technische universität dortmund

Faculty of Business, Economics and Social Sciences
Technology Studies Group

Governance of complex systems
A multi-level model

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Technology Studies Group

- established in 2002
  - part of Faculty of Economics and Social Sciences

- 15 team members
  - 7 assistant professors / research assistants
  - 6 student assistants

- research projects (~ 400.000 € p.a.)
  - human-machine interaction
  - risk management in organizations
  - governance of socio-technical systems
  - modeling and simulation of complex systems

- cooperation with engineering, information, energy sciences

The issue

- risk society
    - self-endangering risk
    - loss of control?

- complexity
    - non-linear interactions
    - emergent system behaviour

- objectives of control
    - system stability (nuclear plant)
    - system change ("Energiewende")

The limits of control

- sceptical view
  - Luhmann 1988
  - Perrow 1984

- optimistic view
  - Willke 1987
  - Roberts et al. 1993, Weick/Sutcliffe 2007
  - Loorbach 2007
  - Duit/Galas 2008

Multi-level model of governance

1. general framework
   - sociological model of socio-technical systems
   - basic mechanisms „control" and „coordination"
   - governance: specific combination of mechanisms
     - interplay of several mechanisms within and between levels
2. sample configuration of modern infrastructure systems
   - coordination processes in negotiation systems (GOV-1)
   - regulation of functional societal systems (GOV-2)
   - operational control of these systems (GOV-3)

Content

Weyer/Adelt/Hoffmann, 2015:
*Governance of complex systems. A multi-level model
(Soziologisches Arbeitspapier 42/2015)*
Dortmund: TU Dortmund

2. State of the art in governance research

- little consensus
  - notion of governance (2.1)
  - modes of governance (2.2)
  - measuring governance (2.3)

- important questions unresolved
  - Grande 2012

2.1 Notions of governance

1. analytical approach
   - meta-category (neutral)
     - comprises all modes of coordination, control and others
   - new category necessary?
     - coordination, actor constellation ...

2. normative approach
   - non-hierarchical coordination (*specific* mode)
     - superior problem solutions (from government to governance)
   - negotiation systems
     - public and private actors
   - new category necessary?
     - policy networks …

2.2 Modes of governance

- market, hierarchy, network
- different combinations
  - 9 types (Willke 1995)
  - 4 types (Duit/Galas 2008)
  - 5 types (Schneider/Bauer 2009)

- mixed modes (in management research)
  - mixed scanning (Etzioni 1967)
  - middle-up-down management (Nonaka/Takeuchi 1997)
  - loose coupling (Weick 1990)

2.2 Modes of governance (cont.)

- mixed modes (in governance research)
  - polycentric governance (Ostrom 2010)
  - interactive governance (Torfing et al. 2012)
  - heterarchical governance (Jessop 2002)
  - meta-governance (Jessop 2011, Loorbach 2007)
          → mostly non-hierarchical coordination

- ideal-type classifications
  - empirical operationalization?

2.3 Measuring governance

- indicators of successful governance
  - coping with complexity ... (Resnick 1995)
  - coping with interdependence ... (Schimank 2007)
  - robustness, reliability, continuity … (Wiesenthal 2000)
  - processes, outputs, outcomes, normative criteria
    (Torfing et al. 2012)

- many open questions ...
  - does governance help solving problems of modern societies?
    (Grande 2012)

2.4 Conclusion

- missing model of socio-technical systems
  - missing knowledge of mechanisms and effects of interventions
  - no measurable indicators

- valuable hints (Schimank, Torfing et al., Grande ...)
  - mechanisms most important
  - multi-level architecture of governance
  - performance indicators
    - goal achievement
    - collective capacity to act
    - legitimacy

