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# Using the *Moise*<sup>+</sup> Organisational Model for a Cooperative Framework of MAS Reorganisation

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# Context

- A multiagent system has two properties which seems controversial:

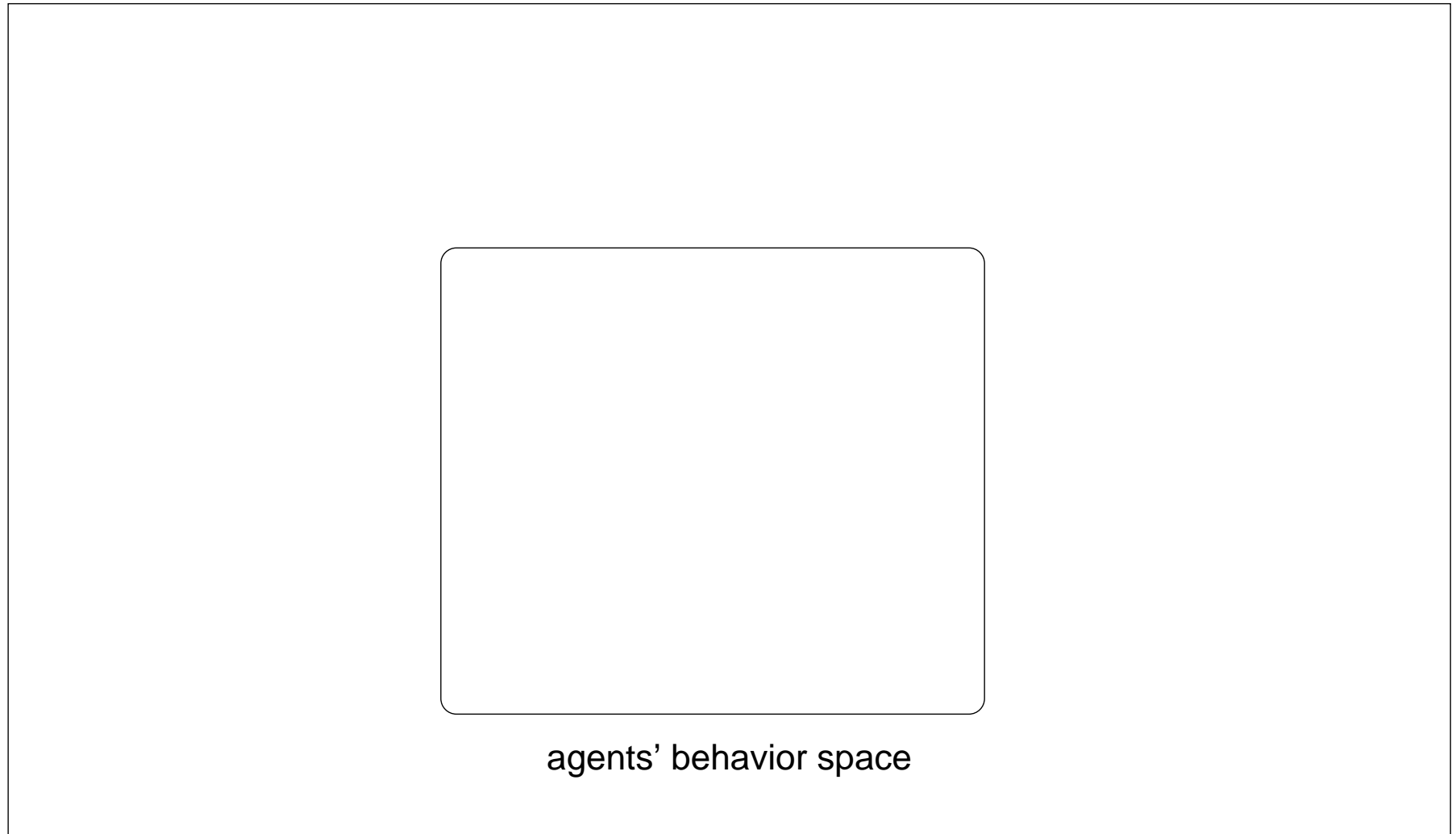
- ★ a **global** purpose × **autonomous** agents

While the autonomy of the agents is essential for the MAS, it may cause the looseness of the global congruence.

- The **organisation** of an MAS is used to solve this conflict constraining the agents' behaviour towards global purposes.
- Example: when an agent adopts a role, it indeed adopts a set of behavioural constraints that collaborates for a global purpose.

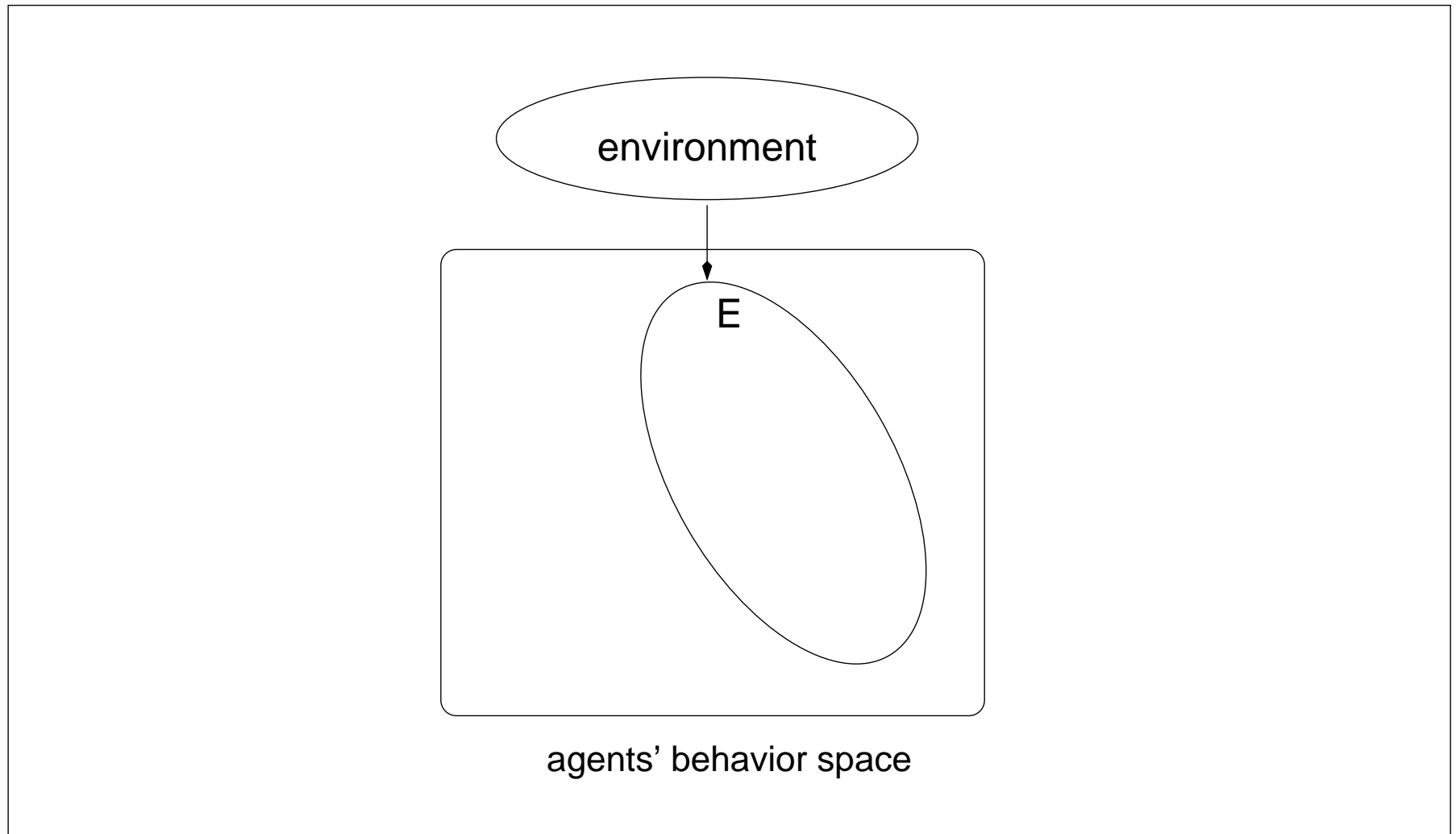
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# Our point of view on organisation

