

# The Brittleness of Unbundled Train Systems

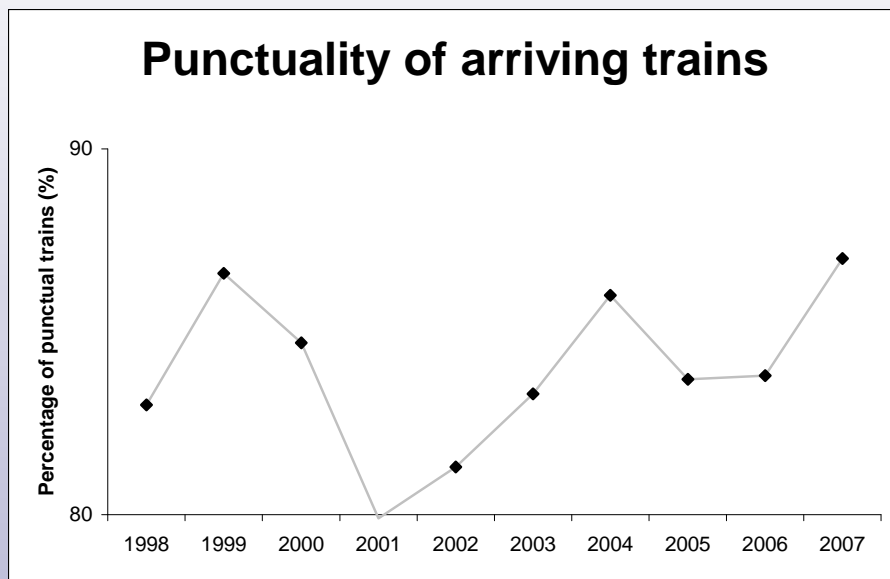
Bauke Steenhuisen and Mark de Bruijne

MIT ESD CESUN, June 2009

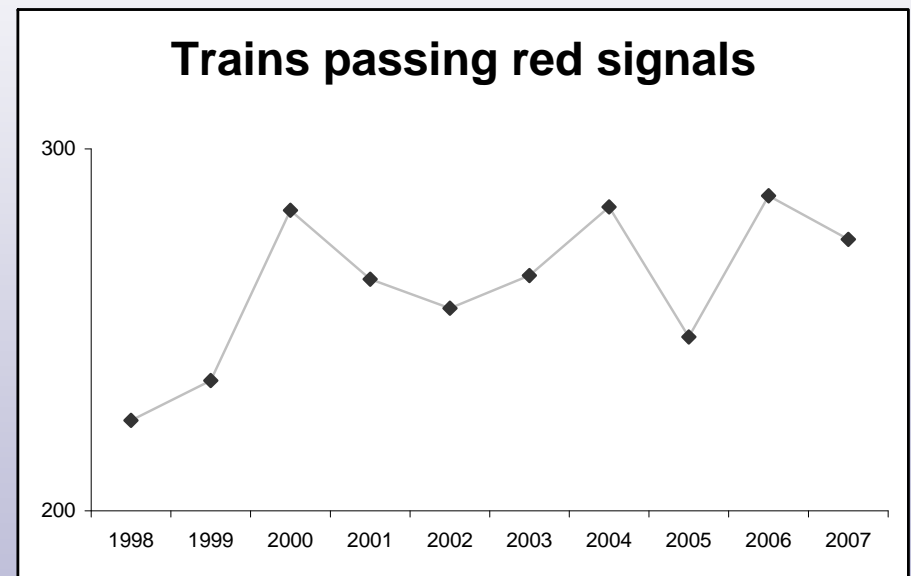
# The Dutch rail system

- 1.2 million passengers daily
- 100,000 metric tons freight daily
- 6,500 km of railway
- 400 stations
- 8,200 switches,
- 9,800 signals
- 4,500 bridges
- 1 infrastructure manager: ProRail
- 30 train operating companies
- Main operator NS transports 1.1 million passengers

