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Social Coordination Frameworks for Social Technical Systems

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Part I
Preliminaries

Chapter 1
Introduction

Huib Aldewereld, Olivier Boissier, Virginia Dignum, Pablo Noriega, and Julian Padget

1.1 Introduction

As interactive systems and social networking applications increase in reach and complexity, there is a growing need to organize interactions between systems or among their components. This is specially the case in socio-technical systems (STS) where interaction between people and artificial systems is essential to the aims of the system. Design of STS must not be limited to the design of the system itself but must include the design of interactions and enable adaptation to different situations. Socio-technical systems are not monolithic but are *systems of systems*, comprised of intricate networks of people, organisations and technical systems, each with their own goals, capabilities and requirements which can only be achieved by pooling and coordinating their resources and capabilities together; the entities in such systems need to have *social coordination* (Noriega et al. 2015). Social

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coordination is a many-faceted phenomenon that has been the subject of attention in a number of scientific communities: from economics to social anthropology, from biology to computer science. The arrival of the internet and the massive adoption of social networks and other web-enabled practices have led the notion of social coordination to acquire new meaning and, in reference to such on-line contexts, an unprecedented and substantial economic and social importance. In fact, the design of socio-technical systems is the design of social coordination.

Given the complexity of these systems and the dynamic nature of their interactions, the technical systems participating in these systems of systems, must be endowed with socio-cognitive capabilities to understand, reason and decide about their position in the whole and their dependencies to the other participants. Therefore, these entities need to be able to understand and reason about each others goals, plans and intentions; the entities need to have *social intelligence*.

This book is concerned with building *socio-cognitive technical systems* (SCTS). An important premise for social intelligence is that of autonomous capability for action (Castelfranchi 1998). Autonomy requires that open environments are able to accommodate the presence of heterogeneous participants, with opaque internal architectures, objectives and plans, allow the participation of such participants in different organisations, and their regulation by different regulatory institutions.

There is therefore an increasing need for frameworks to describe and analyse social coordination and collective intelligence phenomena. These frameworks help decision makers to determine the qualities of related infrastructure, policy, and/or technology considerations as an interrelated whole (i.e. a socio-technological system of systems) (DeLaurentis and Callaway 2004). Moreover, tools are needed to specify and analyse the environment, structure, and participants of SCTS. In particular, these tools must support the "translation" of insights and requirements about SCTS into design specifications that result in better systems. This book introduces models for social coordination (M4SC) and their related tools that fill that gap.

1.2 Positioning

Models for social coordination (M4SC) apply normative, social and organisational concepts from human societies to electronic distributed computational mechanisms for the design and analysis of multi-agent systems (MAS). Using organisational concepts as first-class modelling constructs (Miles et al. 2003), allows for a natural specification of open systems, and can describe both emergent and designed organisations. Just as in human organisations, M4SC describe how participants interact with each other and with the environment.

M4SC define the formal lines of communication, allocation of information processing tasks, distribution of decision-making authority, and the provision of incentives. That is, M4SC describe objectives, roles, interactions and rules in an environment, without considering the particular characteristics of the individuals

involved. Organisational objectives are not necessarily shared by any of the individual participants, but can only be achieved through their combined action. In order to achieve its goals, it is thus necessary that a SCTS employs the relevant participants, and structures their interactions and responsibilities such that (global) objectives can be realised. The performance of an SCTS is therefore determined both by its interaction structures, and by the individual characteristics of the participants.

SCTS implies the existence of several coordinating entities that need to work together to realise some goal, which none individually has the capacity to achieve. As such, SCTS also implies the need for rules to indicate how parts must be put together (i.e., the organisational structure relating roles to each other). Organisational structure can be defined as that "*what persists when components or individuals enter or leave an [SCTS], i.e., the relationships that make an aggregate of elements a whole*" (Ferber et al. 2003).