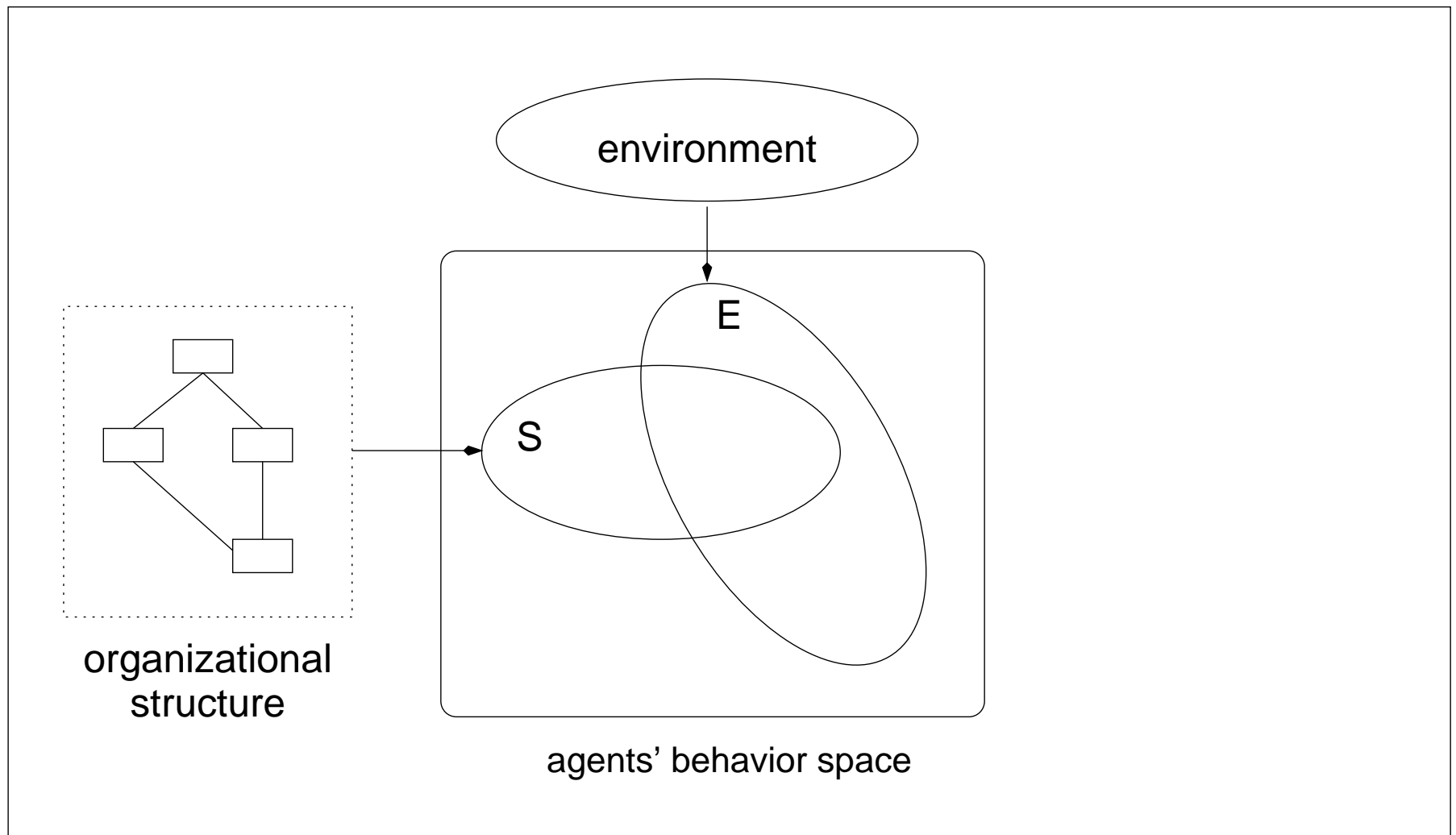


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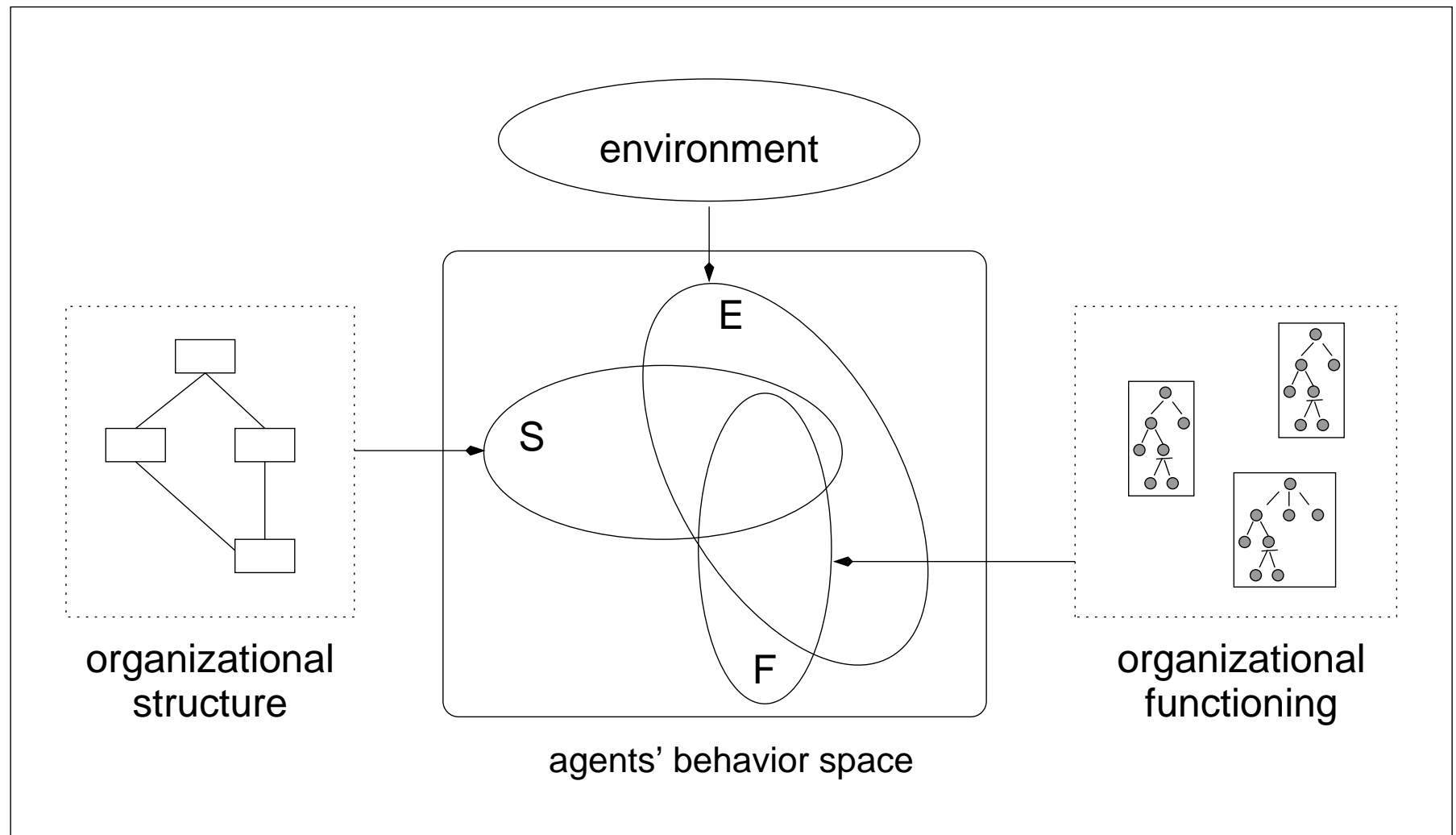
# Our point of view on organisation



