

# Effects of Autonomous Cooperation on the Robustness of International Supply Networks

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Contributions and Limitations for the Management of External Dynamics in Complex  
Systems

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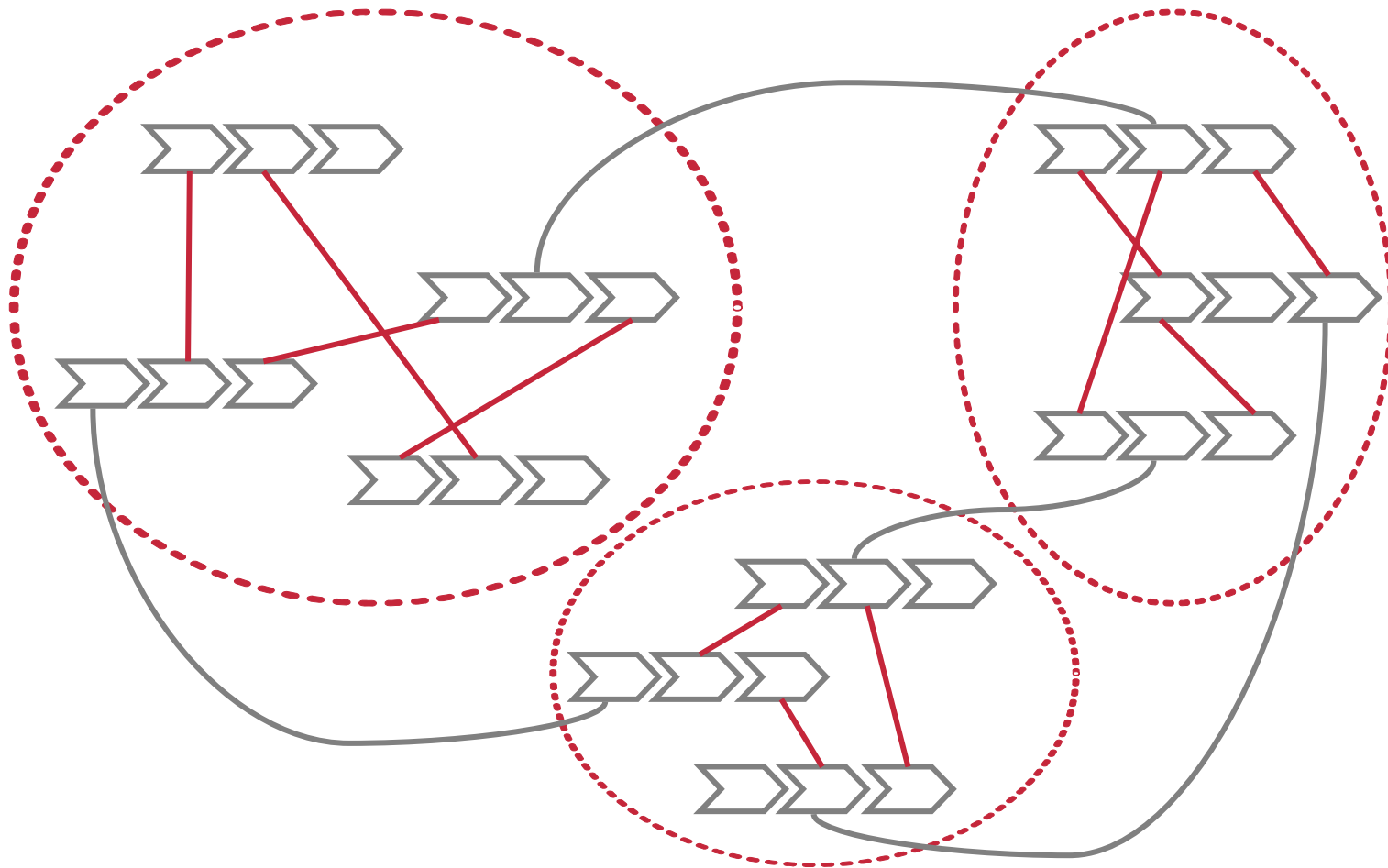
Aim :

To examine the contributions and limitations of the concept of Autonomous Cooperation on the robustness of International Supply Networks