Inspired by So and Durfee (1998), components of SCTS can be classified into three broad classes. The first are *(task) environmental factors*, which include the components and features of the task (such as size, time constraints, uncertainty), the available resources and the external conditions under which a SCTS operates. The second are the *structural factors*, which describe the components and features of the structure itself (such as roles, dependencies, constraints, norms and regulations). The third class of factors are *agent factors*, which describe the characteristics of the individual participants concerning task capability, intelligence (including decision making and reasoning capabilities), social awareness, etc. To sum up, the three main aspects that must be represented in any model aimed at understanding or specifying SCTC performance or behaviour are:

1. **Environment:** this is the space in which SCTSs exist. This space is not completely controllable by the SCTS and therefore results of activity cannot always be guaranteed. Environment can also include the description of tasks and resources (such as size and frequency), and is characterized by properties such as volatility, scarcity, unpredictability and (task) complexity.
2. **Participants:** are the acting, reasoning, entities in the SCTS which have the capability (partially) to control the state of some element(s) in the environment. Participants are defined by their capabilities, typically describing their learning, communication, reasoning and decision-making skills.
3. **Structure:** describes the features of the SCTS, such as objectives, roles, relationships and strategy. The roles and relationships holding in the SCTS determine control, coordination, and power relations. Differentiating dimensions of structure are size, degree of centralization and formalization.

In order to build SCTS, interoperability between the systems based on different models for social coordination is required. Among the possible directions, a meta-model at an higher level of abstraction than the existing models for social coordination could provide grounds for interoperability while still enabling the coexistence of the different approaches, each with its own strengths and areas of application.

Two important requirements for these kinds of systems are:

1. **Opacity/Individuality of participants**: the heterogeneity of the participants and the openness of the environment makes it that one cannot make any assumptions about the inner workings of participants. Consequently, it is impossible to create coordination structures based on knowledge of the internals (beliefs, desires, goals) of participants of the system. Rather, external aspects of the participants (actions, interactions, etc.) have to be leveraged to create the required coordination structures.
2. **Institutional flexibility**: the design of coordination should take an institutional perspective, making explicit the 'rules of the game', but on a level that accommodates changes over time, context, actors, and actor preferences.

If we start from the premise of autonomy, SCTS as an open environment must enable and support the presence of heterogeneous participants, with opaque internal architectures, objectives and plans. Nevertheless, SCTS should enable participants to act in different organisations and 'navigate' between those organisations, even if they are based on different models. This second statement is the main focus of our project, i.e. participants, assumed to have their own reasons for participating in an SCTS, such as access to specific services or other participants with certain abilities, must be supported in understanding the possibilities and constraints a SCTS can provide them, and conversely, SCTS must be supported to control and monitor agent activities within the SCTS. Only then can we truly speak of open environments.

Implicit in the definition of SCTS as instruments of purpose, is the ideas that SCTS have goals, or objectives, to be realised and therefore, the shape, size and characteristics of the SCTS affect its behaviour (Horling and Lesser 2004). Objectives of a SCTS are achieved through the action of the individuals in the SCTS, which means that a SCTS should make sure to employ the relevant actors, so that it can 'enforce' the possibility of making its desires happen. Note that here, an explicit distinction is made between the SCTS position, or role, and the actor, or participant. In this way, separation of concerns is possible. Furthermore, one of the main reasons for creating SCTS is efficiency, that is, to provide the means for coordination that enables the achievement of global goals in an efficient manner. This means that the actors in a SCTS need to coordinate their activities in order to achieve those objectives efficiently.

Over the last 10 years or so, much research has been undertaken with the aim of creating suitable models for social coordination to build such socio-cognitive technical systems. Each of these models differs in focus and, consequently, are tailored for a specific (subset of) applications. We believe, however, that the time is ripe to bring these models together to advance the stage of research on socio-cognitive technical systems, because:

- Work on models for social coordination has now matured sufficiently:
  - Several frameworks are available; and
  - Each has been used extensively in education and applied to diverse areas in projects and industrial collaborations.

- Nevertheless, the heterogeneity of current approaches to modelling socio-cognitive technical systems hinders a wider uptake of such approaches; and
- Social coordination and collective intelligence need to address the interoperability problem at the level of the modelling of organisational and institutional constructs and richer socio-cognitive agent models.

1.3 Objective

This book presents the collective research effort of the research groups working on models for social coordination in an effort to bring the various models, with their differing focus and applications, together to create an unified approach to the creation of socio-cognitive technical systems. The objectives of this book can be summarised as follows:

- To establish a systematic comparison of the existing models for social coordination;
- To develop an integrative meta-model that can account for these models;
- To identify applications, challenges and opportunities for such models.

There has been little work to date, on integrating and comparing the different approaches to models for social coordination (a notable exception being Coutinho et al. 2009). The heterogeneity of current approaches to models for social coordination make such interaction cumbersome. That is, so far, the interoperability between models for social coordination is mostly lacking. In our opinion, social coordination and collective intelligence can only be fostered by addressing the interoperability problem at the level of modelling and reasoning.