# Effects of unbundling?

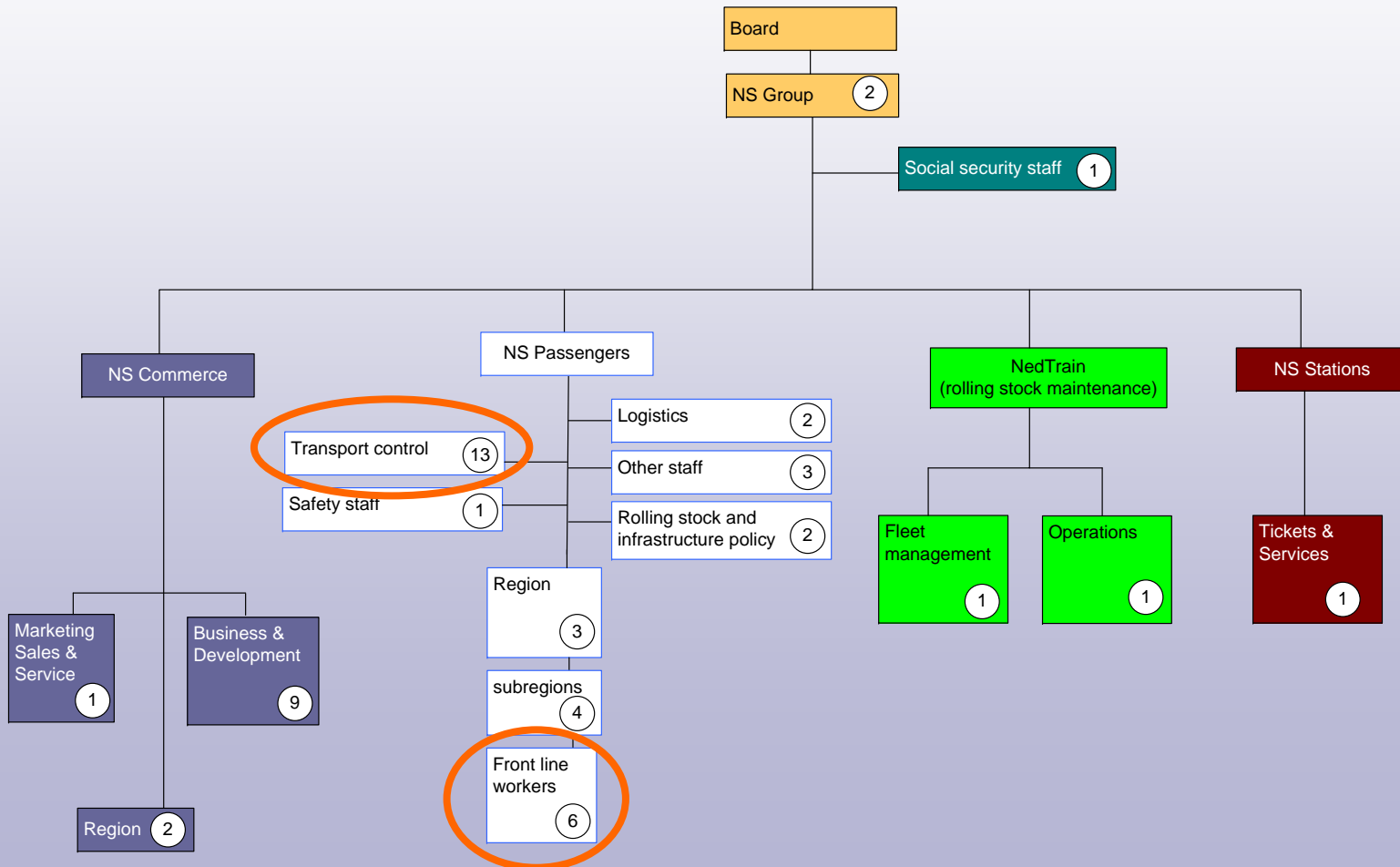


(NS figures)

