Multilevel Adaptation for Sociotechnical Systems

Fatma Başak Aydemir

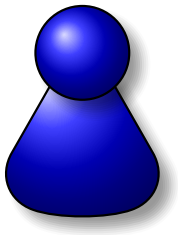
Supervisors: Paolo Giorgini and John Mylopoulos

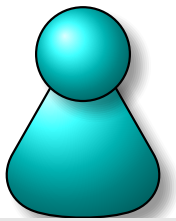
08.02.2013

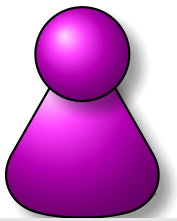
Agenda

SOCIOTECHNICAL SYSTEMS

social systems

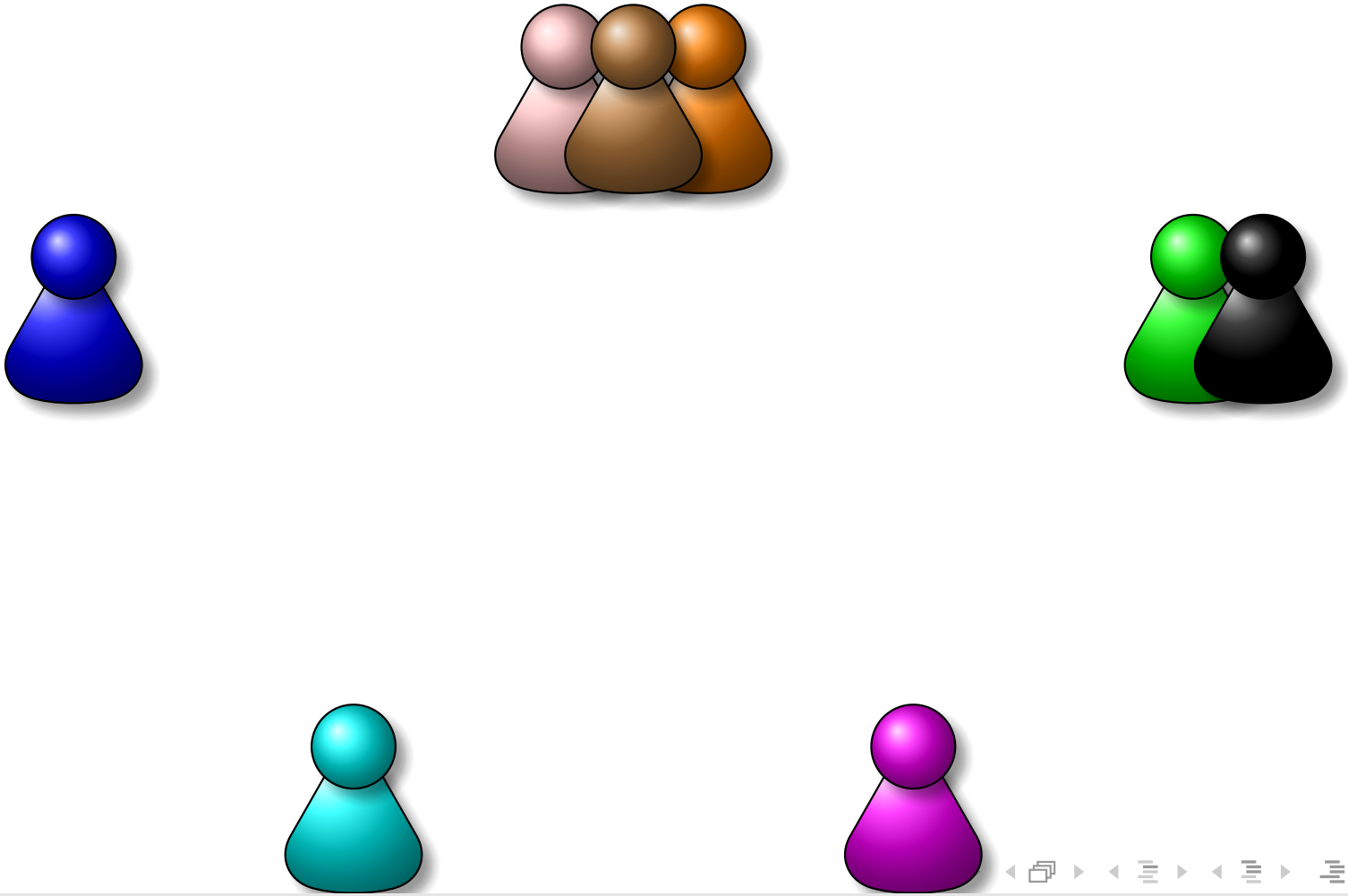






SOCIOTECHNICAL SYSTEMS

social systems



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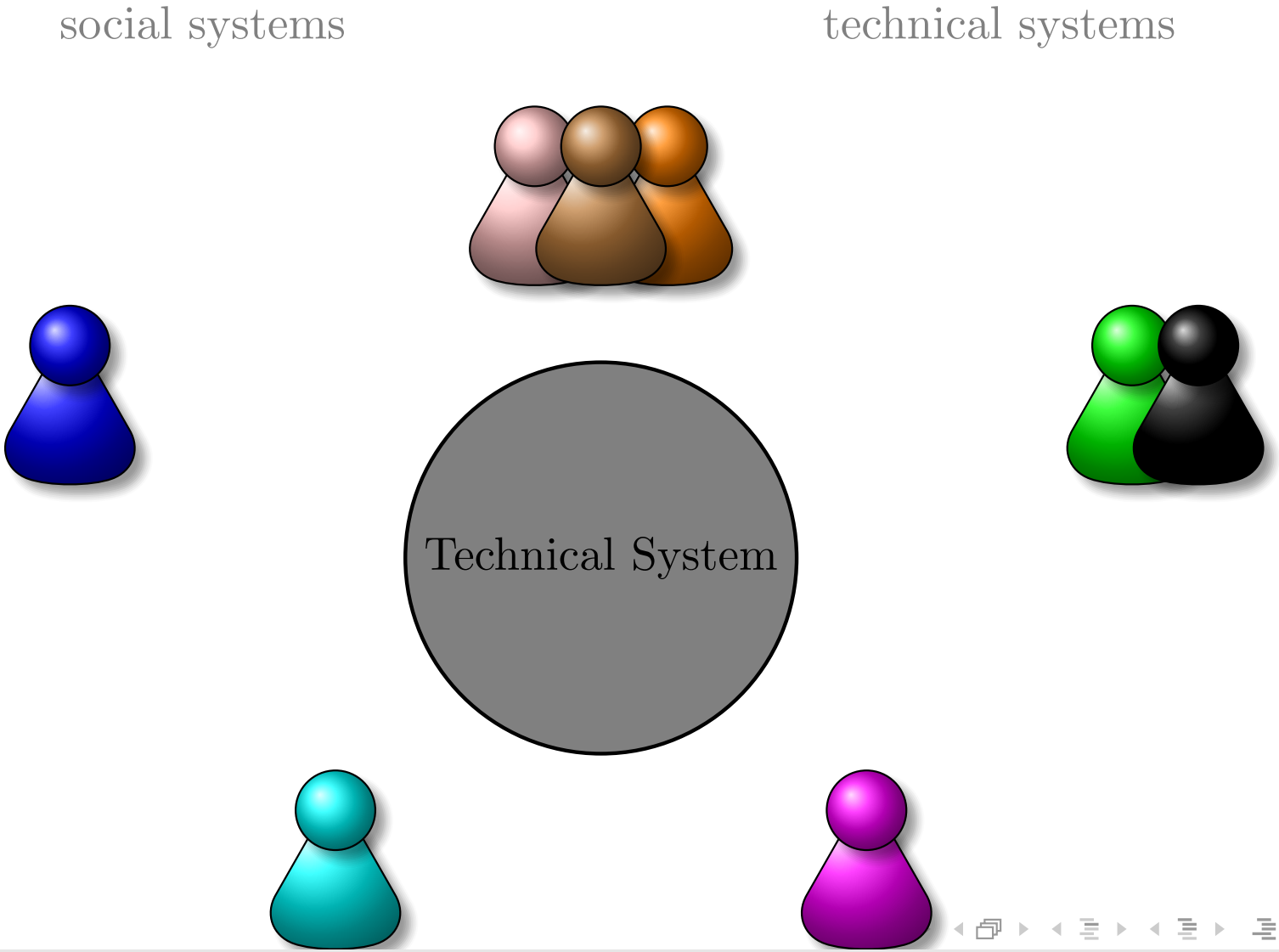

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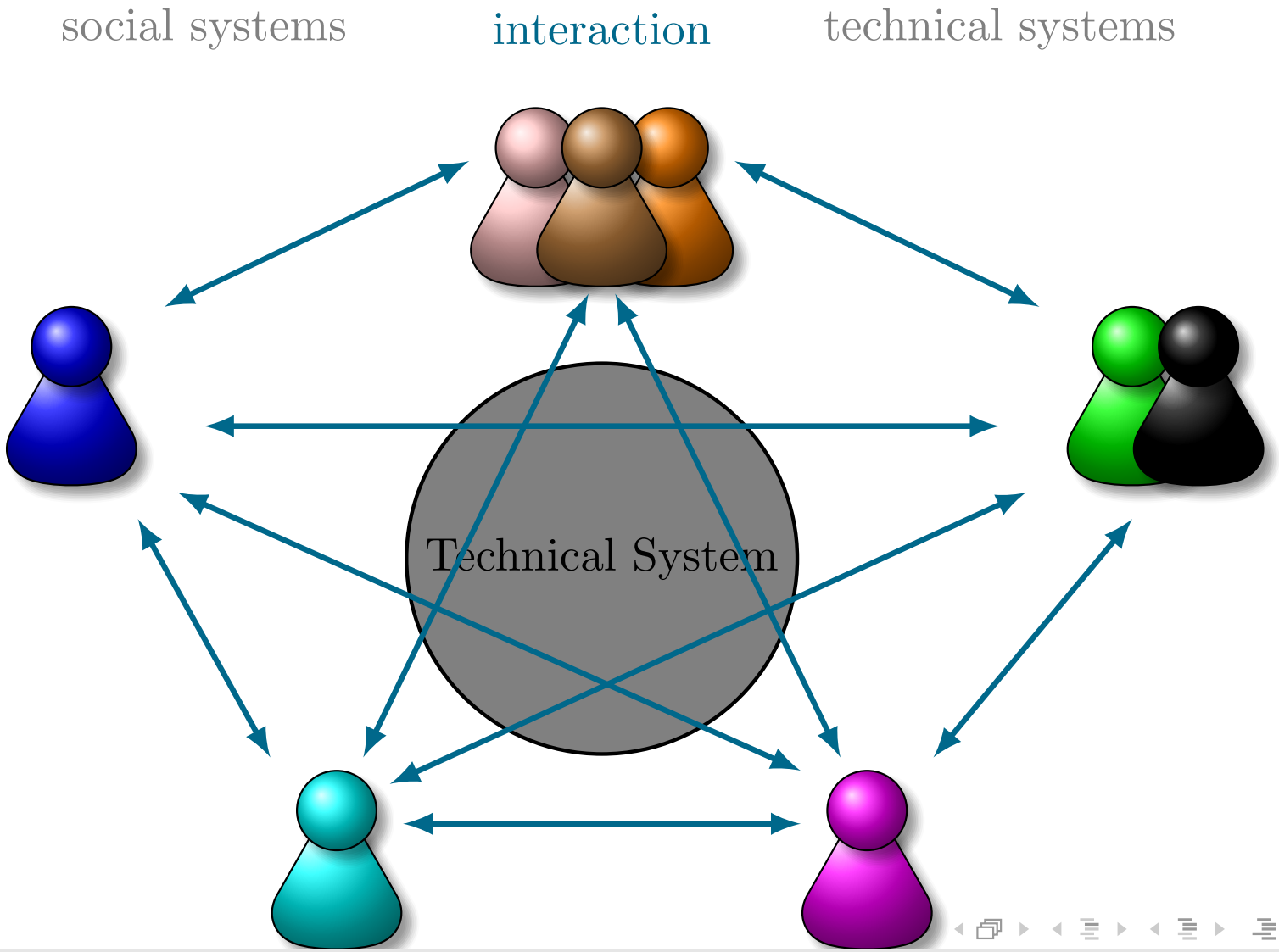

