The pig/pork production system as a Complex Adaptive System

CAS-thinking x Innovation strategy

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Outline of this contribution

- Helping the NW-European <u>pork sector</u> to enter the future is complicated

- We (Wageningen UR) are trying to add a <u>systems approach</u> to the multi-actor-innovation approach

  Complex Adaptive Systems

  Best illustrated with Agent Based Modelling

- Here: focus on the pigs/pork system
  Multi-level project: animal – farm – sector – society

- Put research efforts into a real life context

  - Research as an instrument for

    - Guiding an evolutionary development
    - Enhance sustainable development

Why a systems approach?

Animal production systems are complex!

Understanding is needed

- Understanding what is happening at chain / sector / society level is useful**

- A certain set of glasses helps in good sight

offers a conceptual view

Developments are <u>multilevel</u> & <u>multifactorial</u> and required views are <u>multidisciplinary</u>

→ Conceptual systems approach useful

** Adviser & Horizon2020!

Complex Systems Thinking

- Animal production systems combine biological complexity with human complexity, and function in a complicated (complex) context

Challenge for science to model the development

? Instruments to guide processes?

! Suit animal production into the local context

A Complex Adaptive Systems approach seems to provide a good framework

What makes systems 'Complex Adaptive Systems'?

- Open: in interaction with their environment
- Components that are linked through interactions
- Positive and negative feedbacks
- Non-linear behaviour, nested and multilevel
- Variety of components and interactions between components
- Emergence
- Various orientations (attractors)
- Adaptive

(cas-criteria, adapted from Kauffman and from Bregt)

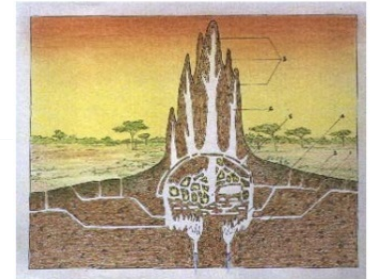Co-evolution, emergence and self-organisation

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Agent Based Modelling
a tool connected to CAS
Agent Based Modelling makes life easier

Examples

- Birds in a swarm
- Termites hill
- Traffic jam
- Crowd behaviour

Termite mound algorithms:

E. Bonabeau et al., Self-Organization in Social Insects, 1997:

Self-organization was originally introduced in the context of
provides a concise description of a wide rage of collective
assumes that interactions among simple individuals can pro
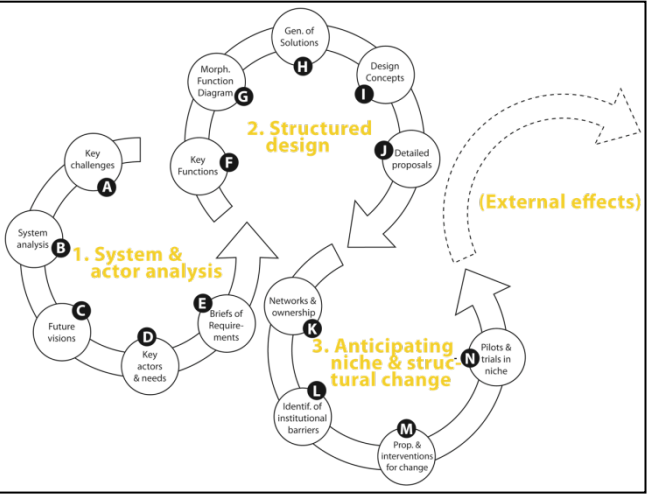http://www.ldc.upenn.edu/myl/abm/