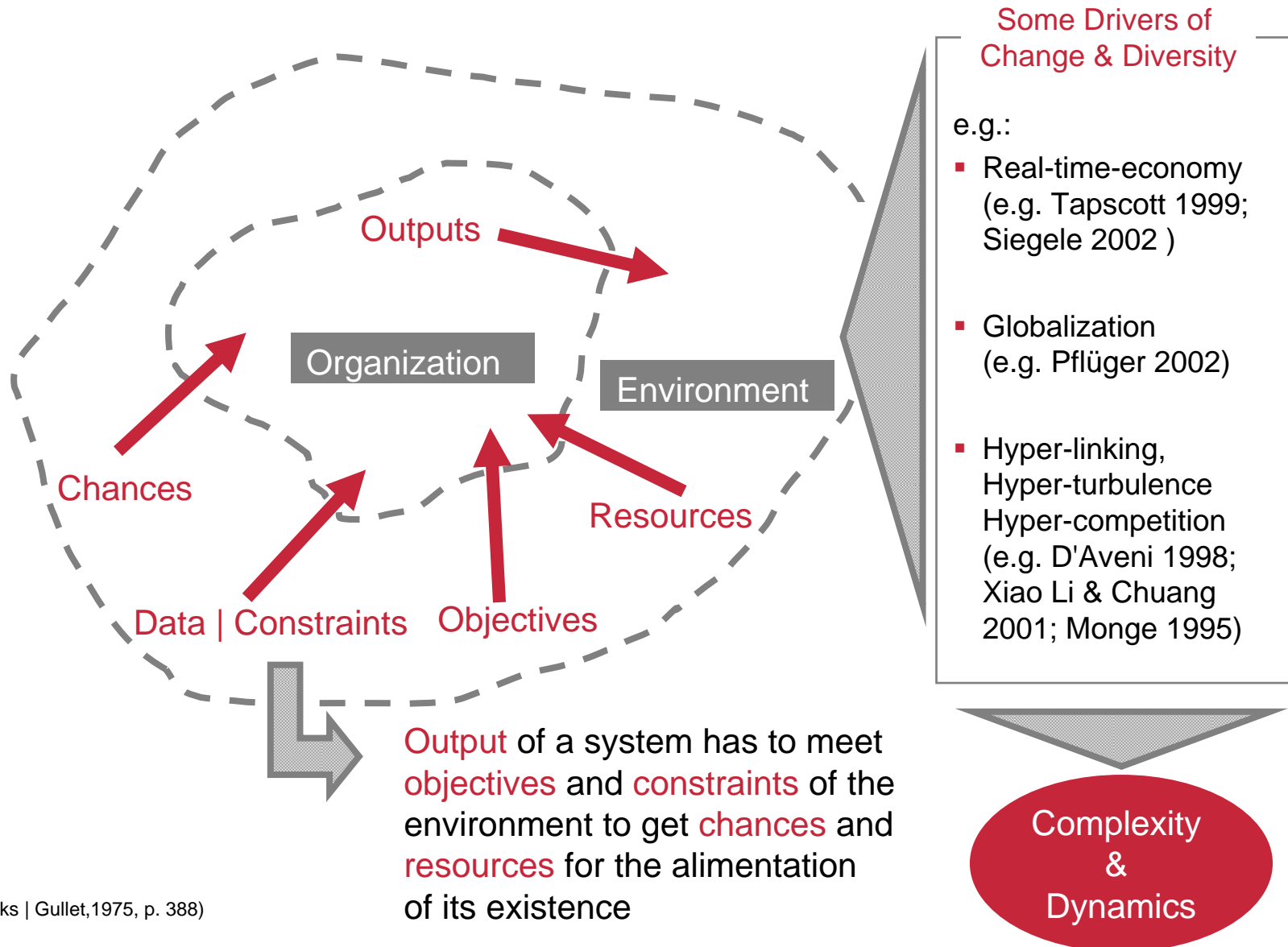


# International Supply Networks

On form of organization that developed due to changed environmental conditions are International Supply Networks