SOCIOTECHNICAL SYSTEMS: EXAMPLES

- Crisis management: police, firefighters, coordination center, sensors, help lines, ...

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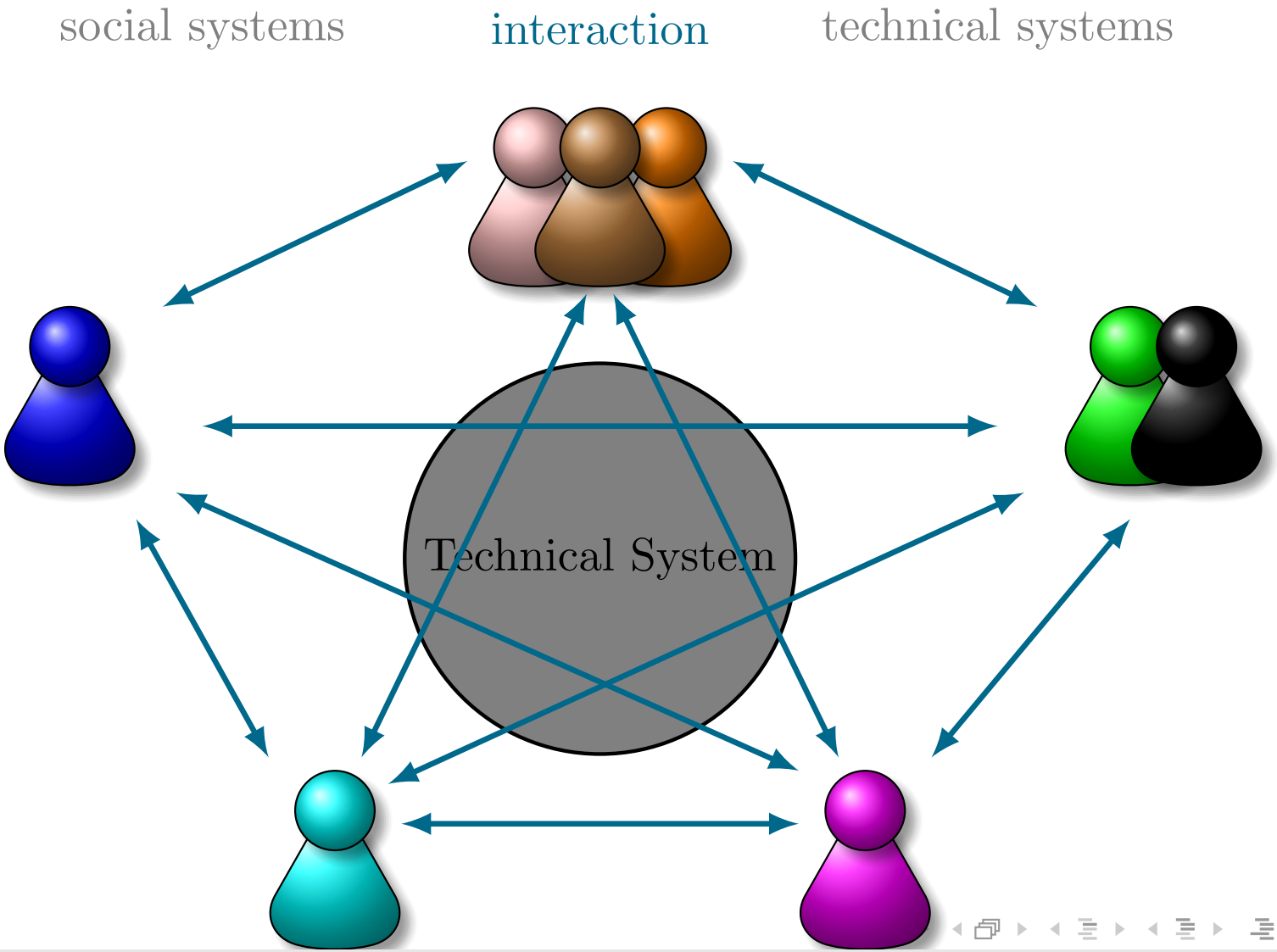
- Healthcare: ministry, hospitals, patience, doctors, clinics, ...

SOCIOTECHNICAL SYSTEMS: EXAMPLES

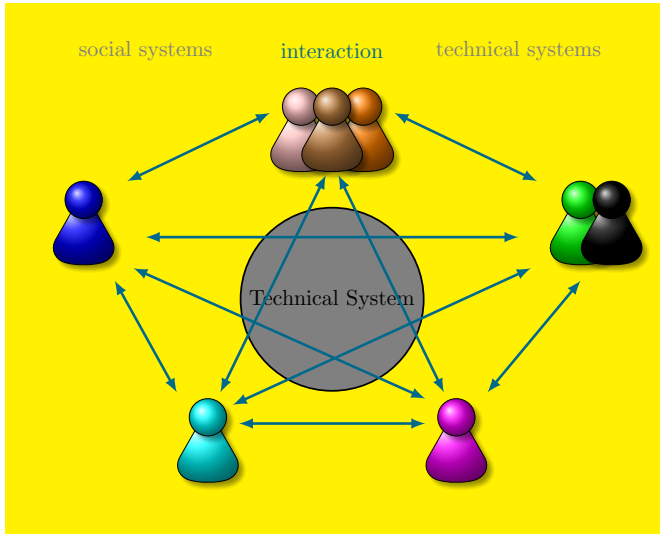
- Crisis management: police, firefighters, coordination center, sensors, help lines, ...
- Healthcare: ministry, hospitals, patience, doctors, clinics, ...
- Universities: departments, administration, students, professors, information systems, ...