Model of socio-technical control (STAMP*)
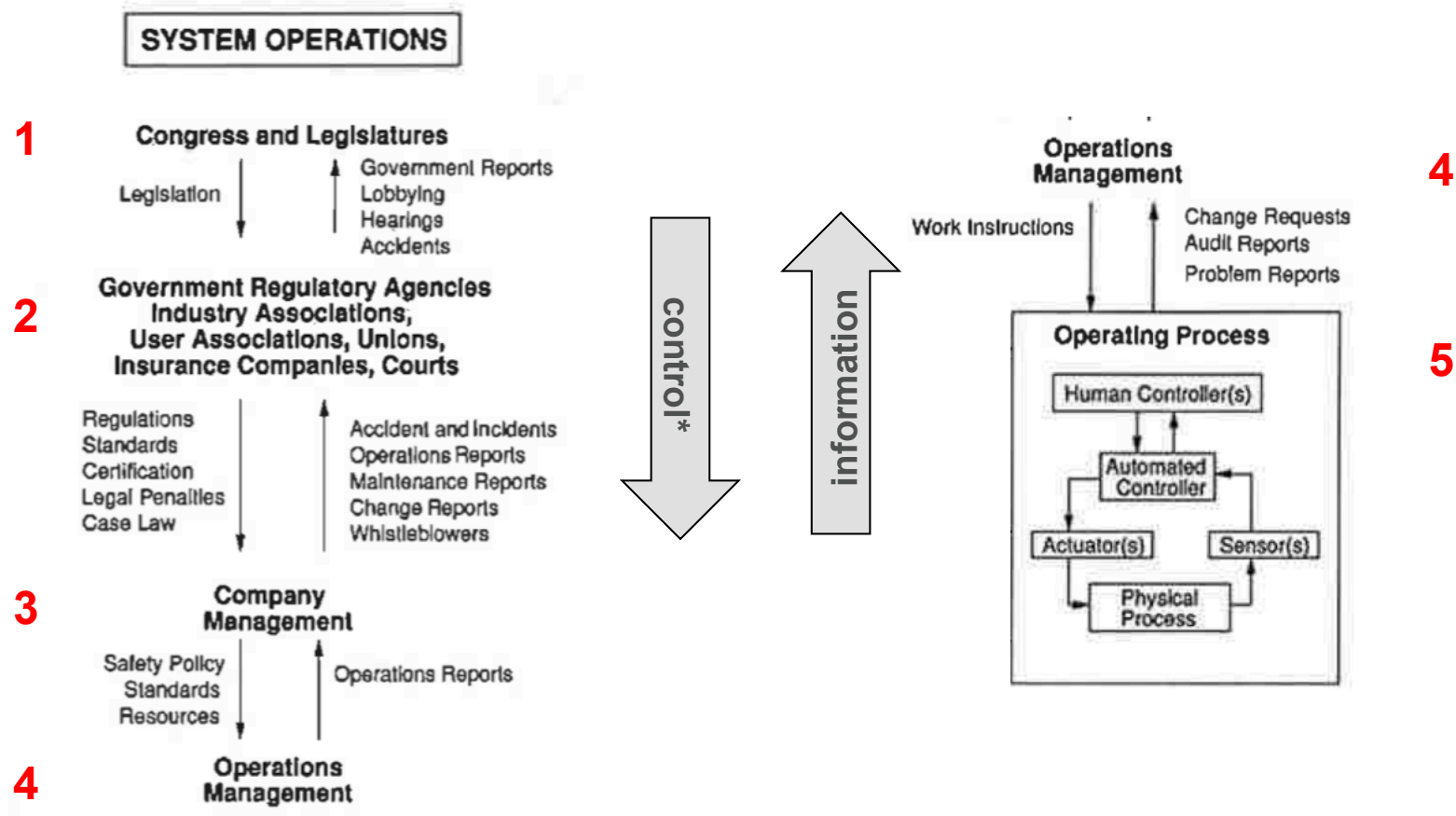
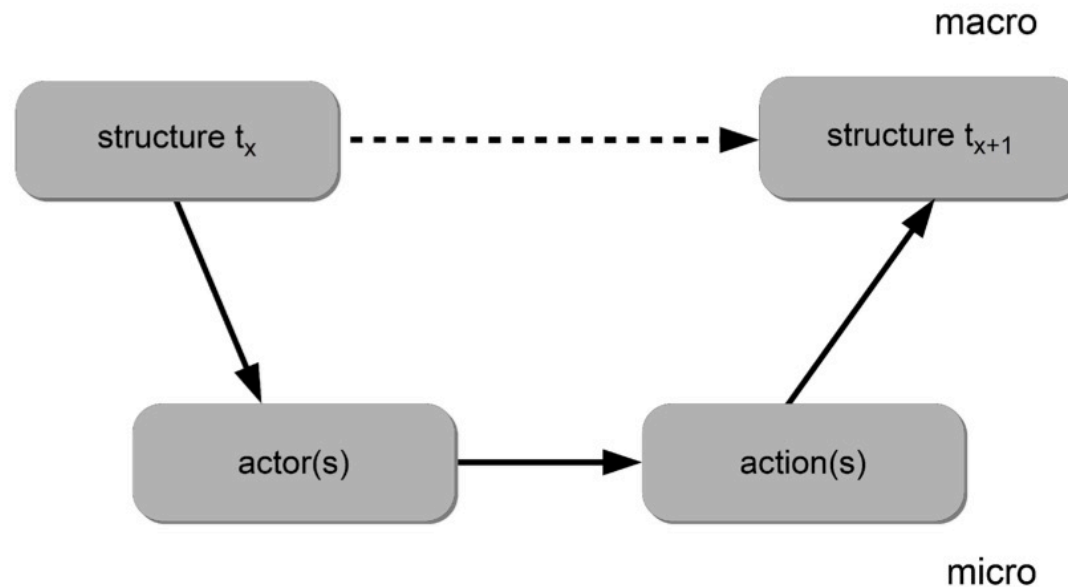* Systems-Theoretic Accident Modeling and Processes (Leveson et al. 2009: 244)

