Circular economy and systems change

Managing circular economy – session #3

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Outline

Basics of systems thinking

Systems thinking and circular economy

Sustainability transitions

Definitions

- **System:** An interconnected set of elements that is coherently **organized in a way that achieves something.**

- Systems consist of **elements *(system structure),*interconnections *(system dynamics)*, and a function or purpose.**

- A system is more than the sum of its parts. It may exhibit adaptive, dynamic, goal-seeking, self-preserving, and sometimes evolutionary behavior (Meadows, 2008; Sterman, 2000).

https://www.youtube.com/watch?v=Miy9uQcwo3U

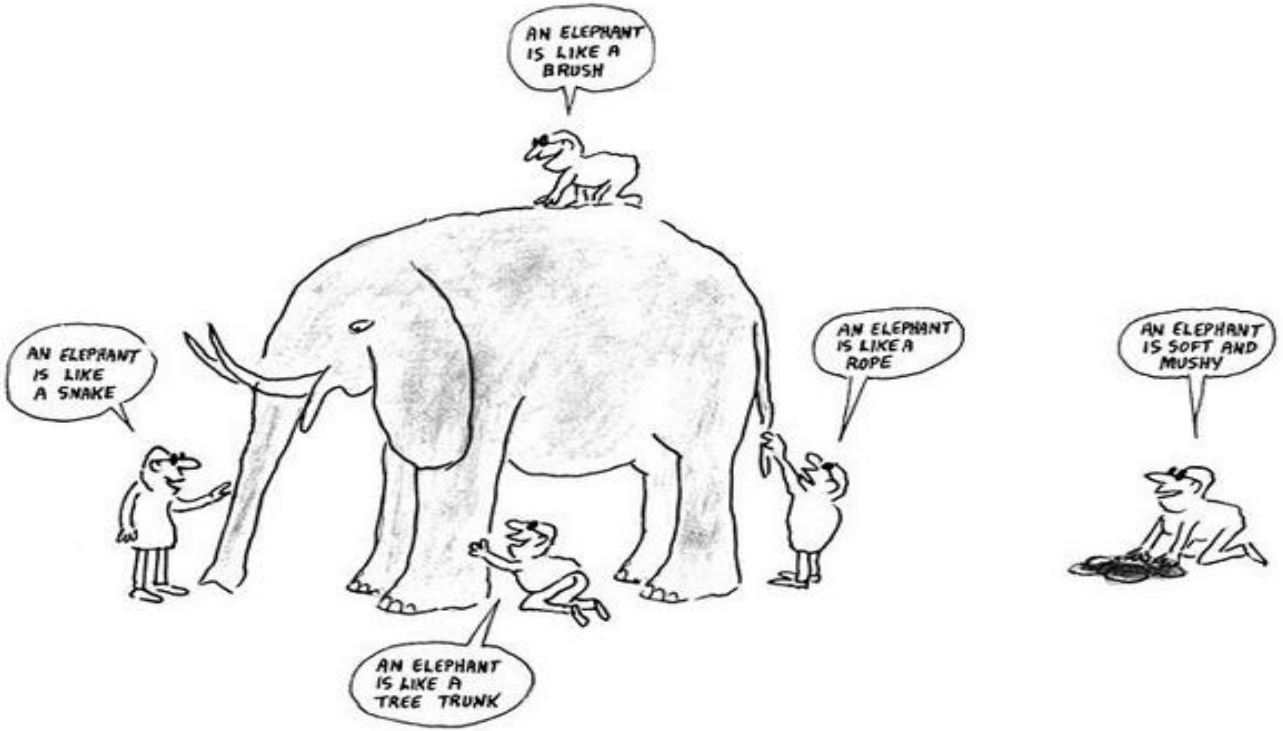
Why utilize systems thinking?