PROBLEM


social systems
interaction
technical systems
Technical System

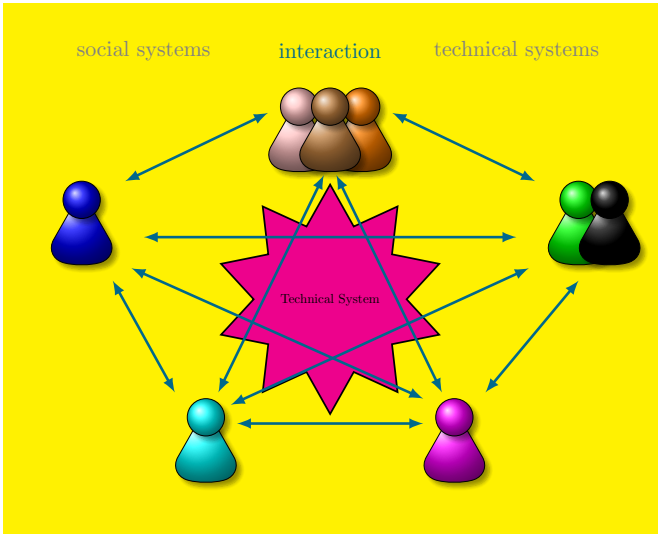
PROBLEM

- Changes in the environment: new law



PROBLEM

- Changes in the environment: new law
- Changes in the technical systems: new technologies



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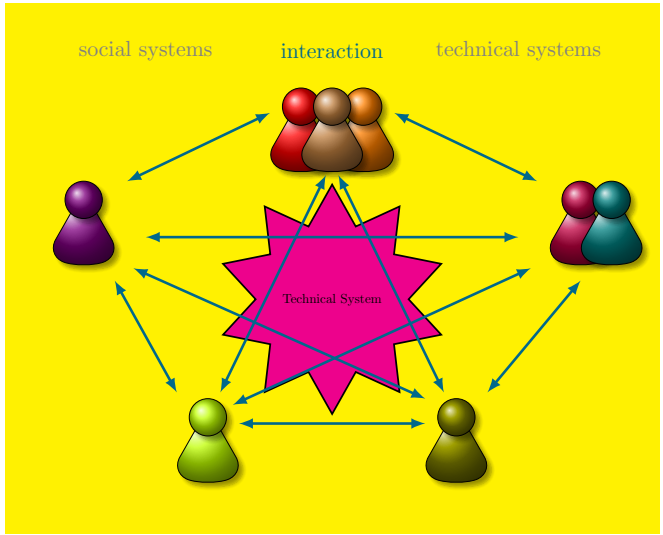
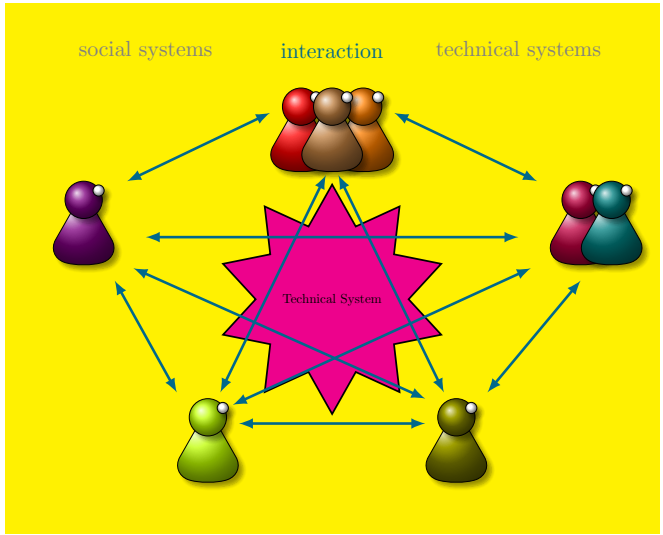
PROBLEM

- Changes in the environment: new law
- Changes in the technical systems: new technologies
- Changes in the social systems
  - Local changes: changes in the requirements



PROBLEM

- Changes in the environment: new law
- Changes in the technical systems: new technologies
- Changes in the social systems
  - Local changes: changes in the requirements
  - Global changes: reorganization, adding or removing systems, adding or dropping requirements



