Using the $\mathcal{M}$oise$^+$ Organisational Model for a Cooperative Framework of MAS Reorganisation

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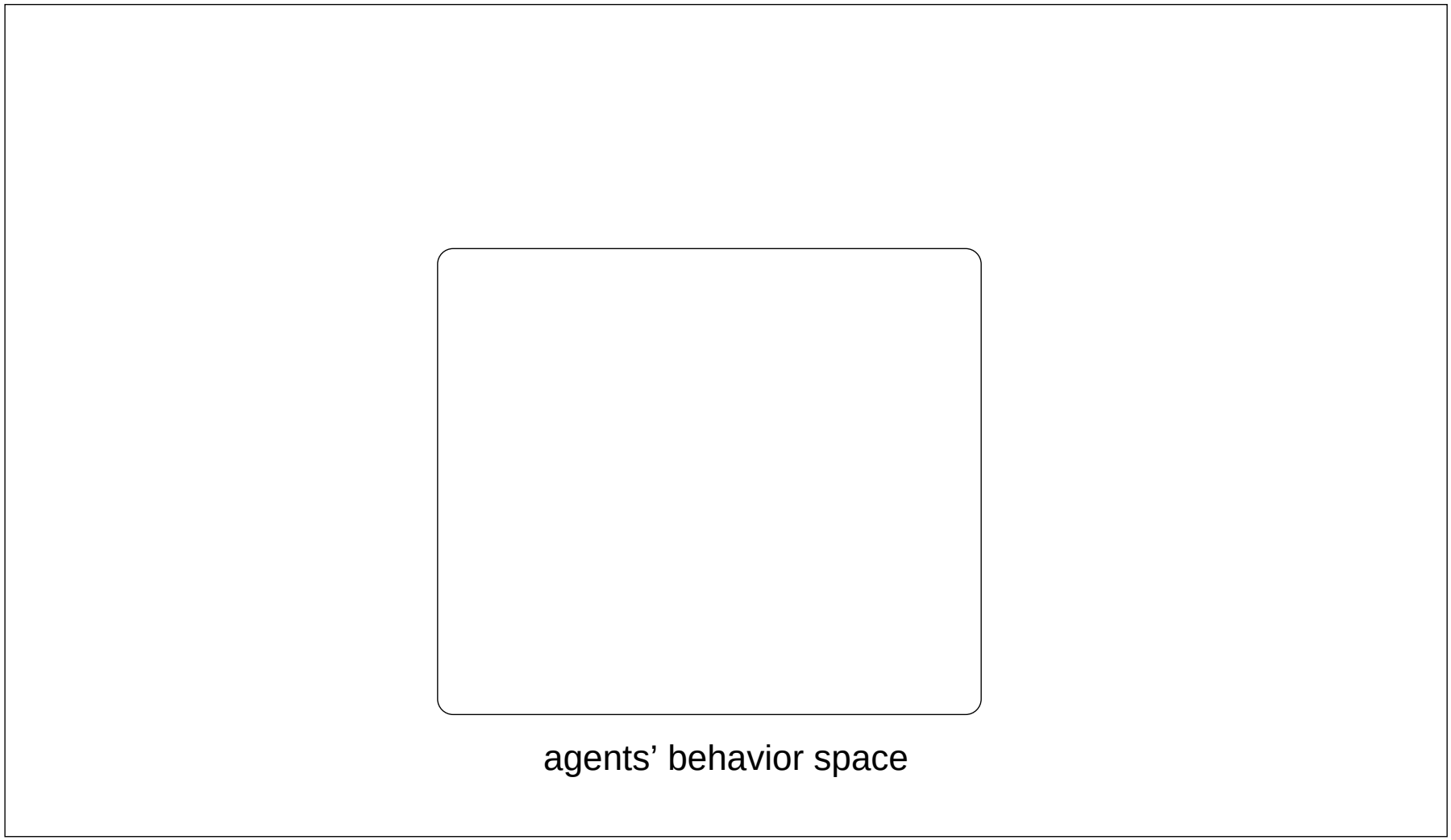
Context

- 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.

Our **point of view** on organisation



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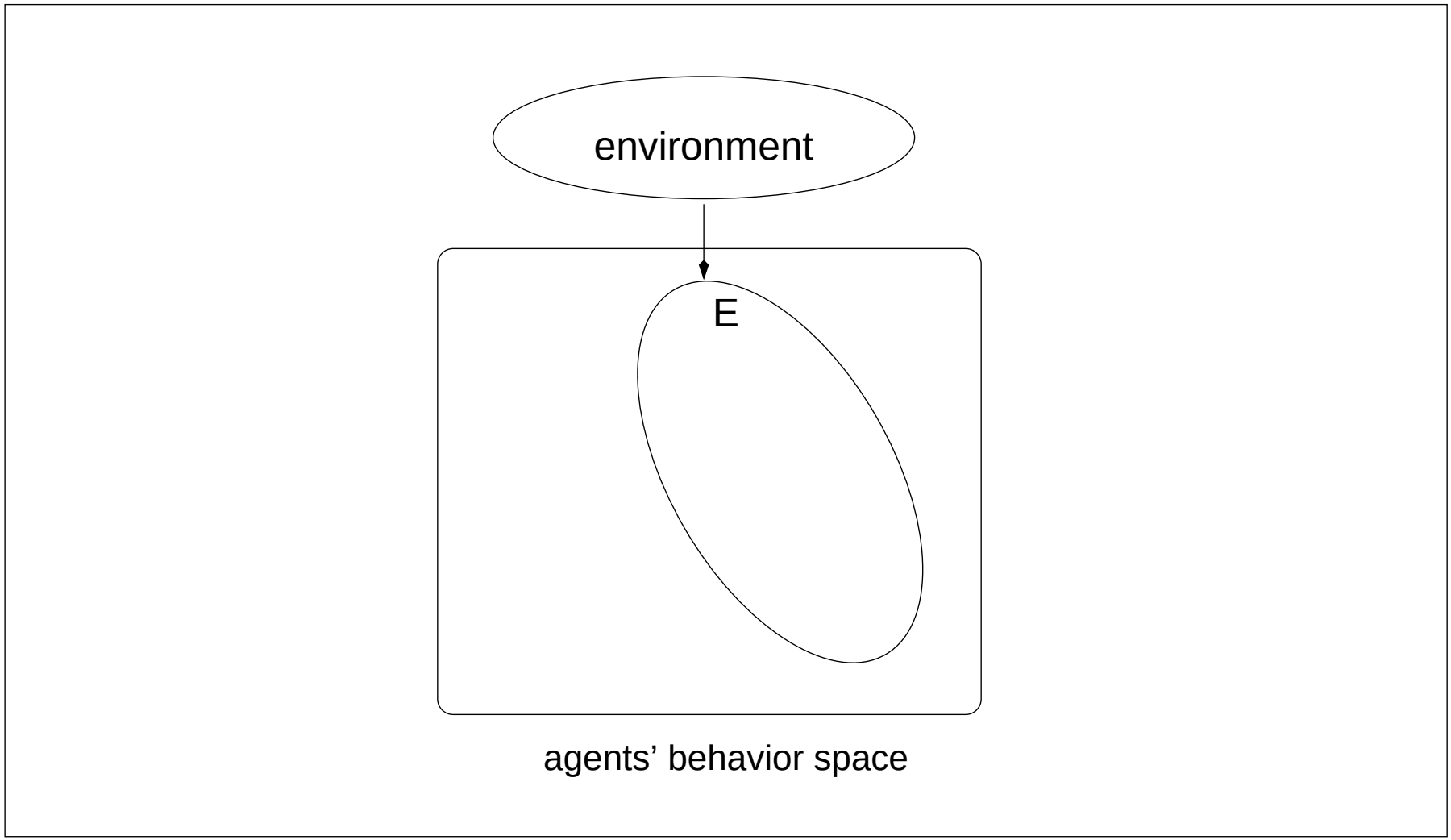