1.4 Overview of Book

The remainder of this book is structured as follows. The book contains three parts; Part I: the front matter or preliminaries (of which this introduction is the first chapter); Part II the framework descriptions and comparison; and Part III the applications and challenges.The remainder of Part II consists of:

- Chapter 2, **Conceptual Map for Social Coordination**, which presents the ongoing work on the unification of the different models for social coordination into one unifying meta-model for social coordination. Chapter 2 includes a description of the Tendering Use-Case that is used as a common example for the discussion of the frameworks in Part II.

Part II comprises presentations of each of the frameworks, going in depth about the different models for social coordination developed by various research groups. The discussions of the frameworks include, among others, a brief history

of the framework, applications, a detailed description of the meta-model, a critical assessment and key references. Part II concludes with a comparison between the frameworks presented. The chapters in Part II are:

- Chapter 3, **ANTE – A Framework Integrating Negotiation, Norms and Trust**, presents the details of the ANTE framework, developed by the Universidade do Porto, Portugal.
- Chapter 4, **Electronic Institutions – The EI/EIDE Framwork**, presents the details of the Electronic Institutions framework, developed by Universitat Autònoma de Barcelona, Spain.
- Chapter 5, **INGENIAS**, presents the details of the INGENIAS framework, developed by the Universidad Complutense de Madrid, Spain.
- Chapter 6, **Ins*AL*: An Institutional Action Language**, presents the details of the Inst*AL* framework, developed by the University of Bath, United Kingdom.
- Chapter 7, **The JaCaMo Framework**, presents the details of the JaCaMo framework, developed by École des Mines de Saint-Étienne, France, Universidade Federal de Santa Catarina, Brazil, Pontíficia Universidade Católica do Rio Grande do Sul, Brazil, and Università di Bologna, Italy.
- Chapter 8, **ROMAS/MAGENTIX2**, presents the details of the ROMAS and MAGENTIX2 frameworks developed by the Universitat Politècnica de València, Spain.
- Chapter 9, **OperA/ALIVE/OperettA**, presents the details of the OperA framework and the ALIVE and OperettA tools, developed by Delft University of Technology, The Netherlands, Universitat Politècnica de Catalunya, Spain, and University of Aberdeen, United Kingdom.
- Chapter 10, **Specifying and Executing Open Multi-Agent Systems**, presents the details of the RTEC framework, developed by NCSR Demokritos, Greece and Imperial College London, United Kingdom.
- Chapter 11 concludes Part II with an comparison between the presented frameworks.

Part III reflects on the applications for models for social coordination and the challenges and perspectives for future research. Part III consists of:

- Chapter 12, **Application Domains**, gives an overview of the characteristics of the domains which are handled well by models for social coordination. Moreover, the chapter presents exemplary cases of applications of the various frameworks included in this book.
- Chapter 13, **Challenges for M4SC**, concludes the book with an overview of challenges for M4SC to be solved in the short-term, and advances a perspective on their short-comings and the possibilities for the future, to inspire future research in the field of M4SC.

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Chapter 2
Conceptual Map for Social Coordination

Huib Aldewereld, Sergio Álvarez-Napagao, Emilia García, Jorge J. Gomez-Sanz, Jie Jiang, and Henrique Lopes Cardoso

2.1 Introduction

The engineering of applications for complex and dynamic domains with autonomous participants is an increasingly difficult process. Requirements and functionalities are not fixed a priori, components are not designed nor controlled by a common entity, and unplanned or underspecified changes may occur during runtime. There is a need for representing the regulating structures explicitly and independently from the acting components (or agents). Organization computational models, based on Organization Theory, have been advocated to specify such

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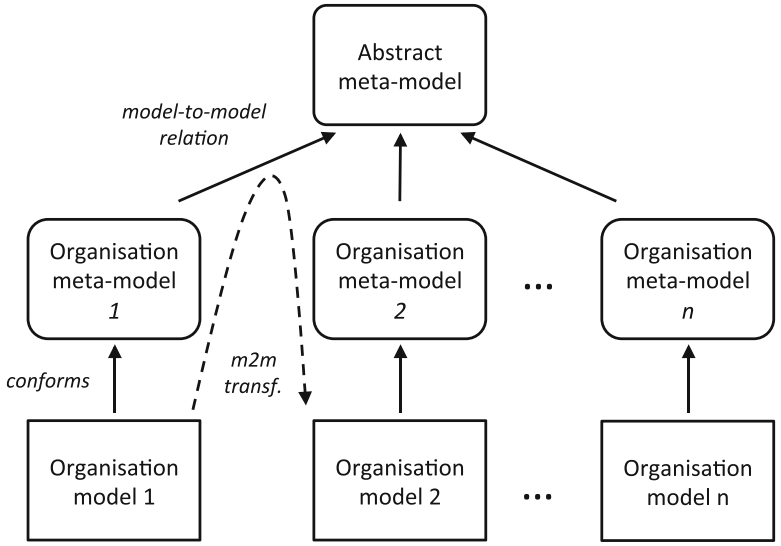

