Aligning institutions and technology

Workshop in Institutional Analysis of Social-Ecological Systems (WINS)
Berlin July 14-16, 2014

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Economics of Infrastructures

TU Delft
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Overview

- The case of infrastructures
- How to relate technology to institutions?
- Aligning framework
- Modes of organization to support critical transactions
- Differences across infrastructures and over time
- Discussion


UNSERE ENERGIE:
SAUBER.
BEZAHLBAR.
AUS BERLIN.
JA! ZUM VOLKSENTSCHEID
ENERGIE AM 3.11.2013
BÜNDNIS 90
DIE GRÜNEN
GRUENE-BERLIN.DE/ENERGIE


CHOOSE LOCAL,
CLEAN ENERGY.


自立分散型の自然エネルギーで地域の未来を考える。
2011年3月11日の震災、そして福島の事故を機に、今まで当たり前として世の中にあった様々な常識がころびつつあります。安全安心に毎日を暮らしていくには、
エネルギーも今までの中央集権型から、住民が自ら参加出来るような自立分散型へ移行していきたい。そしてエネルギー消費自体を少なくしつつも、我慢ではなく、
より新しく、より楽しく生きていけるような、暮らし方へと移行していきたい。藤野電力とは、自然や里山の資源を見直し、自立分散型の自然エネルギーを地域で取
り組む活動です。そして目指すものは、エネルギーシステムの移行自体より、むしろそれによってもたらされる、地域の豊かな未来なのです。
藤野電


UNSER HAMBURG
UNSER NETZ
für die Hamburger Energiewende.