- Avoiding unwanted (unituitive) consequences
- Finding root causes and leverage points
- Understanding the structure of systems and system archetypes

Forest as a system

1. Different elements of the forest are interconnected
2. A forest includes many complex subsystems
3. A forest is self-organized and has emergent behavior

Reductionist thinking vs systems thinking



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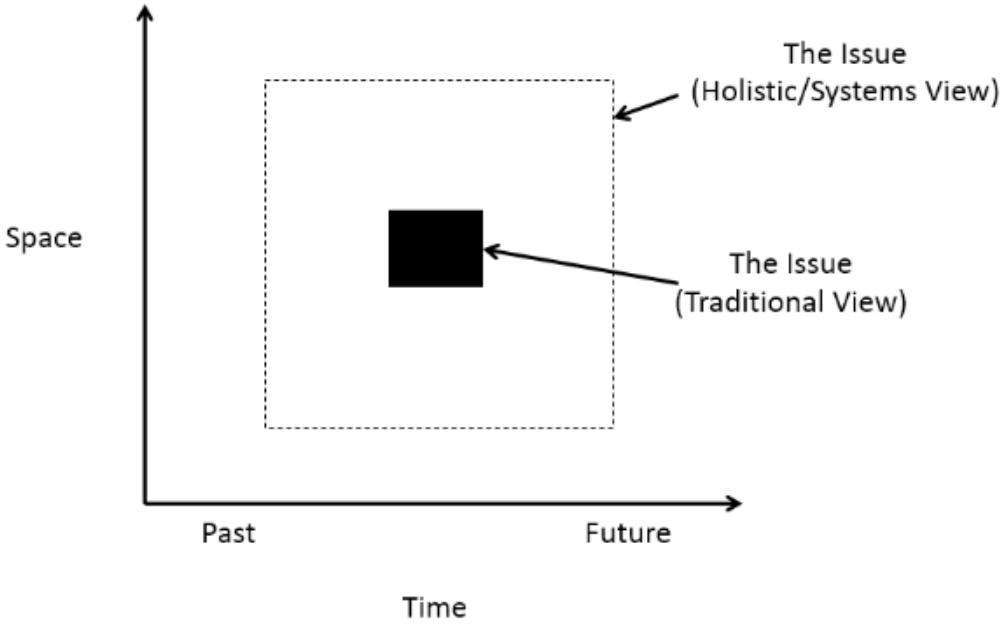
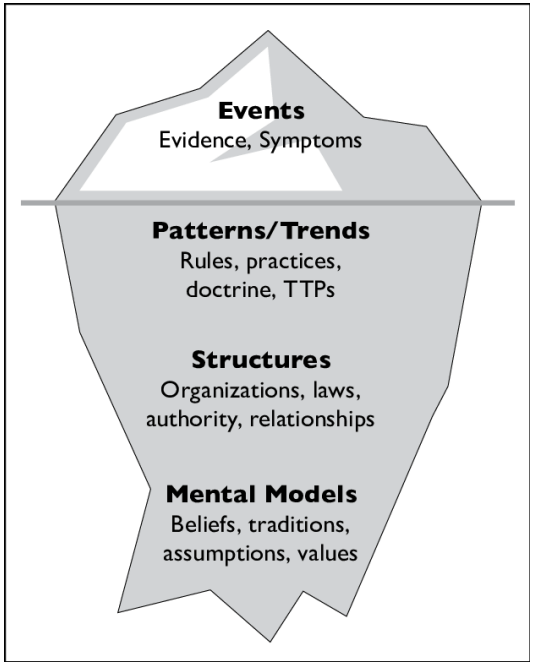
Reductionist thinking vs systems thinking



Iceberg model of systems thinking



Tools of systems thinking – system dynamics

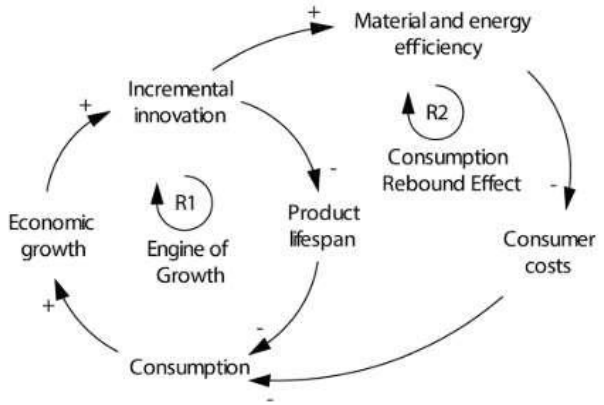


Figure 3 Reinforcing feedback loops Engine of Growth and Consumption Rebound Effect