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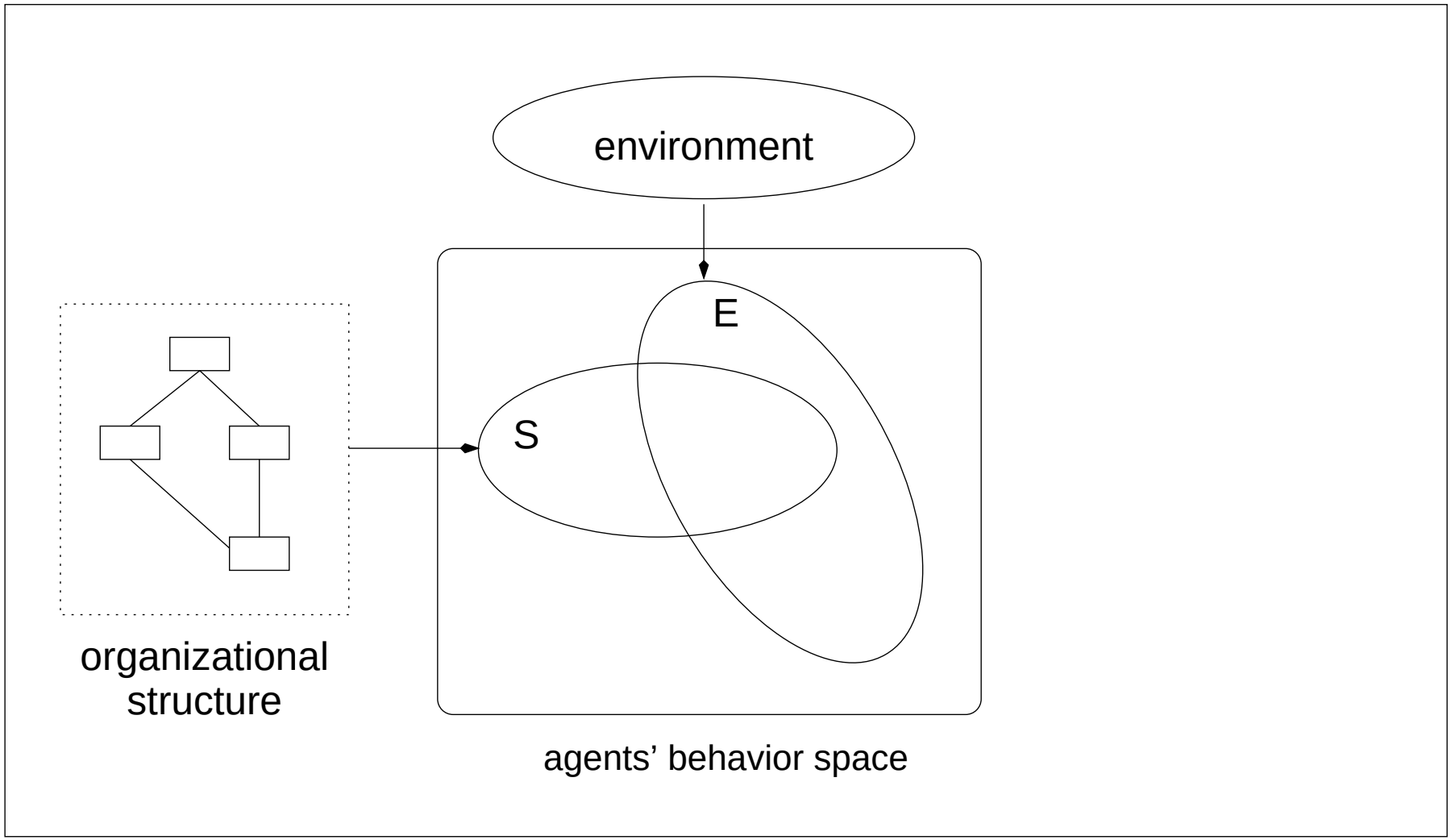

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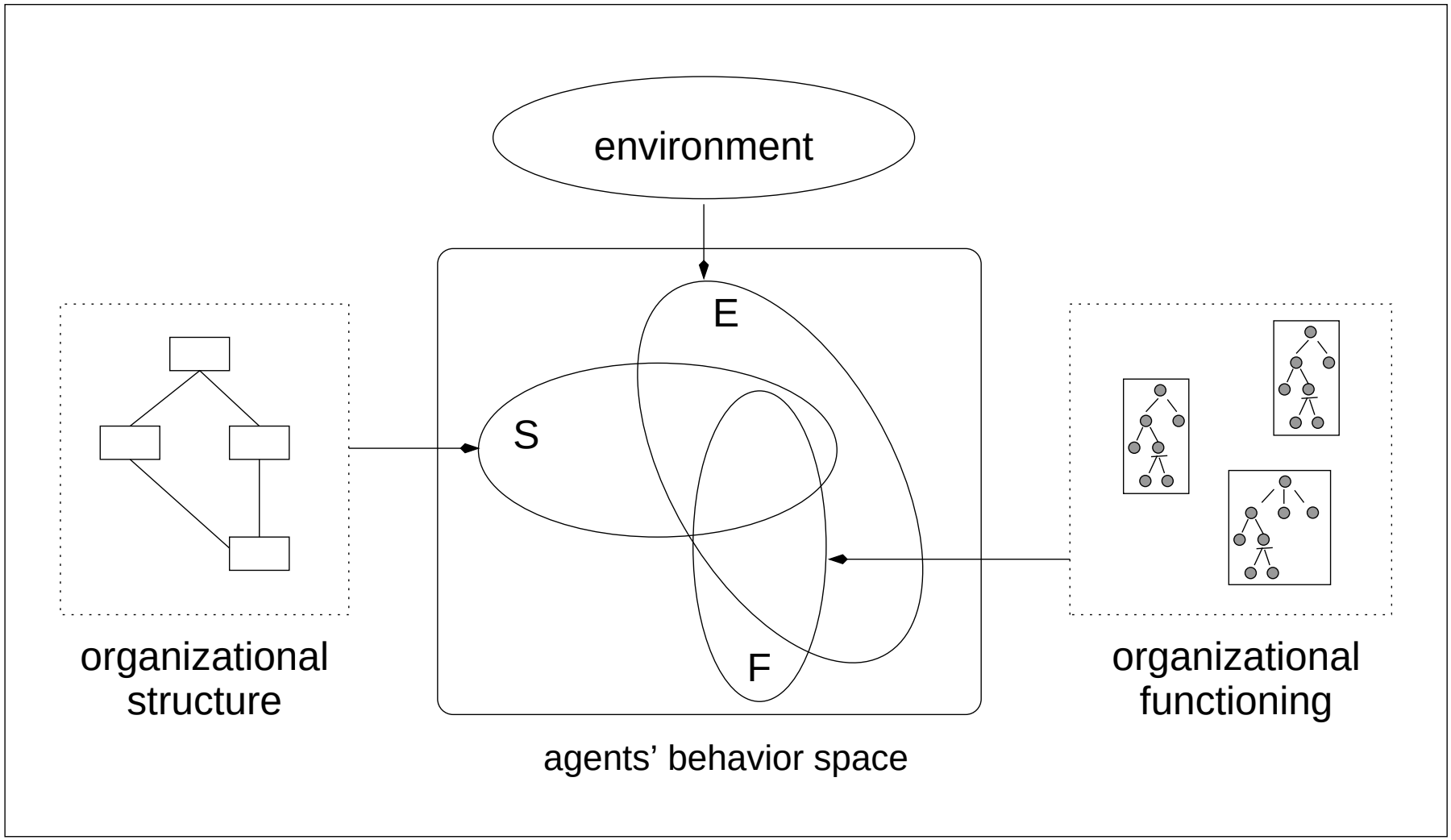
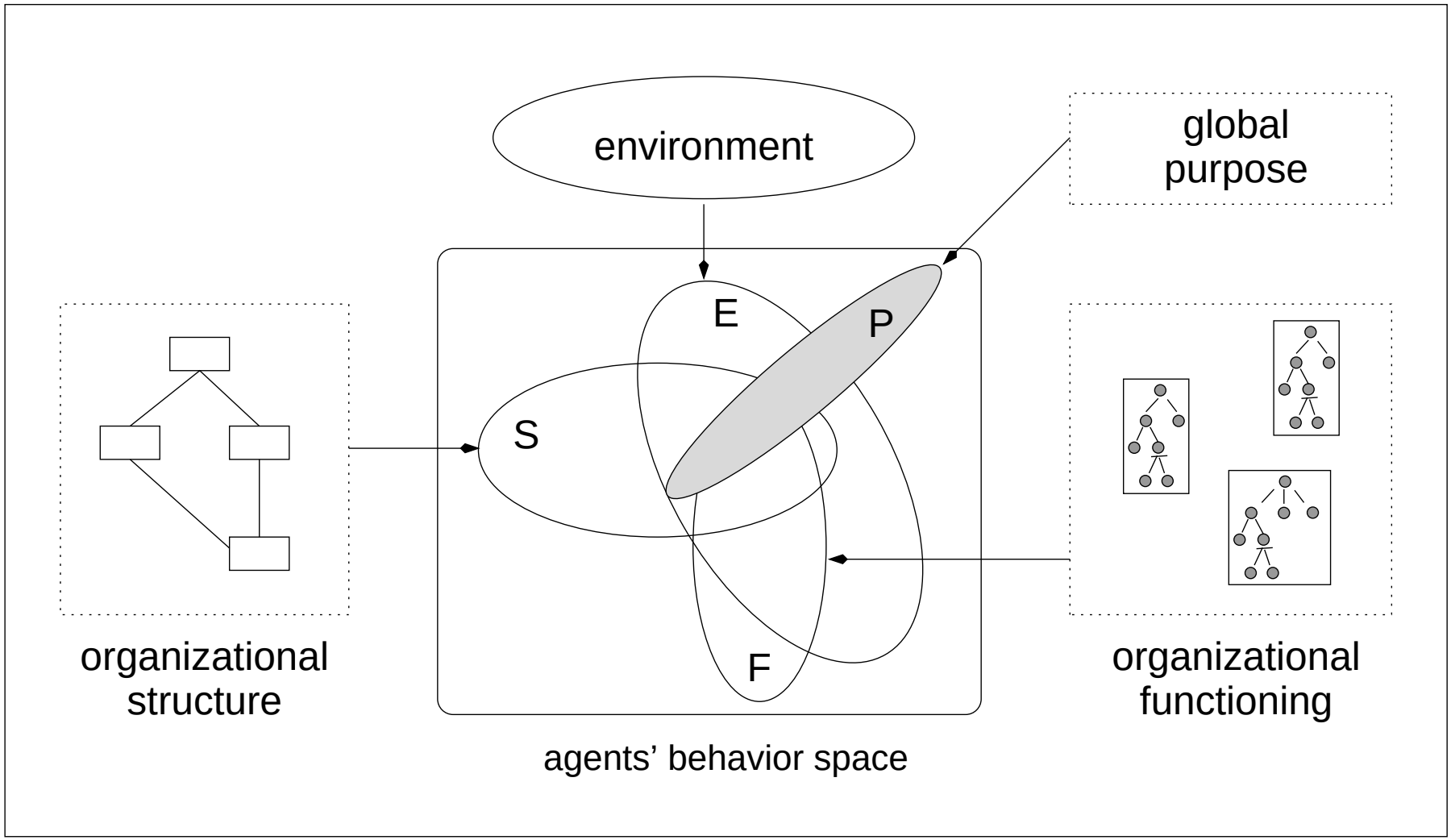
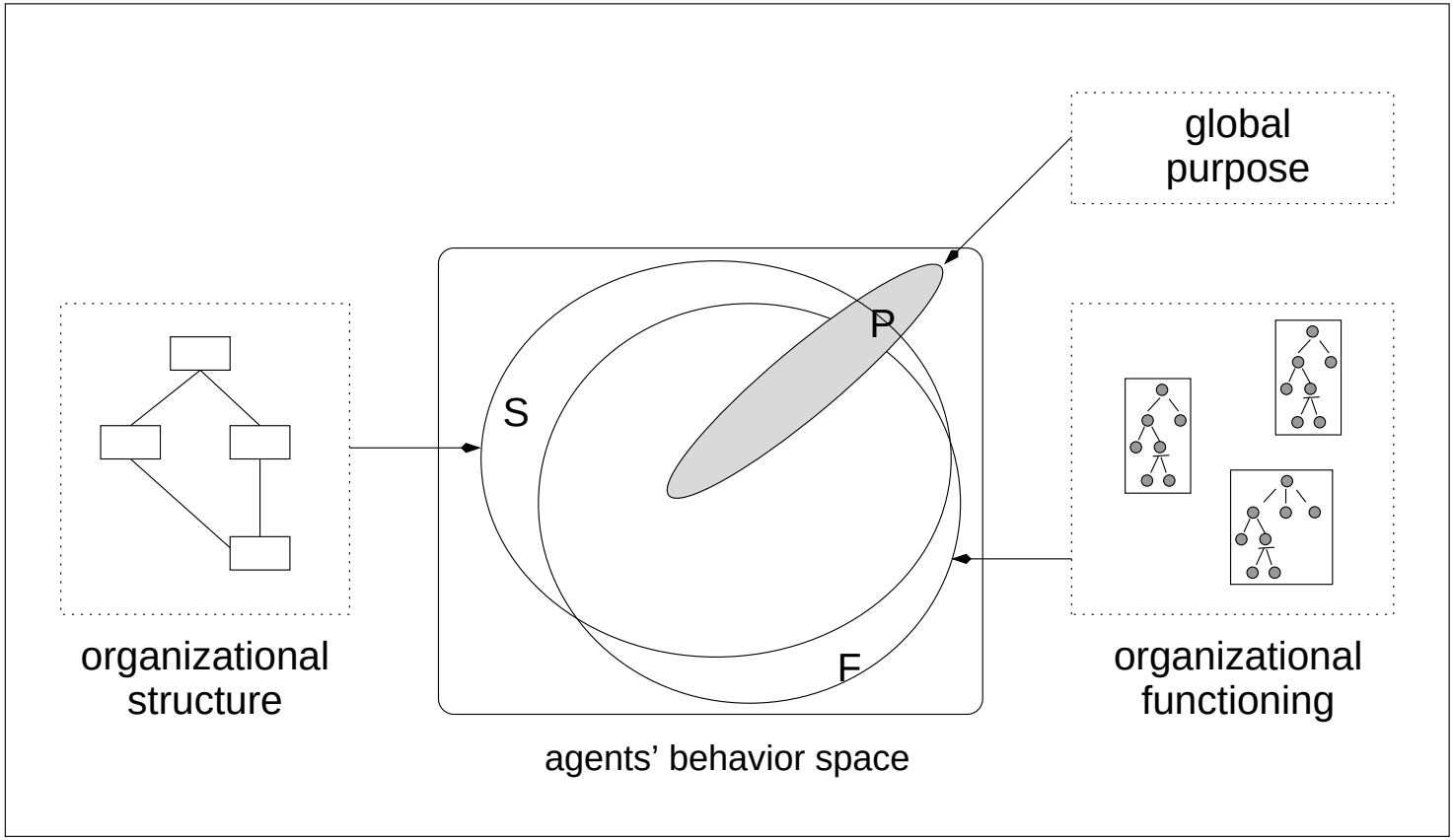