Fig. 2.1 MDE model-to-model transformations

systems. Comprehensive analysis of several agent systems has shown that different design approaches are appropriate for different domain characteristics (Dignum and Dignum 2010).

Work on multi-agent organizations is now sufficiently mature to the extent that several frameworks are available, and have been used extensively in education and applied to diverse areas in projects and industrial collaborations. Nevertheless, there has been little work done on integrating and comparing such different approaches (a notable exception being Coutinho et al. 2009). That is, so far, the interoperability between organizational frameworks is mostly lacking.

In this chapter, we present ongoing work on the integration of models for social coordination. This results in a preliminary version of a meta-model combining the different models for social coordination, build on the work presented in Part II. The combination of the models in Chaps. 3, 4, 5, 6, 7, 8, 9, and 10 is a richness of the meta-model, but also limits it since it is built bottom-up from these models. The integration of the models in an all-including meta-model will allow for seamless integration in open environments.

In order to build such open environments, interoperability between organizations based on different models is required. Among the possible directions, we introduce an organizational meta-model at a higher level of abstraction than that provided by existing organizational models; while providing grounds for interoperability, this approach enables the coexistence of different models, each with its own strengths and areas of application. Such a high-level meta-model would then allow for model-to-model transformations from one organizational framework to another (see Fig. 2.1), following Model Driven Architecture principles (MDA; see Bézivin et al. (2003) for details) with the abstract meta-model as a common basis.

This chapter is organised as follows. In the next section we present the conceptual map for social coordination, including a brief description of the concepts, why they are there, and what the relations between the concepts signify. In Sect. 2.3 we provide more precise definitions of the concepts and relations of the meta-model. In Sect. 2.4 we present a use-case of social coordination (Sect. 2.4.1) and provide a first modelling of this case using the conceptual map (Sect. 2.4.2). We end this chapter with conclusions and future work.

2.2 Core Model

In this section we present the first conceptual map for frameworks of social coordination. The model was developed in the first workshop on Models for Social Coordination (M4SC) in Veldhoven, the Netherlands in March 2014.

The aim of the conceptual map is to show the key concepts and their relations in an interpretation that is largely shared by the frameworks described in Part II. In that way, each of the frameworks can be seen as an extension of this common model; it thus presents a *core model for social coordination* (see Fig. 2.2). By looking at the commonalities we have tried to create an abstract model of social coordination. This abstract model tries to de-emphasise the specific aim of each of the frameworks (e.g., some frameworks focus more on the normative side of social coordination, others on the formalisation of runtime systems), and tries to emphasise which elements should be included in any model for social coordination. The core model will then, in essence, provide the basis for making the necessary model-to-model relations needed to transform models in one of the frameworks to another framework. Being

