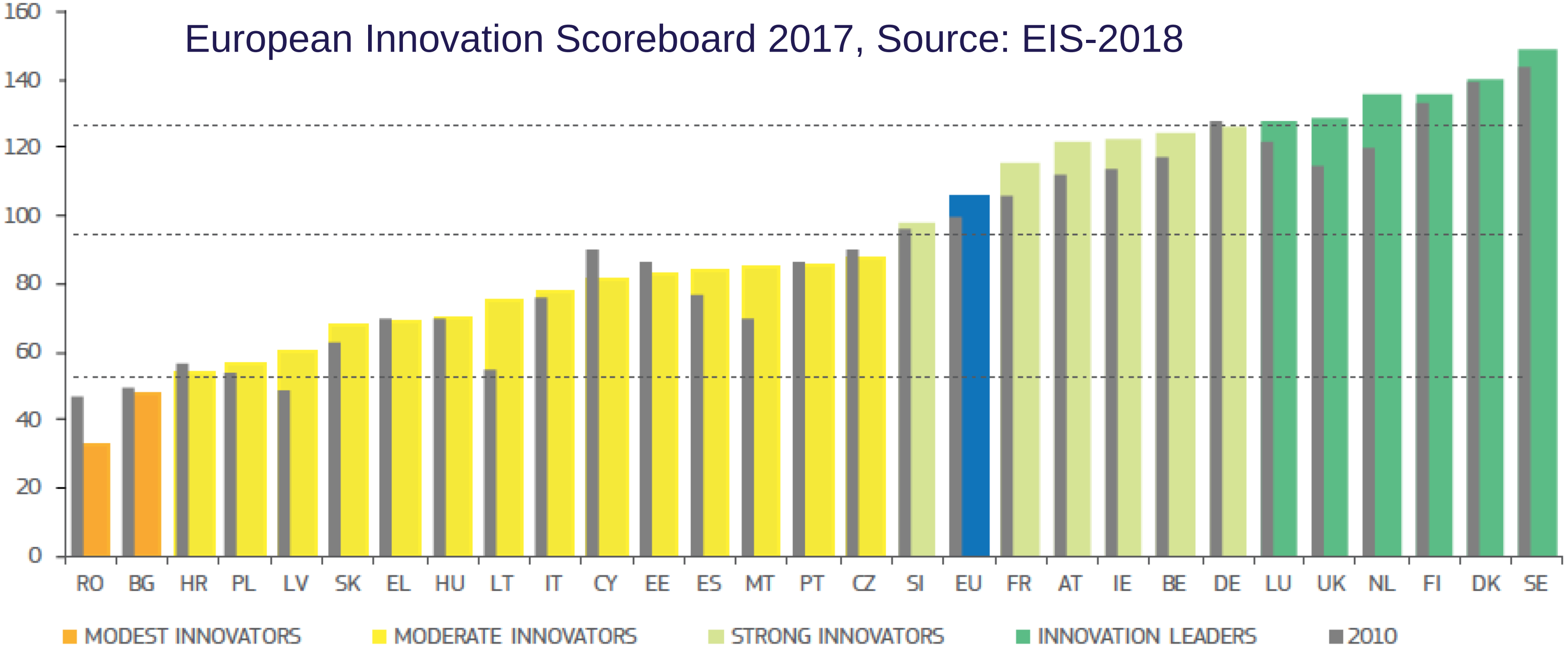
- Industry 4.0
- “Platform economy”
- Disruptive innovation
- Big data and new analytical tools
- What is the core of the innovation (system) study field?
- Variety of systems
- Performance of Innovation systems
- What is our contribution to SDGs?


STS
Transitions
Geography of Innovation
IS
Evolutionary Economics
Economic Geography
Networks
International Business



Source: Rakas & Hain, RP 2019

What do we mean by performance of a NSI?


European Innovation Scoreboard 2017, Source: EIS-2018

Coloured columns show Member States' performance in 2017, using the most recent data for 27 indicators, relative to that of the EU in 2010. Grey columns show Member States' performance in 2010 relative to that of the EU in 2010. For all years, the same measurement methodology has been used. The dashed lines show the threshold values between the performance groups in 2017, comparing Member States' performance in 2017 relative to that of the EU in 2017.