Key concepts

Interconnectedness

Feedbacks

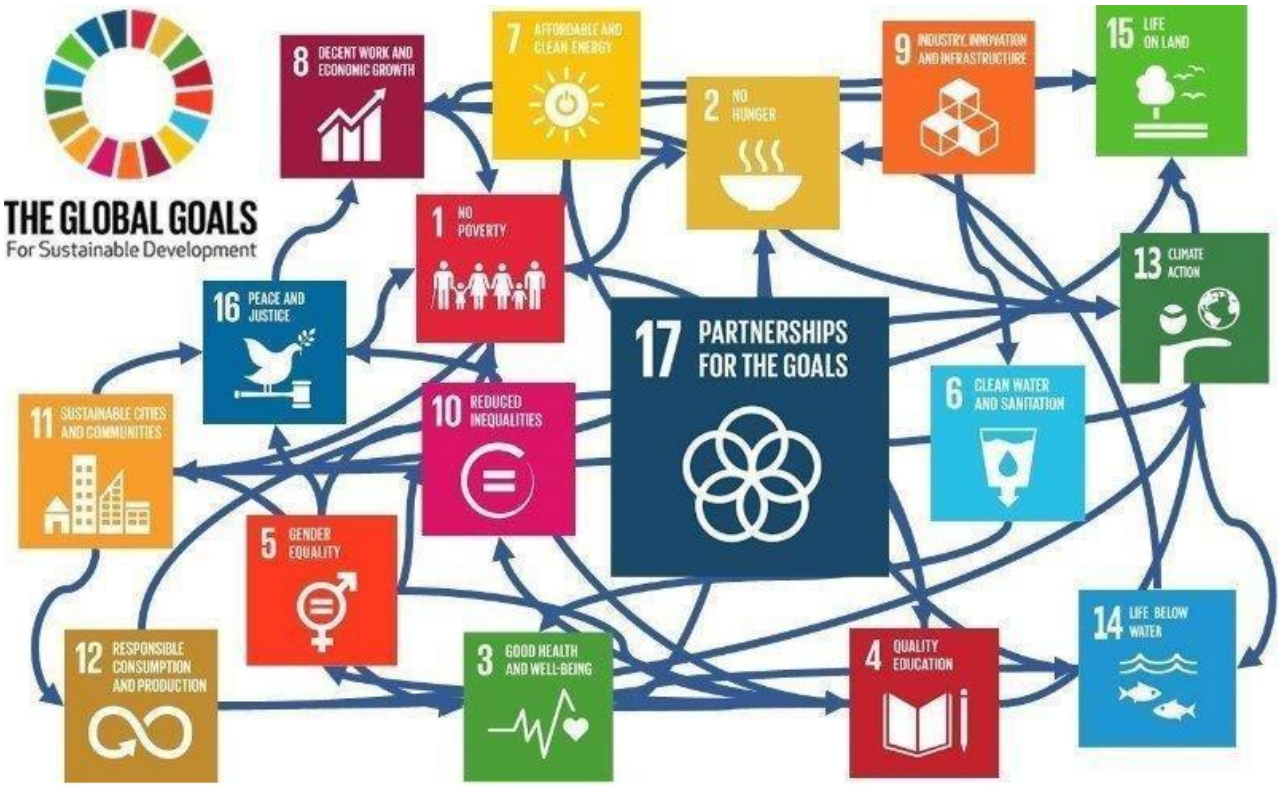
Adaptive capacity/resilience

Self-organization

Emergence

(Williams et al. 2017)

