

Some economics of monitoring and sensing in transmission networks

Second Carnegie Mellon Conference in Electric Power Systems:
Monitoring, Sensing, Software and Its Valuation
for the Changing Electric Power Industry
January 11-12, 2006

Rolf Künneke

Associate Professor

Economics of Infrastructures

Overview

- Occasion
- Some economics of transmission networks
- M&S in liberalized electricity markets
- Design criteria for innovations in M&S
- Illustrative examples
- Conclusions

Occasion (1)

- The need for transmission capacity
 - Market integration
 - Mitigation of market power
 - Enhancing security of supply
 - Economy
- Possibilities to resolve this challenge

Occasion (2)

- Investment in new capacity
 - Technology is assumed to be given
 - Economic challenges: investment incentives, profitability, risk
 - Regulatory issues: incentives, property rights, credibility
- Non-investment solutions:
 - Traditional economists: Improved pricing signals
 - Political economists: Appropriate regulation, especially between states or countries
 - Engineers: Innovative technologies: <- *Focus of this conference*

Some economics of transmission networks (1)

- Transmission networks inhibit fundamental market failures:
 - Public good features: non rival, non excludable services (example: auxiliary services)
 - External effects (loop flows)
 - Network externalities: increasing consumer benefits with an increasing degree of interconnectedness
 - Merit wants: electricity as an essential facility with universal service.
- => Structural impossibility to establish markets under each of these conditions

Some economics of transmission networks (2)

- Traditional resolution of market failures:
 - Public provision of services (European approach)
 - Strict regulation of private enterprise (USA approach)
- Need for new approaches in liberalized electricity markets, including
 - Unbundling
 - Tariff and access regulation
 - Safeguarding public services (security of supply, reliability, environmental objectives)
- => Regulation as a second best option to mimic market conditions

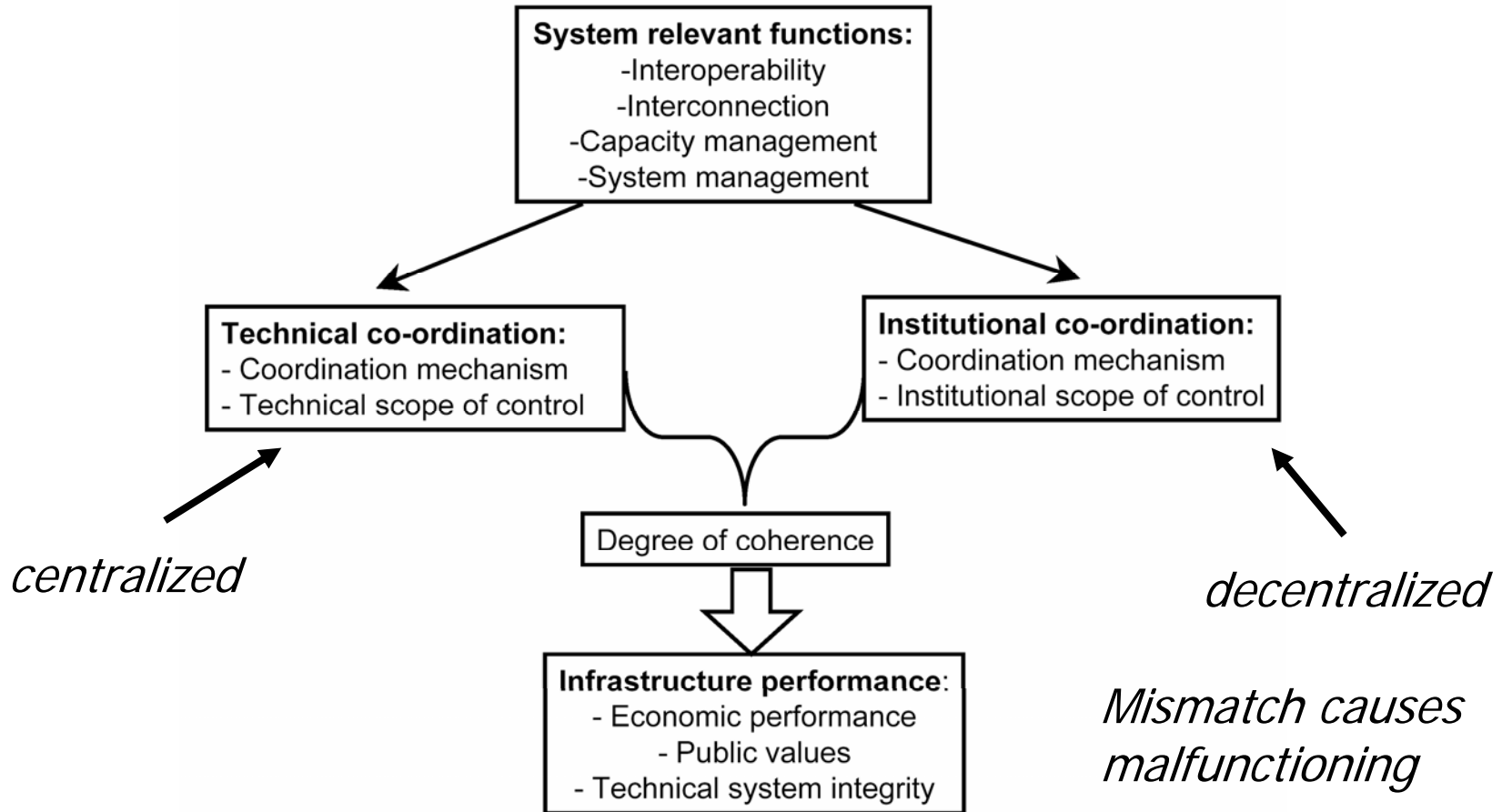
Some economics of transmission networks (3)

