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# Organisational metamodels and organisational mechanisms

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# Outline

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1. Introduction
2. Organisational mechanisms
3. Our vision of multiagent organisations

# Introduction

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## Organisations:

- Entities that:
  - has some global goals or purposes
  - in which individual agents are the active elements
  - Often have some predesigned functioning
- Appropriate concept to treat and design open multiagent systems

# Introduction

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## Organisations for open multiagent systems:

- Systems in which independent agents interact with each other
- Agents may be heterogeneous, possibly designed and created by different entities
- No full control over the behaviour of the agents
- Agents' individual preferences may not be aligned with the global goals of the organisation
- Often dynamic systems (agent may join and leave)

# Introduction

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## Organisations as entities:

- Framework for designing open multiagent systems
- Specify the "rules of the game"
- Define the global functioning of an organisation (not of the agents)
- Concentrates on the abstract organisational level

→ **Organisational meta-models**



## How to organise?:

- Mechanisms for obtaining an "organised behaviour"
- Mechanisms that promote efficiency from a global point of view
- Self-organization, self-configuration, efficient teamwork, ...
- Concentrates on an organisation instance

→ **Organisational mechanisms**

# Introduction

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## Why organisational mechanisms?

- Organisational models aim to define organisations at a global level
- This global definition does not always assure efficiency
- An adaptation of the organisation to its particular context is necessary

# Organisational mechanisms

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**How could mechanisms work that organise open multiagent systems?**

**Obviously:**

- They have to influence the behaviour of the agents

**How we can manipulate the behaviour of independent agents?**



**Manipulate the parameters that influence agents' decisions**

# Organisational mechanisms

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We rely on two basic concepts:

- Open multiagent system
- Rational agents

# Organisational mechanisms

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A **multiagent system** is a tuple  $\langle Ag, A, X, \tau, x_0, \phi \rangle$ , where:

- $Ag$  – is the set of agents in the system
- $A$  – is an action space
- $X$  – is the environmental state space
- $\tau : X \times A^{|Ag|} \times X \rightarrow [0..1]$  is the systems' transition model for joint actions
- $x_0$  – is the initial environmental state
- $\phi : Ag \times X \times A \rightarrow \{0;1\}$  is the agents' capability function

# Organisational mechanisms

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A **rational agent** is a tuple  $\langle S, O, per, g, t, s_0, U \rangle$ , where:

- $S$  – is the set of possible internal states of the agent
- $O$  – is the observation space of the agent
- $per: X \rightarrow O$  is the perception function
- $g: S \times O \rightarrow S$  is the agent's state transition function
- $t: S \rightarrow A$  is the agent's decision function
- $s_0$  – is the initial internal state
- $U: S \rightarrow R$  is a utility function

And where

$$t(s) = \operatorname{argmax}_{a \in A_{\phi=1}} \sum_{s' \in S} U(s') P(s' | s, a)$$

# Organisational mechanisms

## How to manipulate agents decisions?

- We can rely on the fact that agents are utility maximizer

### Decision function of rational agents:

$$t(s) = \operatorname{argmax}_{a \in A_{\phi=1}} \sum_{s' \in S} U(s') P(s' | s, a)$$

Change the capability  
function

→ **Coercive  
mechanisms**

Change the systems'  
Transition model

→ **Incentive  
mechanisms**

Provide information  
To estimate values

→ **Informative  
mechanisms**

# Organisational mechanisms

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## Clasification of the mechanisms:

**Coercive  
mechanisms**

**Incentive  
mechanisms**

**Informative  
mechanisms**

**Regulative mechanisms**  
(change the environment)

**Organisational mechanisms**

# Organisational mechanisms

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## Informative mechanisms:

- Just provide information
- Rational agents have to evaluate the expected utility of each possible action in order to decide their next action
- This decision is based on the agents' own knowledge and experience
- The knowledge about the system is usually limited
- Additional information may improve the accurateness of their estimations

# Organisational mechanisms

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## Regulative mechanisms:

- Regulative mechanisms introduce changes in the environment with the aim to improve a system's behaviour with respect to some global utility function
- Rational agents are perceptive to modifications in the environment
- They will adapt to such changes over time
- Two types of possible changes in the environment:
  - Incentive mechanisms (rewards and penalties)
  - Coercive mechanisms (change the agents' action space)

# Organisational mechanisms

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## Example: Traffic scenario

- Informative mechanisms: information panels
- Regulative mechanisms:
  - Incentive mechanisms: fines, toll roads, ...
  - Coercive mechanisms: barriers, building new roads, ...

# Organisational mechanisms

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- Provide a mean to obtain an efficient functioning in open multiagent organisations:
  - Seem to be more appropriate for adapting an organisation to its particular context (e.g., the agents participating)
- They can be applied even if there is no full control of the system:
  - Coercive mechanisms > incentive mechanisms > informative mechanisms

# Our vision of multiagent organisations

## Multiagent organisations

### **Organisational mechanisms:**

- Aiming at improving the global utility of a system
- Adaptation to a particular context
- Obtaining an efficient global behaviour

### **Organisational meta-model:**

- Designing the global functioning of a system
- Assuring basic behaviour
- Representing real world organisational structures