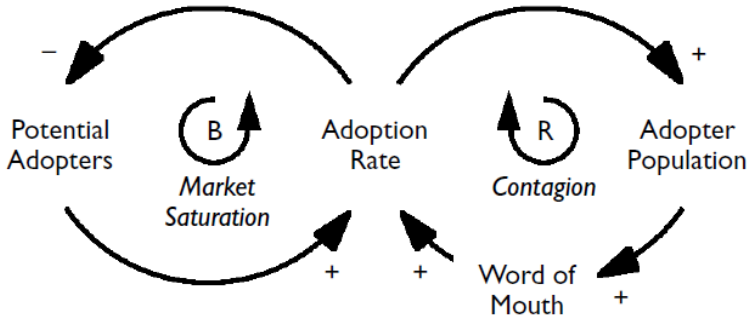
Interconnectedness



Feedback loops

Positive (reinforcing) feedback loops

Negative (balancing) feedback loops



B is a balancing loop
R is a reinforcing loop

Adaptive capacity

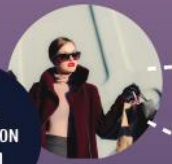
Ensures survival of the system when actors learn from experience and act accordingly

Resilience is an important adaptive feature of sustainable systems

Self-Organization and emergence

Examples

SYSTEMIC CHALLENGES OF THE TEXTILE INDUSTRY



MACRO

MESO

MICRO

LARGE CORPORATIONS DOMINATE FASHION BUSINESS

CURRENT CONSUMPTION PARADIGM

FAST FASHION BUSINESS MODEL

CLIMATE EMISSIONS

DEPLETION OF NATURAL RESOURCES

WATER SCARCITY

MICRO PLASTICS

EXTERNALITIES NOT TAKEN INTO ACCOUNT

MIXED MATERIALS

USE OF PESTICIDES AND CHEMICALS

SYNTHETIC FIBRES

INCINERATION/ LANDFILLING/ DUMPING IN DEVELOPING COUNTRIES

PRODUCTION IN LOW-COST LABOUR COUNTRIES

VIOLATION OF HUMAN RIGHTS

MAXIMIZING SHORT-TERM PROFITS

FASHION IN IDENTITY-BUILDING

LOW RECYCLING RATE

LOW QUALITY

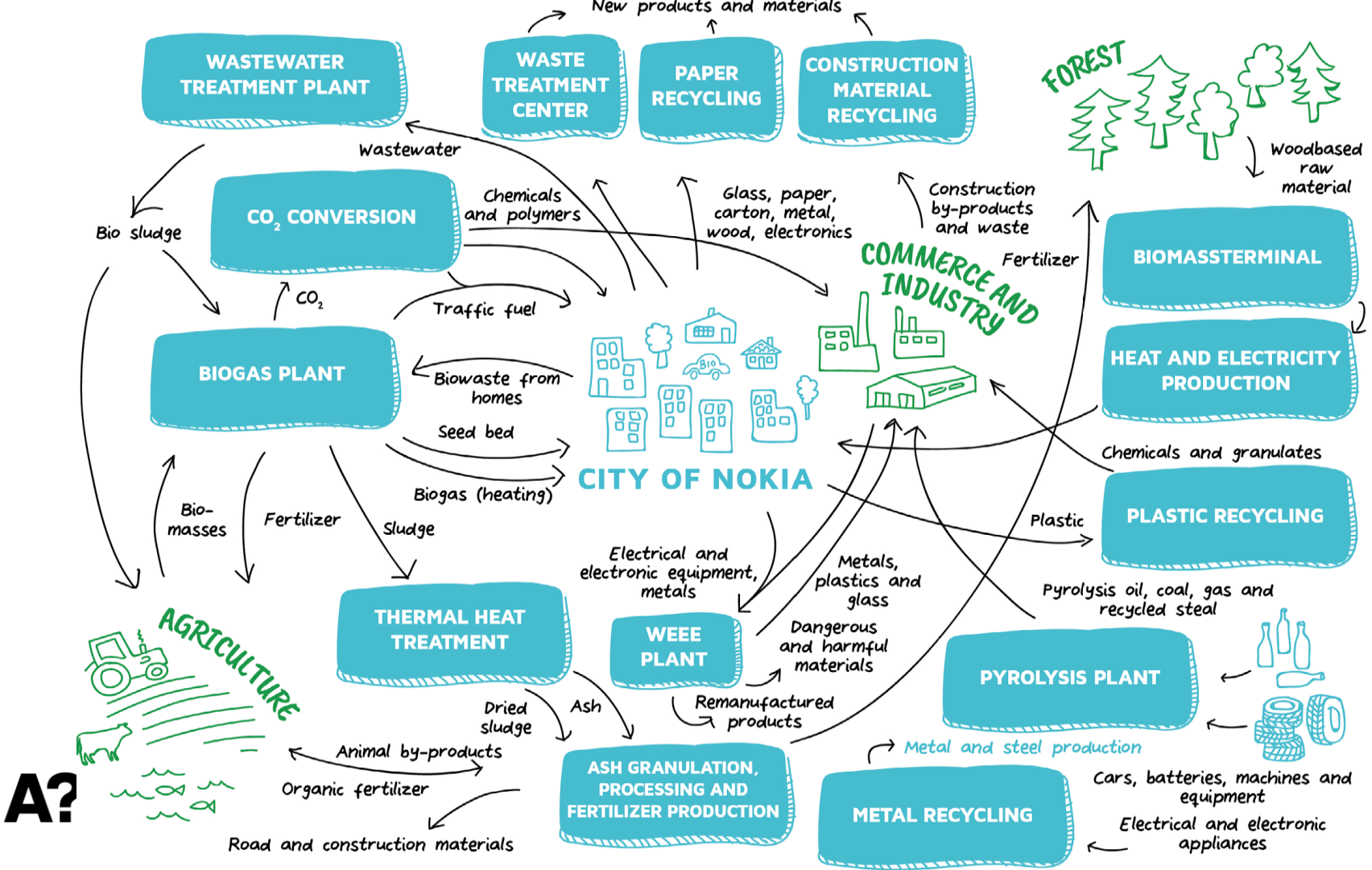
CHEAP PRICES

POOR TRACEABILITY OF CLOTHING

SHORT USAGE TIME

IMPULSE PURCHASES

Closed Plastic Circle


New products and materials
WASTEWATER TREATMENT PLANT
WASTE TREATMENT CENTER
PAPER RECYCLING
CONSTRUCTION MATERIAL RECYCLING
FOREST
Woodbased raw material
Wastewater
Bio sludge
CO_2 CONVERSION
Chemicals and polymers
Glass, paper, carton, metal, wood, electronics
Construction by-products and waste
COMMERCE AND INDUSTRY
Fertilizer
BIOMASSTERMINAL
CO_2
Traffic fuel
BIOGAS PLANT