# ISN as Symbiotic Interacting Ecosystems



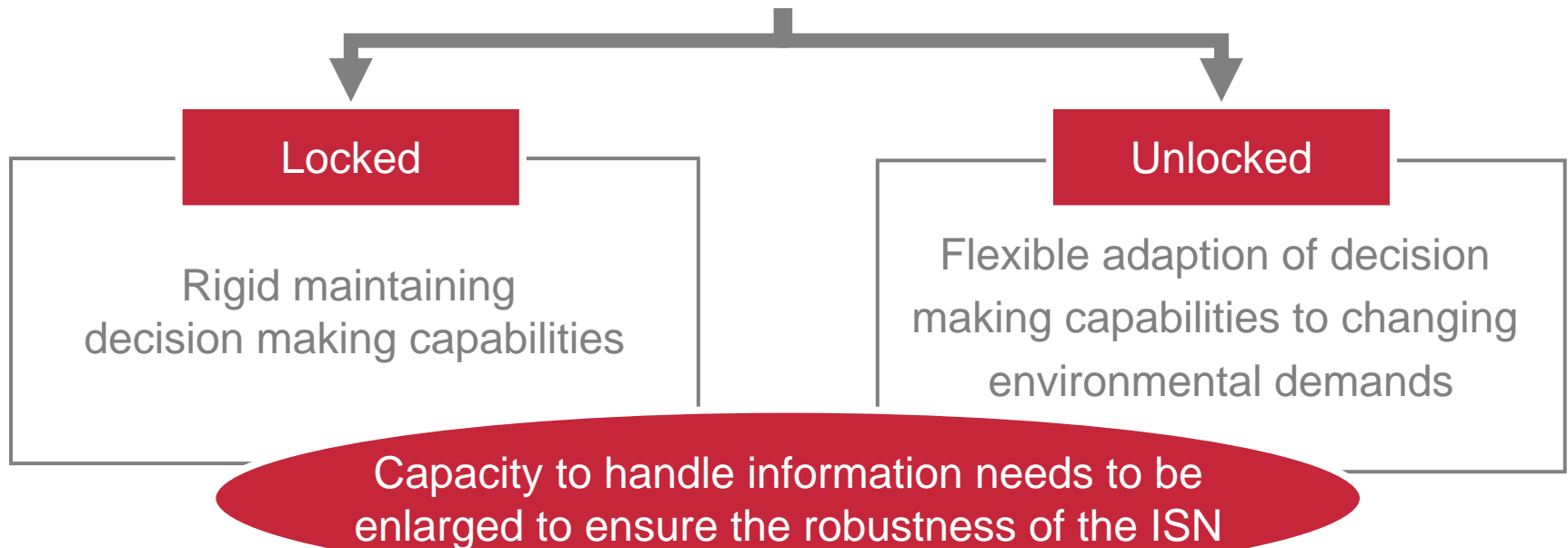
(Hicks | Gullet,1975, p. 388)

# External Dynamics as Determinates of ISN Robustness

## External Dynamics (assumptions)

- Originate from the environment of ISN as organization
- Difficult to manage because of their volatility
- Impossible to forecast the repercussions of decisions

Informational basis deteriorates due to external complexity & dynamics (external risks)





## Autonomous Cooperation ...

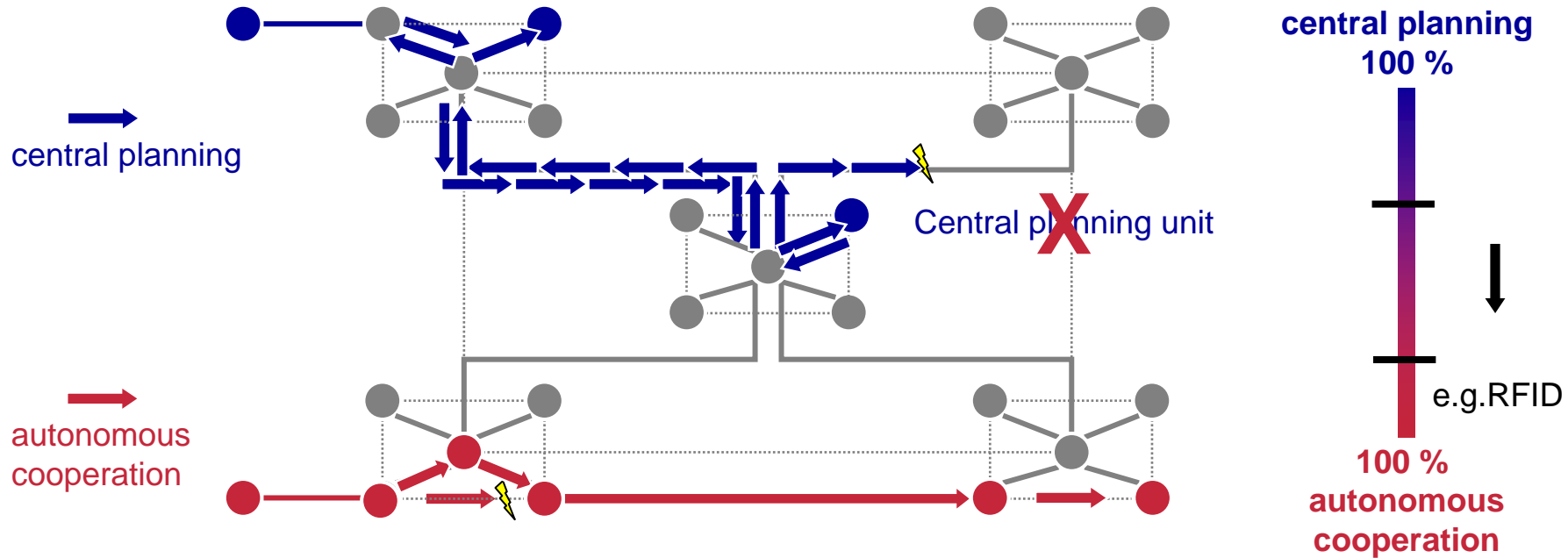
...describes processes of **decentralized decision-making** in **heterarchical** structures.