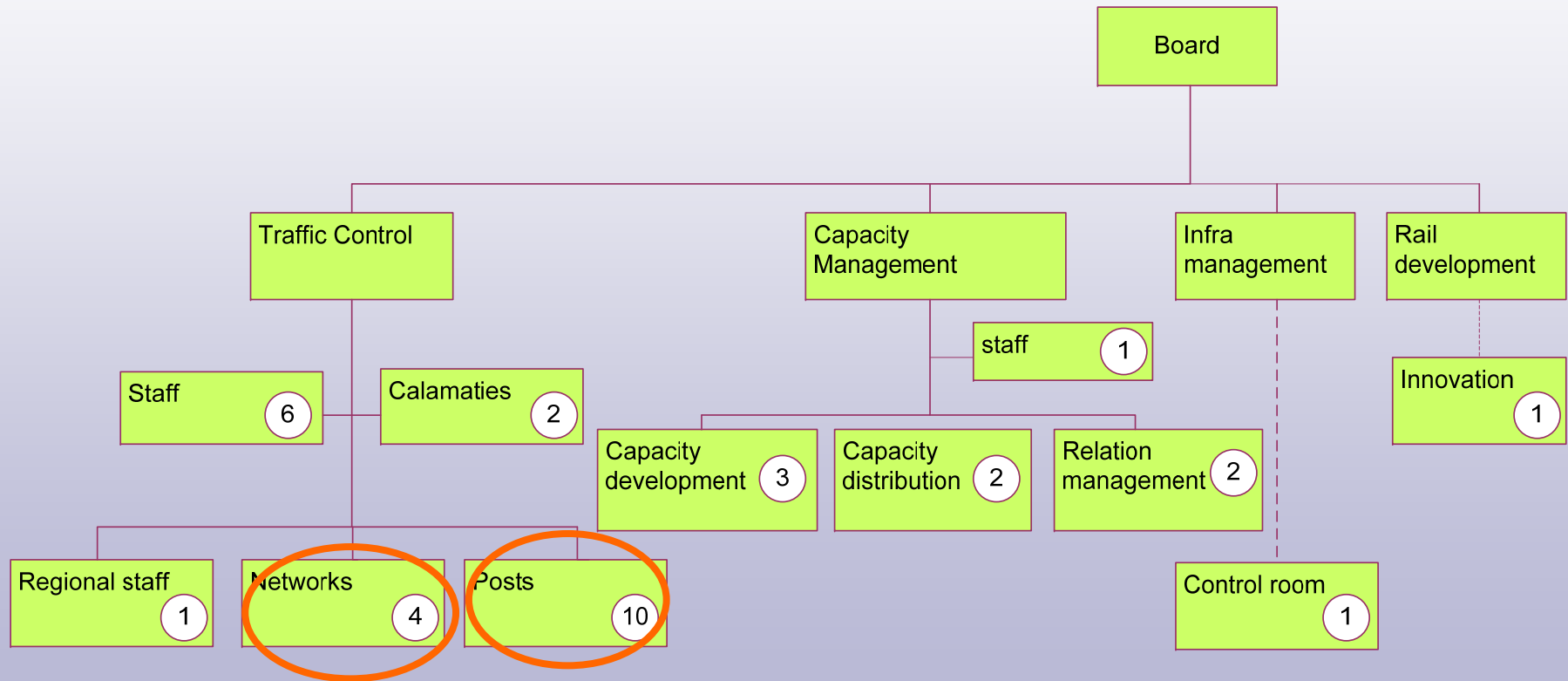


(IVW figures, system wide)