Biowaste from homes
HEAT AND ELECTRICITY PRODUCTION
Seed bed
Chemicals and granulates
CITY OF NOKIA
Biogas (heating)
Bio-masses
Fertilizer
Sludge
Plastic
PLASTIC RECYCLING
Electrical and electronic equipment, metals
Metals, plastics and glass
Pyrolysis oil, coal, gas and recycled steal
AGRICULTURE
THERMAL HEAT TREATMENT
WEEE PLANT
Dangerous and harmful materials
PYROLYSIS PLANT
Dried sludge
Ash
Remanufactured products
Animal by-products
Metal and steel production
Organic fertilizer
ASH GRANULATION, PROCESSING AND FERTILIZER PRODUCTION
METAL RECYCLING
Cars, batteries, machines and equipment
Electrical and electronic appliances
Road and construction materials
A?

Sustainability transitions

Sustainability transitions as a research field

- **Originated in the late 1990s as an interdisciplinary social science research field, with an aim to tackle fundamental *environmental* sustainability challenges**

- **Tries to understand socio-technical system change through**
  - (a) creation and diffusion of innovations (niches, technological innovation systems)
  - (b) path dependencies, lock-ins and the processes of destabilising socio-technical regimes/systems
  - (c) influence of broader landscape changes

Key concept: a socio-technical system

- **E.g. energy supply, water supply, transportation, food supply**

- **“*consists of (networks of) actors (individuals, firms, and other organizations, collective actors) and institutions (societal and technical norms, regulations, standards of good practice), as well as material artefacts and knowledge”***