A flock of birds demonstrate how individuals can interact together and form emergent patterns of behavior.
© iStockphoto.com/Árpád Radóczy

http://www.fhwa.dot.gov/advanced
research/pubs/11036/

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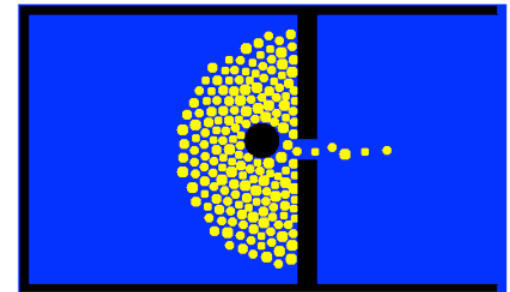
Views on innovation
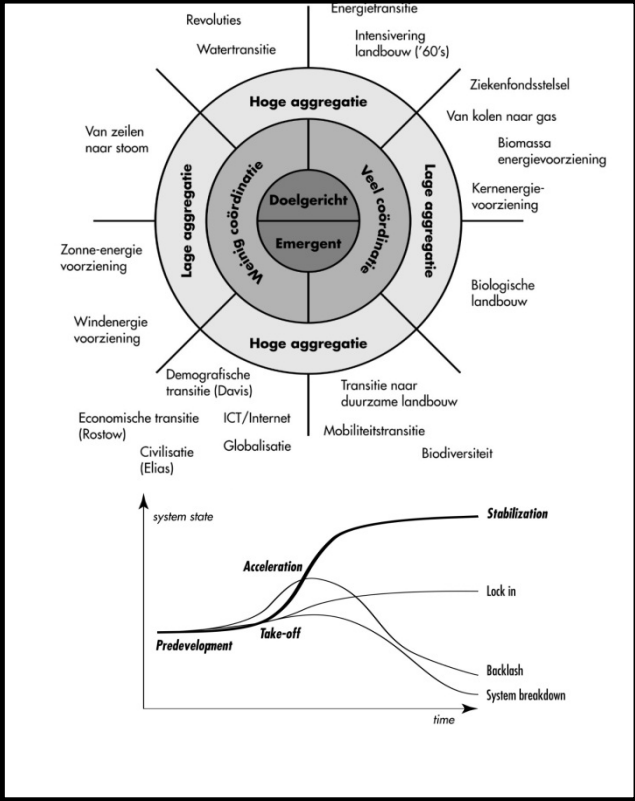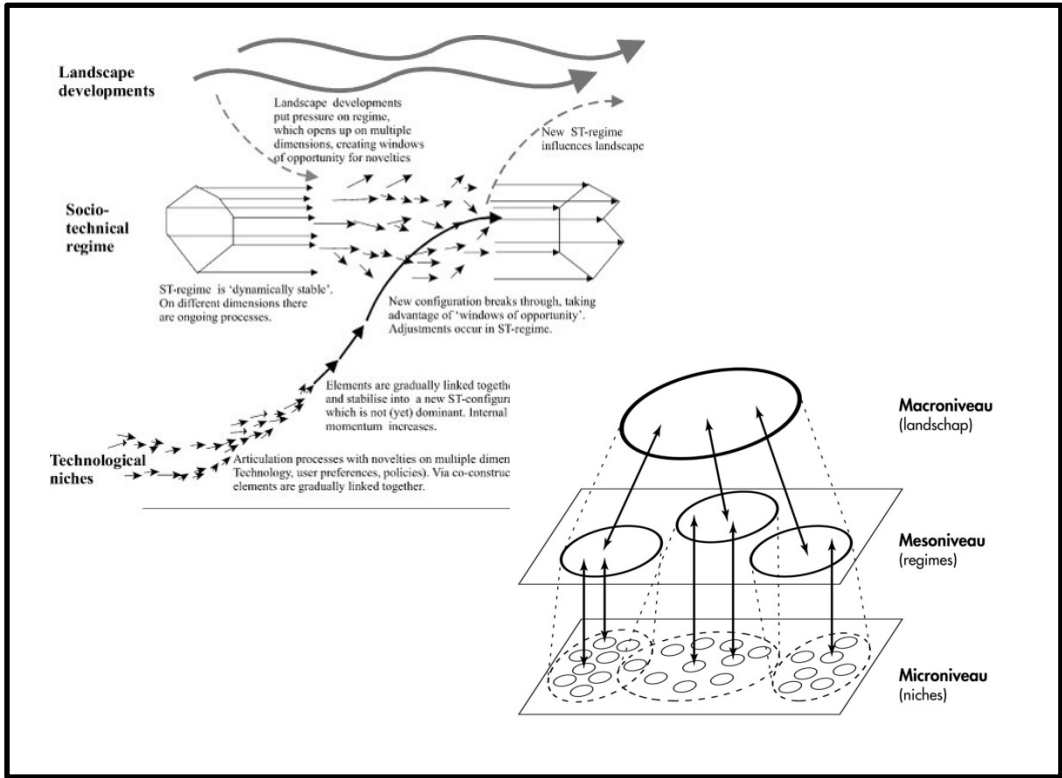
View on innovation