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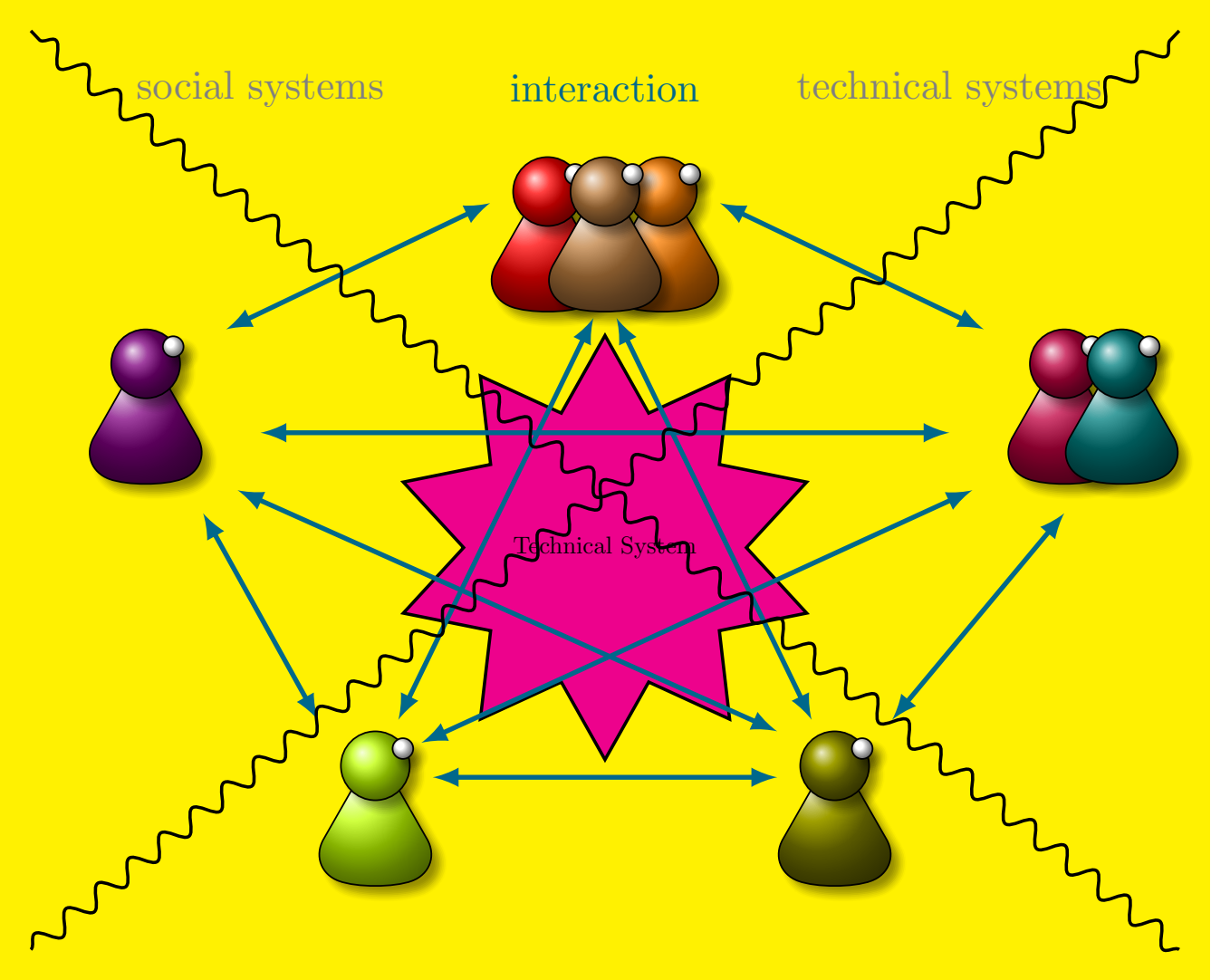