Our **point of view** on organisation

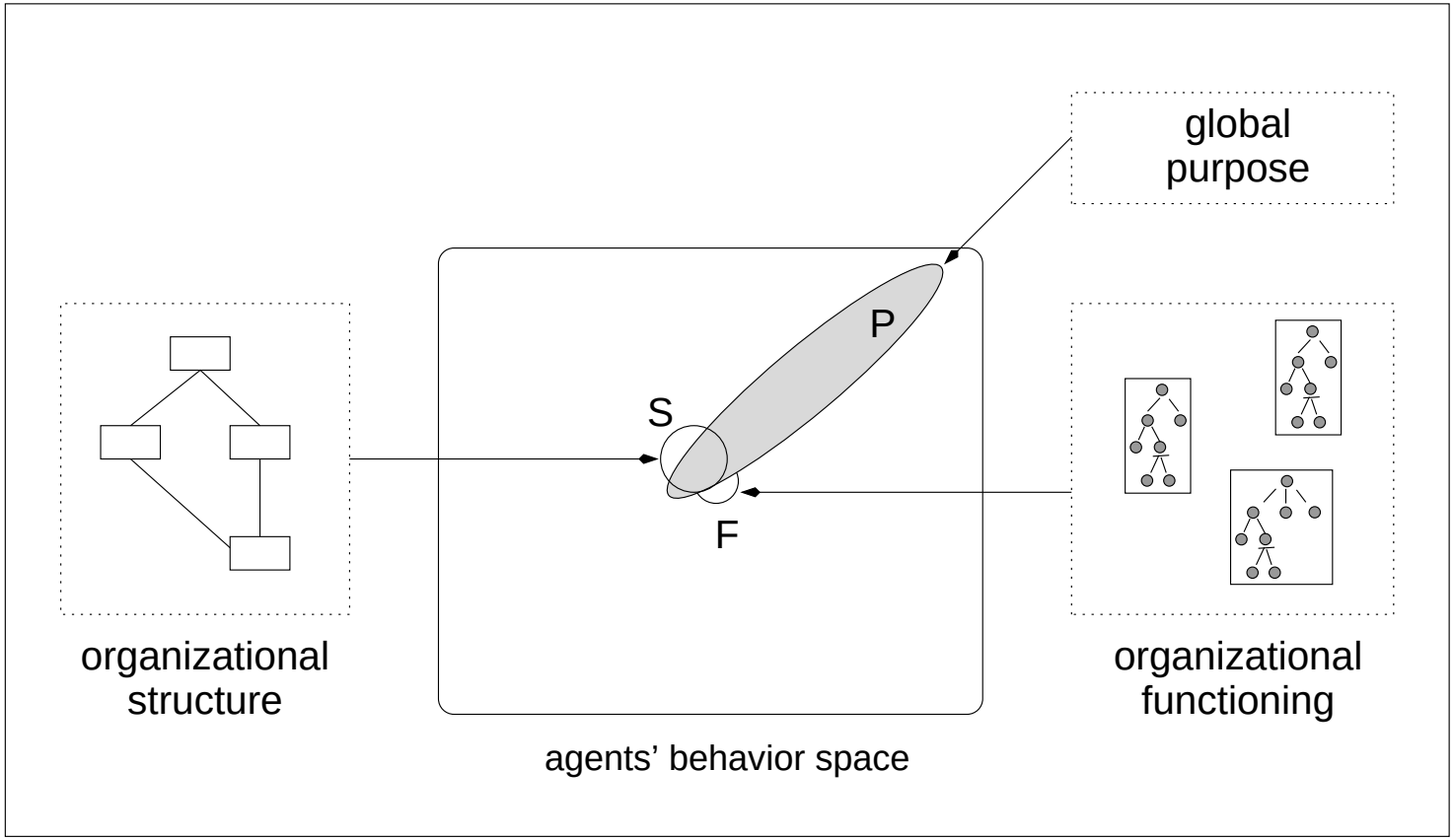


The **problem** of finding a good organisation



(the organisation does not help to global purpose)