- Guided process OR evolutionary development
- Interventions? Planning versus stimulating?, Help?

IF CAS THEN "create an adequate environment"
BETTER THAN "perform interventions".

Relevant for policy makers
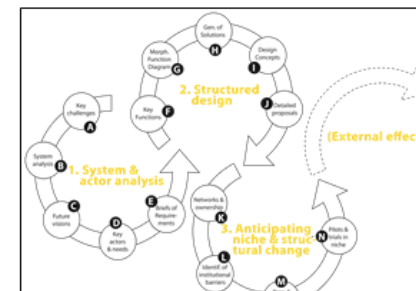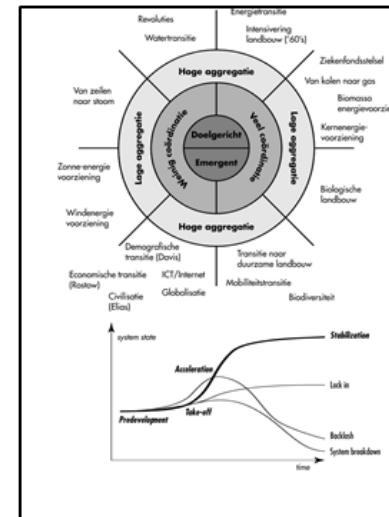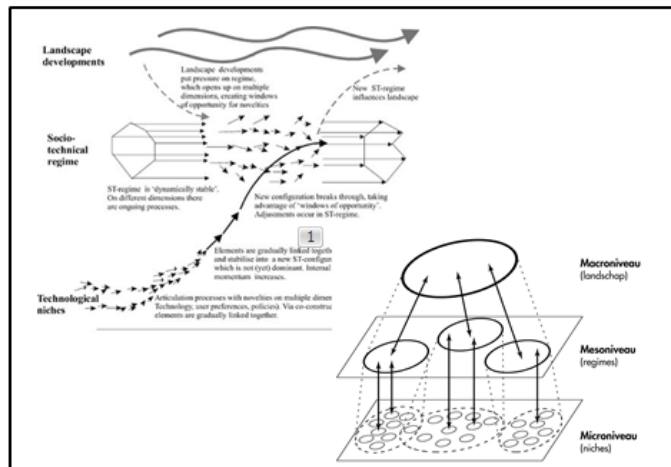
CASE: The World Pork System

- Commodity (exchangeable)
- Many (~diverse) actors on the ends of the chain

-> market price to marginal cost = lowest cost performance

→Operational excellence

→Harmonisation

→ ~ locked in

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Key ambitions/ questions - overall

- Analyse whether pork sector behaves as a Complex Adaptive System

- Answer to the question: Why does a (seemingly inert) commodity system change: *emergence, forces*

- What is the role of the 'Innovation arena' in the change

→ Understand

→ Explain

→ Advise

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CAS-criteria (Kauffman?)

