



Integrating Objective & Subjective Coordination in Multi-Agent Systems

- **Andrea Omicini**
 - *joint work with*
 - Alessandro Ricci, Mirko Viroli, Giovanni Rimassa

Special Track on Coordination Models, Languages & Applications
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Outline

- Subjective & Objective Coordination
 - The gap and the bridge (Activity Theory)
- Crossing the bridge
 - Extending FIPA model towards Objective Coordination
 - TuCSoN + FIPA model investigation
- Research plan

The Babel's Tower of Coordination

- Possibly, the most un-coordinated research area
- A multiplicity of non-related approaches
 - From a huge and heterogeneous range of research fields
- Some successful attempts for a rationale
 - Objective vs. Subjective (Schumacher)
 - Methodological gap (Omicini, Ossowski & Ricci)

Subjective Coordination

- *Coordination from the agent's viewpoint*
 - Components are the *coordinating* entities
 - Assumes some deliberative / intelligent capability by components
- Historically: from DAI
- Our champion today
 - FIPA model / JADE infrastructure

Coordination in FIPA

- Foundations of Intelligent Physical Agents
 - Standardisation body
- Communication via Speech Act
 - Communication is always agent-to-agent
 - Performatives come along with any message
 - inform, request, call-for-proposals, ...
- Semantic interoperability
 - Feasibility Preconditions and Rational Effects (FP & RE)
 - Formal model based on Beliefs, Desires, Intentions (BDI)
- Subjective approach if there is one...

Objective Coordination

- *Coordination from the designer's viewpoint*
 - Components are the *coordinated* entities
- Assumes no deliberative / intelligent capability by components
 - Typically disregards them...
- Historically: from SE / PDS / PL
- Our champion today
 - TuCSoN model & infrastructure

Coordination in TuCSoN

- Coordination as a service
 - Agents coordinate through ReSpecT tuple centres
 - Coordination abstractions with behaviour
 - Distributed coordination space
 - Multiple local coordination spaces
 - Each agent interacts through an Agent Coordination Context (ACC)
 - Coordination, organisation, security
 - *Orthogonality w.r.t. the agent model / platform*