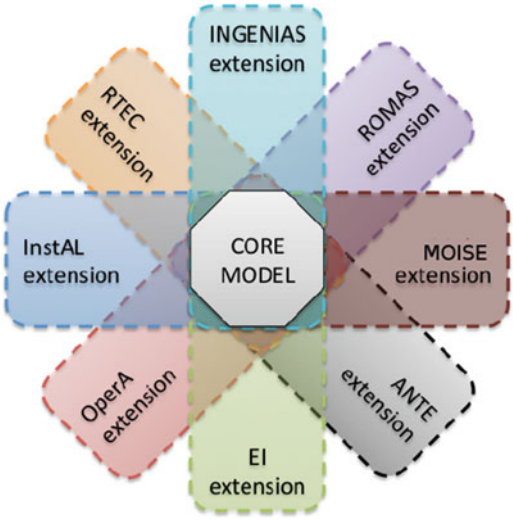

Fig. 2.2 Common core model for frameworks of social coordination

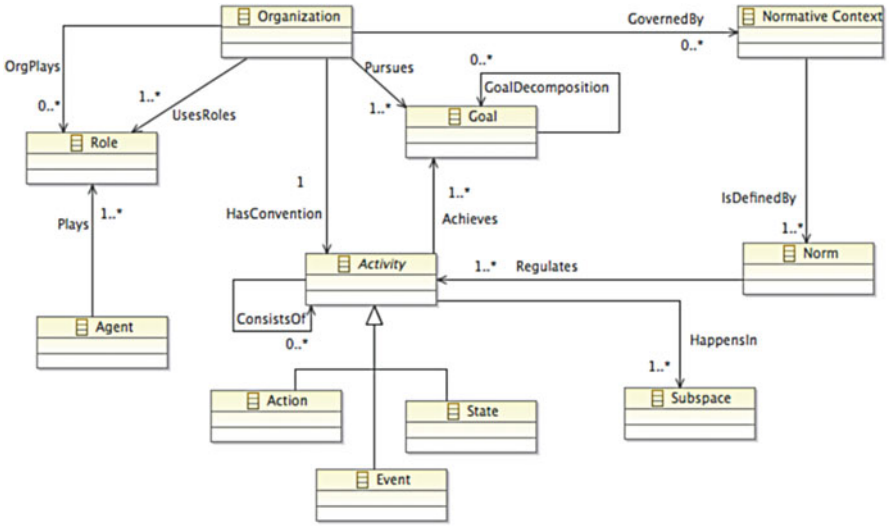

Fig. 2.3 Unified meta-model

the shared core of all the models, the conceptual map presents the opportunity for integration attempts between the frameworks.

In order to integrate, compare and reuse existing agent organization models, we propose a meta-modelling approach. An organizational meta-model abstracts from the details of specific models, highlighting the generic properties of organizations. An overview of the meta-model is shown in Fig. 2.3.

As expected, the main concept of the meta-model is **Organization** (for an interpretation of each of the concepts, see the next section). Organizations exist to fulfil some common objective or **Goal**, and contain a number of **Roles** whose players are supposed to interact to achieve this goal. Roles are played by **Agents** or Organizations. The Goal of an Organization might be decomposed into smaller (more elementary) Goals. The fulfilment of Goals is accomplished through **Activities** of the Roles. The Activity of an Organization can be composed of smaller, more elementary Activities. Atomic Activities can either be **Actions**, **States**, or **Events**. Activities may be situated in a **Subspace**. Lastly, the Organization and the organizational Activity are governed by sets of rules (**Norms**) composing proper **Normative Contexts**.

A discussion of the meaning of the concepts, and links to existing literature, is presented in the next section.

2.3 Concepts

In this section, we provide an analysis of the concepts in the meta-model. For each concept, we first give a general explanation and some examples to indicate an intuitive understanding of the concept. Furthermore, we present a number of selected interpretations from the literature to show different perspectives in defining the concept.

Concept	Explanation	Examples
Organization	A number of individual entities/agents that are coordinated for the pursuit of some collective goals	A university, (a department inside) a company, an auction house
Selected interpretations		
March and Simon (1958): *Organizations are assemblages of interacting human beings that feature high specificity of structure and coordination*		
Schein (1965): *An organization is the rational coordination of the activities of a number of people for the achievement of some common explicit purpose or goal, through division of labor or function, and through a hierarchy of authority and responsibility*		
Pfeffer and Salancik (1978): *An organization is a coalition of groups and interests, each attempting to obtain something from the collectivity by interacting with others, and each with its own preferences and objectives*		
North (1994): *Organizations are made up of groups of individuals bound together by some common purpose to achieve certain objectives*		
Scott (1995): *Organizations are groups whose members coordinate their behavior in order to accomplish shared goals or to put out a product*		
Ostrom (2009): *Organizations are groups of participants, bound by some common purpose to achieve outcomes, in situation structures composed of multiple simultaneous and sequential action situations, all constituted by rules as well as by the physical world*		

Concept	Explanation	Examples
Goal	The desired ends that are pursued by individuals or organizations	Make profit, publish papers, win the auction
Selected interpretations		
Simon (1964): *Goals provide criteria for generating and selecting among alternative courses of action*		
Scott (1992): *Goals are conceptions of desired ends – conditions that participants attempt to effect through their performance of task activities*		
Rao (1996): *A goal is a state of the system which the agent wants to bring about*		
DeLoach (2009): *A goal is a desirable state of the world or the objective of a computational process*		

(continued)