...requires that **interacting** elements in **non-predictable** systems possess the capability and the possibility of making decisions **independently**.

...aims at an increased robustness and positive emergence of the complete system through distributed and flexible coping with dynamics as well as complexity.

(Windt & Hülsmann 2007)

# Illustration of AC





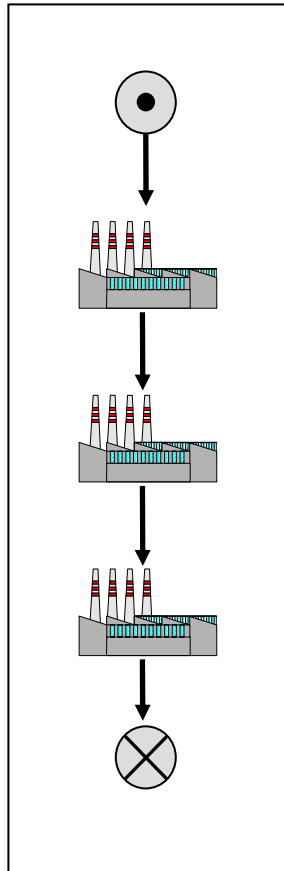
# Coping with External Dynamics?

Characteristics of AC	Technical consequence	Impacts on the management of ISN	Implications on External Dynamics in ISN
Autonomy	Element is responsible for its own system design	Enables the system to develop itself and simultaneously maintain its identity	Superior structures to handle complexity and dynamics and to balance between flexibility and stability
Interaction	Elements communicate directly with each other.	Capacity of the ISN to handle information increases because new structures and processes can be developed	Risk of suboptimal decision-making due to information overload falls
Non-determinism	Higher efficiency in dealing with complexity and uncertainty	The processing of information can be handled more flexible	Capacity to cope with complexity and dynamics increases