The **problem** of finding a good organisation



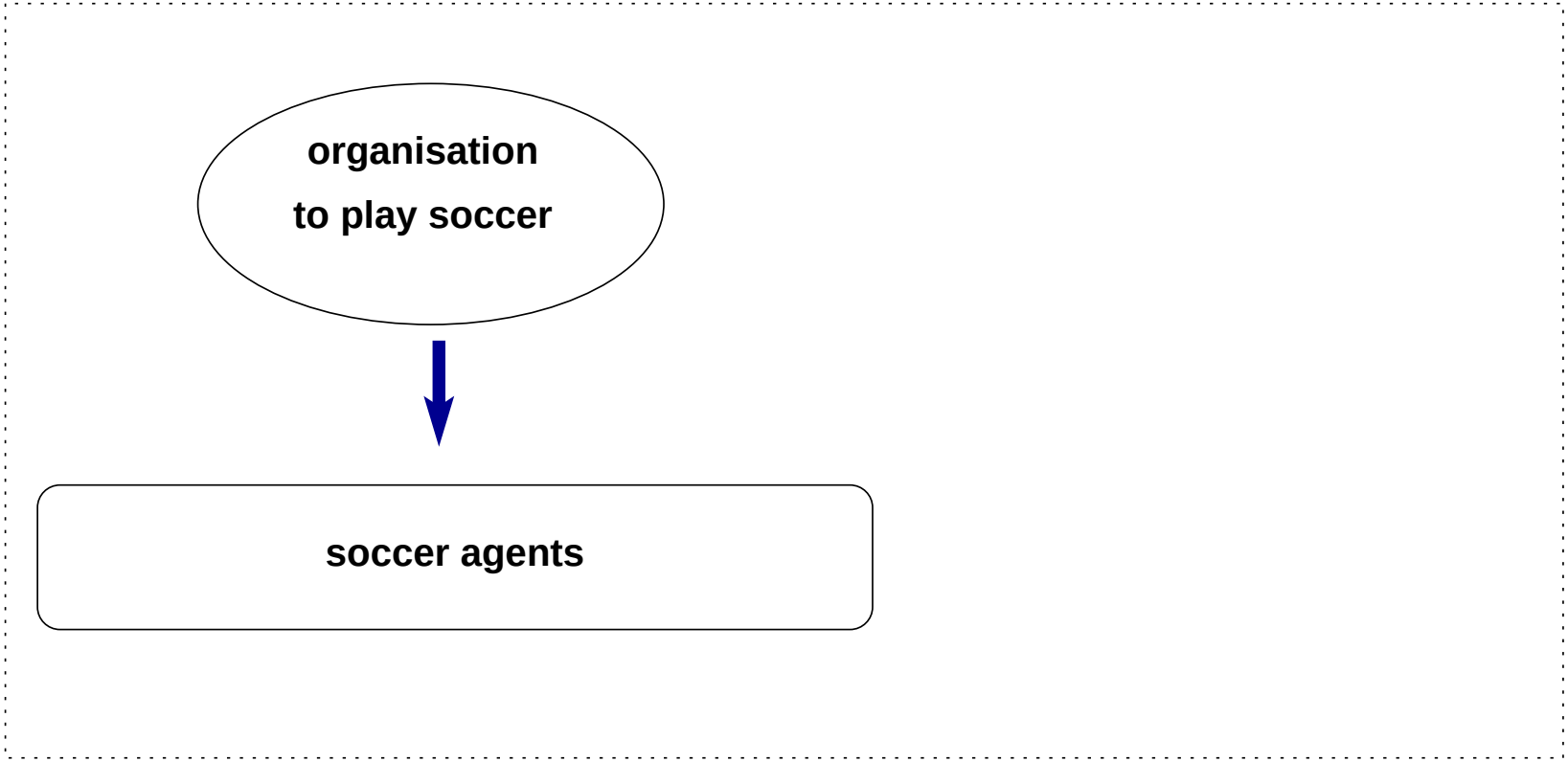
(the organisation extinguish the agents' autonomy)

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

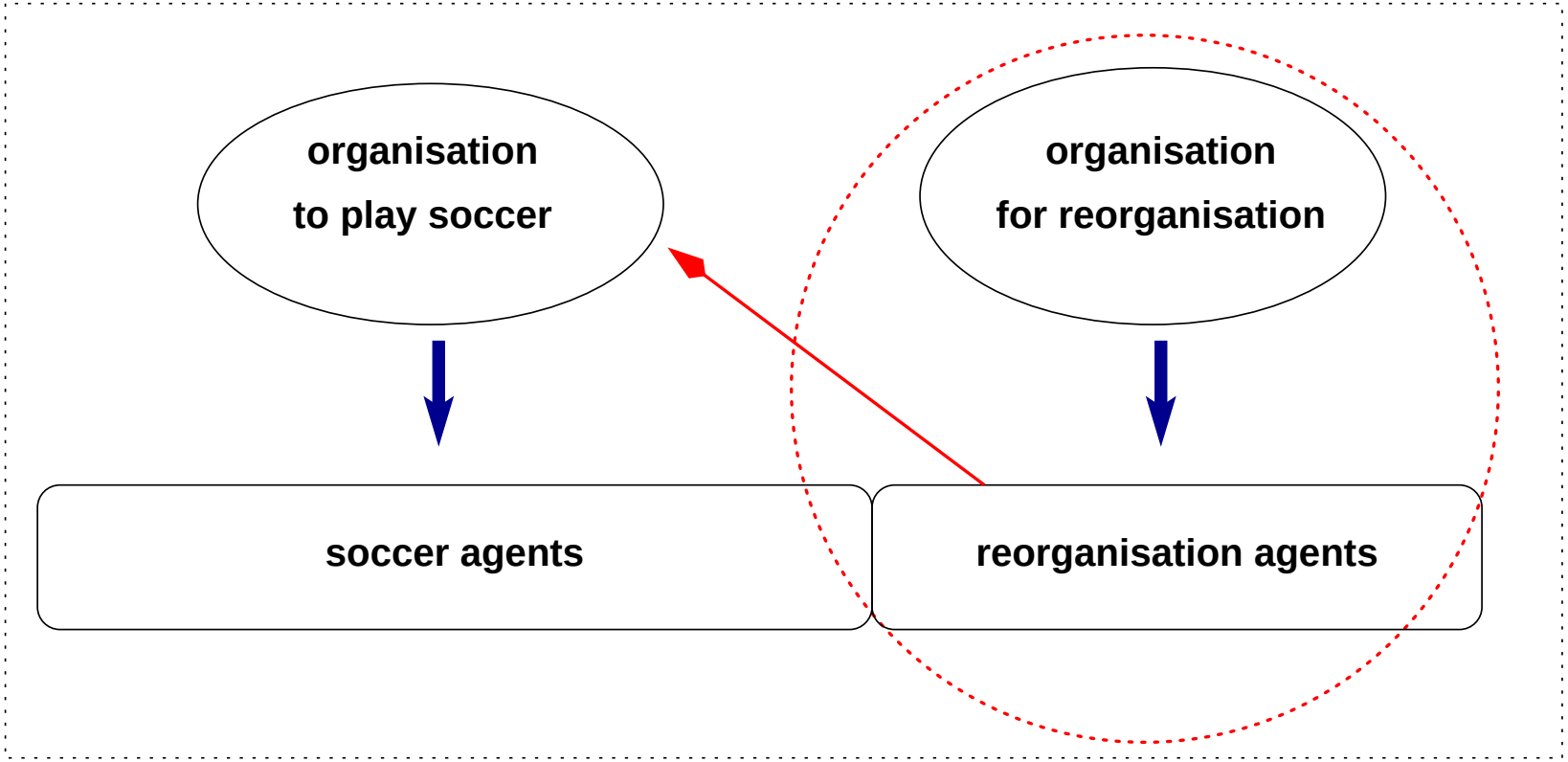
- Initially, the problem can be solved by the MAS designer.
- On dynamic and open environments, the agents themselves must change its organisation.
  - ⋆ **reorganisation**