# Train operator NS

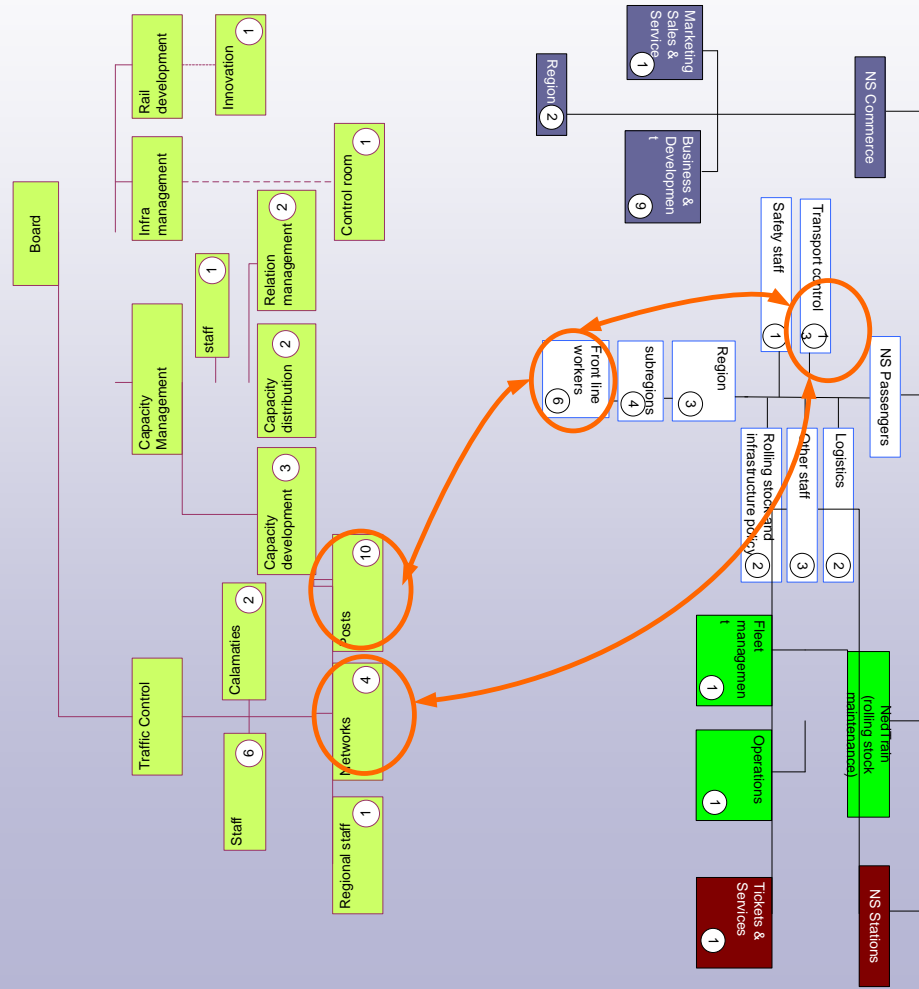


# Dutch Infrastructure manager ProRail



# Traffic control & transport control

Infrastructure manager  
ProRail

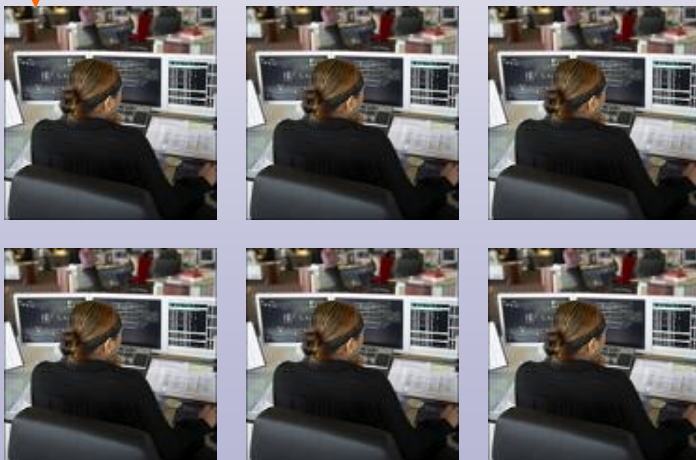


Service provider  
NS

# Infrastructure manager ProRail

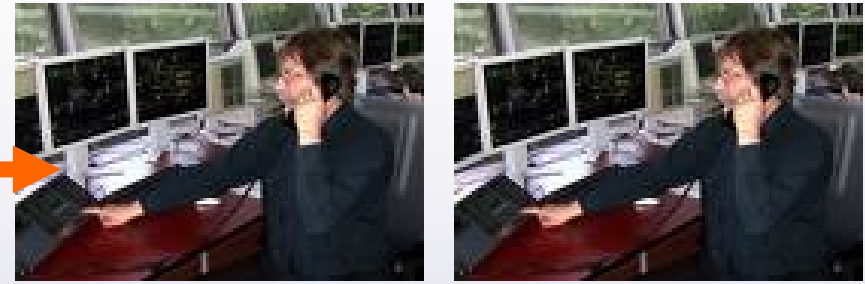


Regional *network* controllers



Local controllers