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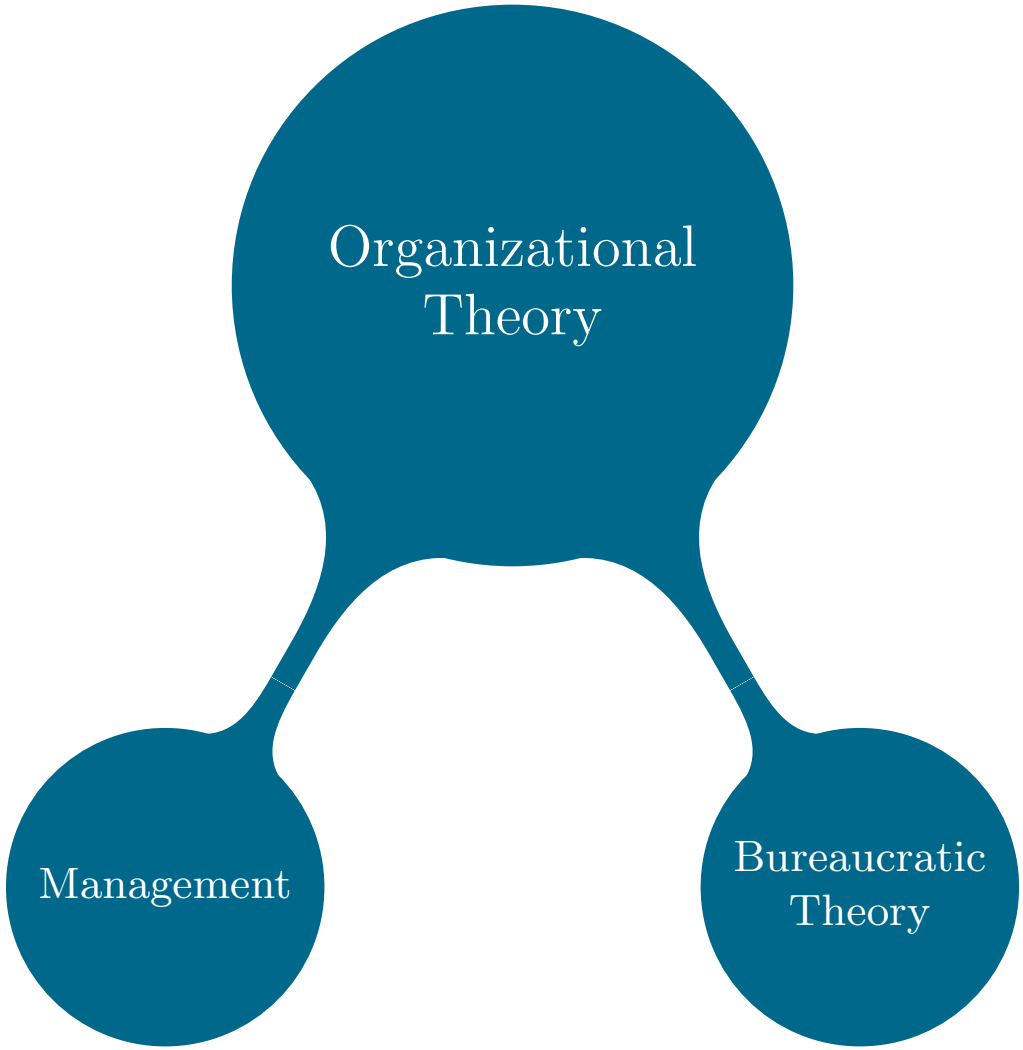
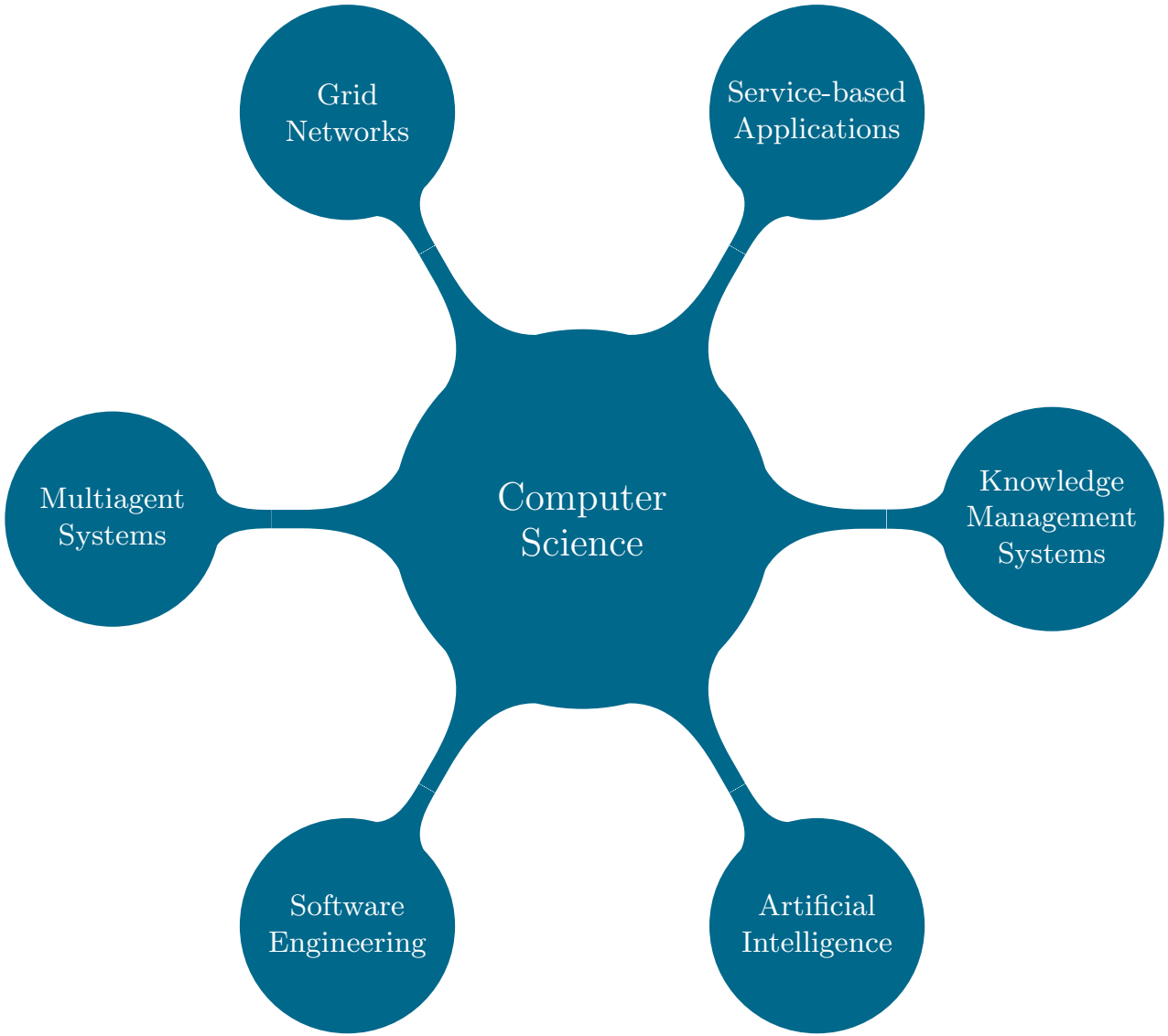
PROBLEM