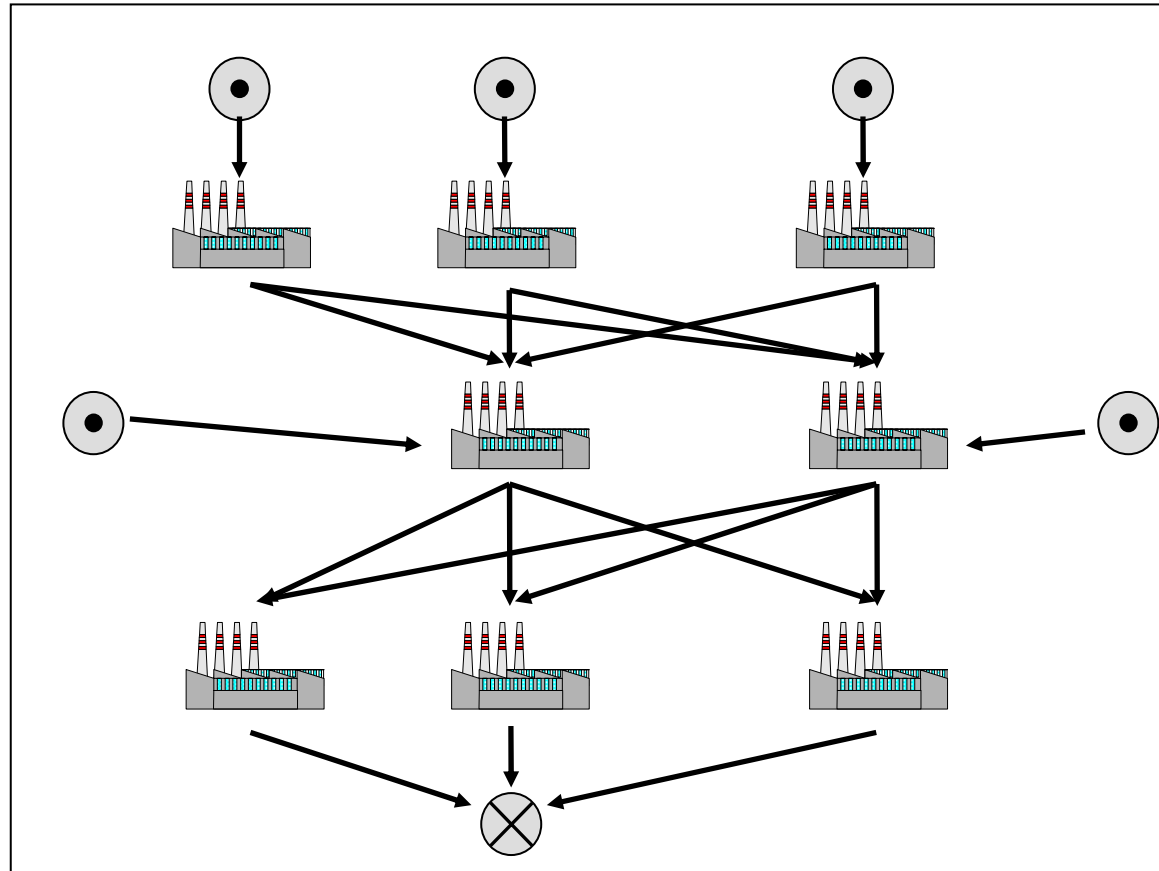


# Empirical Evaluation of External Risks of ISN

## Supply Chain



## International Supply Network



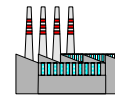
Source



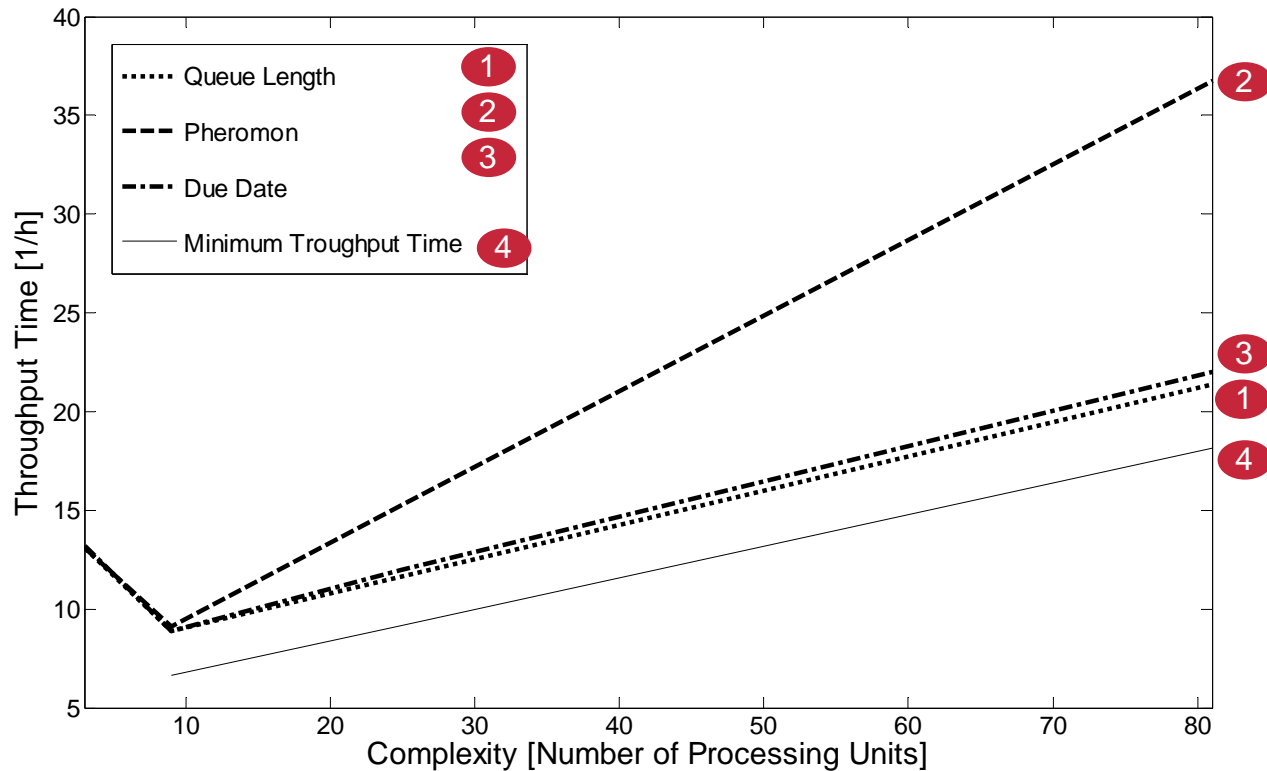
Drain



Possible next  
processing  
steps



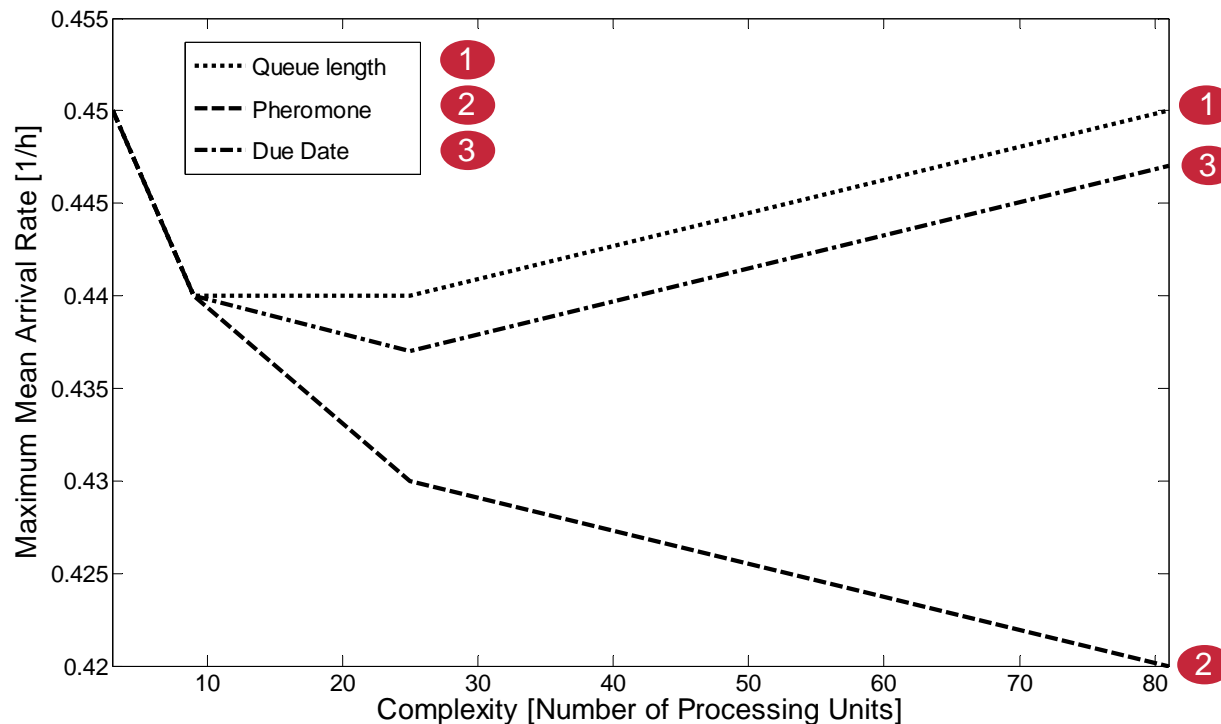
Processing Unit



## Findings:

- By applying the adequate degree of autonomous control a **constant logistical goal achievement is accomplished** under rising complexity and rising dynamics
- For this kind of scenario, representing rising levels of external risks, the **queue length estimator** is an **appropriate** autonomous control method
- Because of high dynamics, the **pheromone method** has **not been able to adapt** to the changing conditions