- Economists approach is primarily focused on incentives and behavior of individual actors.
- => Assumption: by optimizing individual objectives social welfare will be maximized
- Problem with respect to the electricity system:
 - This does not recognize the fundamental technical and economic complementarities in electricity systems.
- => Economists treat the electricity system as an atomistic market, whereas a system approach is needed.

M&S in liberalized electricity markets

- Essential technical functions:
 - Interoperability
 - Interconnection
 - Capacity management
 - System management
- These functions need to be supported by technology and institutional arrangements
- In liberalized markets institutional arrangements changed fundamentally, whereas technology is a constant.

The mismatch between technical and institutional coordination



Technical innovation and coordination

- Sustainability of liberalized electricity market institutions vis-a-vis the path dependence of the current technological system
- Bridging or enhancing the gap between technical and institutional coordination?
- Monitoring and sensing stimulates market functioning by:
 - Technically resolving market failures
 - Allowing for decentralized technical coordination of the electricity system ('electricity web')
- Provision of information is essential in decentralized systems:
 - Information on the technical conditions of the system
 - Information on the availability of capacity
 - Information about the current utilization of the system.

Design criteria for innovations in M&S

- Does monitoring and sensing
 - resolve economic market failures?
 - contribute to a decentralized technical coordination?
- Performance criteria:
 - Enhancement of system efficiency
 - Contribution to safeguarding essential system services

Example (1)

- FACTS:
 - avoiding external effects
 - allows for correct economic prices
 - Other market failures remain
 - Still a need for centralized coordination
 - => Only part of the economic problem is solved
 - => increasing system efficiency

Example (2)

- DTCR (Dynamic thermal circuit rating):
 - Allows for a better utilization of system capacity
 - But does not resolve market failures.
 - Centralized technical coordination is still needed.
 - => Enhances system efficiency

Conclusions

- Liberalization creates a need for transmission capacity
- Improved monitoring and sensing offers opportunities for 'non investment solutions' by:
 - Technically resolving fundamental market failures
 - Bridging the gap between technical and institutional coordination by allowing for decentralized technical coordination.
- Monitoring and sensing stimulates market functioning by providing essential information on system capacity and utilization
- It is to be expected that only part of the M&S innovations will meet these requirements.