Content

3.1 Basic model of a socio-technical system

- macro-micro-macro model
  - Giddens 1988, Coleman 1990, *Esser 1993 (MSE)*,
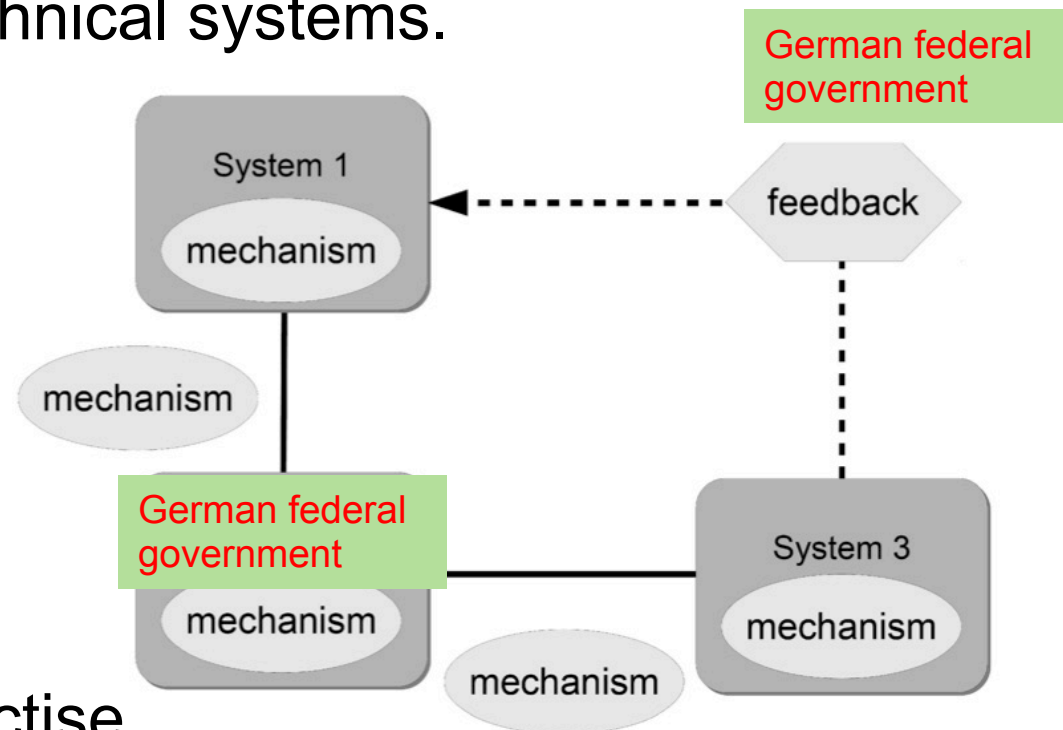   Ostrom 2005, 2010 (IAD), Kooiman et al. 2008

3.2 Governance

- The term "governance" depicts a specific combination of the basic mechanisms* of control and coordination in multi-level socio-technical systems.