Study Case: **Robocup** small size league

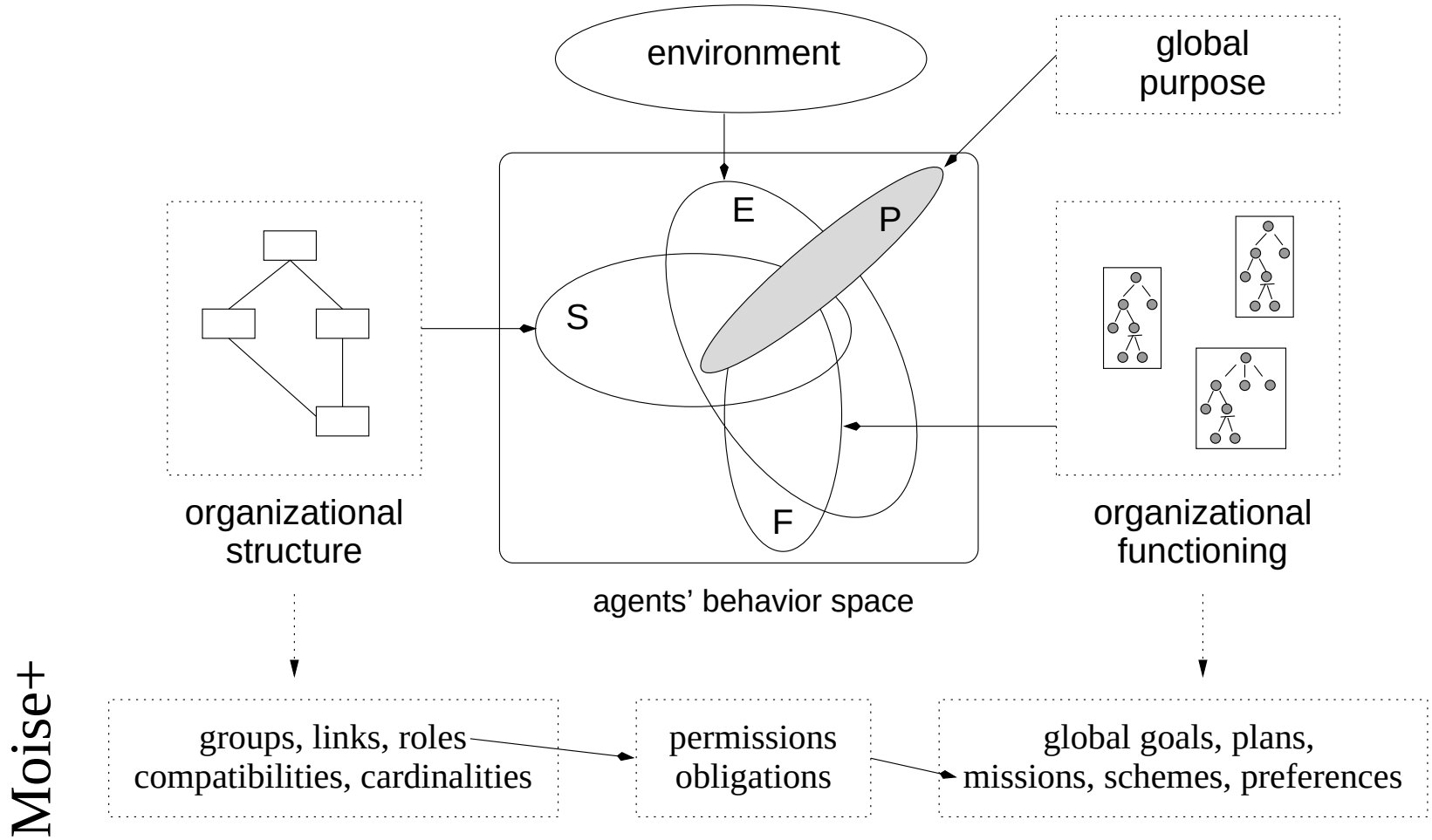
JOJTEAM organisation



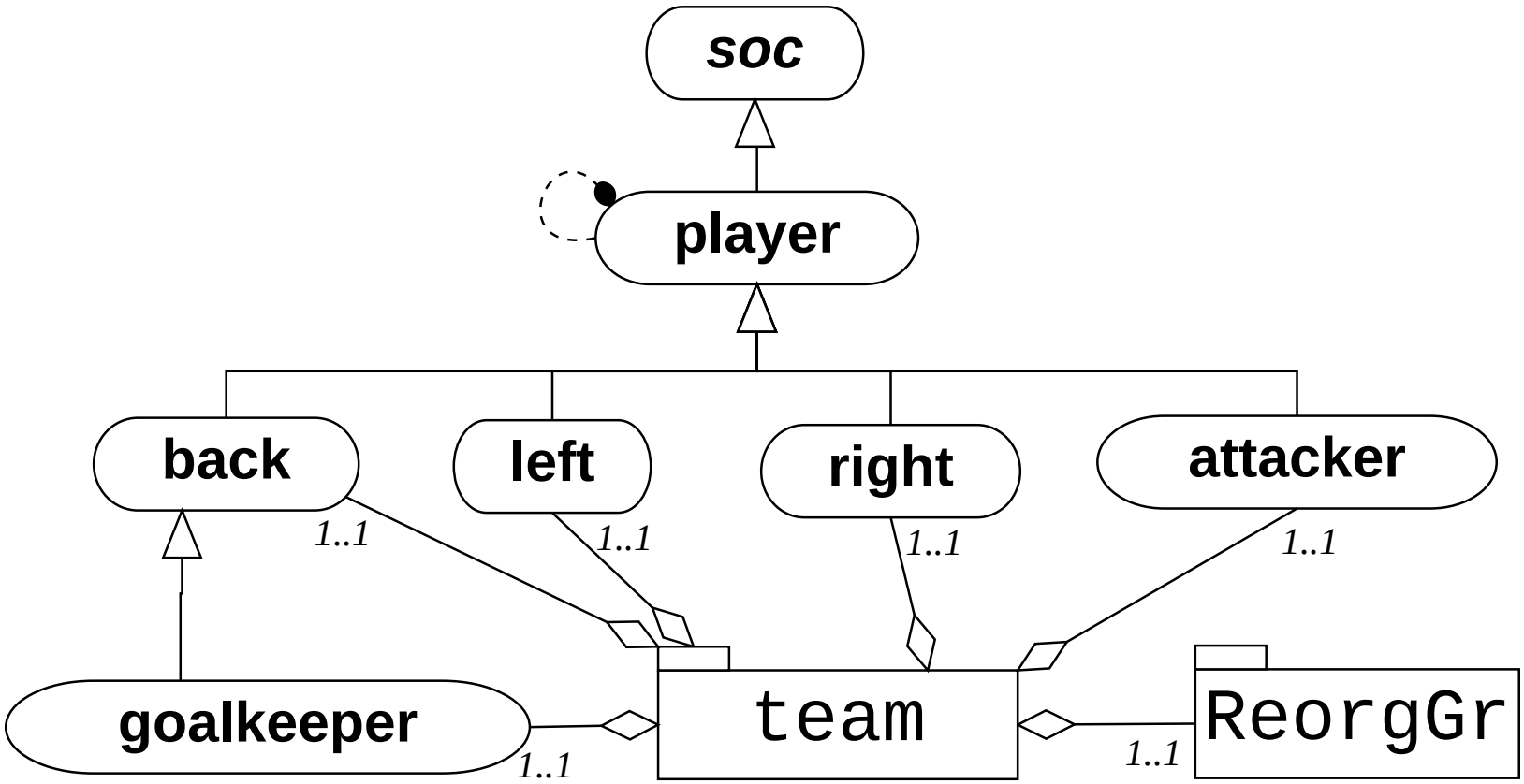
Our **approach**

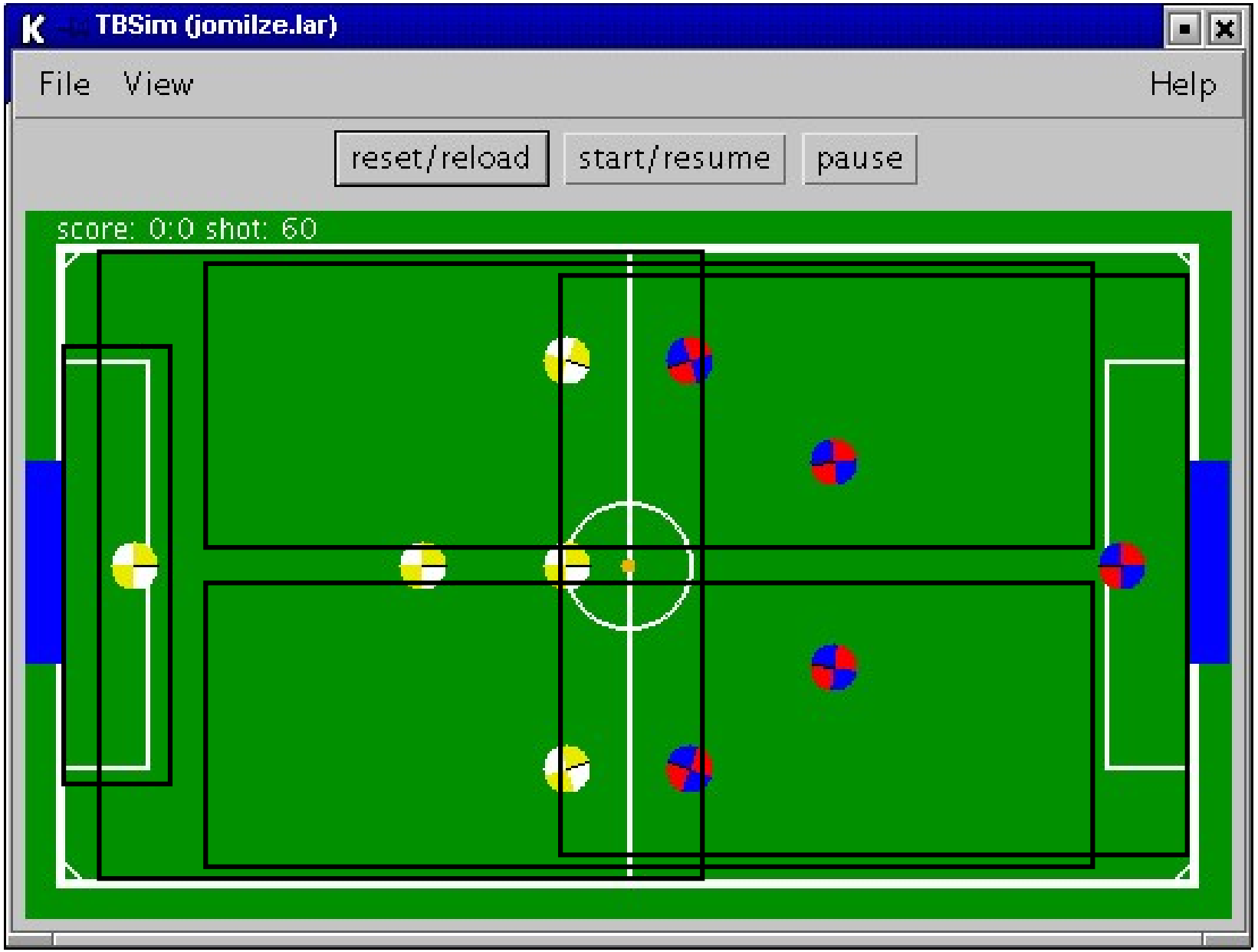


Specifying organisations $\mathcal{M}$OISE$^+$



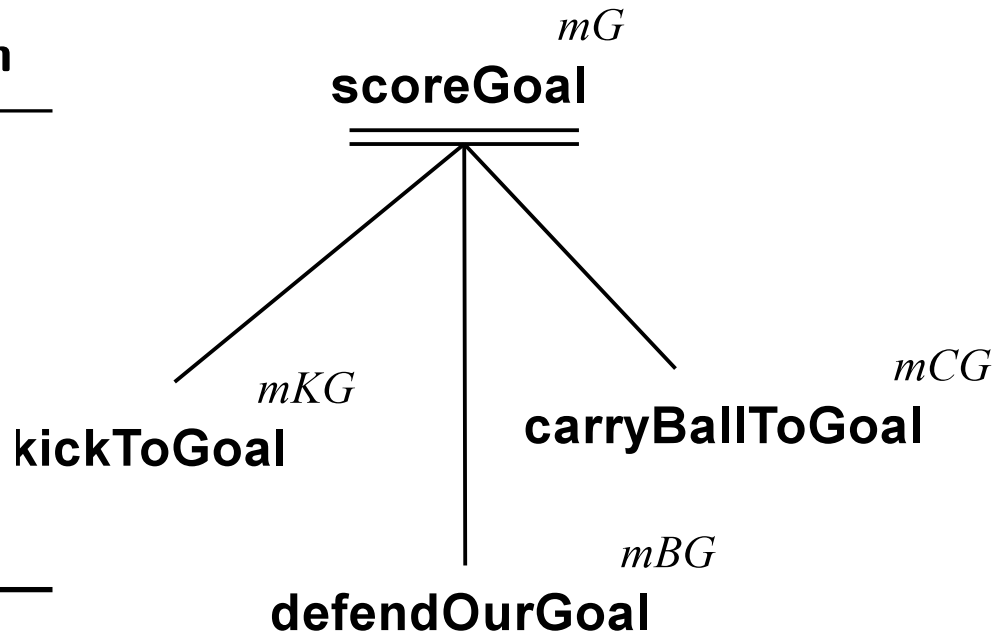
The initial organisational **structure** of the JOJTEAM



