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)
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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

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)
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3.1 Basic model of a socio-technical system

- macro-micro-macro model
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
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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4.1 “Regelungsstruktur” and “Leistungsstruktur”

Regelungsstruktur

negotiation system

GOV-1

GOV-2

functional system

Leistungsstruktur

Mayntz/Scharpf 1995
4.2 The missing third level

Regelungsstruktur

negotiation system

corporative aktors  GOV-1  state

GOV-2

functional system

system operator

actor  GOV-3  actor

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

Weyer – Adelt – Hoffmann  |  2015
4.4 Measuring governance

- control $\rightarrow$ target-performance comparison
- coordination $\rightarrow$ common problem solution
- success dependent on levels
  - GOV-1 $\rightarrow$ consensus
  - GOV-2 $\rightarrow$ legal regulation (legitimacy)
  - GOV-3 $\rightarrow$ system performance
- system stability $\rightarrow$ different indicators (Adelt 2014)
- system change $\rightarrow$ 5 percent (Geels/Schot 2007)
  - factors facilitating regime change (Johnson 2013)
- actors' goal achievement (micro indicators)
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5. Sorry, no conclusion
   - But there is one more thing ...