* mechanisms
  - internal
  - exchange
- zoom-in zoom-out
- different combinations in practise

German federal government

System 1

mechanism

feedback

mechanism

German federal government

mechanism

System 3

mechanism

mechanism

3.3 Control („Steuerung")

- Control shall be the intentional intervention into socio-technical systems, aiming at producing intended effects. (Willke, Mayntz/Scharpf)
  - attempt to control, not bound to success!
  - risk of failure!

- (BC-1) Control is a unidirectional relation between a steering subject and an object-to-be-controlled.

3.3 Control („Steuerung")

- (BC-2) Control functions via incentives, which shape the situational context of the objects-to-be-controlled.
    - leeway of actors to choose alternatives
    - soft measures (stimuli) vs. strong measures (constraints)

- final objective of control
    - desired state* of the system (macro)

        * *system stability or system transformation*
    - by a „detour" via the actors' behaviour (micro)

3.3 Modelling control

- attempt of A
  - to purposely influence B
  - by changing situational parameters
- (un-)intended effects?
  - „controlled emergence"

- zoom-in/zoom-out
 - internal mechanisms of A
  - feedback from B to A
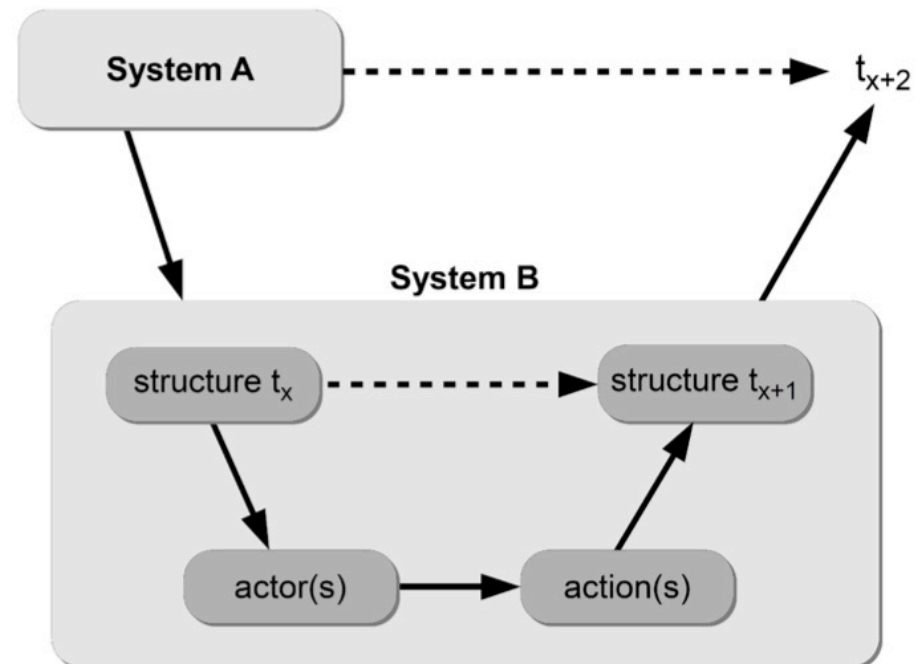
3.4 Coordination

- Coordination shall be the mutual adjustment of heterogeneous actors aiming at collectively solving problems in a way that is acceptable to all parties involved.
  (Habermas, Mayntz/Scharpf, Torfing et al., Kooiman et al.)