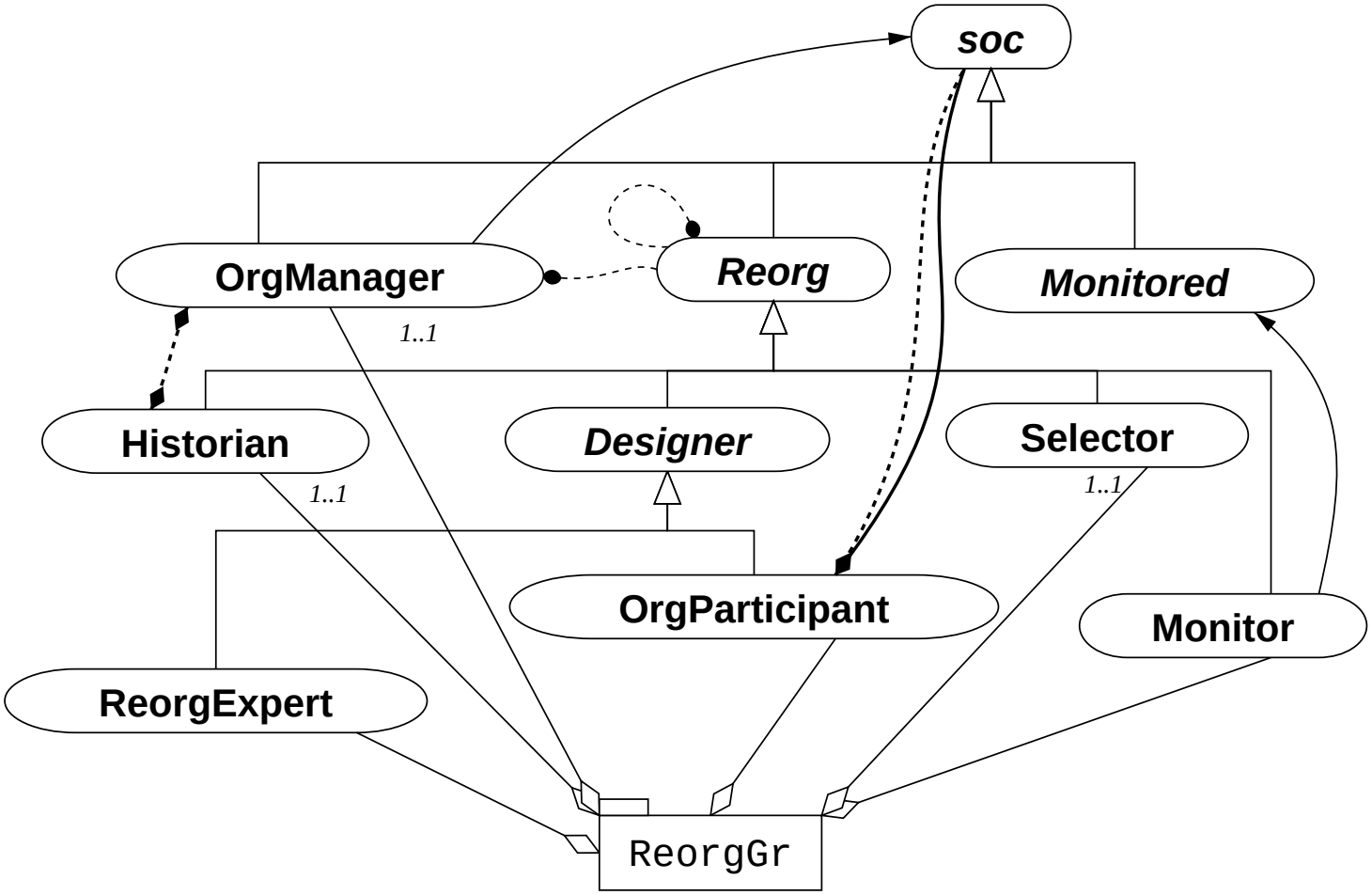

TBSim (jomilze.lar)
File
View
Help
reset/reload
start/resume
pause
score: 0:0 shot: 60

The initial organisational **functioning** of the JOJTEAM

role	deontic	mission
back	*obligated*	mKG
left	*obligated*	mCG
right	*obligated*	mCG
attacker	*obligated*	mCG
goalkeeper	*obligated*	mBG



