

# Approaching Vulnerability in Socio-technical Emergency Response Systems

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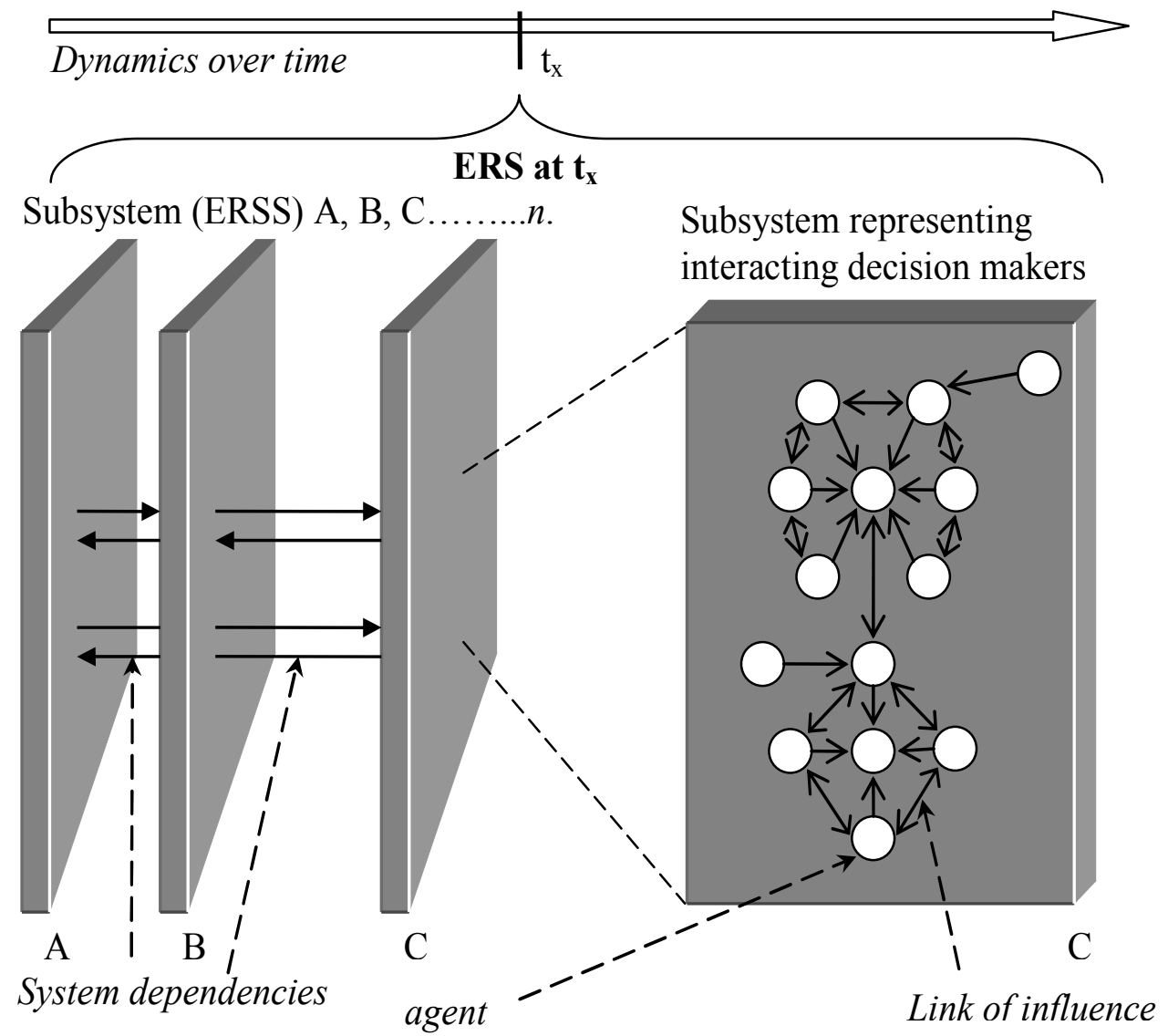


# Outline

1. Agents and links of influence as a social dimension of an emergency response system
2. The balance between top-down and bottom-up
3. The vulnerable system
4. Discussion and Q&A