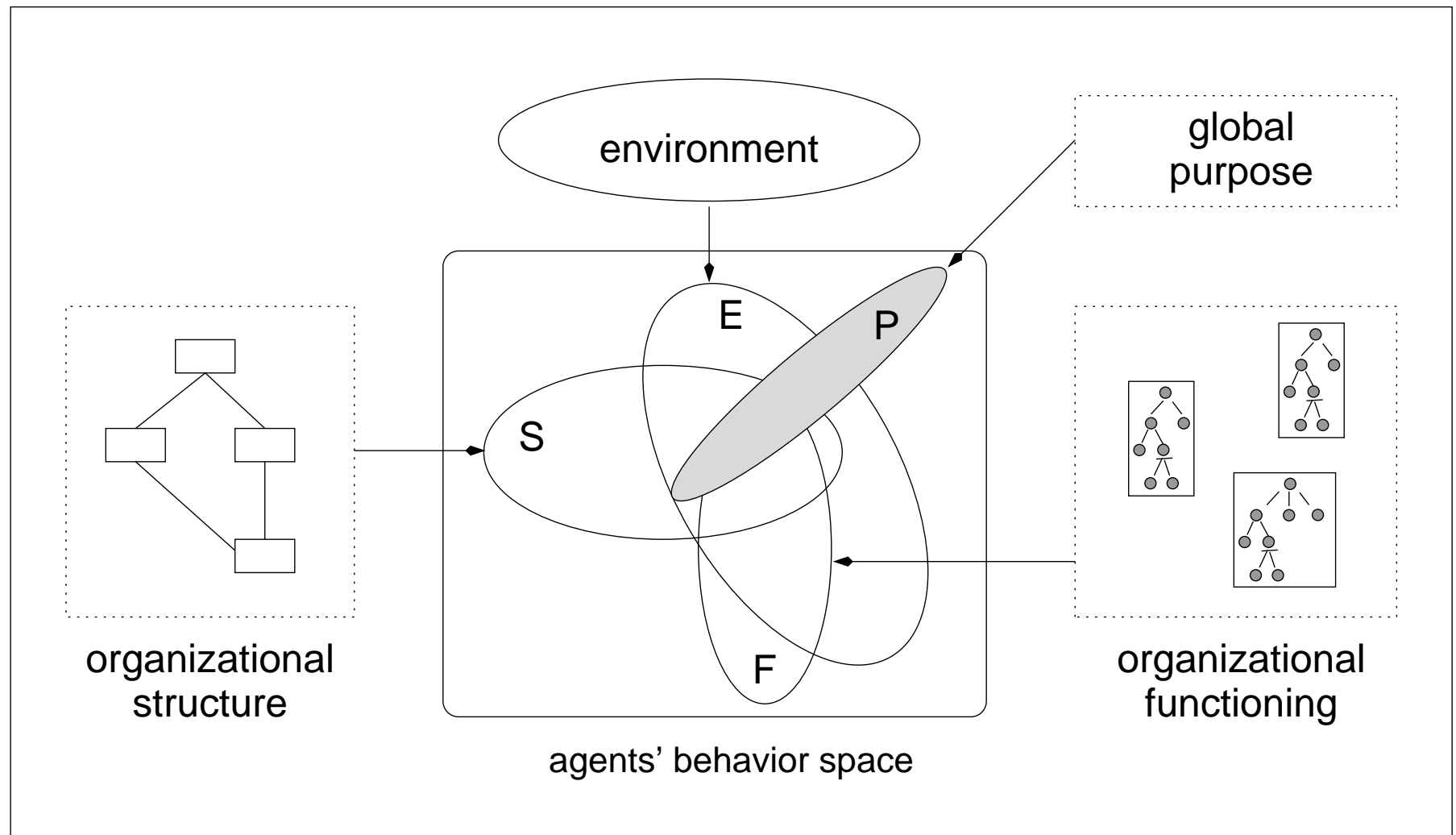
# Our point of view on organisation



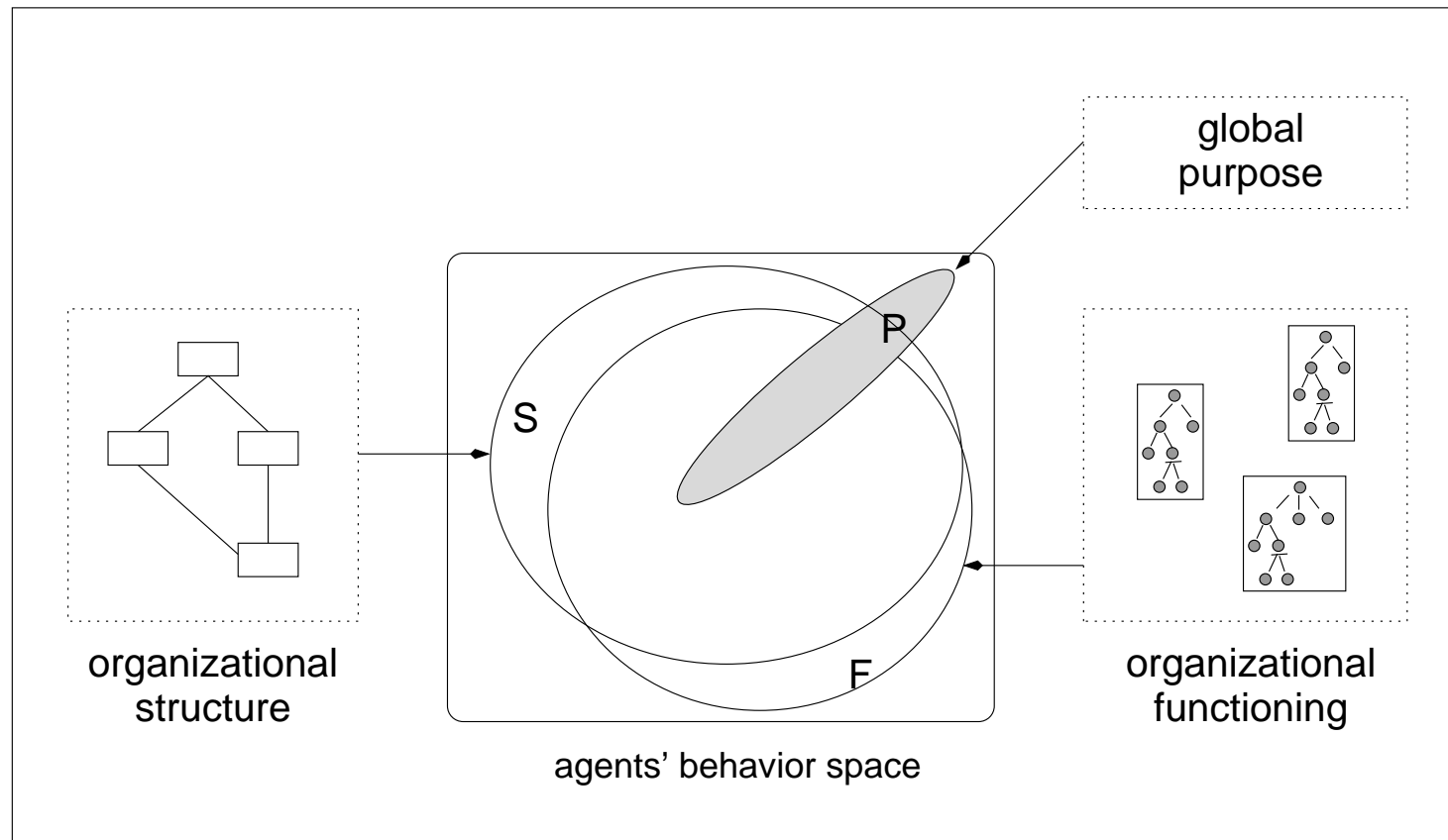
# Our point of view on organisation



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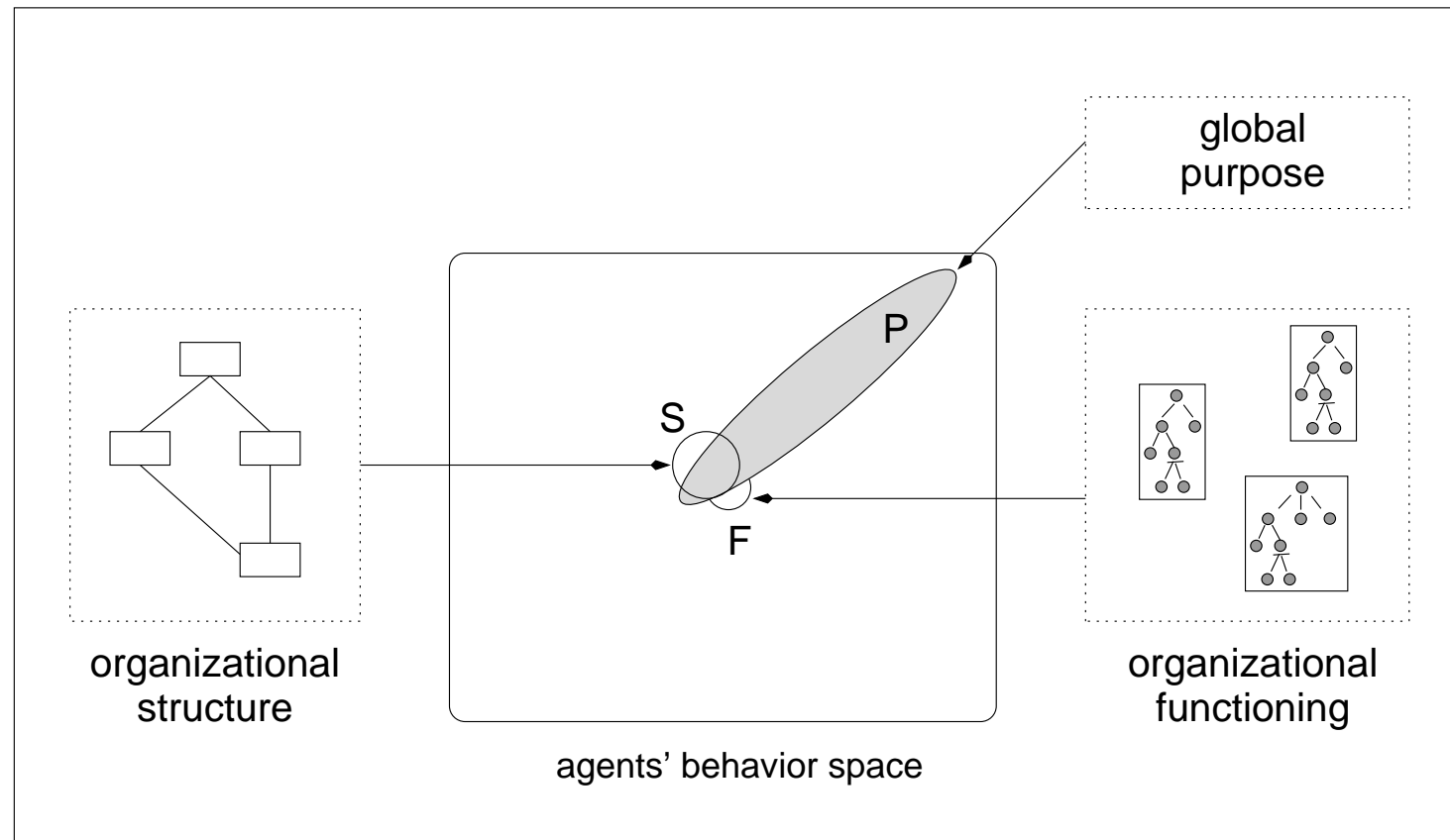
# The **problem** of finding a good organisation



(the organisation does not help to global purpose)



# The **problem** of finding a good organisation



(the organisation extinguish the agents' autonomy)

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## The problem of finding a good organisation on **dynamic** environment

- Initially, the problem can be solved by the MAS designer.
- On dynamic and open environments, the agents themselves must change its organisation.