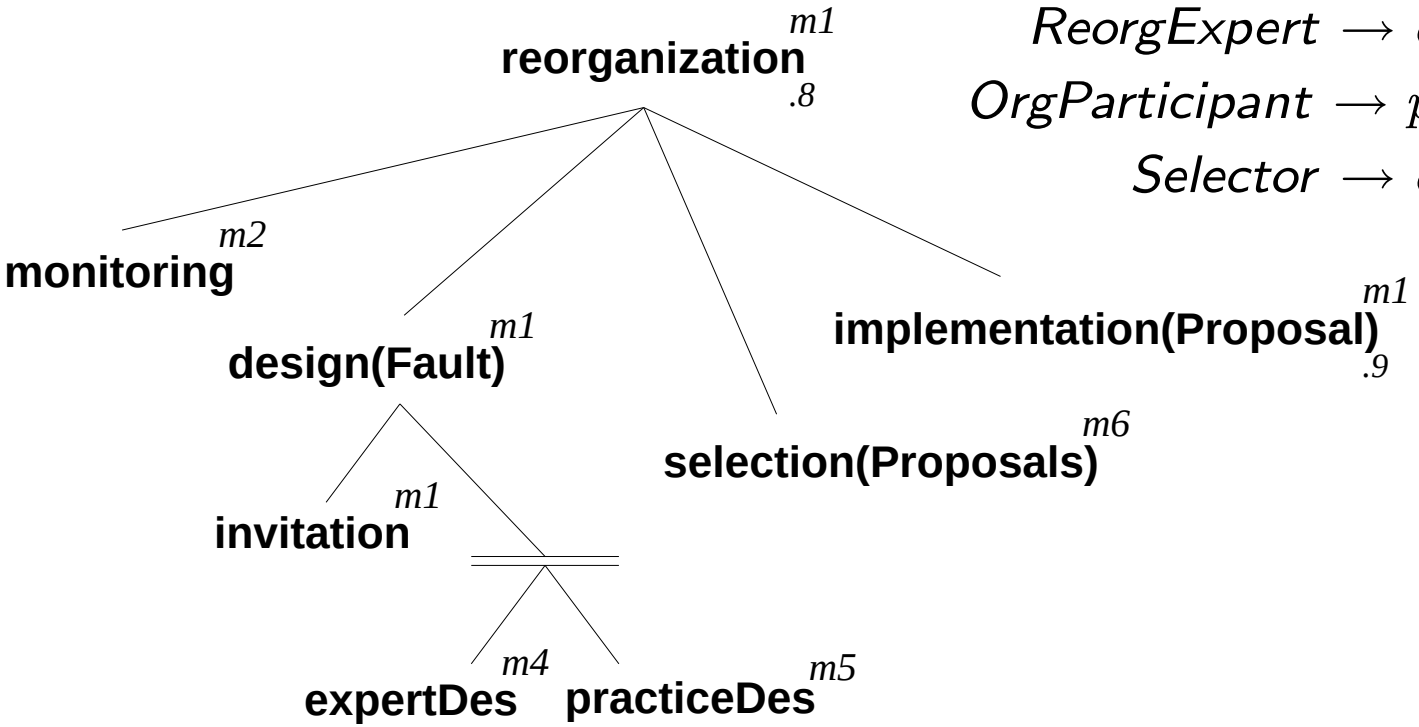
Structural dimension of the **reorganisation**



Functional dimension of the reorganisation

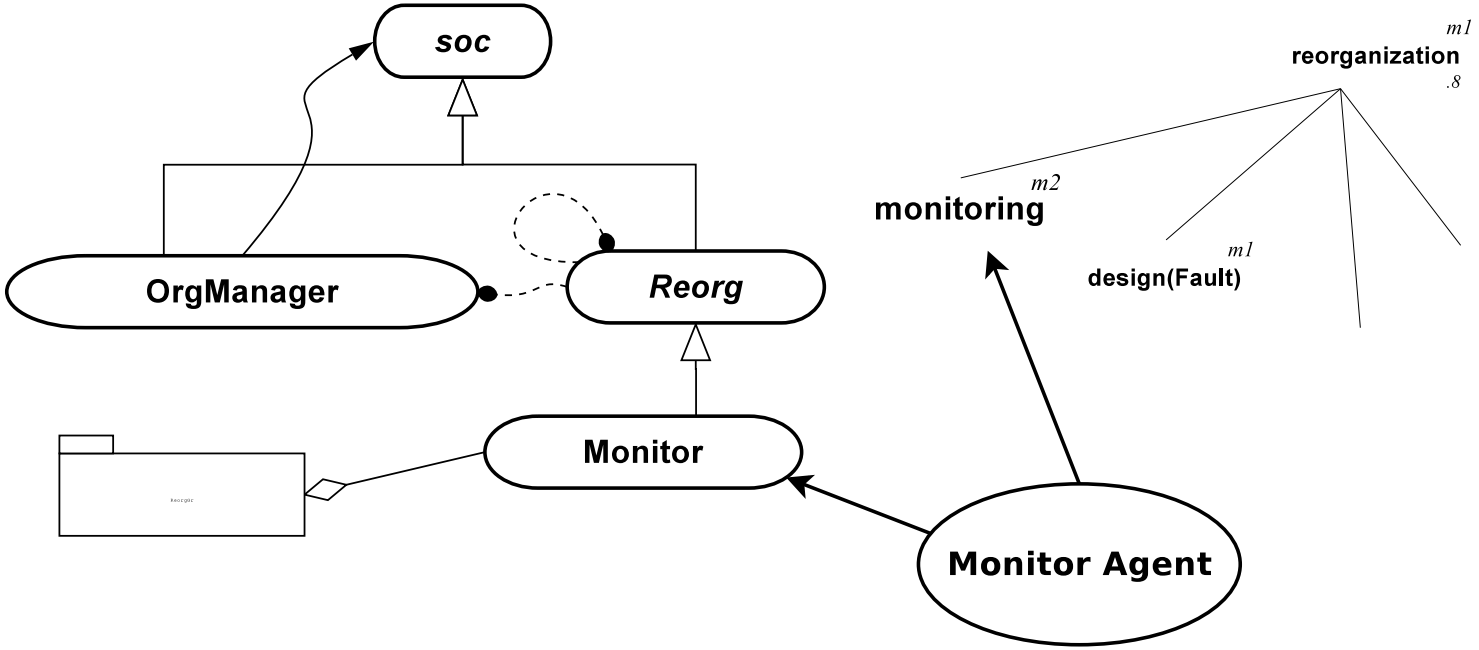
deontic relations:

$$\mathit{OrgManager} \longrightarrow obl(m_1)$$
$$\mathit{Monitor} \longrightarrow obl(m_2)$$
$$\mathit{ReorgExpert} \longrightarrow obl(m_4)$$
$$\mathit{OrgParticipant} \longrightarrow per(m_5)$$
$$\mathit{Selector} \longrightarrow obl(m_6)$$



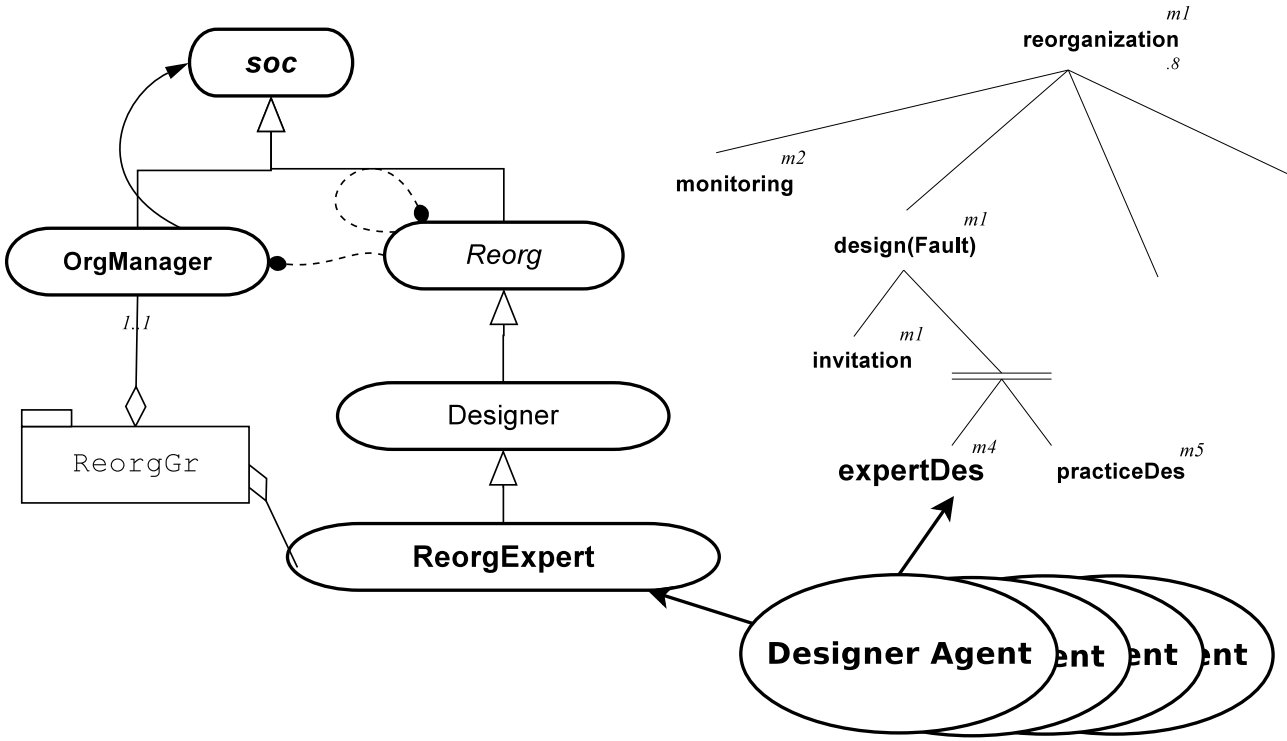
Monitoring goal

- 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 king of reorganisation (1×1×3, 4×1, increase the players area, change the team goals, ...)