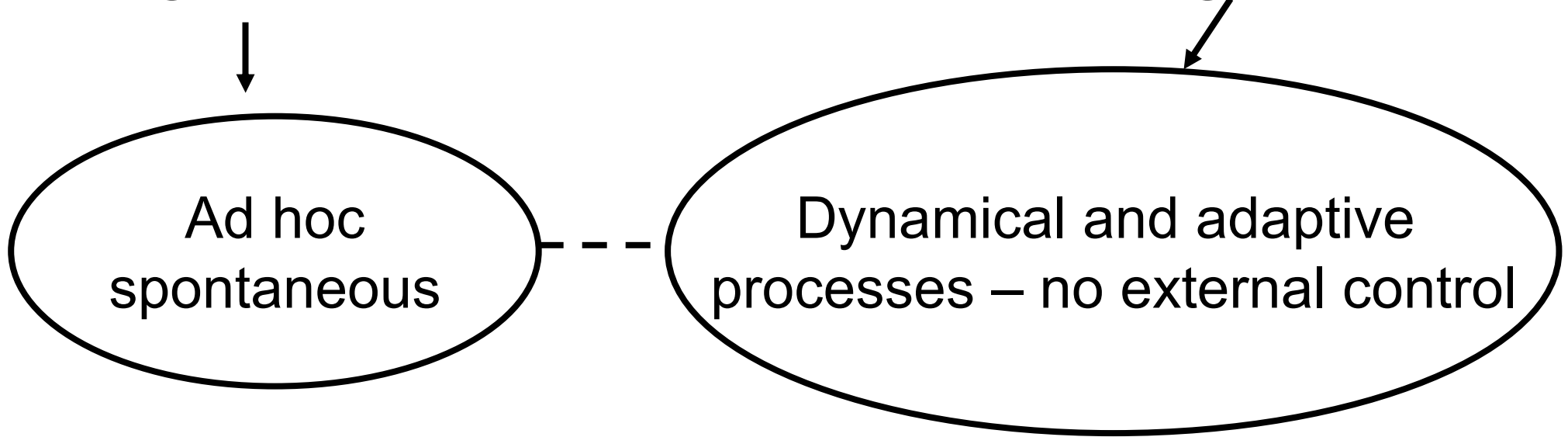
# Agents and links of influence as a social dimension of an emergency response system



Agents and links of influence as a social dimension of an emergency response system



Emergent phenomena and self-organization...



...take place in the subsystems of agents and their links of influence

# The balance between top-down and bottom-up



**Top-down** – *“activities undertaken by responsible decision makers which provide a direction or regulation for employees”* / Heiss, Stoeckl and Hausknotz (2006) → traditional C2. Deriving from a central authority(ies)

**Bottom-up** – *“voluntary activities undertaken by employees for certain management aspects which influence planning and decisions of decision makers in a relevant way”* / Heiss, Stoeckl and Hausknotz (2006) → Emergent phenomena and self-organization



# Hypothetical system characteristics

**Top-down**

## possible advantages

- Clear distribution of responsibility
- Low risk for local dysfunctional behaviour
- Facilitates distribution of information