Concept	Explanation	Examples
Role	A position within an organization that can be taken by qualified agents, which become endowed with specific rights and are expected to achieve a particular goal or set of goals	Buyer, student, author
Selected Interpretations		
Biddle (1986): *Roles in organizations are assumed to be associated with identified social positions and to be generated by normative expectations*		
Scott (1992): *Roles are expectations for or evaluative standards employed in assessing the behavior of occupants of specific social positions*		
Gasser (2001): *Roles typically describe an organizationally-sanctioned structured bundle of activity types*		
Ostrom (2005): *Roles/positions are the connecting link between participants and actions. In some situations, any participant in any position may be authorized to take any of the allowable actions in that situation. However, in most organized situations, the capability to take particular actions in assigned to a specific position*		
Hindin (2009): *A role can be defined as a social position, behavior associated with a social position, or a typical behavior*		

Concept	Explanation	Examples
Agent	An entity that is capable of autonomous behavior	A human, a robot, a company, a personal assistant (software)
Selected interpretations		
Weber (1978): *Agents are regarded as socio-cognitive entities that are capable of individual social behavior*		
Shoham (1993): *An (artificial) agent is an entity possessing formal versions of mental state, and in particular formal versions of knowledge, beliefs, capabilities, choices, commitments, and possibly a few other mentalistic-sounding qualities*		
Russell and Norvig (1995): *An agent is anything that can be viewed as perceiving its environment through sensors and acting upon that environment through effectors*		
Wooldridge and Jennings (1995): *An agent is an encapsulated computer system that is situated in some environment and that is capable of flexible, autonomous action in that environment in order to meet its design objectives*		
Franklin and Graesser (1997): *An autonomous agent is a system situated within and a part of an environment that senses that environment and acts on it, over time, in pursuit of its own agenda and so as to effect what it senses in the future*		
Searle (2003): *An agent is an entity able to make decisions and perform intentional actions on the basis of reasons, and capable of perception, belief, desire, memory, reasoning, as well as commitment*		

(continued)

Concept	Explanation	Examples
Norm	Prescriptions that are used to organize the activities of agents and/or constrain their behaviour in order to achieve shared expectations	Students should be on time for classes, sellers should deliver the goods once the buyer makes the payment
Selected interpretations		
Ganz (1971) and Ostrom (2005): *Norms/rules may be defined to be shared understandings by participants about enforced prescriptions concerning what actions (or outcomes) are required, prohibited, or permitted*		
Axelrod (1986): *A norm exists in a given social setting to the extent that individuals usually act in a certain way and are often punished when seen not be acting in this way*		
Scott (1992): *Norms are the generalized rules governing behavior that specify, in particular, appropriate means for pursuing goals*		
Jones and Sergot (1993): *A norm is a prescription of how the agents ought to behave, and specify how they are permitted to behave and what their rights are*		
North (1994): *Constraints that human beings impose on human interaction, consisting of formal rules (constitutions, statute law, common law, regulations) and informal constraints (conventions, norms and self-enforced codes of conduct)*		
Searle (2005): *Rules that either (1) create institutional facts from brute facts, thus substantively constituting the very behaviour they regulate (constitutive), or (2) regulate activities that exist prior or independently of the norm (regulative)*		

Concept	Explanation	Examples
Activity	A set of functionalities offered by one or several agents that may consume resources and make changes in the environment and into the agents mental state	Paper review, party planning
Selected interpretations		
Bennett et al. (2010): *An activity is a group of one or more actions that may execute as a result of a triggering event*		
Object Management Group (2007): *An activity is the specification of parameterized behavior as the coordinated sequencing of subordinate units whose individual elements are actions*		

Concept	Explanation	Examples
State	The particular condition of an individual, the environment, a system, or the world	Being rich, submitted, evaluated
Selected interpretations		
Wittgenstein (1922): *The world is everything that is the case. What is the case (a fact) is the existence of states of affairs. A state of affairs (a state of things) is a combination of objects (things). The possibility of its occurring in states of affairs is the form of an object. Objects are what is unalterable and substantial; their configuration is what is changing and unstable*		
Armstrong (1993): *States of affairs have as constituents particulars, properties and relations. A state of affairs exists if and only if a particular has a property, or a relation holds between two or more particulars*		

(continued)

Concept	Explanation	Examples
Action	The fact or process of doing something	Walk, eat, turn on light
Selected interpretations		
McCarthy and Hayes (1969): *An action, depending on a specific agent and a certain current situation, produces (or not) a result that may be reflected in a change in the state of the world*		
Davidson (1980): *An action, in some basic sense, is something an agent does that was intentional under some description*		
Cohen and Levesque (1990): *In the way that usually the content of beliefs and knowledge is considered to be in the form of propositions, the content of an intention is typically regarded as an action*		

2.4 Tender Request Scenario

To illustrate the use of the conceptual map for social coordination, we now model a use-case of social coordination: the Request for Tender. This use-case is also modelled by each of the frameworks presented in Part II. Before we model the use-case, we first present a description of the use-case.