# Train operator NS



Regional *transport* controllers



Train staff

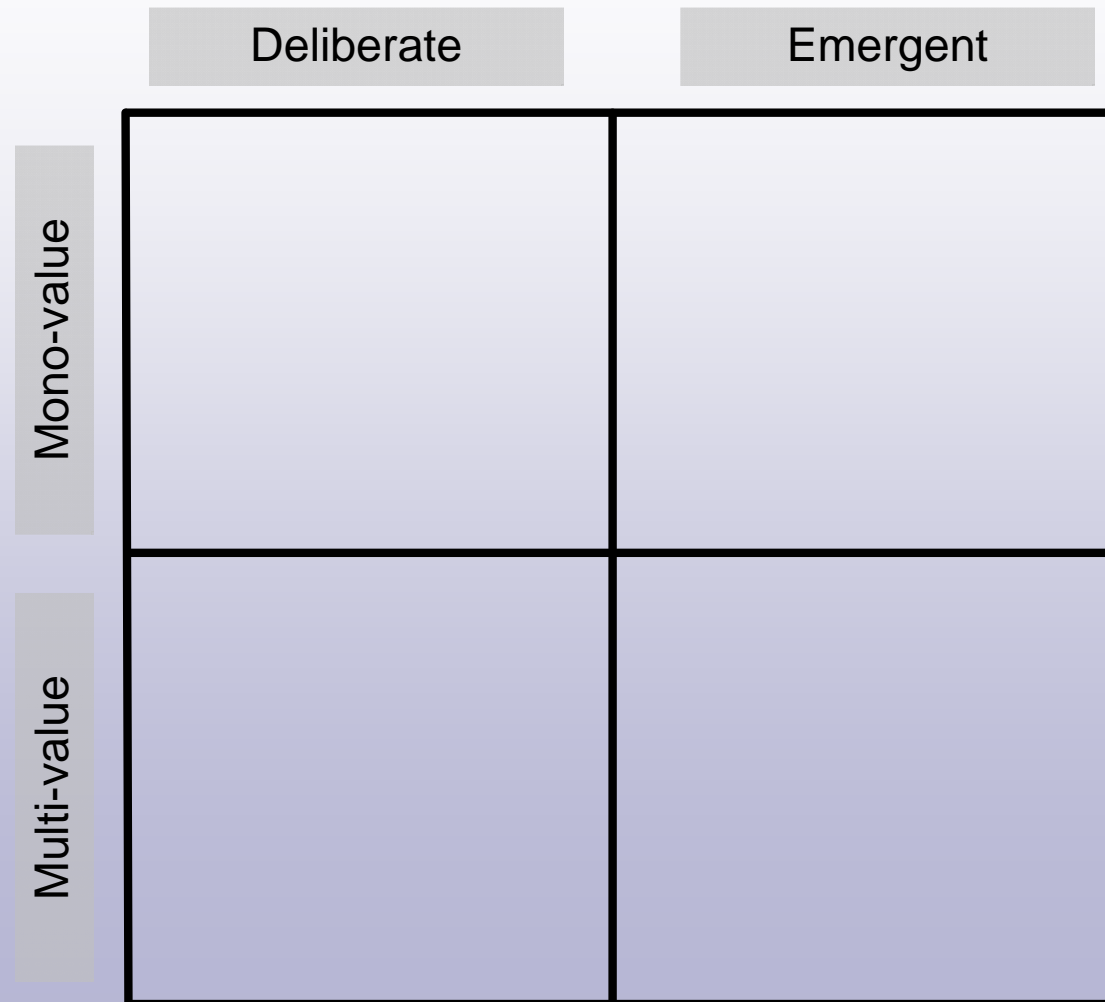
# Research approach

- Literature review on ‘coping’ with value conflicts
  - result: high variety
- Interviews and observing work shifts
  - result: even more variety
- Analysis: two explanatory dichotomies
  - ‘mono-value’ versus ‘multi-value’ coping
  - deliberate versus emergent coping