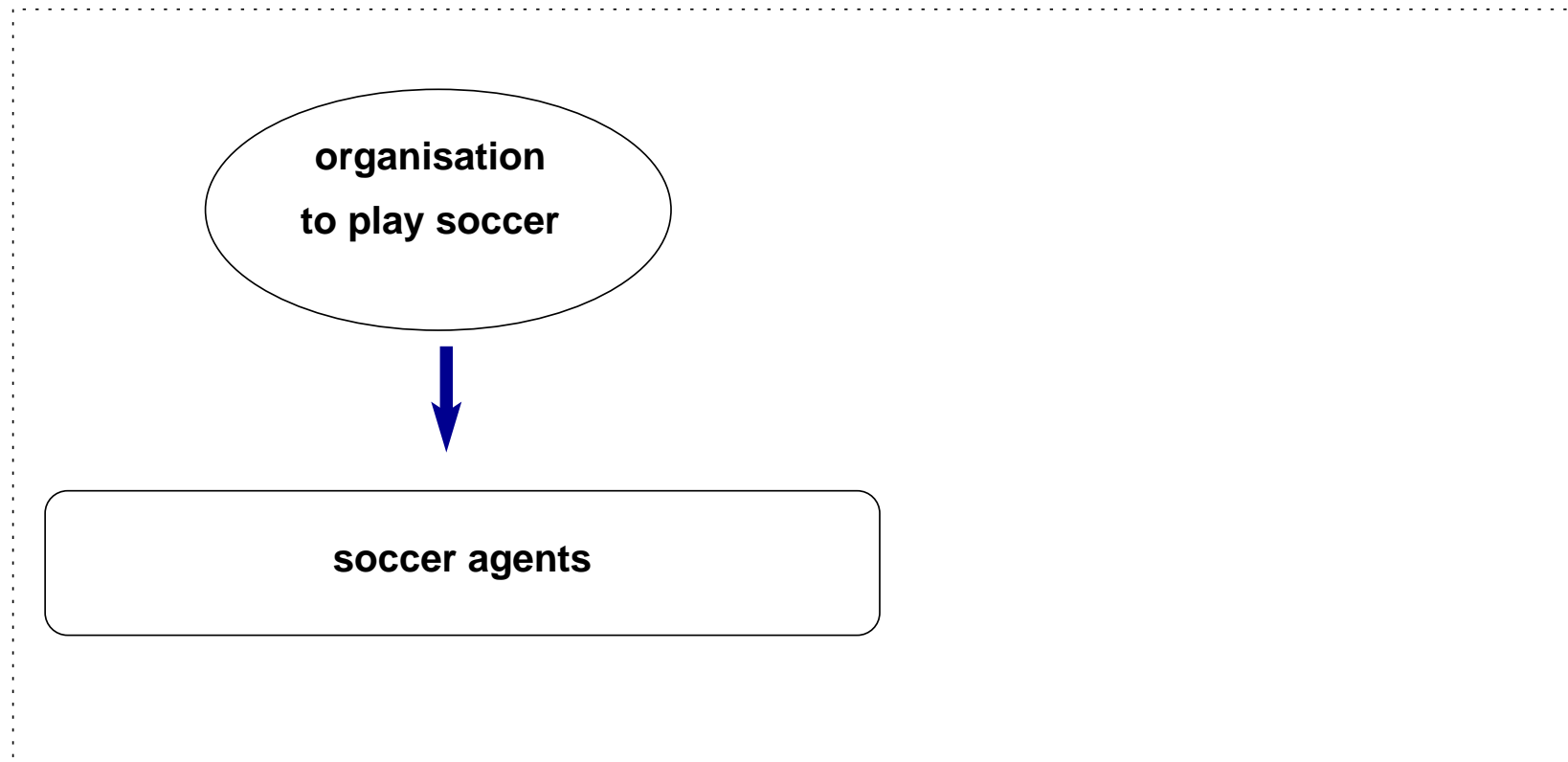
★ **reorganisation**

# Study Case: **Robocup** small size league

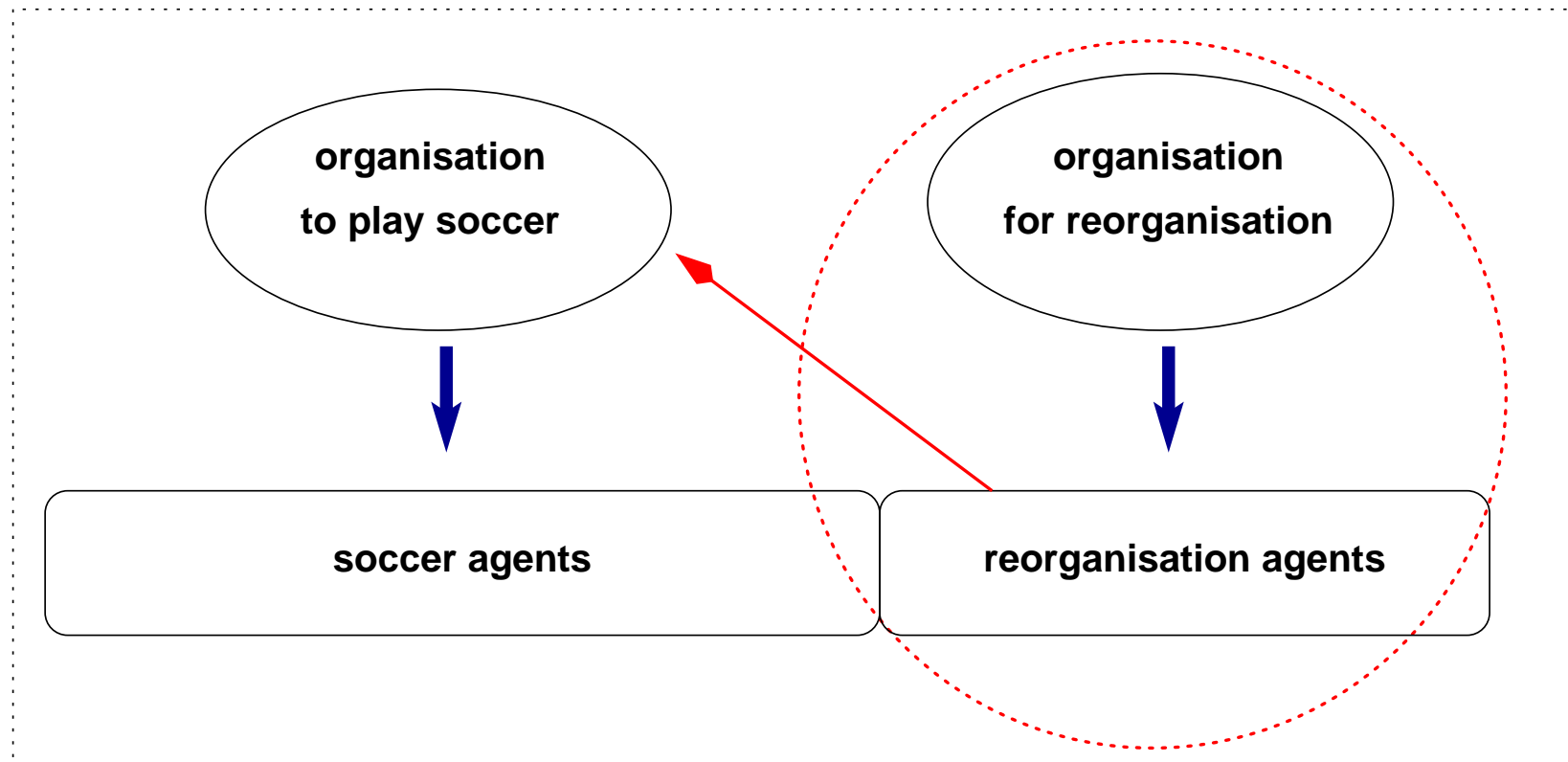


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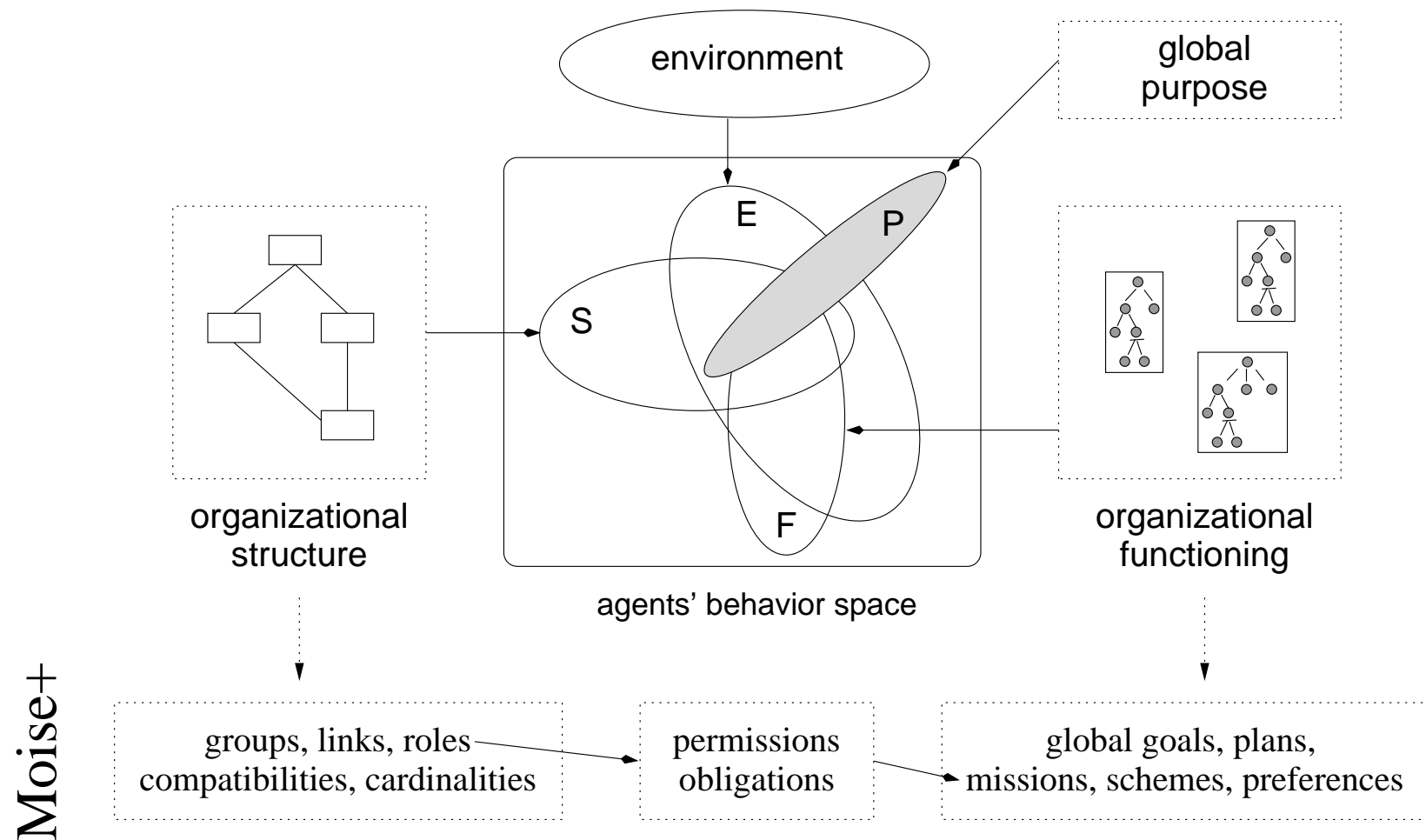
# JOJTEAM organisation



