Aligning institutions with technology: Critical transactions in the reform of infrastructures

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Overview

- Problem statement
- Technical criticality in infrastructures
- Critical transactions
- Modes of organization to support critical transactions
- Differences across infrastructures and over time
- Discussion

Problem statement

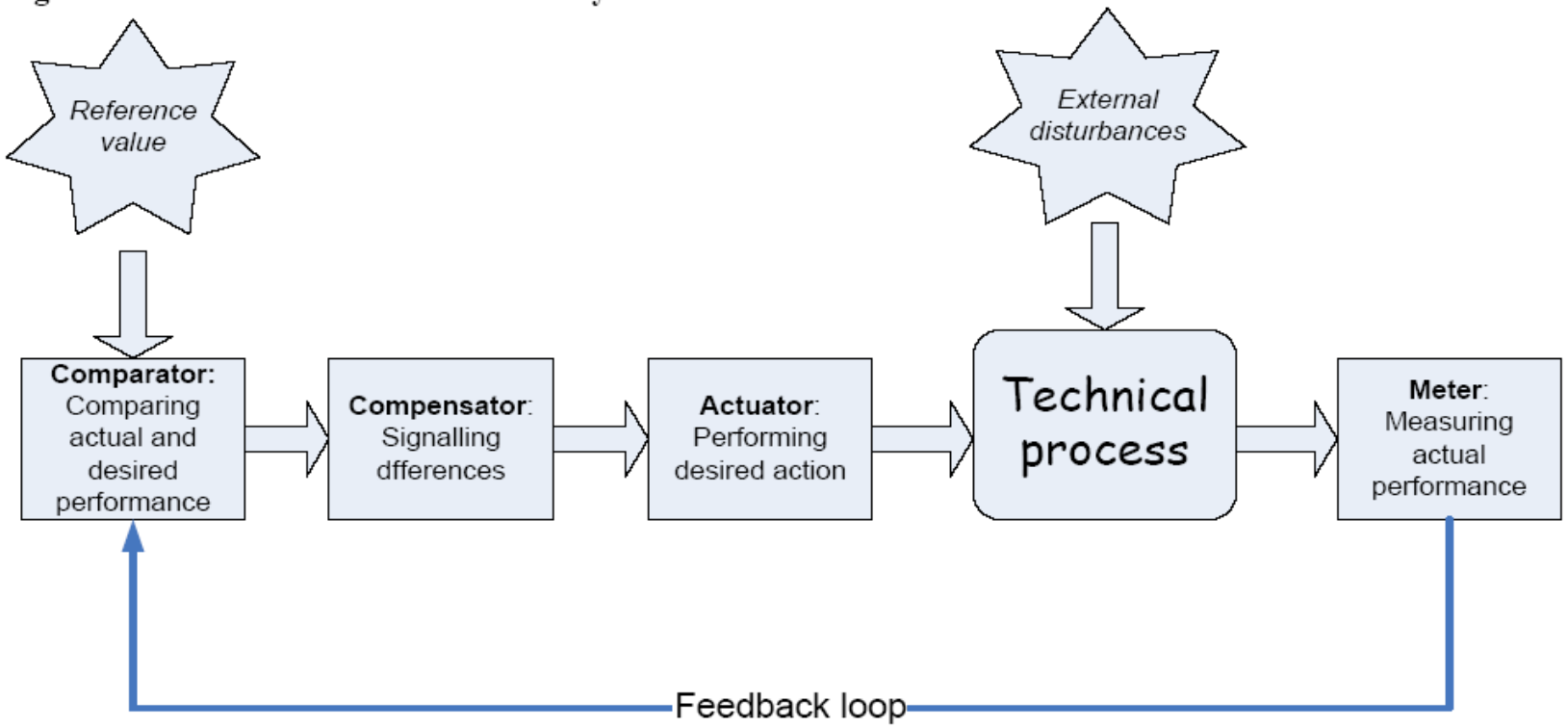
- Re-regulation of infrastructures:
  - a matter of institutional change only?
  - Technology as an important factor enabling or frustrating this process of change?
  - Infrastructures as complex socio-technical systems
- Our focus:
  - Technical performance
  - Technical functioning of infrastructures needs to be supported by appropriate modes of organization
- Objective: How do critical technical functions impose properties on transactions that should be reflected in the modes of organization?

Technical criticality in infrastructures

- Functions that are essential in order to meet expectations with respect to the technical functioning of these systems
- Focus on reliability

Control engineering perspective

Figure 1. Elements in a technical control system



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Critical control in infrastructures

- significant *technical scope of control* and *unique*
- strong *time constraints*

Criteria for the technical effectiveness of control mechanisms

- speed of control
- scope of control
- Accuracy
- Robustness

Critical transactions

- Transactions that are essential to accommodate critical control mechanisms
- Systemic dimension:
  - Technical scope
  - Speed of adjustment
- Organization specific dimension
  - Degree of asset specificity
  - Degree of uncertainty
  - Strategic behavior
  - Need for powerful incentives

Modes of organization to support critical transactions

(Organizational needs in parenthesis)

Scope of control / **Speed of adjustment**	**System** *(requires directive intervention)*	**Subsystem** *(requires coordination)*	**Component** *(requires corroboration)*
T_0 Operational balancing *(requires supervision)*	Authoritative supervision ['system operator']	Collaborative supervision ['system regulator']	General framework conditions ['system norms and standards']
T_5 Capacity utilization *(requires monitoring)*	Compulsory monitoring and enforced adjustment	Mutual monitoring and stimulated adjustment	Self monitoring and voluntary adjustment
T_{15} Capacity allocation *(requires facilitation)*	Controlled allocation mechanism	Guided allocation mechanism	Competitive allocation mechanism
T_{50} System transformation and innovation *(requires planning)*	Directive planning	Indicative planning	Decentralized planning

Differences across infrastructures

- Different infrastructures imply different critical transactions
- Different opportunities for sector restructuring depend on feasible modes of organization of critical transactions
- In order to guarantee reliable system services, modes of organization in a specific infrastructure need to constitute a coherent framework.

Differences over time

- Impact of information and communication technology
- New technological paradigms of distributed and intelligent networks
- Convergence of infrastructures

Discussion

- Lessons to be learned with respect to the re-regulation of various infrastructures
- Implications for policy
- Opportunities for dynamic regulation
- How to cope with infrastructure transitions, for instance sustainable energy systems?