- two types
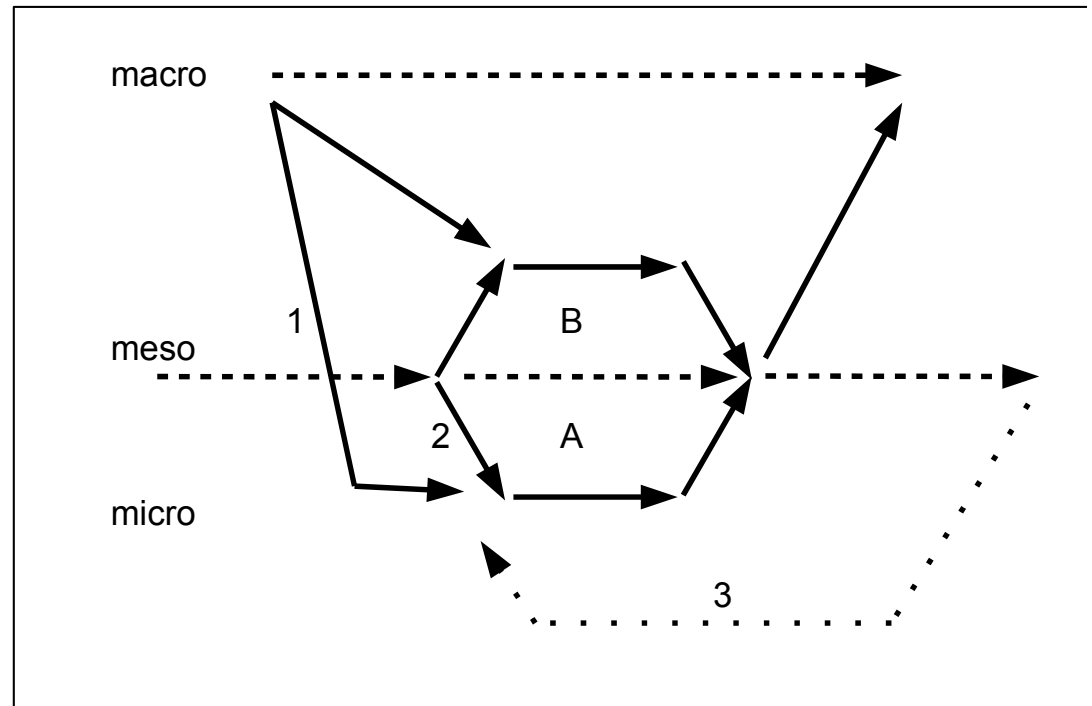   - spontaneous
    - reflexive (Kroneberg 2005)

3.4 Spontaneous coordination

- sequential

- short-range

- adaptive

- individual goals

- local optimization
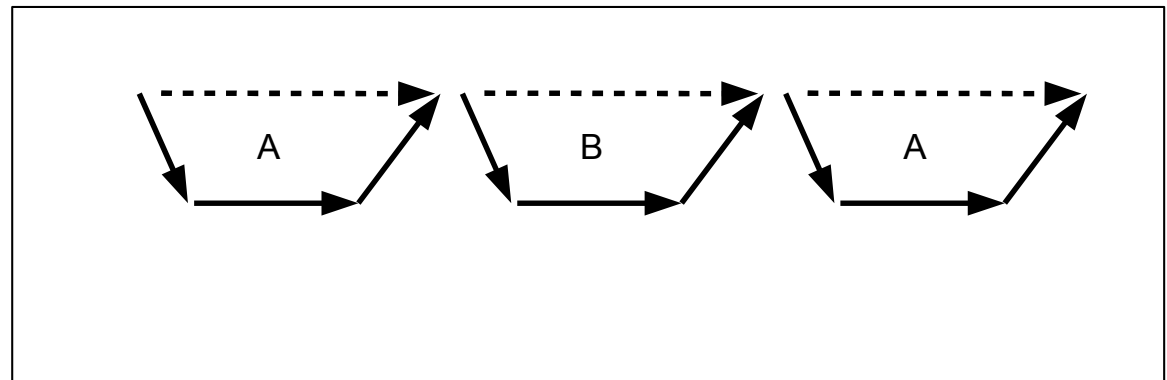
3.4 Reflexive coordination

- simultaneous

- long-range
- strategic
- individual goals plus external effects
- global optimization

3.5 Relating control and coordination

- both: attempts to influence system's behaviour
    - from an external point of view
    - by changing situational parameters
    - → two extreme points of one basic mechanisms?
- differences
    - power to define the situation
    - external/internal position
    - reflexiveness
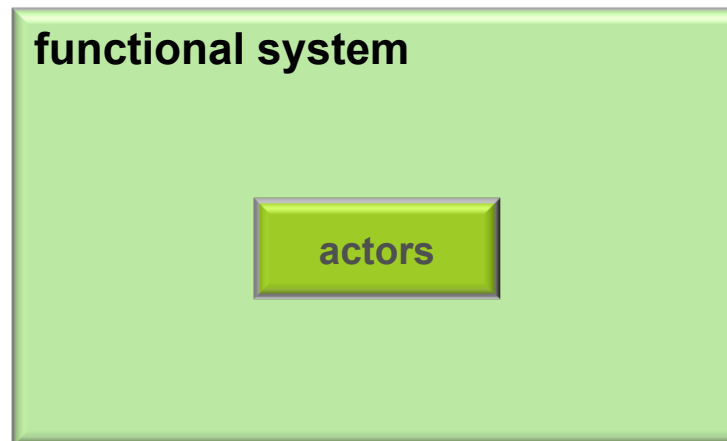
- coordination as a means of control?