## possible disadvantages

- Low flexibility/redundancy
- Low creativity
- Slow reaction time

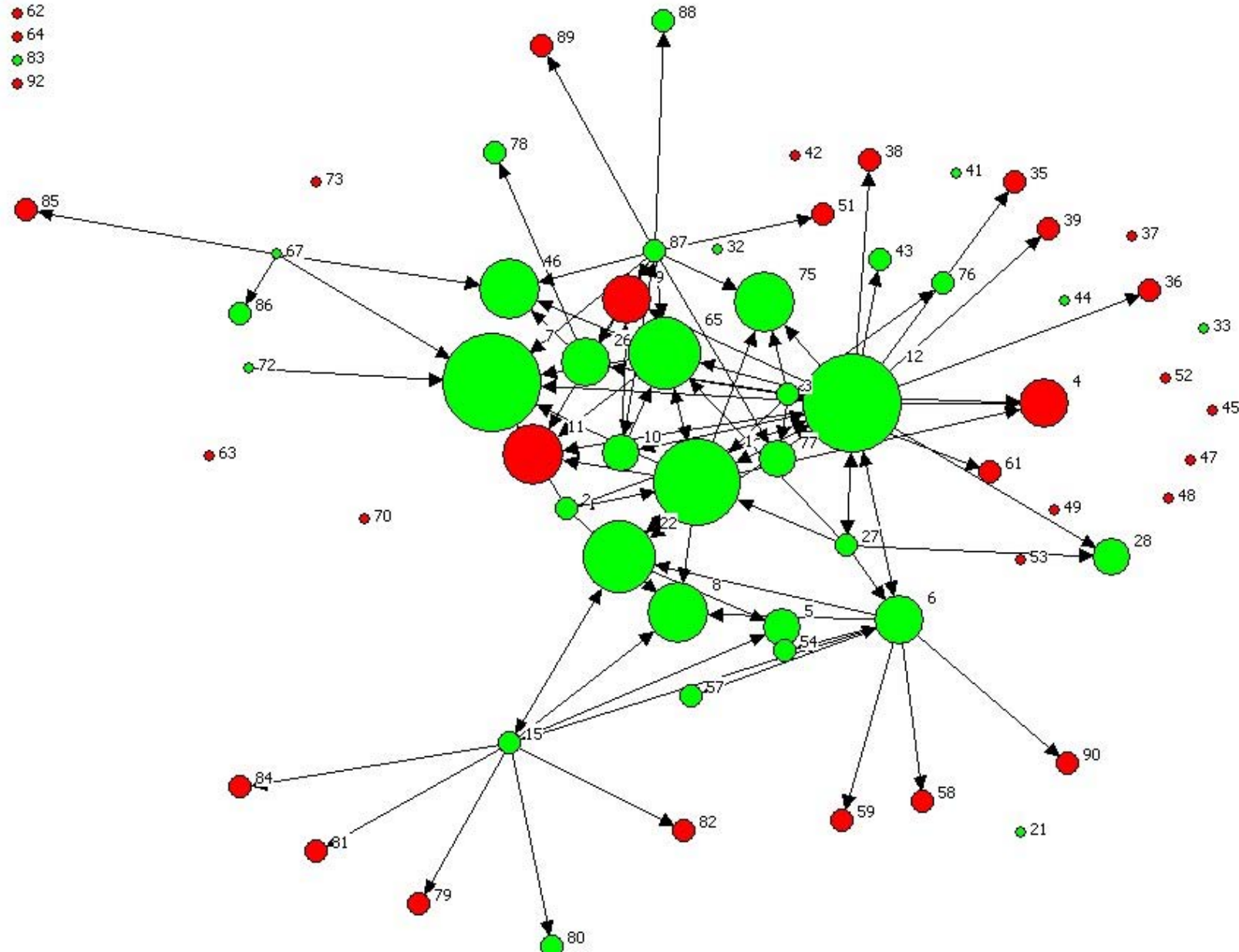
**Bottom-up**

- High flexibility/redundancy (adaptive)
- High creativity
- Fast reaction time

- Indistinct distribution of responsibility
- Scope for local maladaptive behaviour
- Depending on inventiveness and individuals



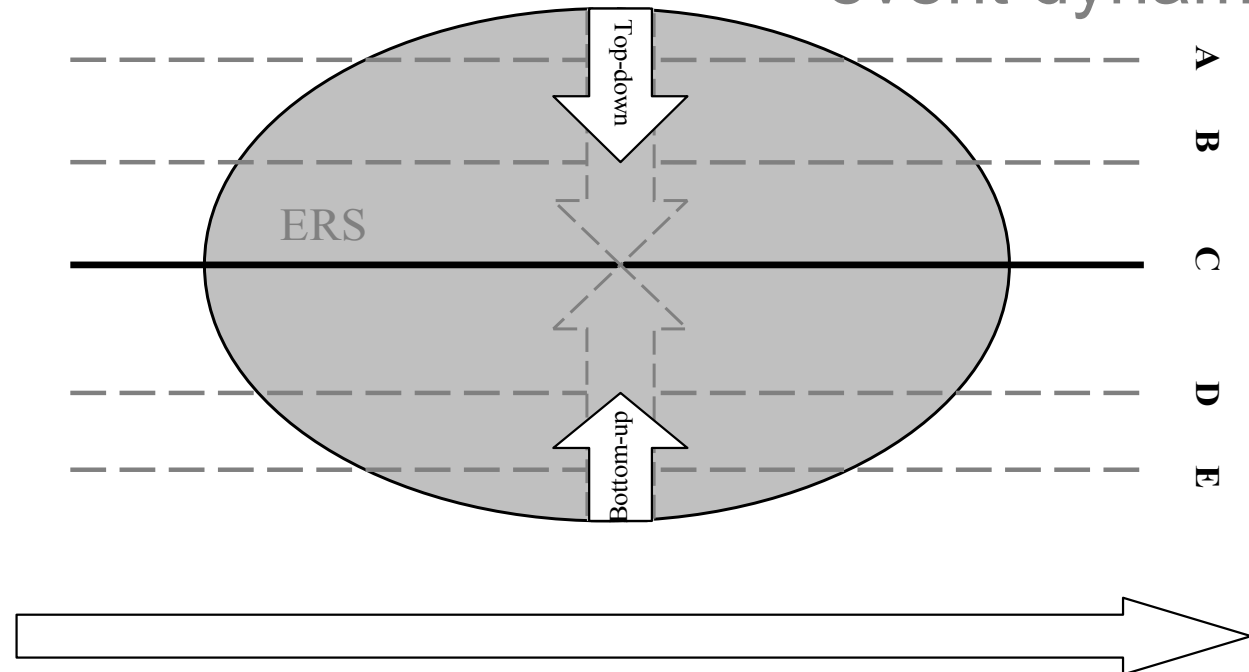
# Example of empirical findings



# The vulnerable system



Optimal balance  
in relation to the  
event dynamics



**Perturbations** – influences that affect the ERS in a negative way in its endeavor to find an optimal balance between top-down and bottom-up

*“Complex adaptive systems theories presume that the adaptation of a system to its environment emerges from the adaptive efforts of individual agents that attempt to improve their own payoffs” (Anderson, 1999)*





# Discussion

- The ERS can be seen as an CAS that to a certain degree has to be open to influences, even the “destructive” ones.
- This makes the ERS vulnerable by nature.
- The consequence of an ERS “out of balance” is a reduced capability to respond to an event and achieve its system goal.
- An important task for emergency response managers is to deal with perturbations and aim for a contextually dependent balance between top-down and bottom-up influences.