We need mechanisms to ensure coherence as the sociotechnical system is evolving, that is, make sure that global requirements are fulfilled since there may be multiple levels of subsystems and adaptations may be contradictory to each other or to global requirements.

Related Work



RELATED WORK



RESEARCH BASELINE

Concept	Area	Reference
Requirements Problem	SE	Jackson & Zave (1995)
Goal Oriented RE	RE	Van Lamsweerde (2001)
Commitments	MAS	Singh (1999)
Distributed Problem Solving	AI	Yokoo et al. (1998)

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RESEARCH PLAN

1. Develop a framework to design sociotechnical systems and support evolution
2. Define coherence condition (1^{st} year)
3. Identify mechanisms that create coherent solutions (2^{nd} year)
4. Identify requirements for coherence(2^{nd} year)
5. Validate the solution through case studies (3^{rd} year)
6. Thesis (3^{rd} year)

Proposed Solution: Formalizing Sociotechnical Systems

$$
\begin{aligned}
org(O,T) &= (S,R,D_G) \\
sys(O,T) &= S \text{ (Systems)} \\
req(O,T) &= R \text{ (Requirements)} \\
dom(O,T) &= D_G \text{ (Global Domain Assumptions)}
\end{aligned}
$$

$$
\begin{aligned}
org(Unitn, T) &= (S_{Unitn}, R_{Unitn}, D_{Unitn}) \\
sys(Unitn, T) &= \{CS, Physics, Administration\} \\
req(Unitn, T) &= \{maxStudentsRegistered, coursesGiven\} \\
dom(Unitn, T) &= \{(maxNumberOfStudents = n)\}
\end{aligned}
$$

$$
\begin{aligned}
org(CS, T) &= (S_{CS}, R_{CS}, D_{CS}) \\
sys(CS, T) &= \{Swen, Security\} \\
req(CS, T) &= \{meetingRoomIsAvailable\} \\
dom(CS, T) &= \{(minNumberOfGradStudents = m)\}
\end{aligned}
$$

Proposed Solution: Formalizing Sociotechnical Systems

$$
\begin{aligned}
syst(S,T) &= (C, P, D_L) \\
com(S,T) &= C \text{ (Commitments)} \\
pref(S,T) &= P \text{ (Preferences)} \\
doms(S,T) &= D_L \text{ (Local Domain Assumptions)}
\end{aligned}
$$

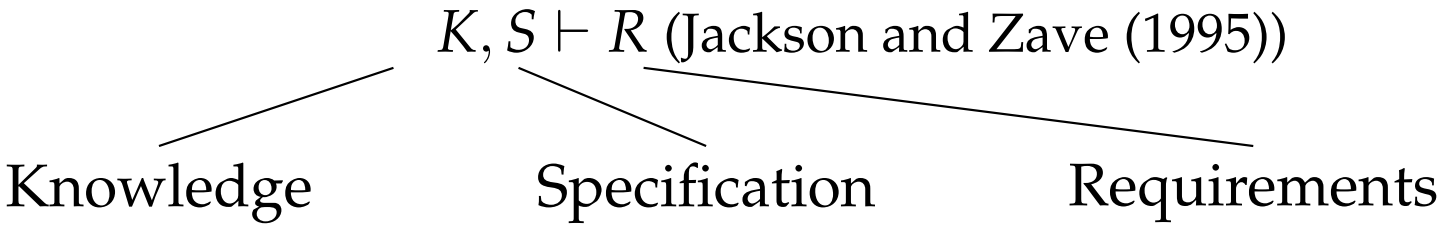
PROPOSED SOLUTION: FORMALIZING SOCIOTECHNICAL SYSTEMS

$$
\begin{aligned}
syst(CS, T) &= (C_{CS}, P_{CS}, D_{CS}) \\
com(CS, T) &= \{C(CS, UniTn, budgetAssigned, javaCoursesGiven)\} \\
pref(CS, T) &= \{meetingRoomIsAvailable\} \\
doms(CS, T) &= \{(minNumberOfGradStudents = m)\}
\end{aligned}
$$

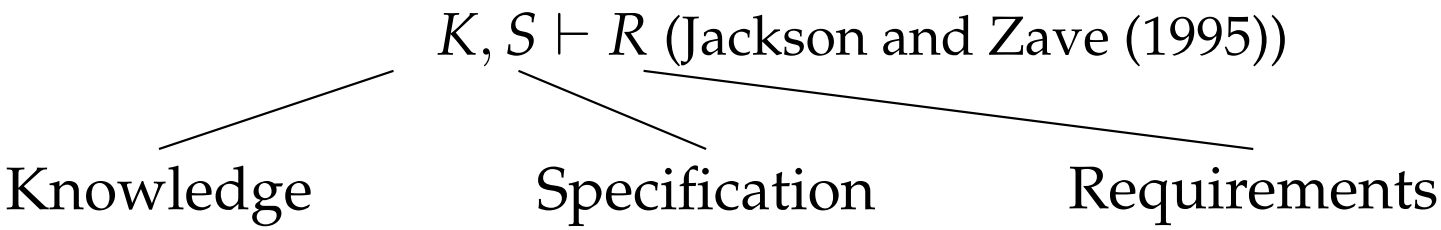
PROPOSED SOLUTION: ENSURING COHERENCE

$K, S \vdash R$ (Jackson and Zave (1995))