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Co-evolution, emergence and self-organisation

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Influences on the pork chain

DEMAND:

- Market development

SUPPLY:

- Technical development

ENVIRONMENT:

- Societal development
  - Animal welfare, environmental issues, …
  - Competing claims (labour, area, support)
  - …

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Conceptual view on developments in the pork chain

representatives

sector

FARM

DEMAND:

- Market development

SUPPLY:

- Technical development

ENVIRONMENT:

- Societal development

  - Animal welfare, environmental issues

  - Competing claims (labour, area, support)

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Conceptual view on developments in the pork chain

Politics

Media

National government

NGO's

Chain parties

Farmer-organisations

representatives

sector

FARM

Local government

Neighbours

DEMAND:

- Market development

SUPPLY:

- Technical development

ENVIRONMENT:

- Societal development

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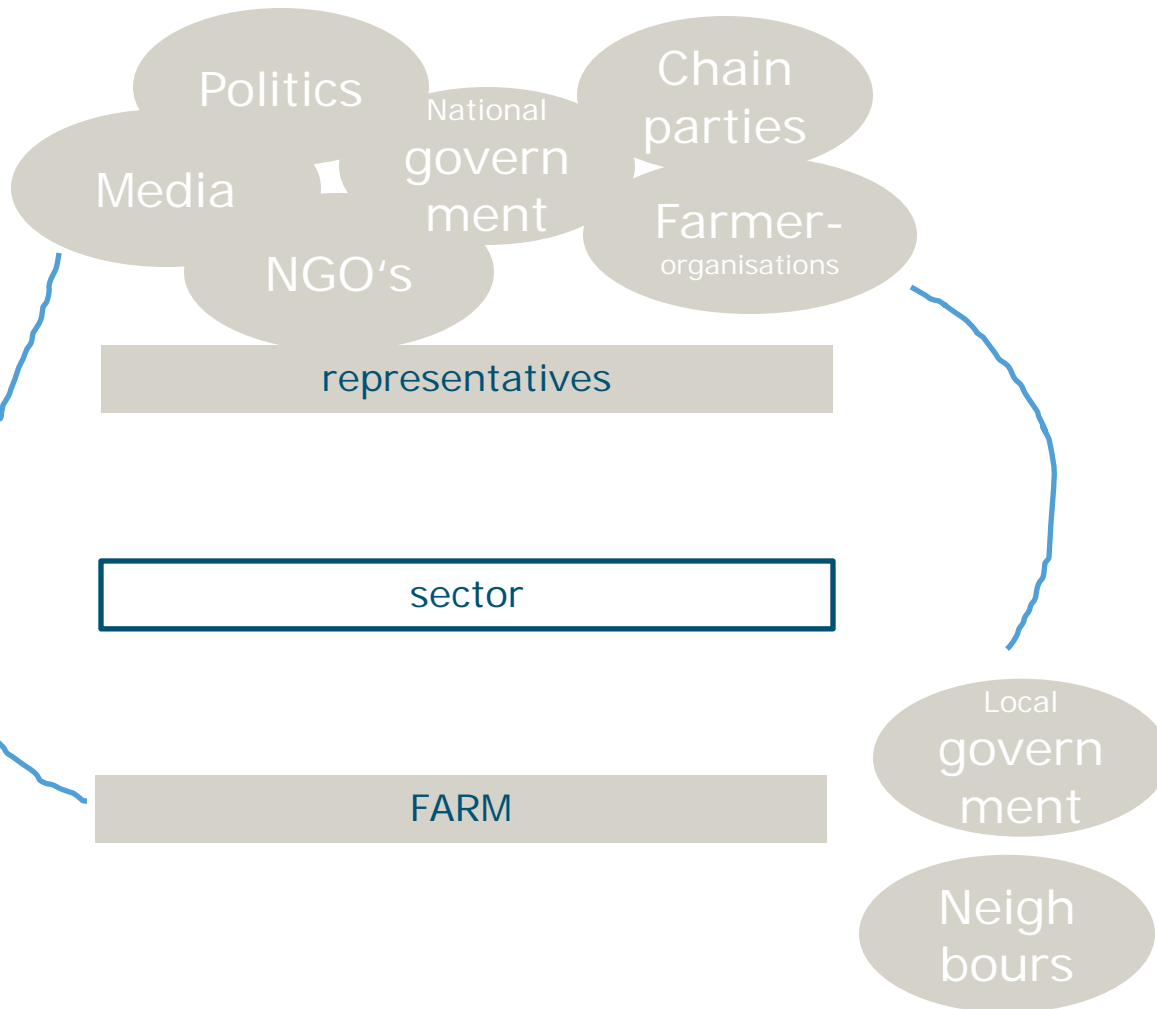
ResPork: a multi-level approach to the innovation process in the pork system