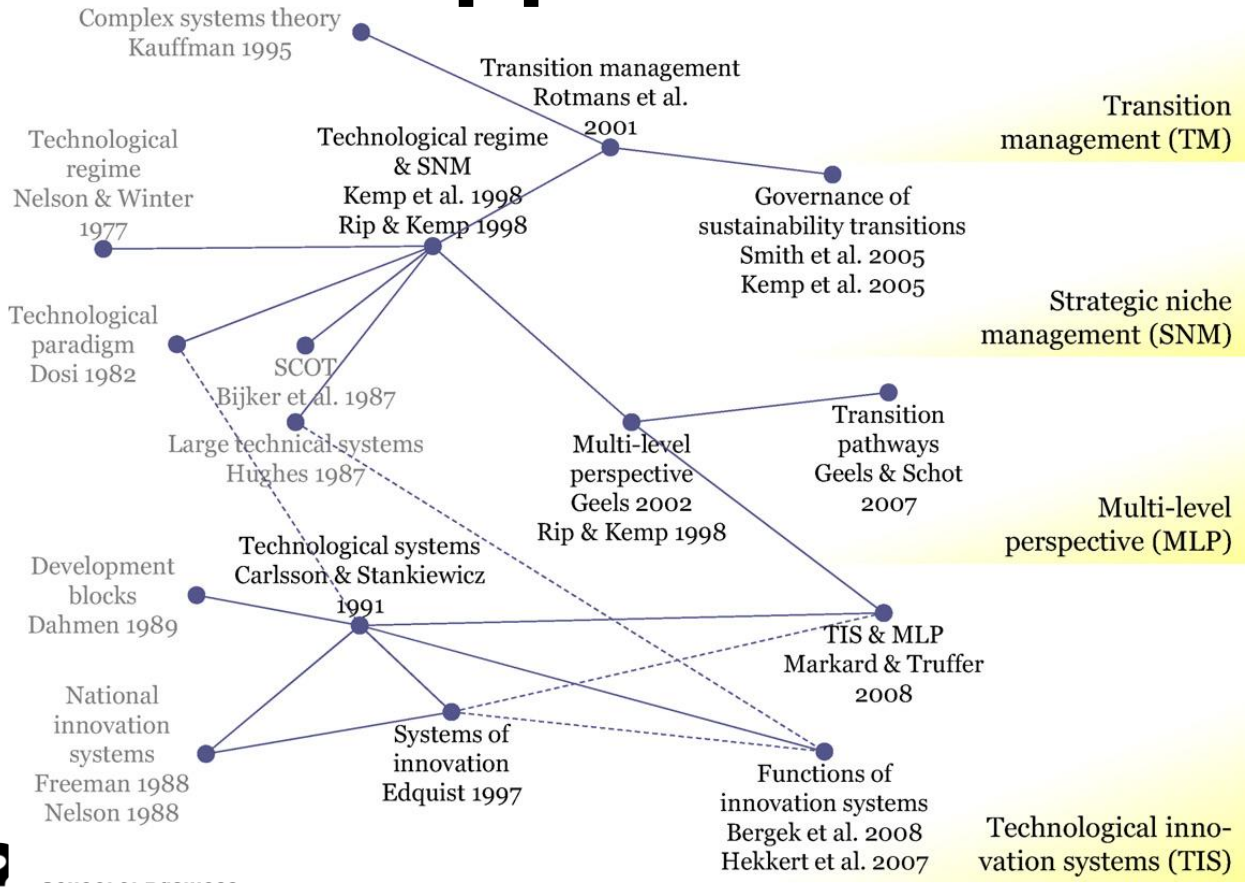
- **Different elements of the system interact providing services for the society**

Socio-technical transition

- **“*set of processes that lead to a fundamental shift in socio-technical systems*”**
  - Contains extensive changes along different dimensions: not just technological, but also organisational, institutional, political, economic, and socio-cultural
  - Include a large variety of actors
  - typically take a very long time (> 50 years).
  - During a transition, new products, services, business models, and organisations emerge
  - Technological and institutional structures undergo fundamental changes