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Local energy system

Courtesy: Alliander

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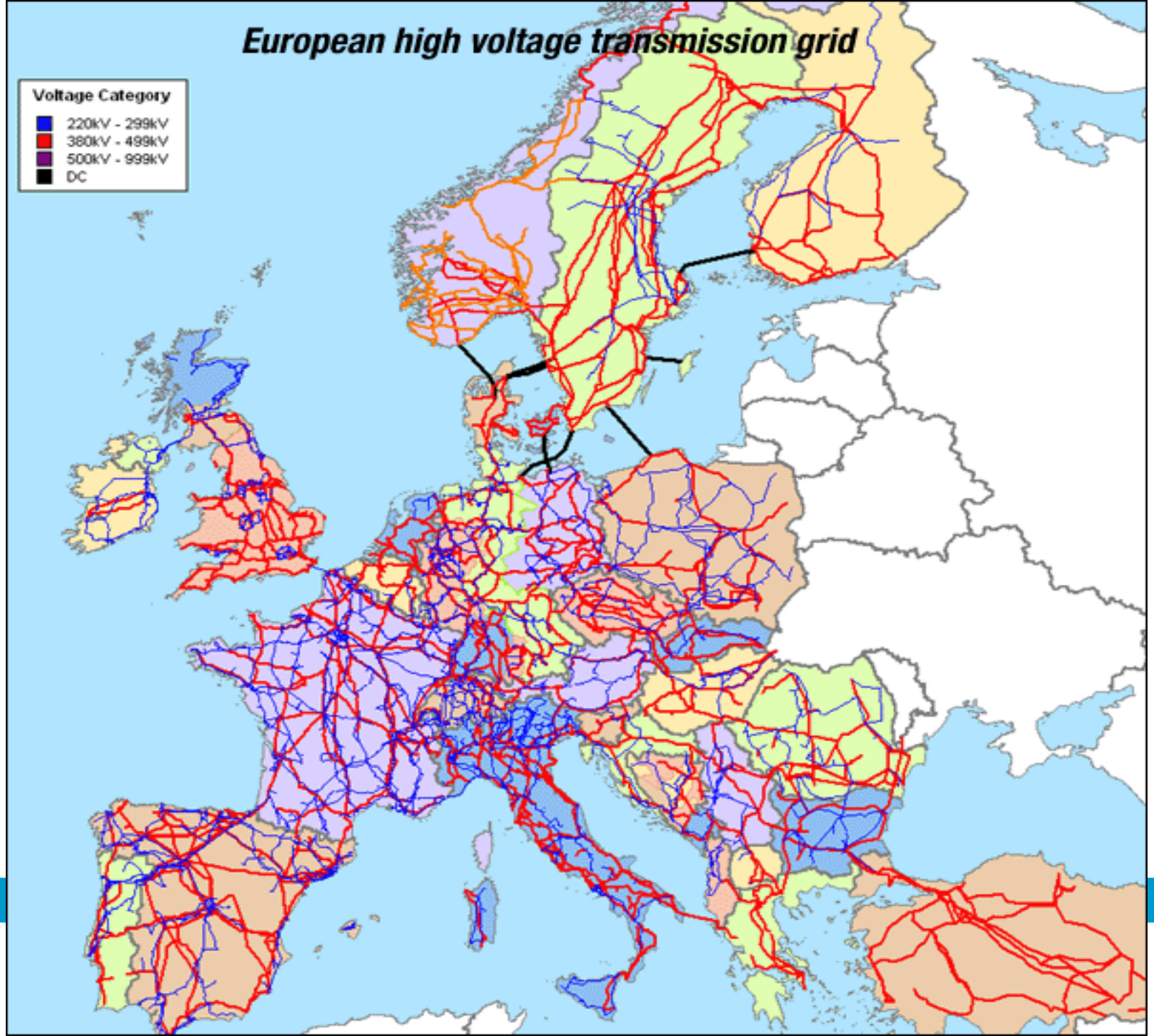
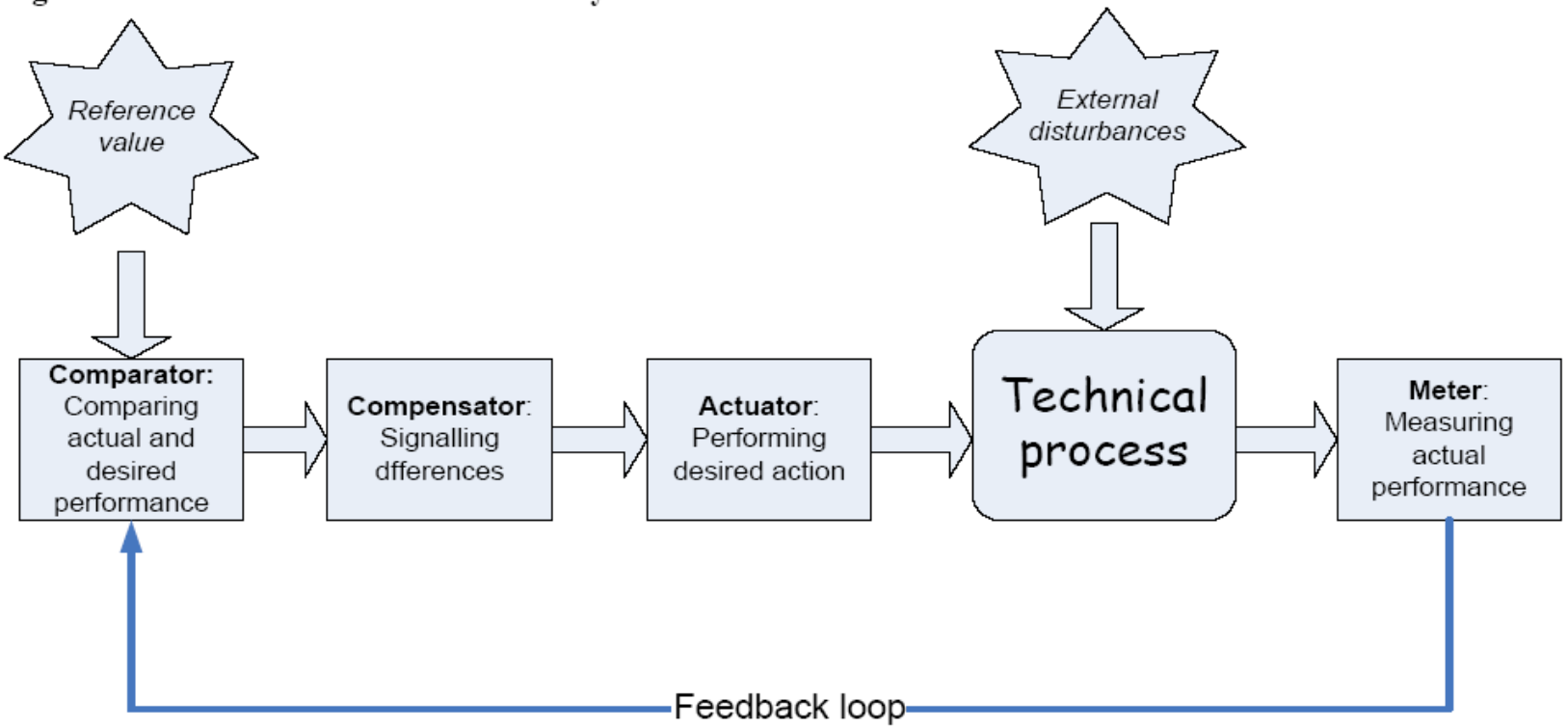

European high voltage transmission grid
Voltage Category
220kV - 299kV
380kV - 499kV
500kV - 999kV
DC

How to relate technology to institutions?