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1. Introduction
2. State of the art in governance research
3. General framework of governance of socio-technical systems
4. **Modelling multi-level governance**
5. Conclusion

4.1 "Regelungsstruktur" and "Leistungsstruktur"

Regelungsstruktur

negotiation system

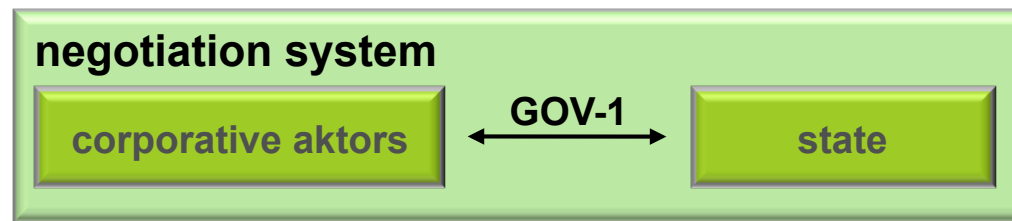| corporate actors | ← **GOV-1** → | state |

↓ **GOV-2**

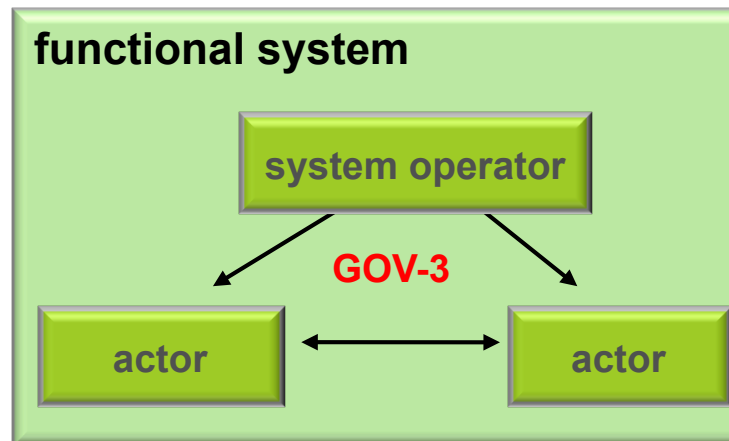**functional system**

actors
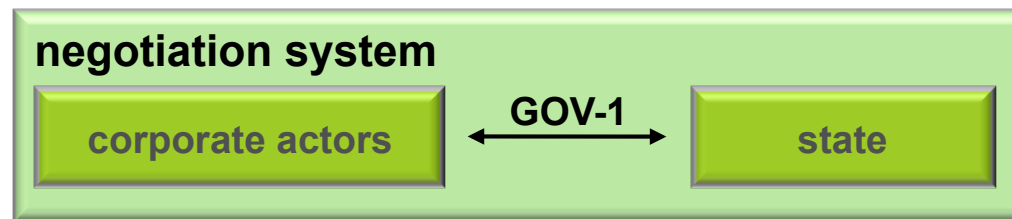
Leistungsstruktur

Mayntz/Scharpf 1995

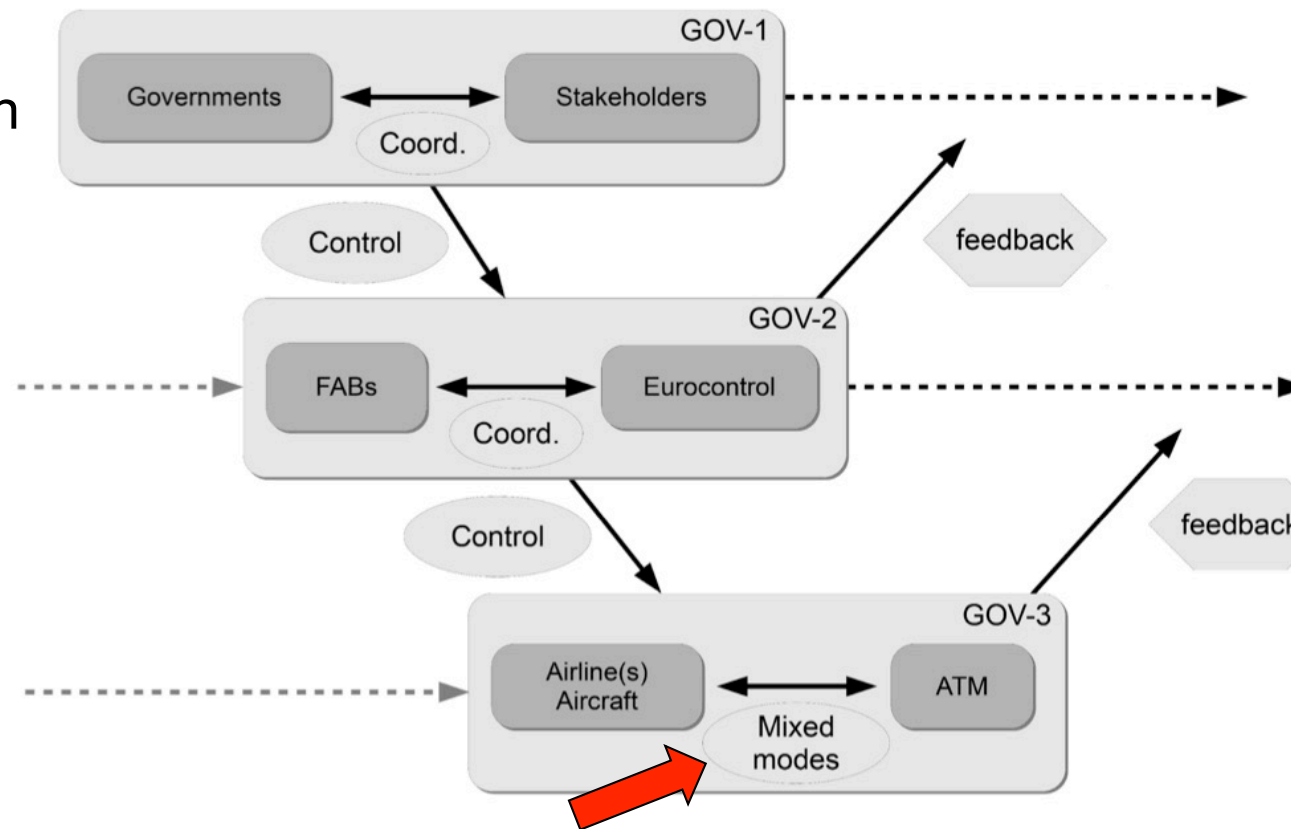# 4.2 The missing third level

Regelungsstruktur

Leistungsstruktur

4.3 A sample* multi-level model of governance

* applies to large-scale infrastructure systems (case study ATC/SES)

GOV-1: coordination
processes in negotiation
systems

GOV-2: regulation of
functional societal
systems

GOV-3: operational
control of the systems

GOV-1

Governments ⟷ Stakeholders
Coord.

Control

feedback

GOV-2

FABs ⟷ Eurocontrol
Coord.

Control

feedback

GOV-3

Airline(s)
Aircraft ⟷ ATM
Mixed
modes

horizontal arrows: coordination
vertical arrows: control

Weyer – Adelt – Hoffmann | 2015

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4.4 Measuring governance

- control → target-performance comparison

- coordination → common problem solution

- success dependent on levels
  - GOV-1 → consensus
  - GOV-2 → legal regulation (legitimacy)
  - GOV-3 → system performance

- system stability → different indicators (Adelt 2014)

- system change → 5 percent (Geels/Schot 2007)
  - factors facilitating regime change (Johnson 2013)

- actors' goal achievement (micro indicators)

Content

1. Introduction
2. State of the art in governance research
3. General framework of governance of socio-technical systems
4. Modelling multi-level governance
5. **Sorry, no conclusion**
   - But there is one more thing ...