- 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).

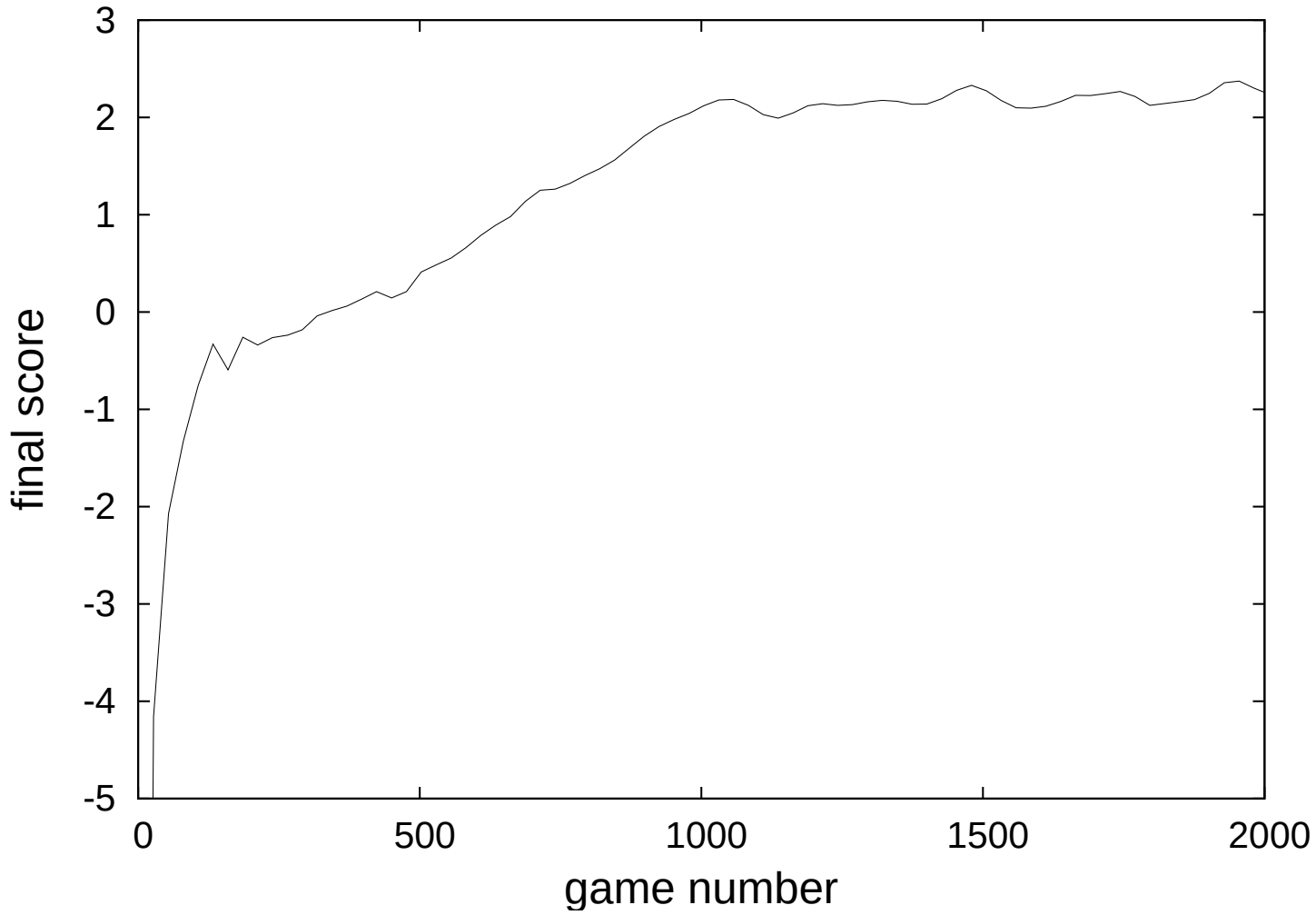
Selection goal

- 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

Implementation goal

- The OrgManager agent executes the reorganisation plan selected.

Results

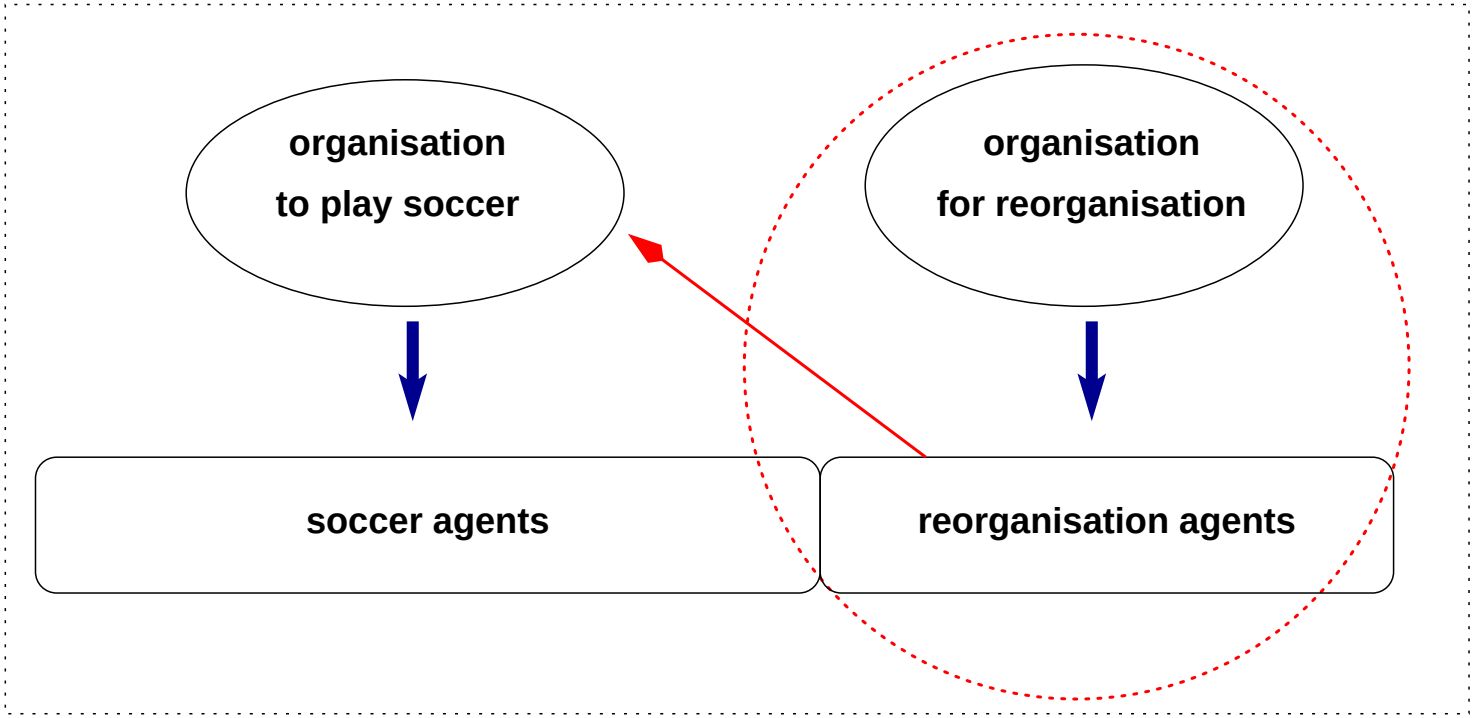


Learnt policy

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 $\mathcal{M}$OISE$^+$ specification can participate on reorganisation — thus it simplifies **openness**, "team programming".



- 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 $\mathcal{M}$OISE$^+$ independence among struncture and funcioning simplifies the construction of reorganisation plans.
- An implementation is available at `http://www.lti.pcs.usp.br/moise`