Norms In Distributed Organizations

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Domain and goal

1. Our domain: distributed exogenous normative organizations.
2. Main goal: to move towards distributed organizations.
3. Question I: What kinds of distribution do we encounter?
4. Question II: How can we determine whether a distributed organization can enforce a given set of norms?

Need for distributed organizations

1. Scalability
2. Separation of concerns
3. Modularization for development
4. Robustness (graceful degradation)
5. Human organization resemblance

Example I

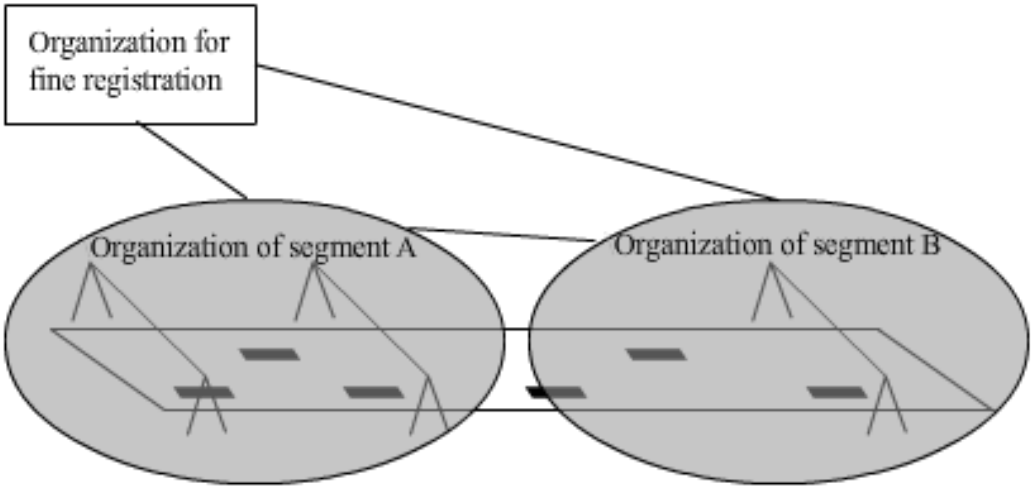

Figure 1: Smart roads overview

1. Smart roads: assign organizations to highways.
2. Goal: to increase throughput and safety.

Normative Organizations

1. Norms describe which states count as violations.
   - $\varphi \Rightarrow v$
2. Sanctioning is required for reacting to violations.
   - $v \Rightarrow \psi$
3. Monitoring requires observation capabilities.
4. Sanctioning requires control capabilities.

Distributed organizations

1. Distributed organization is a network of organizations.
   - $DO = \langle \mathbb{O}, R_r, R_i \rangle$
2. Each organization has observation and control capabilities.
   - $O = \langle \Gamma_{obs}, \Gamma_{con} \rangle \in \mathbb{O}$
   - $O \vDash_{o/c} \varphi$

Different kinds of distribution:

1. Distribution of capabilities
2. Distribution of rule application
3. Assignment of norms and sanctions

Distribution of capabilities

N = norms, S = sanction rules, $\langle \mathbb{O}, R_r, R_i \rangle$ = distributed organization

1. Local monitoring and sanctioning by $O \in \mathbb{O}$
   - $\forall(\varphi \Rightarrow v) \in N : O \vDash_o \varphi$
   - $\forall(v \Rightarrow \psi) \in S : O \vDash_c \psi$
2. Global monitoring and sanctioning by $O \in \mathbb{O}$
   - $lit(\varphi)$ are the literals of ϕ
   - $\forall(\varphi \Rightarrow v) \in N, \forall l \in lit(\varphi), \exists(O, O') \in R_r : O' \vDash_o l$
   - $\forall(v \Rightarrow \psi) \in S, \forall l \in lit(\psi), \exists(O, O') \in R_r : O' \vDash_c l$

Distribution of rule application

N = norms, S = sanction rules, $\langle \mathbb{O}, R_r, R_i \rangle$ = distributed organization

1. Centralized enforcement of N by S for an organization $O \in \mathbb{O}$ is possible iff all norms and sanctions in N and S are locally or globally applicable in O.
2. Decentralized enforcement of N by S for an organization pair $(O, O') \in R_i$ is possible iff for each norm and sanction in N and S:
   - The norm is locally monitorable in O and
   - the sanction is locally or globally applicable by O'.

Enforcement in distributed organizations

$N =$ norms, $S =$ sanction rules, $\langle \mathbb{O}, R_r, R_i \rangle =$ distributed organization A distribution is a set of $(N_i, S_i), N_i \subseteq N, S_i \subseteq S$ containing all matching norm-sanction pairs $(\varphi \Rightarrow v, v \Rightarrow \Psi)$.

Definition

Global enforcement. Let N be a set of norms, S a set of sanctions and $\langle \mathbb{O}, R_r, R_i \rangle$ a distributed organization. $\langle \mathbb{O}, R_r, R_i \rangle$ can globally enforce N by S iff there is a distribution $\{D_0, \ldots, D_n\}$ of (N, S) such that for each D_i there either exists an organization $O \in \mathbb{O}$ that can centrally enforce D_i or there exists a pair of organizations $(O, O') \in R_i$ such that (O, O') can decentrally enforce D_i.

Example II

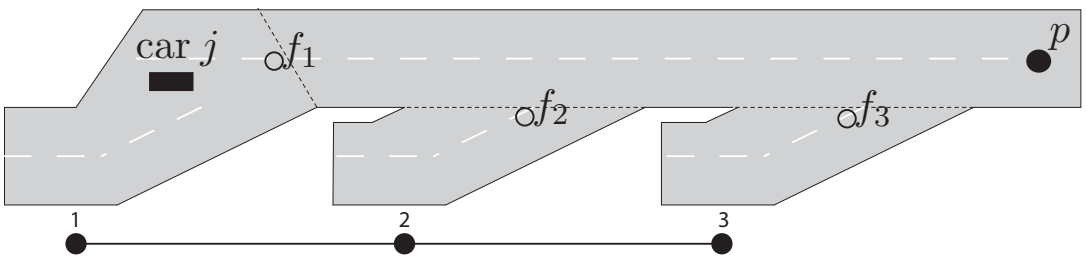

Figure 2: Example scenario. The lines between the organizations represent both R_r and R_i.

1. Norm is $f_1 \wedge f_2 \wedge f_3 \wedge speed_j > 120 \Rightarrow v_j$, sanction is $v_j \rightarrow fine_j$. O_1 can observe $speed_j > 120$ and $O_1 ... O_3$ can all control $fine_j$, O_i can observe f_i.
2. Combination of observations of f_1, f_2, and f_3 is required to monitor the norm. So only global monitoring possible but there is a choice for centralized or decentralized enforcement.

Assignments

1. An assignment describes which norms and sanctions are being applied by which organization.
2. The possible assignments depend on the capabilities of the organizations.
3. There is at least one assignment iff all matching norm and sanction pairs are can be enforced (centralized or decentralized) by at least one organization.

Future work

1. Properties of different assignments.
2. Constitutive norms and other expansions.
3. Dynamics in distributed organizations.

Conclusion

1. A distributed organization is a network of organizations.
2. We can distinguish between local and global monitoring and sanctioning, and centralized and decentralized norm/sanction application.
3. Assignments are possible if the norms are enforceable by the sanctions in the distributed organization.
4. We will continue to build on this basis.

Thank you for your attention.