2.4.1 Use-Case Description

A **request for tenders** (RFT) is a formal, structured invitation to suppliers, to bid, to supply products or services. For example, a company or government may put a building project 'out to tender'; that is, publish an invitation for other parties to make a proposal for the building's construction.

The aim of the process is to ensure finding the best supplier possible for the requested service or product, such that no parties will have an unfair advantage of separate, prior, or closed-door negotiations for the contract. The Actors, or stakeholders, involved in a RFT are the following: contracting authority, bidders consortium (possibly consisting of several partners), evaluators, publication body, etc.

A system for RFT should handle more that one RFT at the same time; i.e. there can be more than one contracting authority putting out a request to be fulfilled by different bidder consortia, and possibly advertised by different publication bodies.

An RFT process consists of (at least) the following stages (Fig. 2.4):

1. Tender elaboration: decide on terms, conditions, deadlines, etc. for the RFT.
2. Publication: publication of the tender and/or distributed to potential bidders.
3. Request for information: interested bidders can ask for further information to clarify any uncertainties.
4. Bid preparation.

   (optionally) Consortium formation.
5. Bid submission.

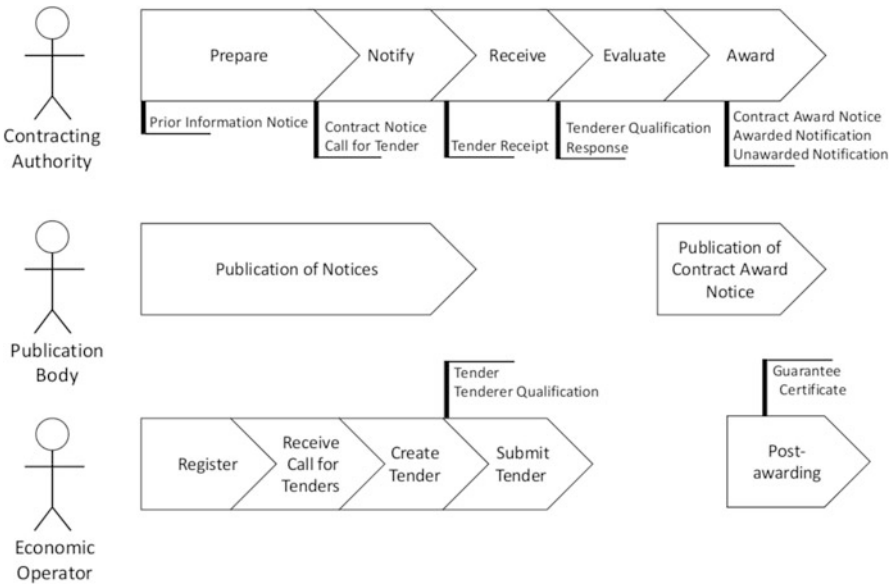

Fig. 2.4 Illustrative example of the request for tender (RFT) process

6. Bid evaluation and decision: an evaluation team will go through the tenders and decide who will get the contract. Each tender will be checked for compliance and if compliant, then evaluated against the criteria specified in the tender documentation. The tender that offers best value for money will win the business.
7. Notification: When a contract has been awarded, the successful tenderer will be advised in writing of the outcome. Unsuccessful tenderers are also informed.

   (optionally) may be offered a debriefing interview.

8. Contract formation: a formal agreement will be required between the successful tenderer and the contracting authority.

The process of requesting for tenders is governed by a number of norms. Some of the norms holding in this scenario are (examples):

- Bids must be submitted before the deadline.
- Reviewers have to submit their evaluation on time.
- All bids must be written in English.
- Bids include at least X and at most Y partners.
- Each tender must receive at least Z different bids.
- Reviewers and requester cannot participate in any bid consortium.
- Bids must be blind.