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Narrow and broad performance of NSI

	Narrow Performance	**Broad performance**
Narrow NSI approach	Patents Scientific publications New high-tech product	Number of high-tech spin-off companies University-Industry collaboration
Broad NSI approach	New to the market innovations (incl. medium and low tech sectors) UNCTAD ICI ArCo index	Organizational innovations Innovation in health care and education Environmental innovations

European Innovation scoreboard

Gregersen & Johnson (2005)

Discrete and embedded performance of (broadly defined) NSI

	Discrete performance	Embedded performance (econ. performance)	Socio-economic performance
Narrow performance concept	Scientific publications Citations Patents **European Innovation scoreboard**	Productivity growth Employment Bal. of Payment	
Broad performance concept	Formation of new firms System Linkages UNCTAD ICI ArCo index	UNIDO IPI Investment Export market shares	UNDP HDI Social capital Sustainable growth

Gregersen & Johnson (2005)

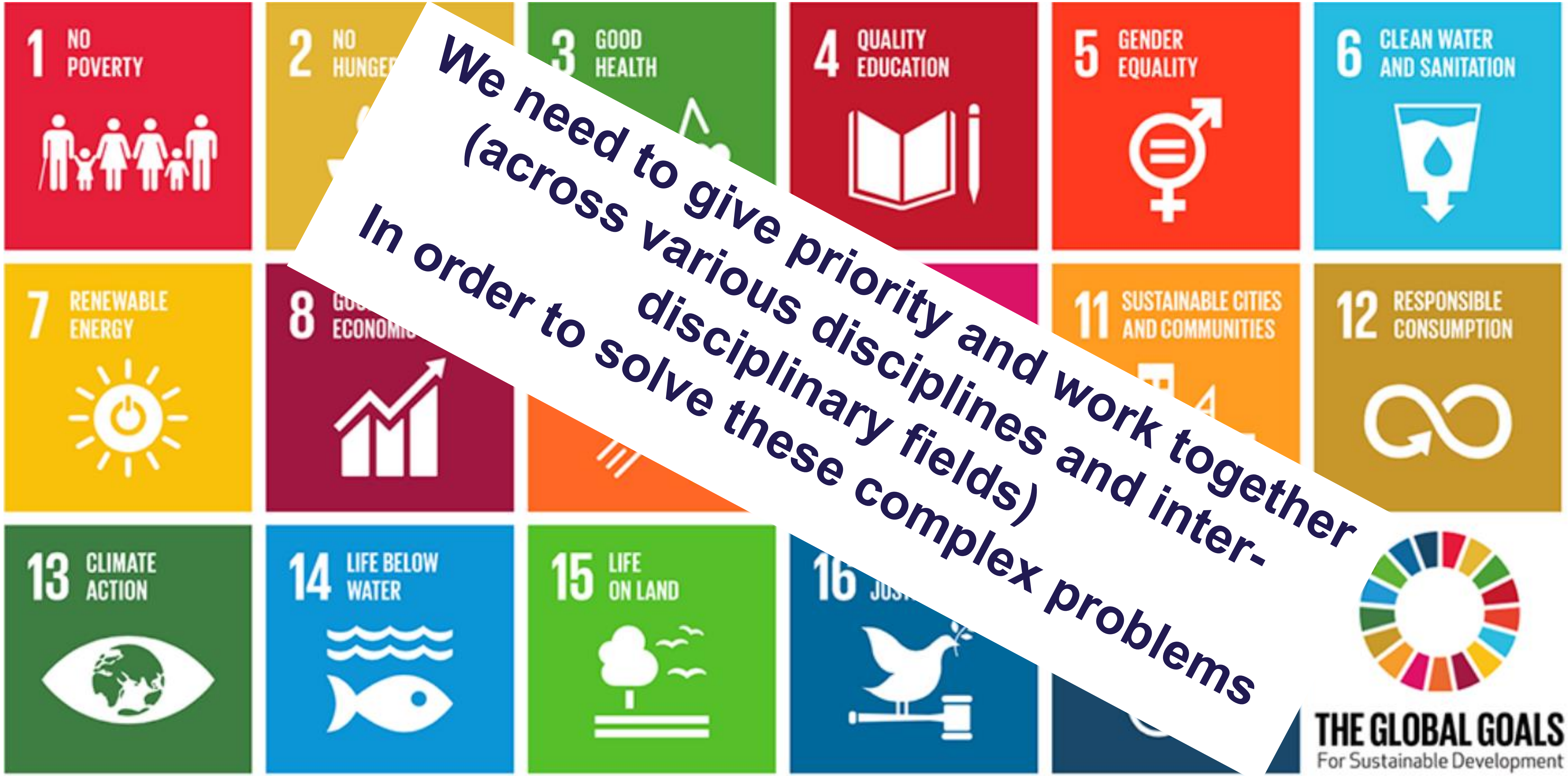
Static and dynamic performance of NSI

	Discrete performance	**Embedded performance (econ. performance)**	**Socio-economic performance**
Static performance concept	Number of engineers and scientists per capita Patents **European Innovation scoreboard**	Productivity growth UNIDO IPI	UNDP HDI Social capital
Dynamic performance concept	Education and comp. building Labour mobility	Labour mobility Knowledge sharing	Social security Political freedom Transparency

Gregersen & Johnson (2005)

Challenges for our innovation study community

What is our contribution?


1 NO POVERTY
2 NO HUNGER
3 GOOD HEALTH
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 RENEWABLE ENERGY
8 ECONOMIC
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16
THE GLOBAL GOALS
For Sustainable Development

We need to give priority and work together (across various disciplines and inter-disciplinary fields)

In order to solve these complex problems

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