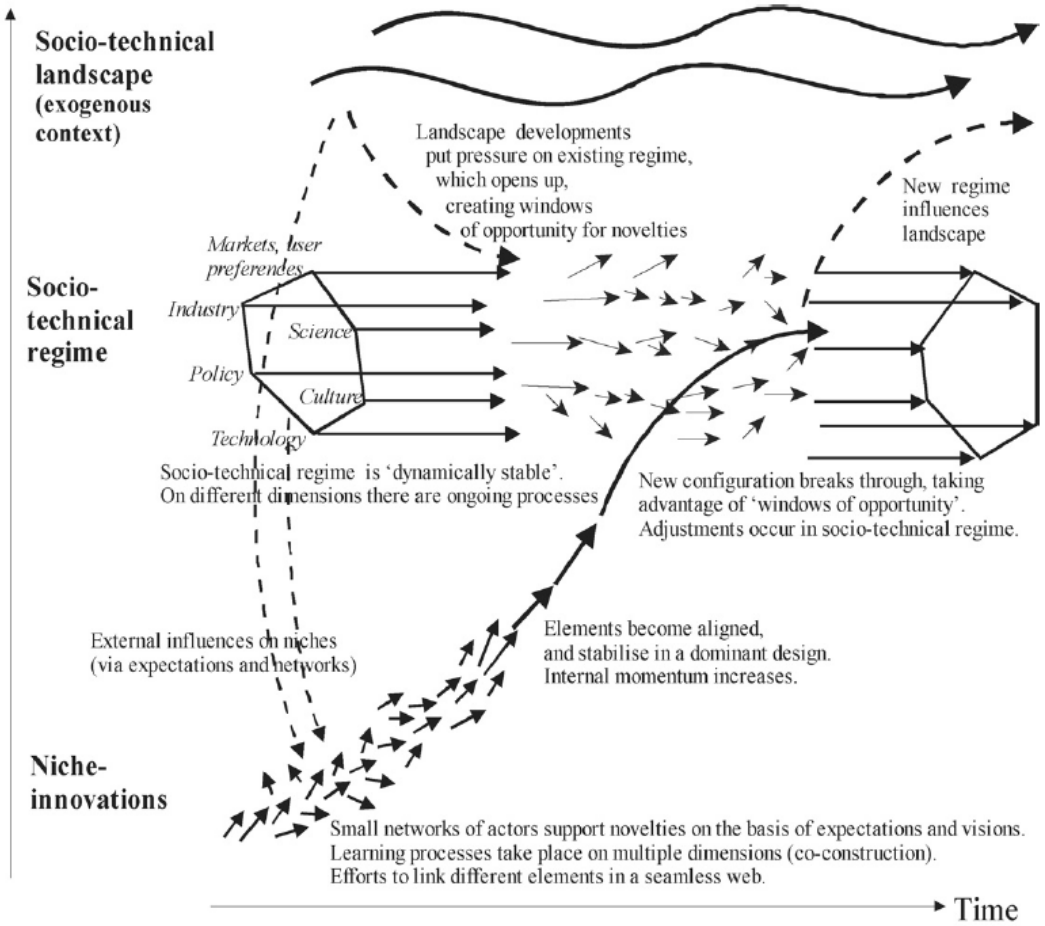
Markard et al. 2012

Different approaches



Markard et al. 2012

Multi-level perspective on sustainability transitions



Geels & Schot (2007)

Technological innovation systems (TIS)

- **TIS adopts a systemic perspective to analyse the links between different actors, networks and the institutional contexts around a specific emerging technology (Bergek et al. 2008).**

- **A well-functioning TIS is regarded as a requirement for the development and diffusion of a technology**

- **Seven functions and ‘motors of innovation’**



Technological innovation systems

Seven core functions of technological innovation systems:

- **Knowledge development and diffusion**
- **Entrerpreneurial experimentation**
- **Influencing the direction of the search**
- **Market formation**
- **Development of positive environmental economies**
- **Legitimation**
- **Resource mobilization**

(Bergek et al.2008)