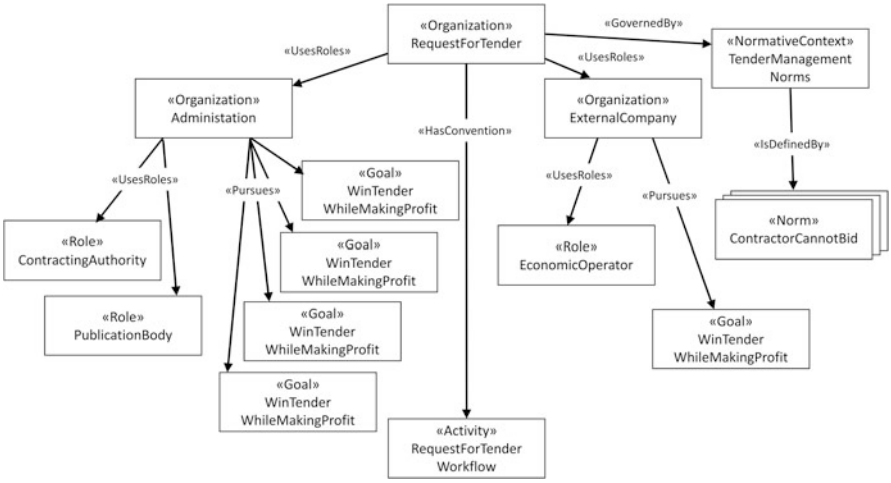

Fig. 2.5 Example of meta-model instantiation, identifying organizations in the call for tender case study

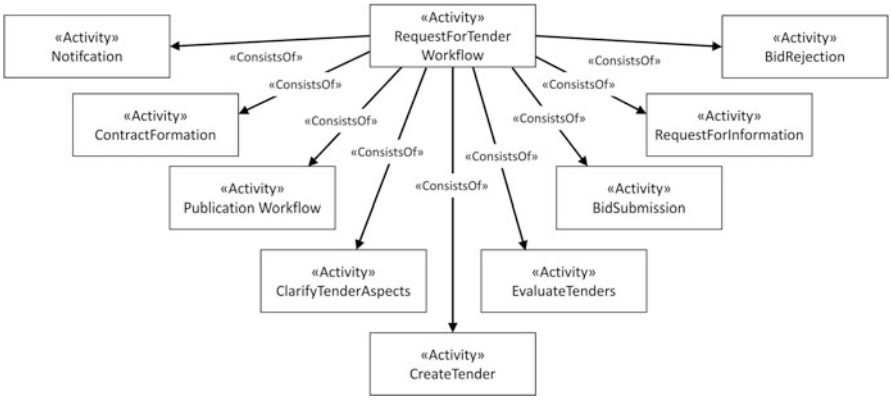

Fig. 2.6 Example of meta-model instantiation, identifying activities in the call for tender case study

In the next section, the Request for Tender example is used to illustrate modelling with the conceptual map. It is also used as an example case of Social Coordination in Artificial Social Cognitive Systems in the discussion of the different modelling frameworks in Chaps. 3, 4, 5, 6, 7, 8, 9, and 10.

2.4.2 Use-Case Model

The meta-model defines one single diagram where these entities can be used. Figure 2.5 shows a possible interpretation of the problem using those entities. The call for tender involves one administration and one or many external companies. The administration will publish the call for tenders, will be responsible for clarifying questions about the call, registering bids, and will contract only those economic operators that satisfy the contracting norms. One of the norms is that a contractor cannot be a bidder. The company acknowledges the existing norms and participates in the request for tender activity. The company pursues to make profit, so it is willing to participate if it is possible to respect the norms and do the job better than others.

The activities involved in the call for tender are several, as shows in Fig. 2.6. They have not been fully decomposed. The meta-model does not allow to indicate dependencies/ordering among activities beyond the decomposition. Some activities have been identified as atomic actions, like the *evaluate tenders*. This may be a shortcoming of the current meta-model.

2.5 Conclusions

Organization-oriented approaches have proven well suited to describe social interactions, service networks, complex software architectures, or socio-technical systems. In these, mostly open, environments, many different organizations or societies, and many agents from different sources can enter and interact with the environment and with each other and therefore require frameworks to describe and analyse social coordination and collective intelligence phenomena. In fact, social coordination and collective intelligence can only be fostered by addressing the interoperability problem at the level of organization modelling and reasoning.

This chapter brings together the work that has taken place in the last decade on the development of conceptual and computational frameworks for open regulated multiagent systems and explores their potential for the development of the emerging field of social intelligence.

We are currently further refining and validating this meta-model. Evaluation is being done by applying the meta-model to describe existing agent organization models included in the next chapters.

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