PROPOSED SOLUTION: ENSURING COHERENCE



Proposed Solution: Ensuring Coherence

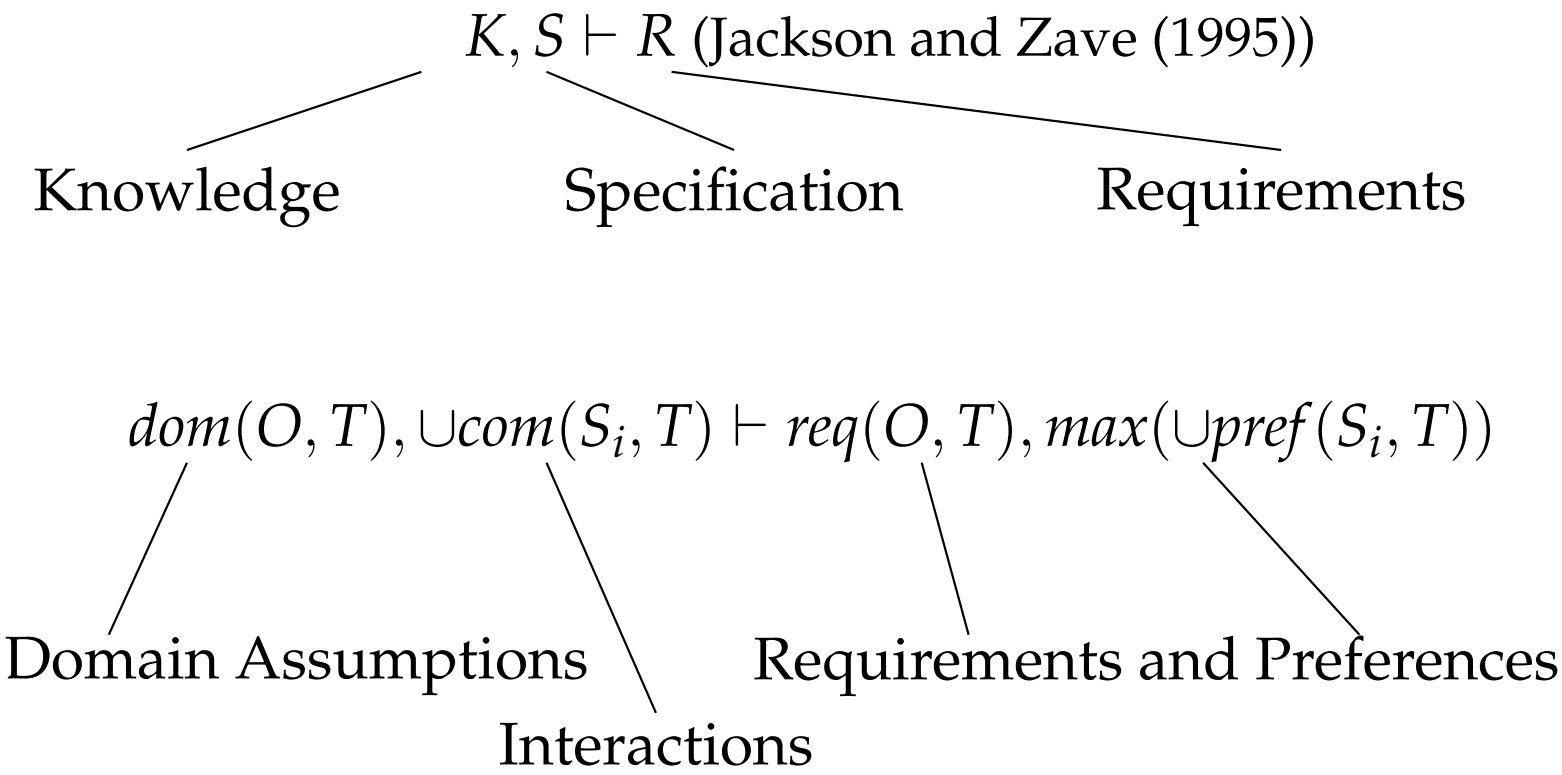


Domain Assumptions

Requirements and Preferences

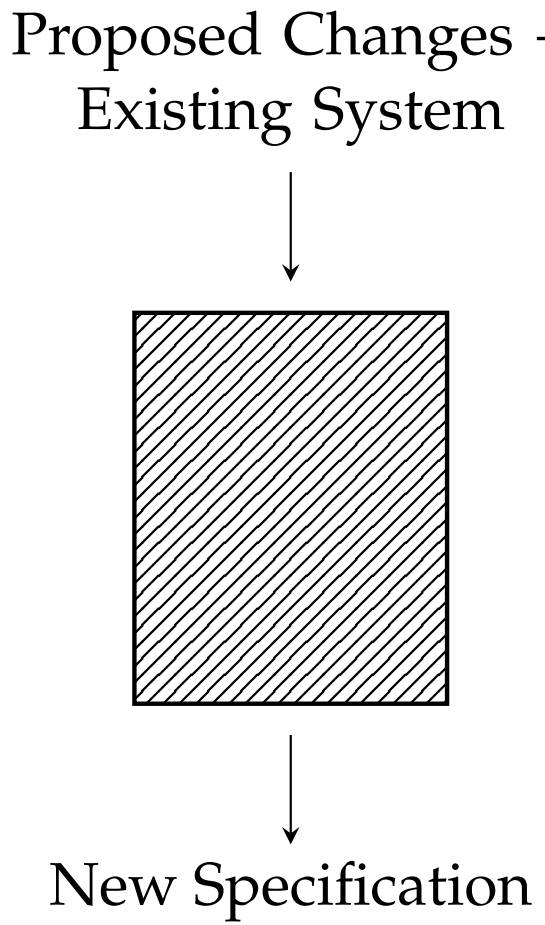
Interactions

Proposed Solution: Ensuring Coherence



Proposed Solution: Coherence Mechanisms

- Input: proposed changes and existing system
- Process: negotiation, decision making, reasoning via priorities ...
- Output: new commitments, requirements, preferences, domain assumptions



Proposed Solution: Coherence Mechanisms, Changes

Proposed changes may involve:

Proposed Solution: Coherence Mechanisms, Changes

Proposed changes may involve:

- Global requirements

Proposed Solution: Coherence Mechanisms, Changes

Proposed changes may involve:

- Global requirements
- Local preferences

Proposed Solution: Coherence Mechanisms, Changes

Proposed changes may involve:

- Global requirements
- Local preferences
- Commitments

Proposed Solution: Coherence Mechanisms, Changes

Proposed changes may involve:

- Global requirements
- Local preferences
- Commitments
- Domain assumptions

Proposed Solution: Coherence Mechanisms, Process

- Central solution: minimum change, minimum cost, maximum utility

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- Central solution: minimum change, minimum cost, maximum utility
- Negotiation: peer to peer, global

Proposed Solution: Coherence Mechanisms, Process

- Central solution: minimum change, minimum cost, maximum utility
- Negotiation: peer to peer, global
- Distributed problem solving

Proposed Solution: Coherence Mechanisms, Outcome

- New model

Proposed Solution: Coherence Mechanisms, Outcome

- New model
- New specification

INTENDED OUTCOME

A framework that helps developers to design sociotechnical systems and support evolution.

CONTRIBUTIONS

- Methodology and tools for designing and supporting evolution for sociotechnical systems
- Formalization for reasoning on requirements, interactions and changes
- Algorithms to ensure coherence during evolution

QUESTIONS

Questions?

References I

Jackson, Michael, & Zave, Pamela. 1995.

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Yokoo, M., Durfee, E.H., Ishida, T., & Kuwabara, K. 1998.

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