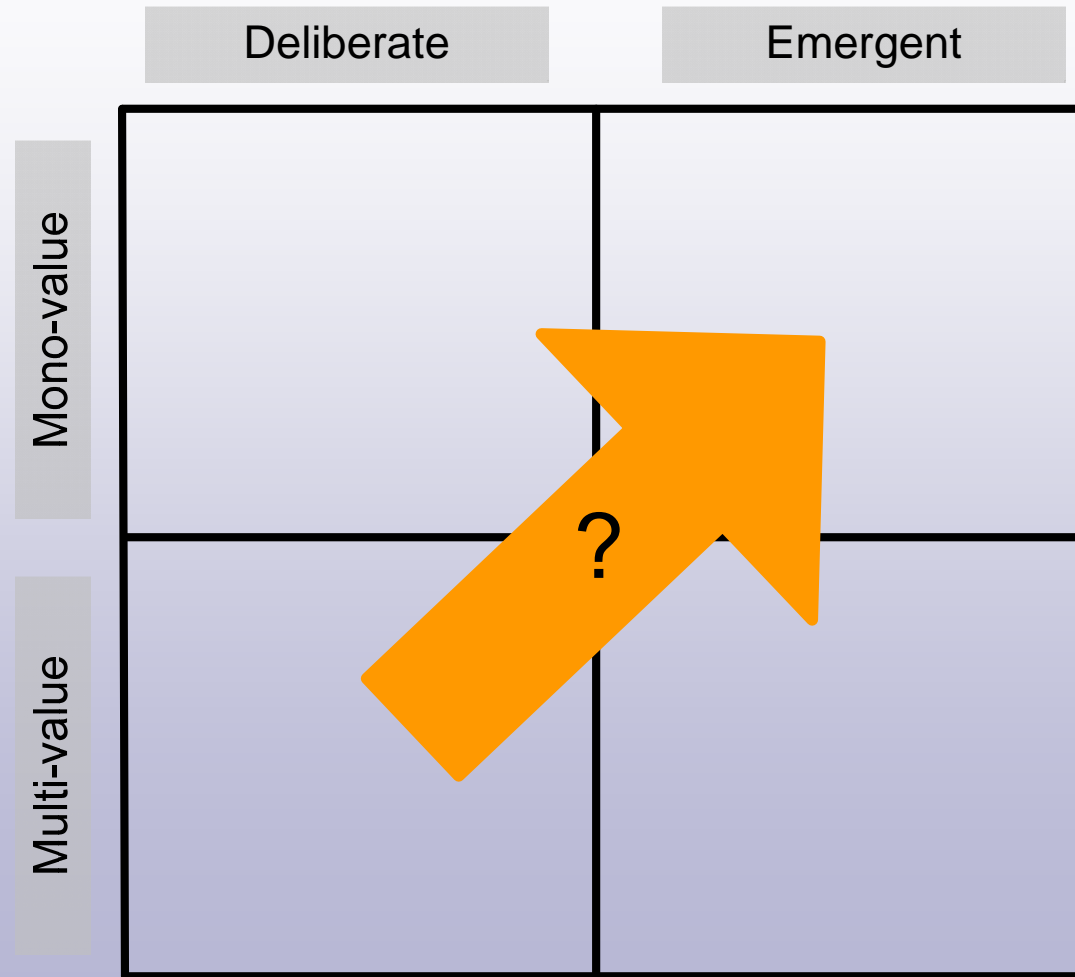
# Coping framework

	Deliberate	Emergent
Mono-value	e.g. fix safety in procedures	e.g. reliability today, efficiency tomorrow
Multi-value	e.g. cost-benefit analyses	e.g. cut the knot as you lose control over the situation