# Empirical Analysis - Simulation



## Findings:

- By applying the adequate degree of autonomous control a **higher robustness and stability is accomplished** under rising complexity and rising dynamics
- For this kind of scenario, representing rising levels of external risks, the **queue length estimator** is an **appropriate** autonomous control method
- Because of high dynamics, the **pheromone method** has **not been able to adapt** to the changing conditions



### Key Findings ...

- AC might enable an ISN to enlarge its capacity of information handling and processing
- Larger capacity to cope with external dynamics
- Risks of external dynamics can be reduced
- AC might increase the robustness of an ISN

### Research Outlook

- The correlations between dynamics and robustness have to be evaluated
- AC as an approach especially to cope with risks has to be analysed
- What kind of internal risks might evolve from using AC

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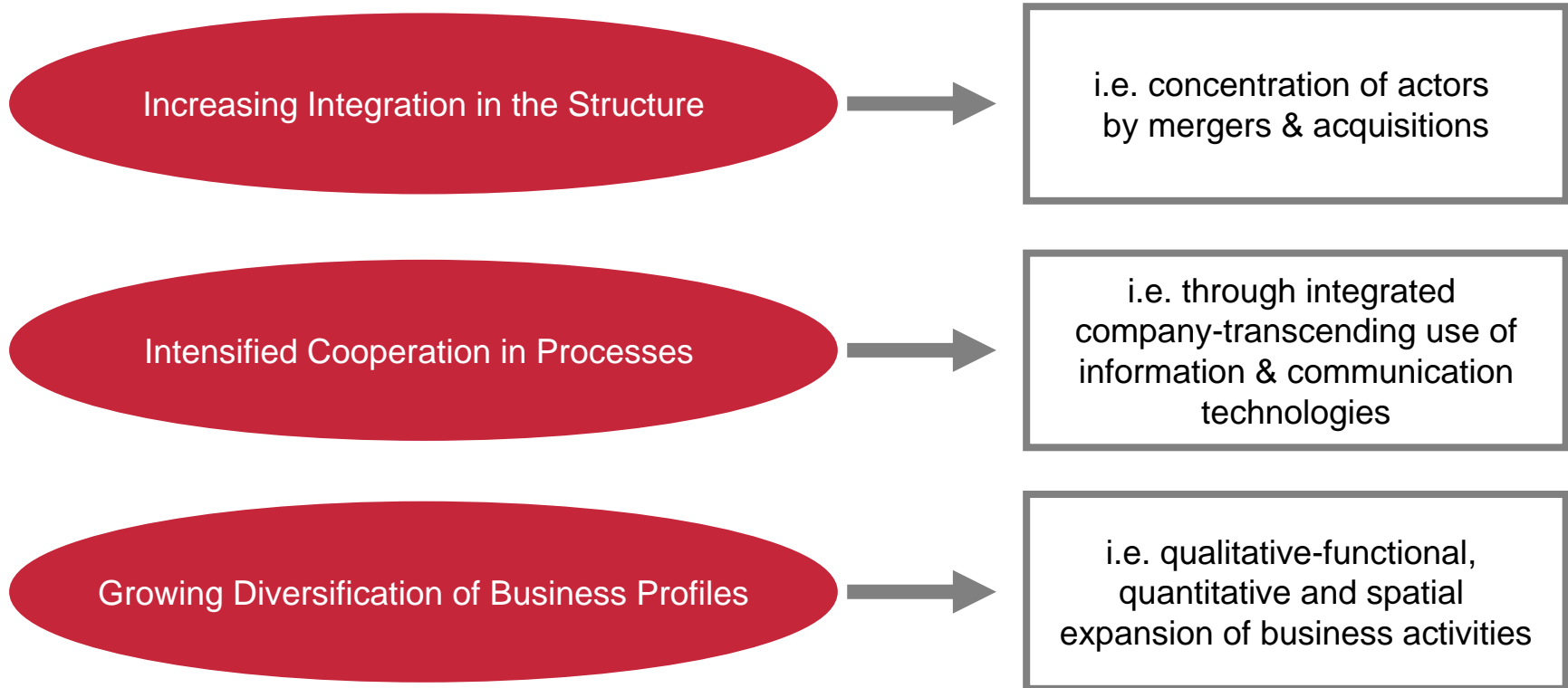
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# Change Drivers of Logistic Processes



(Herzog et al. (2003))