'Innovation Arena'

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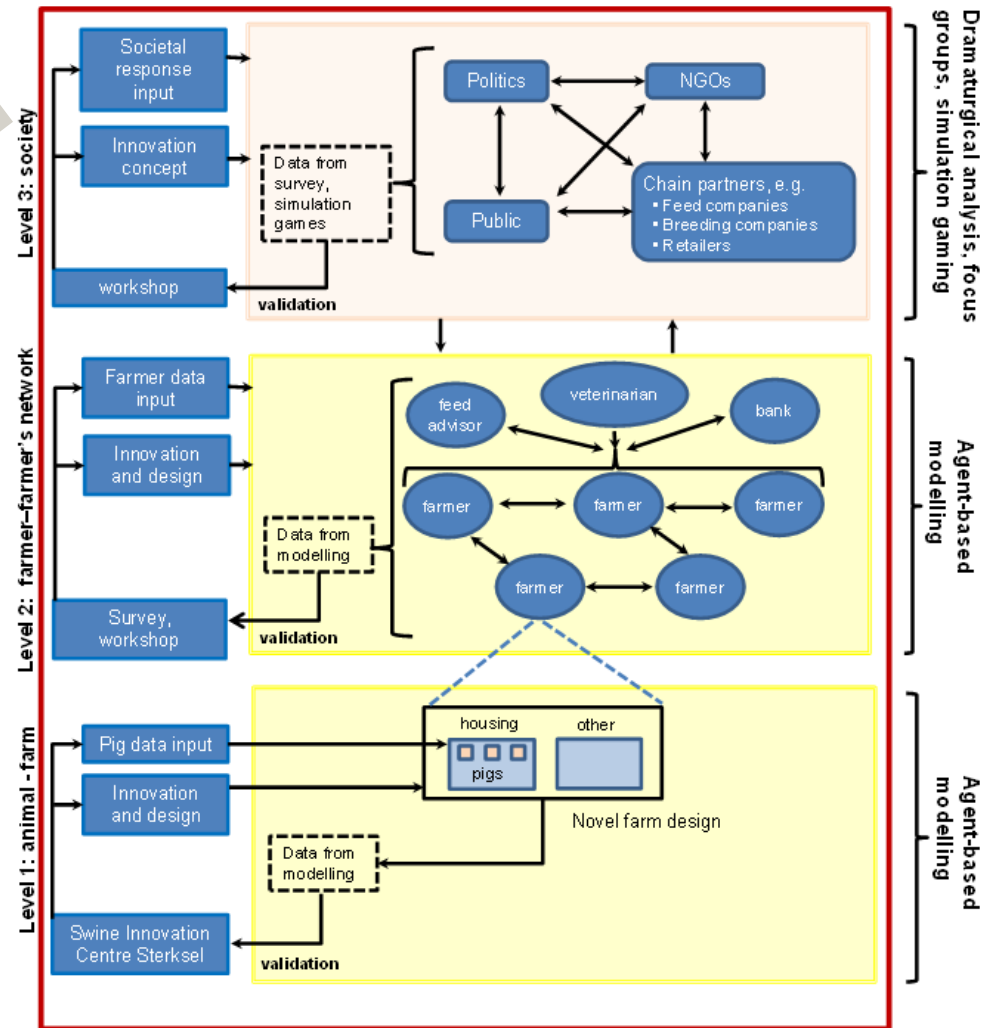
ambition