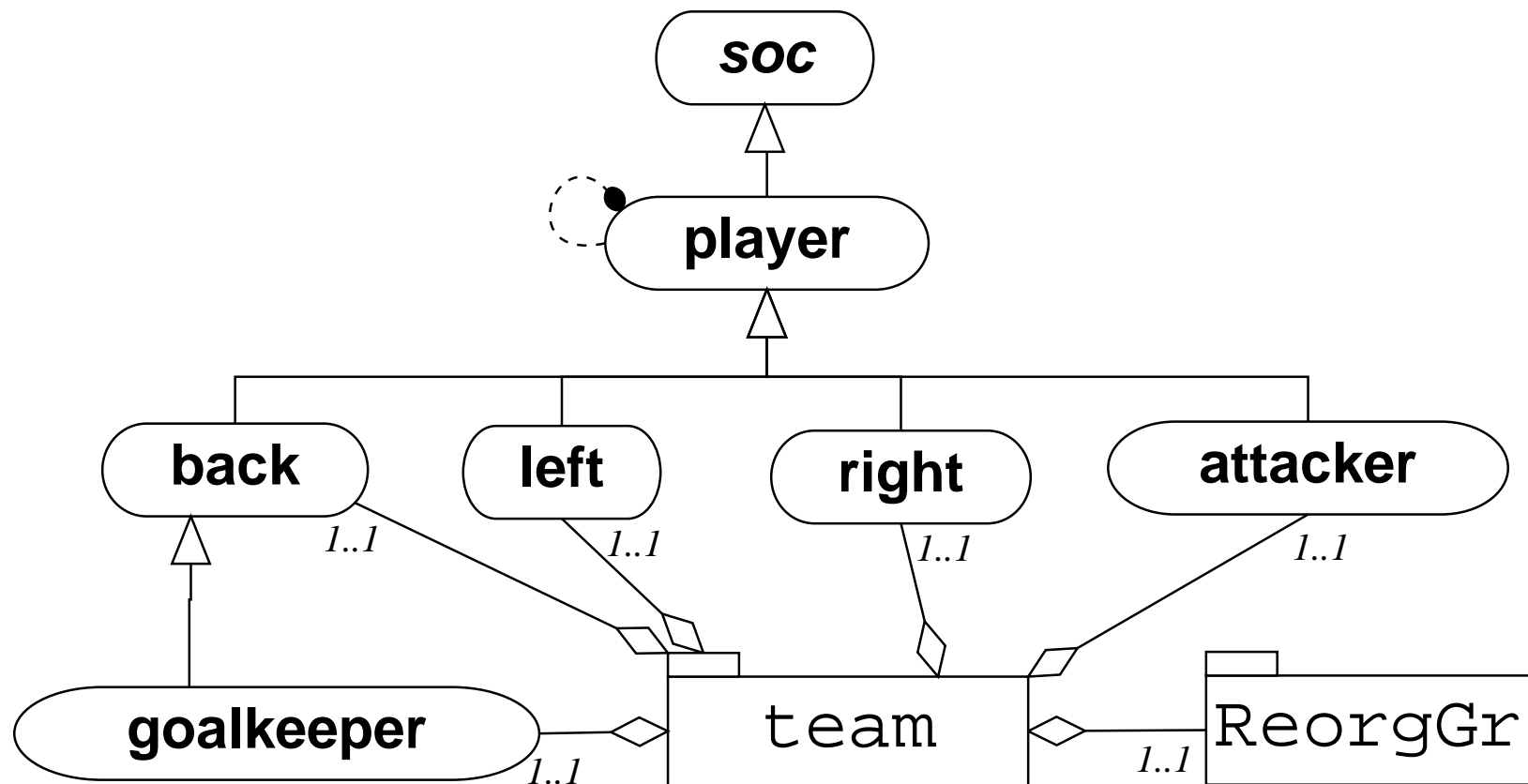
# Our approach

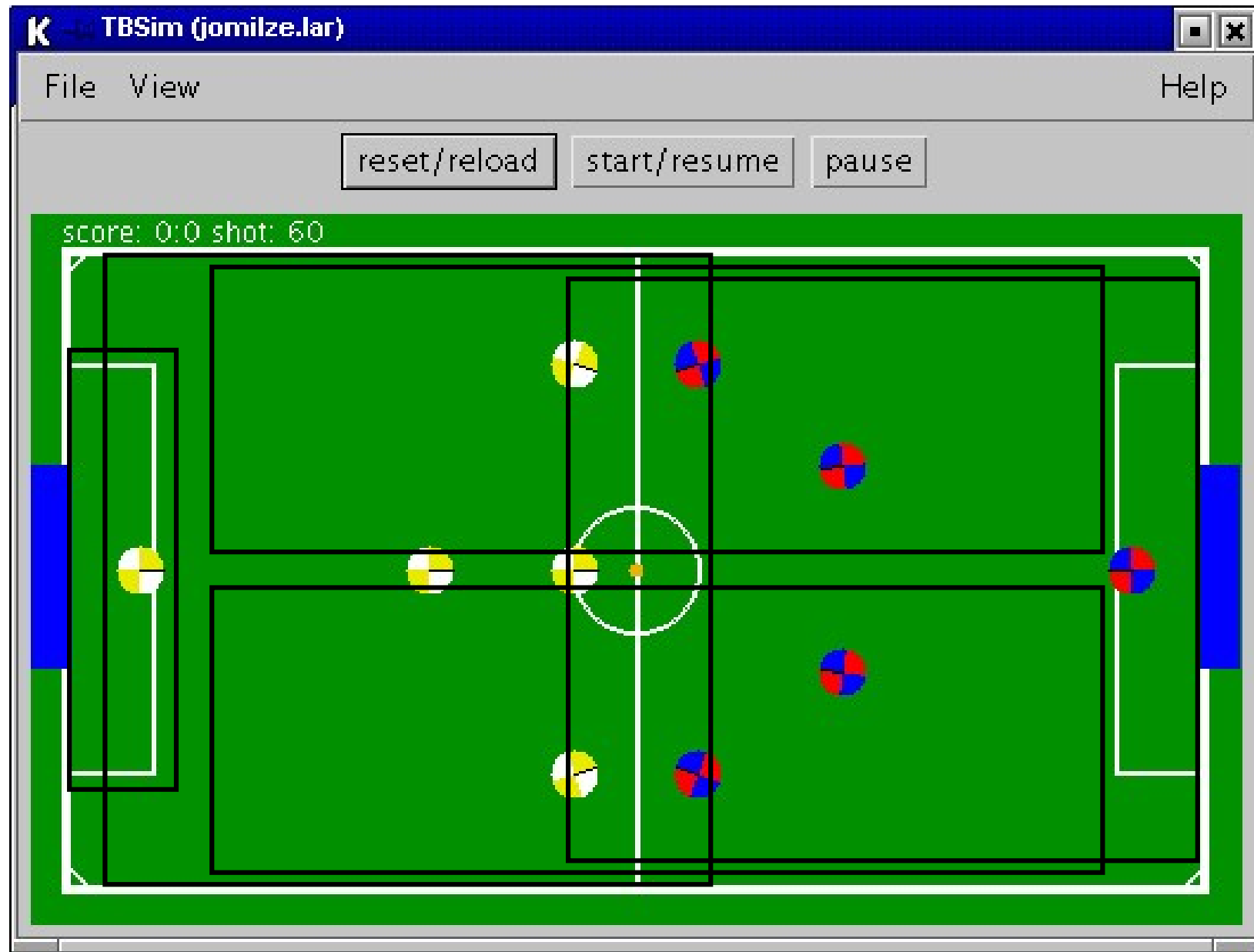


# Specifying organisations $\mathcal{MOISE}^+$



# The initial organisational structure of the JOJTEAM

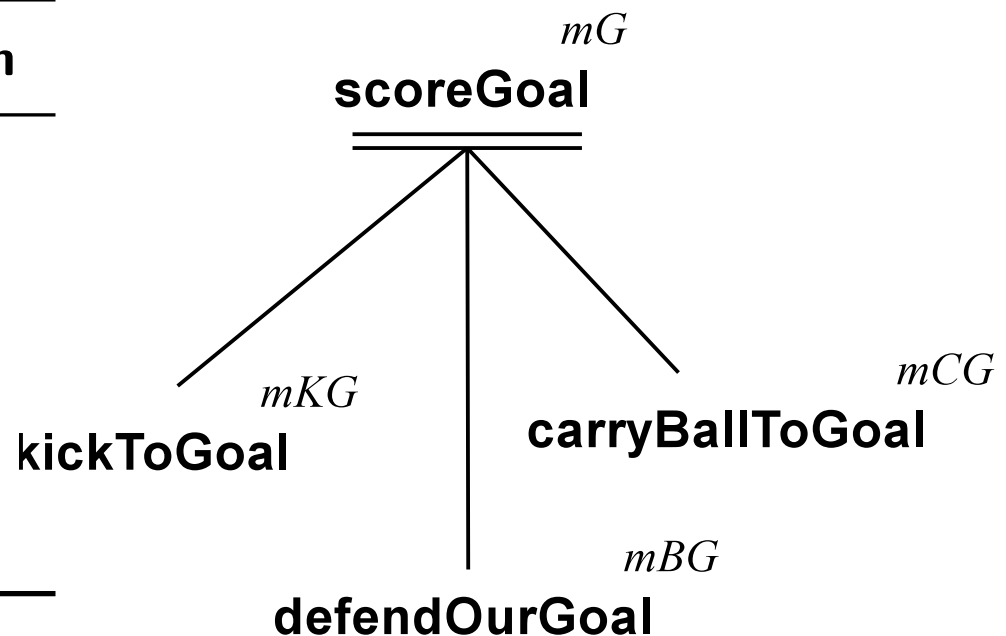




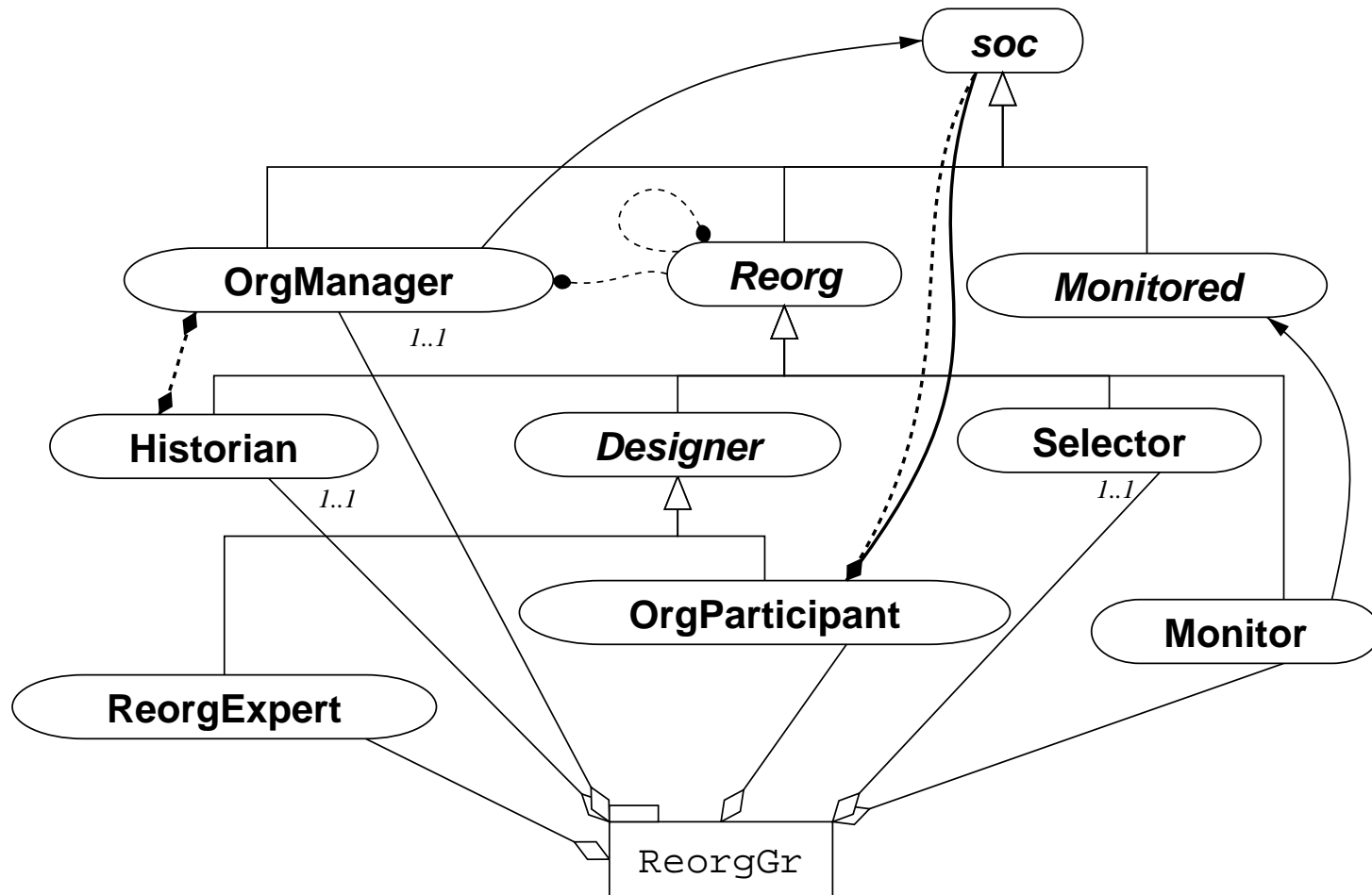


# The initial organisational functioning of the JOJTEAM

role	deontic	mission
<i>back</i>	<i>obligated</i>	<i>mKG</i>
<i>left</i>	<i>obligated</i>	<i>mCG</i>
<i>right</i>	<i>obligated</i>	<i>mCG</i>
<i>attacker</i>	<i>obligated</i>	<i>mCG</i>
<i>goalkeeper</i>	<i>obligated</i>	<i>mBG</i>