- Infrastructures are socio-technical systems
- Coordination: technical & institutional
- Critical functions:
  - System control
  - Capacity management
  - Interoperability
  - Interconnection

Control engineering perspective

Figure 1. Elements in a technical control system



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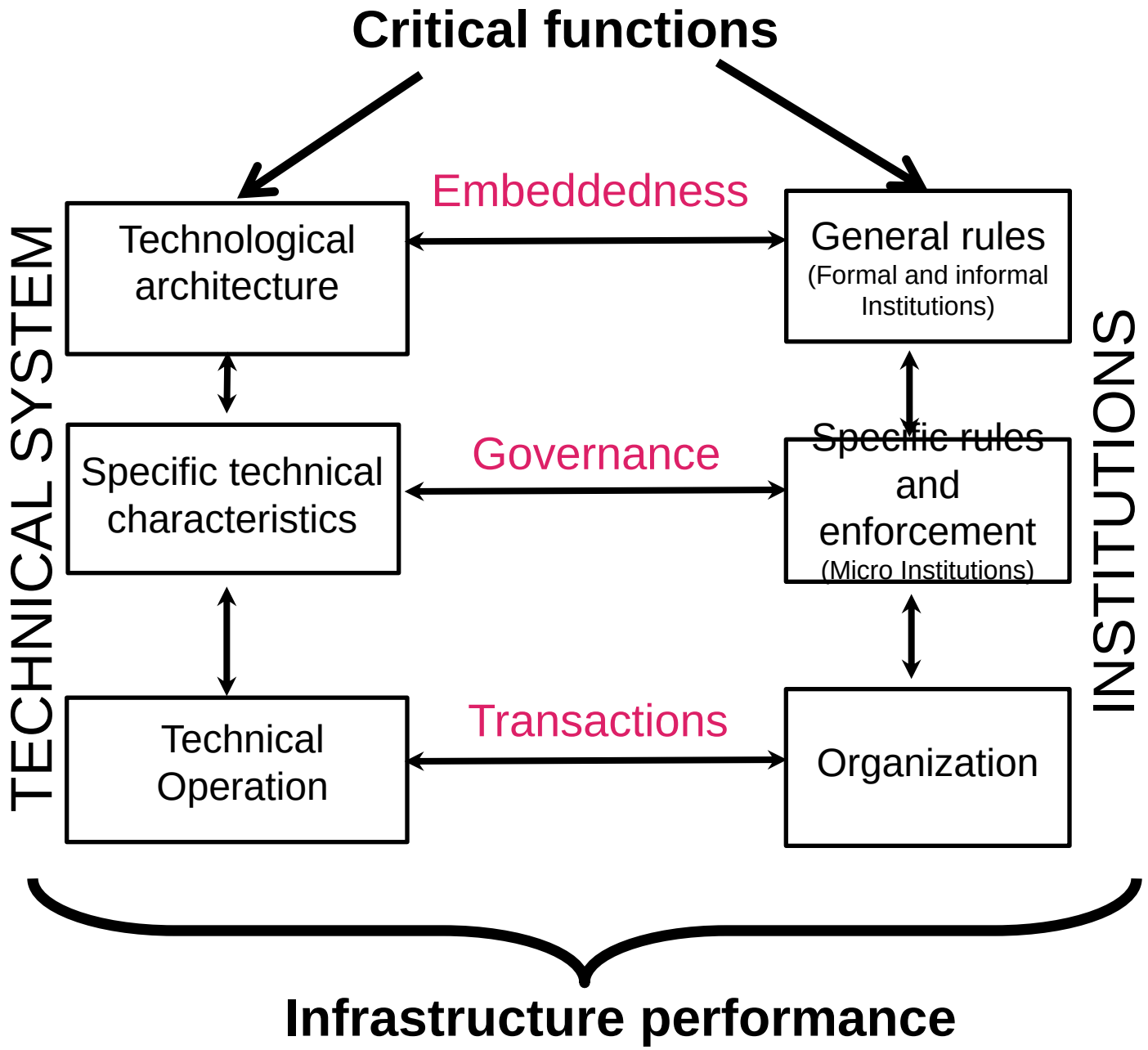
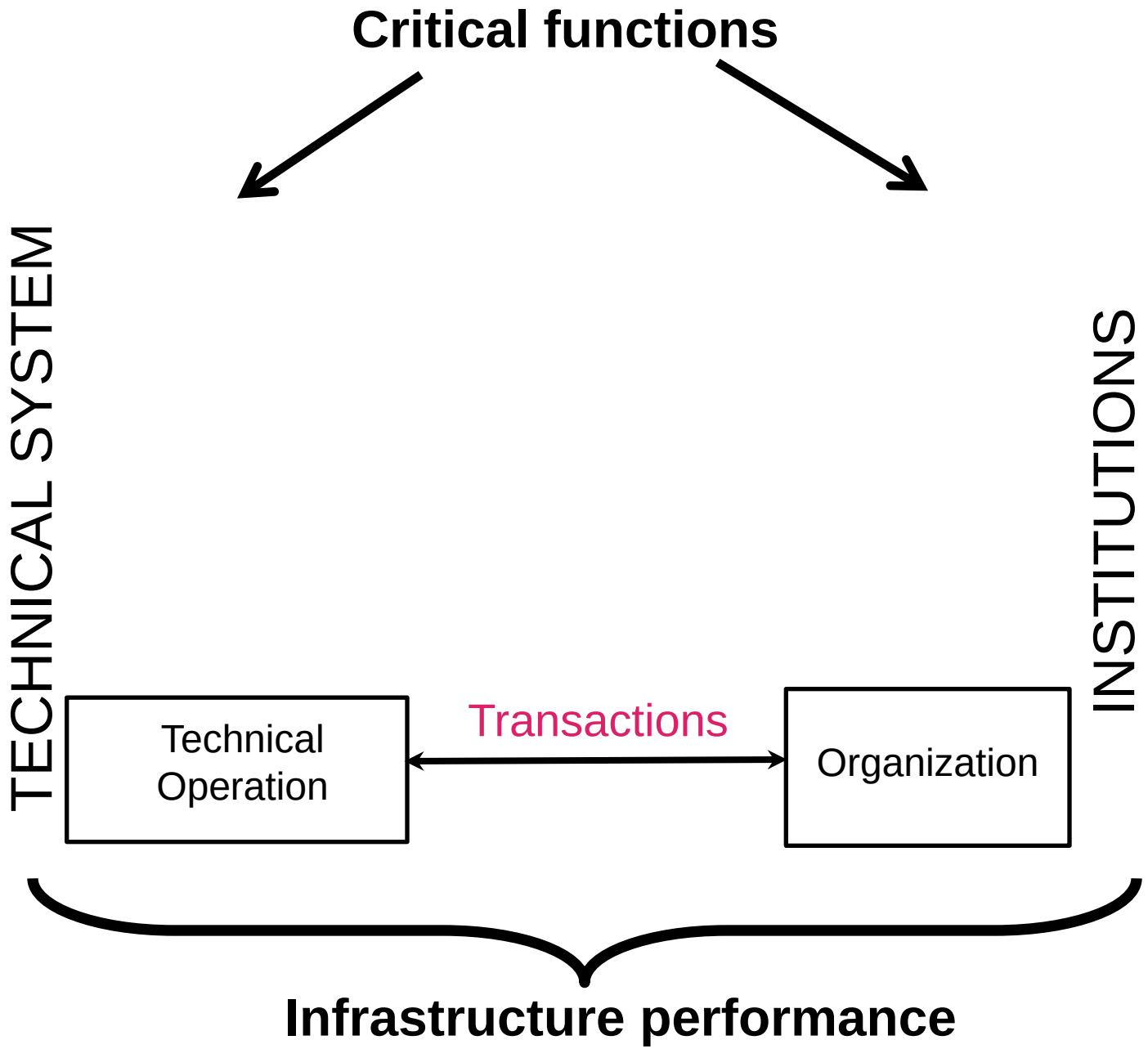

Critical functions
Embeddedness
Technological architecture
General rules
(Formal and informal Institutions)
TECHNICAL SYSTEM
INSTITUTIONS
Specific technical characteristics
Governance
Specific rules and enforcement
(Micro Institutions)
Technical Operation
Transactions
Organization
Infrastructure performance


Critical functions
TECHNICAL SYSTEM
INSTITUTIONS
Technical Operation
Transactions
Organization
Infrastructure performance

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

Answers to the questions of WINS organizers

- What analytical framework: NIE, System Engineering
- Scientific community: emerging
- Interest in WINS: cross sector comparison
- Joint educational activities
- Next steps for WINS: identification and stimulation of joint projects