- Apply CAS-view to the pork sector
  - evaluate whether pork system behaves as a CAS
- Model the systems behaviour
  - Multi level: Animals, Farmers, Representants
- Connect CAS to Innovation theory
- Analyse/ judge / evaluate strategies
  - For the actor groups involved
    - In our specific context

      Polder NL   Joint / collective / construction

Experiences so far

- **CAS-thinking**
  - sharper conceptual view (why, how, who)

- **Agent based modelling**
  - Deal with the multi and many-actors situation
  - Technical and human factors combined
  - brings forward multi-actor-crowd processes

- Take a humble **analyst**-position in the sector-development

  (complex, multi-actor, multifactor, adaptive)

  Planned behaviour in a non-steerable environment

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  Complex Adaptive Systems

  Best illustrated with Agent Based Modelling

- Multi-level project: animal – farm – sector – society

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CHALLENGING MULTI-LEVEL SYSTEMS APPROACH

Complex Adaptive Systems approach:

a valuable addition to our systems toolkit

Thank you

messages

- Helping the NW-European pork sector to enter the future is complicated

    - Difficult market position, difficult societal position

- Change needed, but <u>Locked in </u>(commodity system!)

- Various factor and drivers

- Innovation theory (evolution model vs design model, niche management vs

- multi-actor processes (Dutch polder model)

- Integrality Balance interests,

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4 phases

1. Identify major changes (emergence of systems changes) develop time line [2012+]

2. Choose changes that are not obvious (not elsewhere, opposite trend etc.) group housing and castration as cases

3. Describe & analyse the change(s) in their context: nature of the change, influencing factors

4. Model the development (time, influences, appearance)

Conceptual development: combine innovation theory with CAS-thinking

- Rotmans, Geels, Grin

- 'Transition cannot be organised, but it can be influenced'
- 'innovations need a bedding'

  - Principal approach (frame, paradigm)
    - Design approach (Grin, RIO)
    - Evolutionary approach (Rotmans)
    - Niche management approach (Geels, Schot)

  -> Intervention tools?

  -> role of public policy tools

Geels et al

Landscape developments

Landscape developments put pressure on regime, which opens up on multiple dimensions, creating windows of opportunity for novelties

New ST-regime influences landscape

Socio-technical regime

ST-regime is 'dynamically stable'. On different dimensions there are ongoing processes.

New configuration breaks through, taking advantage of 'windows of opportunity'. Adjustments occur in ST-r

Elements are gradually linked together, and stabilise into a new ST-configurati which is not (yet) dominant. Internal momentum increases.

Technological niches

Articulation processes with novelties on multiple dimensi Technology, user preferences, policies). Via co-constructi elements are gradually linked together.

Macroniveau (landschap)

Mesoniveau (regimes)

Microniveau (niches)

Rotmans et al.

Energietransitie
Revoluties
Intensivering landbouw ('60's)
Watertransitie
Ziekenfondsstelsel
Hoge aggregatie
Van zeilen naar stoom
Van kolen naar gas
Biomassa energievoorziening
Lage aggregatie
Veel coördinatie
Lage aggregatie
Doelgericht
Kernenergie-voorziening
Zonne-energie voorziening
Emergent
Weinig coördinatie
Biologische landbouw
Windenergie voorziening
Hoge aggregatie
Demografische transitie (Davis)
Transitie naar duurzame lar
Economische transitie (Rostow)
ICT/Internet
Mobiliteitstransit
Civilisatie (Elias)
Globalisatie

system state
Stabilization
Acceleration
Lock in
Take-off
Predevelopment
Backlash
System breakdown
time

Grin et al.

2. Structured design

Gen. of Solutions **H**

Morph. Function Diagram **G**

Design Concepts **I**

Key challenges **A**

Key Functions **F**

Detailed proposals **J**

1. System & actor analysis

System analysis **B**

(External effects)

Future visions **C**

Key actors & needs **D**

Briefs of Requirements **E**

Networks & ownership **K**

3. Anticipating niche & structural change

Pilots & trials in niche **N**

Identif. of institutional barriers **L**

Prop. & interventions for change **M**