# Structural dimension of the reorganisation



# Functional dimension of the reorganisation

## deontic relations:

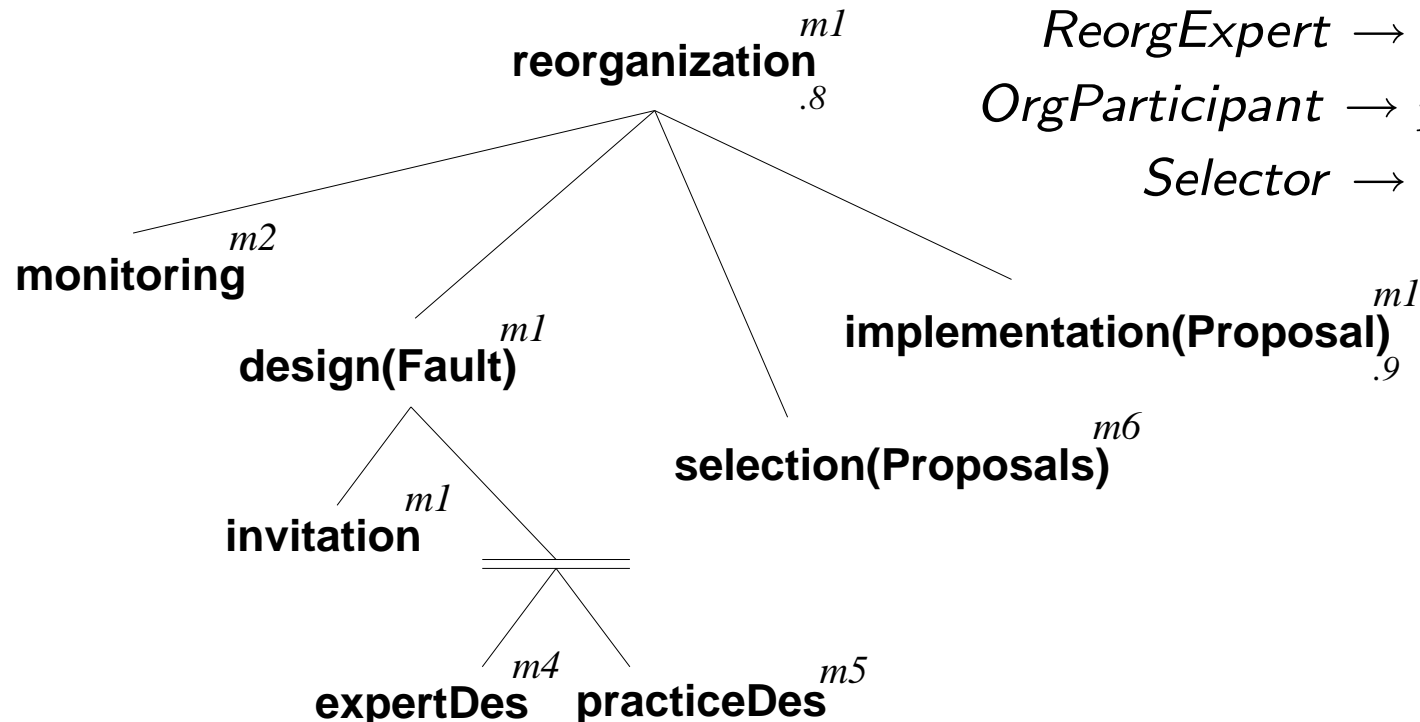
*OrgManager*  $\rightarrow$  *obl*( $m_1$ )

*Monitor*  $\rightarrow$  *obl*( $m_2$ )

*ReorgExpert*  $\rightarrow$  *obl*( $m_4$ )

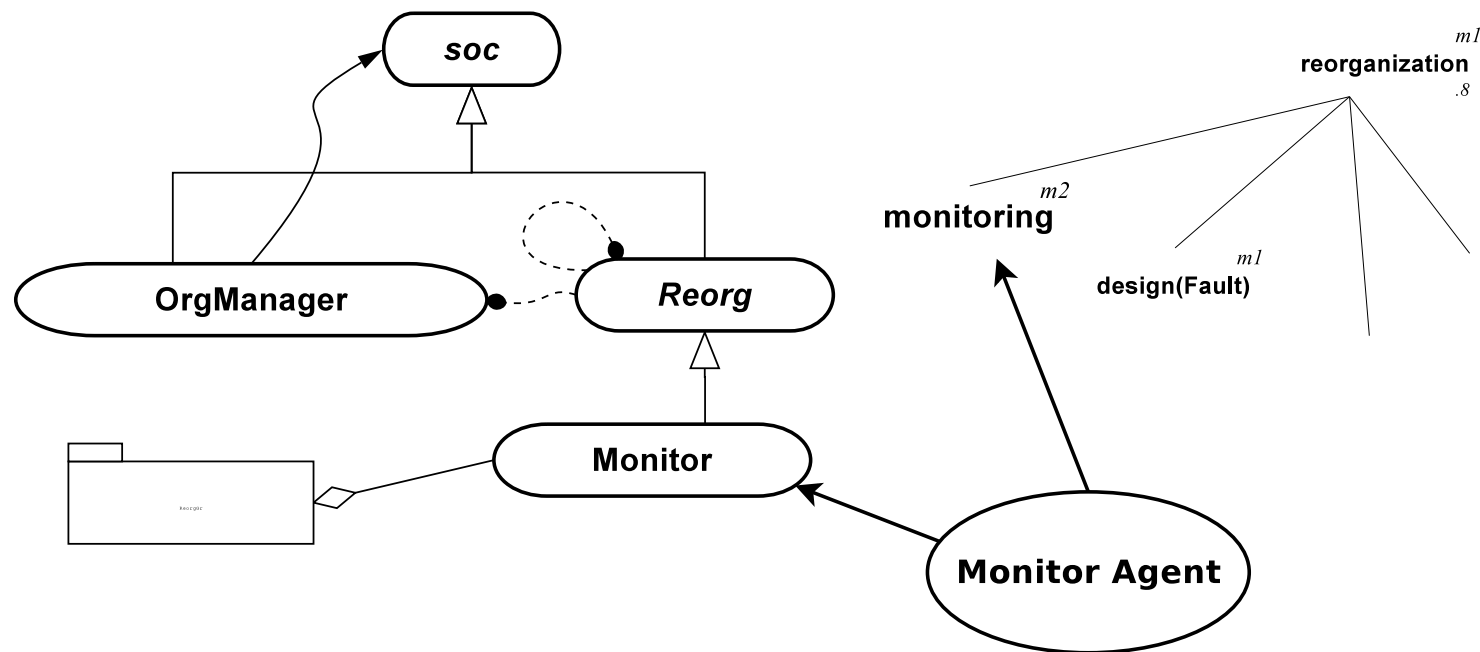
*OrgParticipant*  $\rightarrow$  *per*( $m_5$ )

*Selector*  $\rightarrow$  *obl*( $m_6$ )



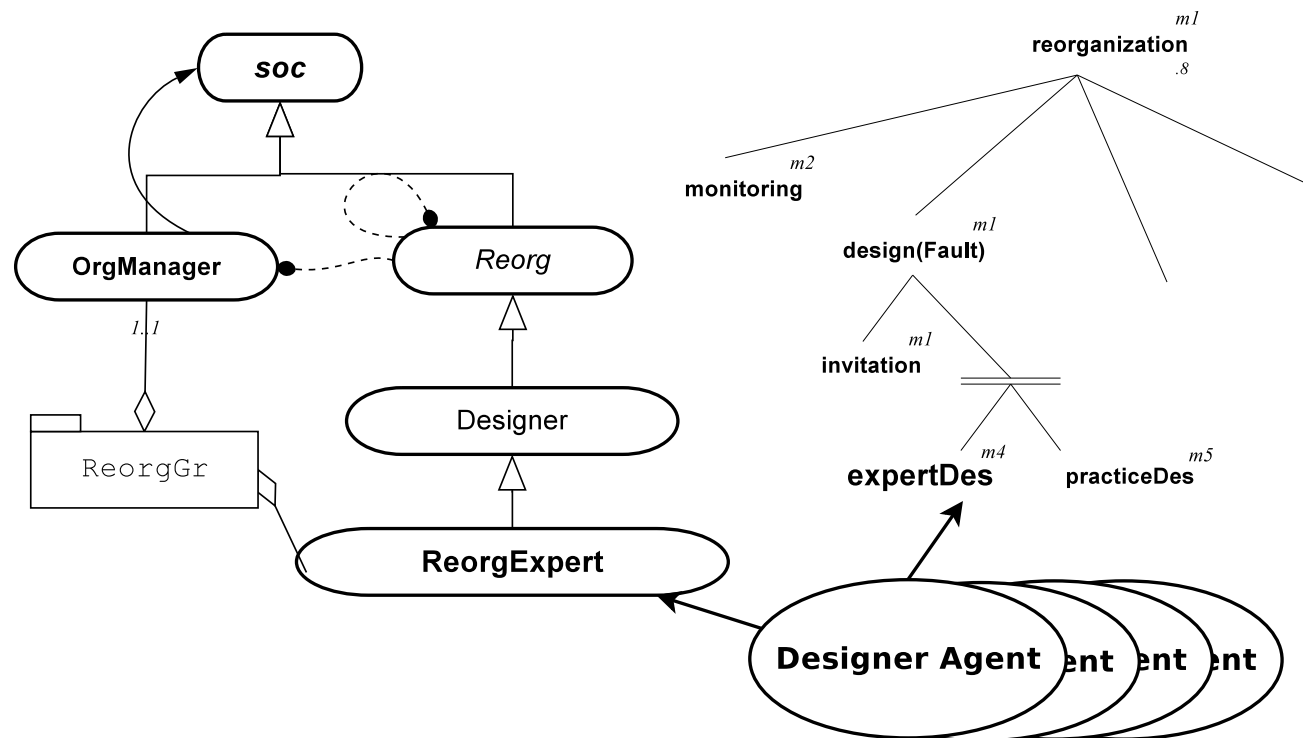
# Monitoring goal

- JOJTEAM: the Monitor agent starts a reorganisation each 24.000 simulation step (5 reorganisation each game)



# Design goal

- JOJTEAM: 9 designers that always propose the same kind of reorganisation ( $1 \times 1 \times 3$ ,  $4 \times 1$ , increase the players area, change the team goals, ...)