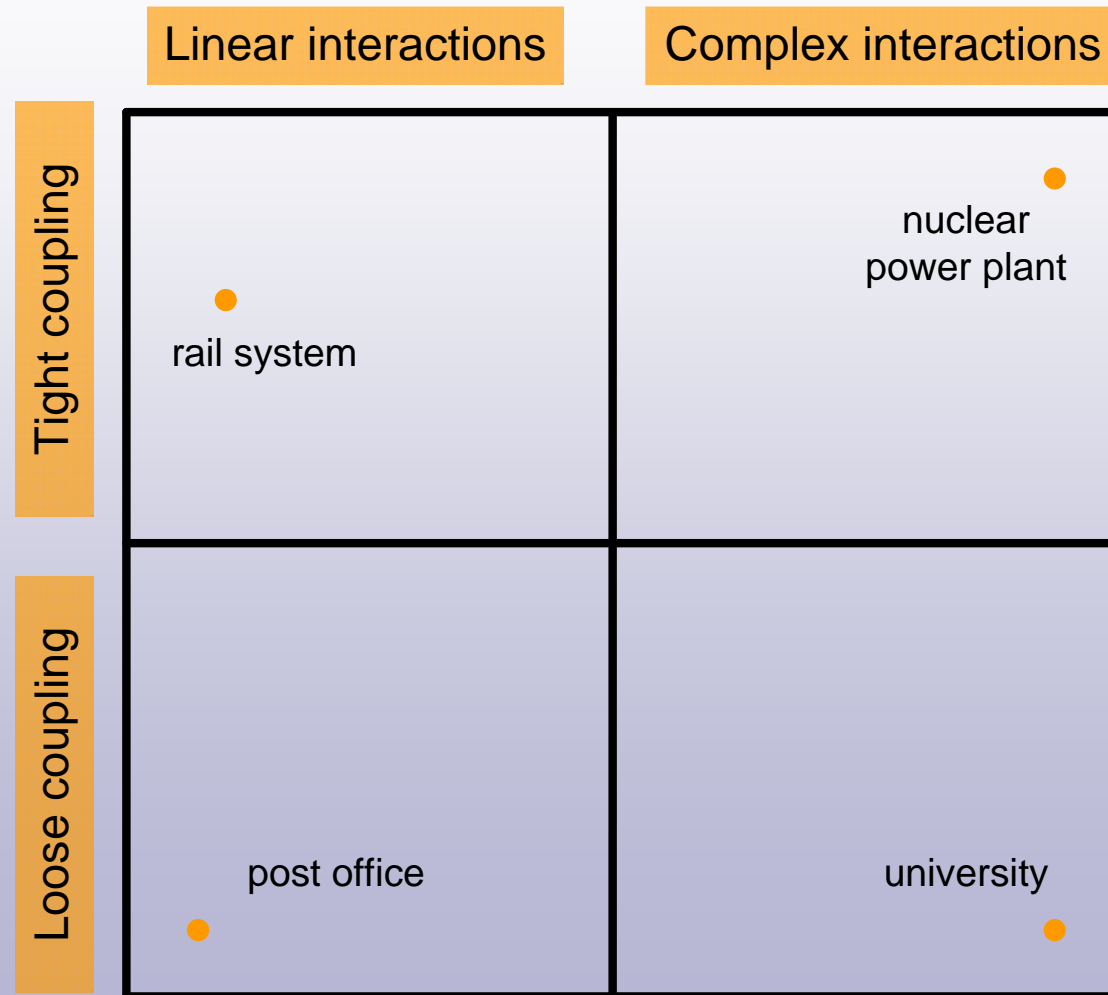
# Coping strategies in unbundled rail operations



# *Crumbling* operational strategies



# Managing complex technologies



Perrow (1999)

# Manageability of complex systems

	Linear interactions	Complex interactions
Tight coupling	Centralized control required for tight coupling	<i>“Catch-22”</i>
Loose coupling		Decentralized control required for interactions

Perrow (1999)

# Conclusions

- Constant conflicts in rail operations
- Many decentralized improvisations
- Effects of unbundling:
  - shifting ‘socio-technological’ complexity
  - a managerial ‘catch-22’
  - dissociation between managers and operators
  - long term: operational resilience erodes away