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- The reorganisation change must be proposed as a **reorganisation plan**.
  - Example:
    1. remove all roles from group team;
    2. create role back extending player;
    3. set back property area as "-137x40 10x-40";
    4. add role back into group team;
    5. define mission mKG as {kickToGoal};
    6. add mission mKG as obligation for back;
    - ...
  - A plan may change either the structure or the functioning (e.g. add a new mission for the Goalkeeper).

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## Selection goal

- JOJTEAM: 1 agent that uses Q-Learning the learn when to choose each designer proposal
- State: match time (5 moments) and game score  $(-2,-1,0,1,2)$
- Actions: choose designer 1, choose designer 2, .... choose designer 9
- Reward: goals

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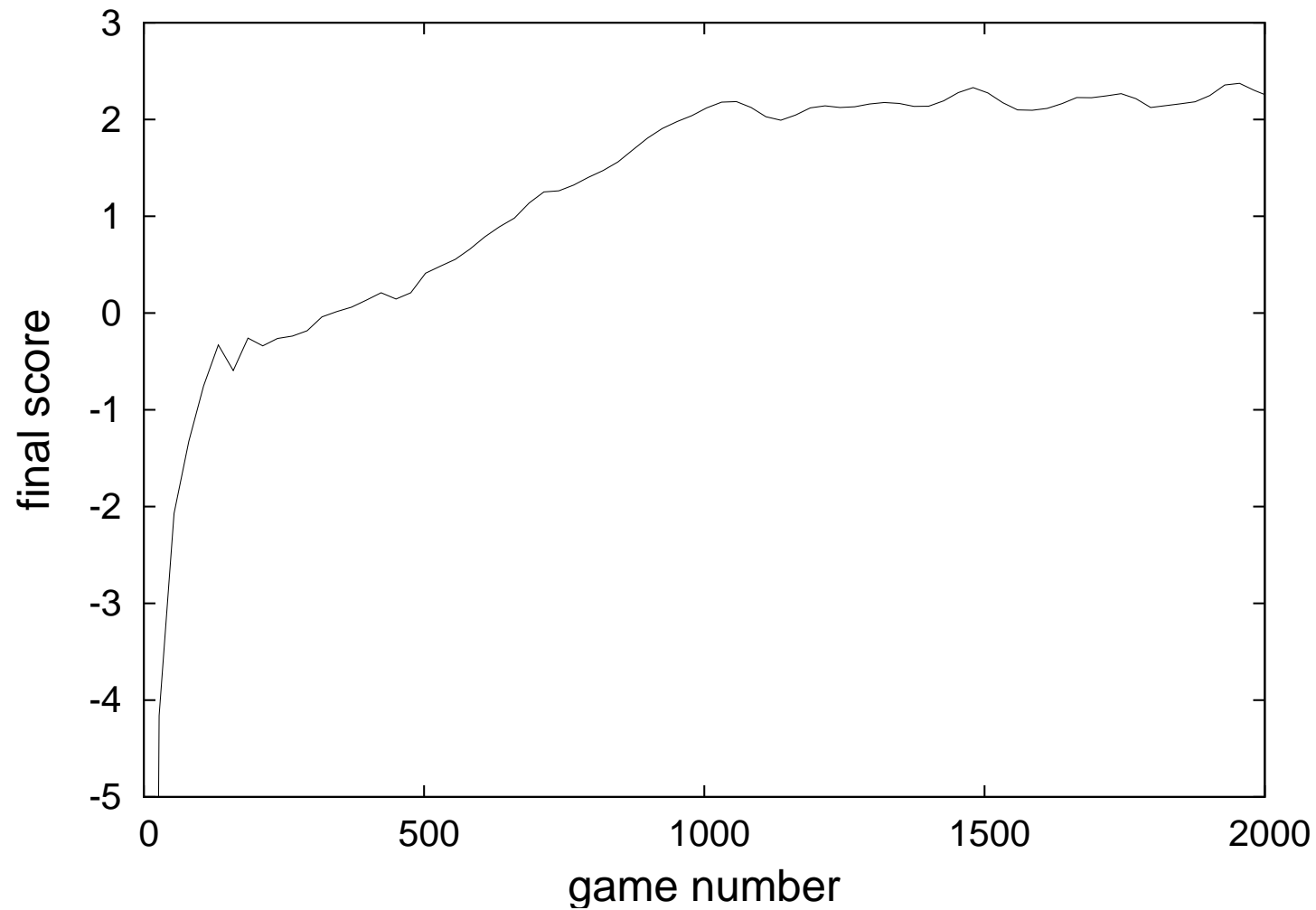
## Implementation goal

- The OrgManager agent executes the reorganisation plan selected.



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# Results

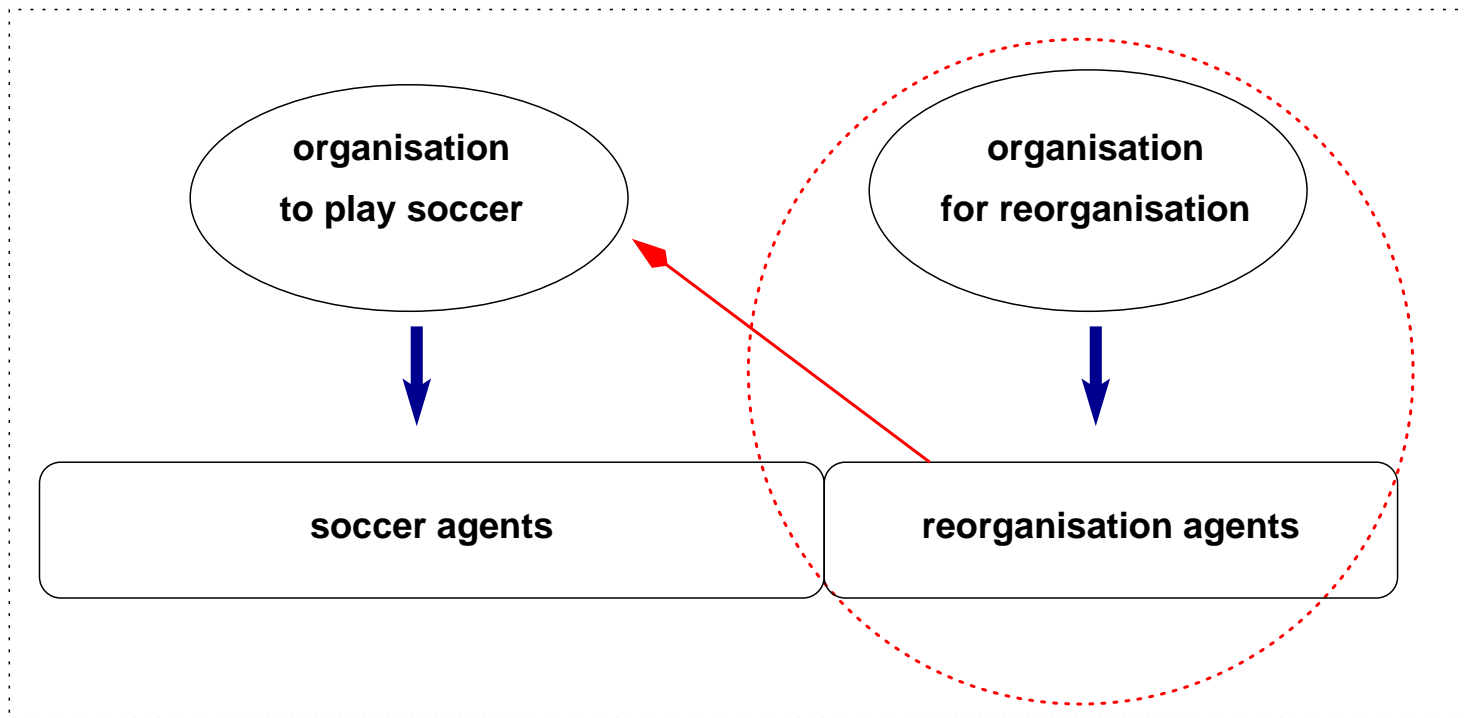


# Learnt policy

state (time, score)	action	state (time, score)	action
(0,0)	4x1		
(1,-2)	1x3x1	(2,-2)	4x1
(1,-1)	4x1	(2,-1)	4x1
(1,0)	4x1	(2,0)	nochange
(1,1)	unflexGolie	(2,1)	nochange
(1,2)	nochange	(2,2)	flex
(3,-2)	1x1x3	(4,-2)	4x1
(3,-1)	flexGolie	(4,-1)	nochange
(3,0)	1x1x3	(4,0)	flex
(3,1)	4x1	(4,1)	flex
(3,2)	nochange	(4,2)	nochange

# Conclusions

- Since the reorganisation is a process like any other, an agent that understand  $\mathcal{M}\text{OISE}^+$  specification can participate on reorganisation — thus it simplifies **openness**, “team programming”.



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- The reorganisation can have many monitoring and designing strategies.
  - The reorganisation plans simplifies the design of new organisation and deal with some implementation problems.
  - The  $\mathcal{M}\text{OISE}^+$  independence among structure and functioning simplifies the construction of reorganisation plans.
  - An implementation is available at  
<http://www.lti.pcs.usp.br/moise>