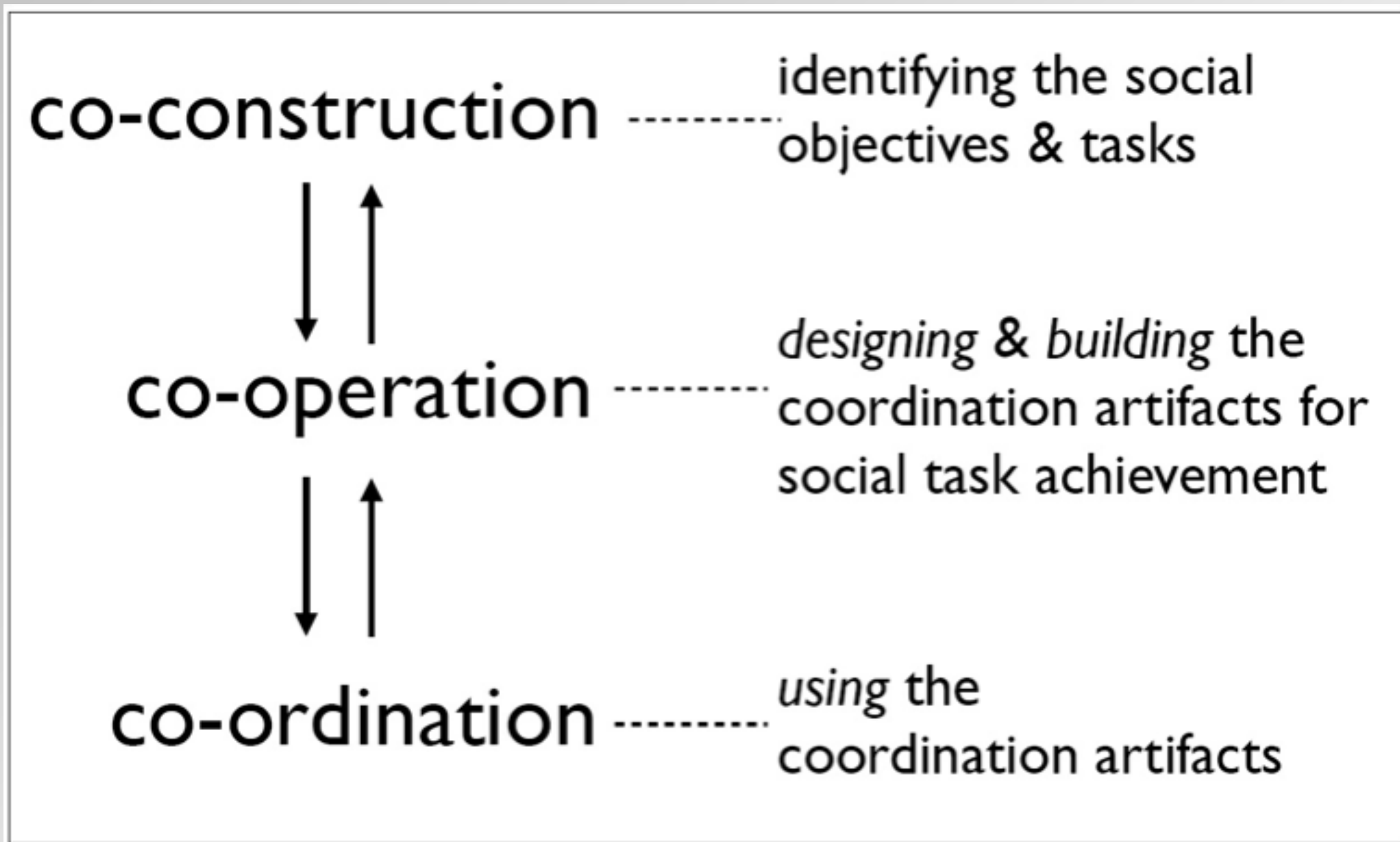
Aim of this Research

- Given years of separate development, the gap is no longer confined to models...
 - Gap between technologies & infrastructures
 - The need to bridge the gap is even more urgent
- Here we try to devise out a roadmap towards a possible convergence between
 - TuCSoN and FIPA models
 - TuCSoN and JADE infrastructures

Activity Theory

- Conceptual framework for the analysis of (human) collective work
 - Activity
 - Objectives & Context
 - Artifacts
 - Mediated Interaction
- Collaborative activities
 - Coordination artifacts

Levels of Collaborative Activity



FIPA toward Objective Coordination

- Goal
 - Embedding coordination artifacts in FIPA / JADE
- Conceptual premise
 - Artifacts are not ontologically equivalent to agents
 - Agents should not be expected to interact with artifacts by means of Speech Acts
- *Agent-artifact interaction modelled through Physical Acts*

TuCSoN + FIPA Models

- Agent interaction with the Environment is twofold:
 - Interaction with agents via Speech Acts
 - Interaction with coordination artifacts via Physical Acts
- TuCSoN coordination model + FIPA agent model
 - TuCSoN tuple centres as coordination artifacts for FIPA agents

Agents & Coordination Artifacts

- Two basic categories
 - Agents as *users* of artifacts
 - Typically co-ordination level
 - Intelligence not mandatory here
 - Agents as *managers* of artifacts
 - Typically co-operation level
 - Intelligence required here

Agents as *Users* of Artifacts

- Modelling use of coordination artifacts
 - TuCSoN tuple centre *coordination actions* (Linda-like) as FIPA *Physical Acts*
 - `out / in / rd / inp / rdp`
- Need for a suitable ontology
 - to define FP / RE of coordination primitives

Agents as *Managers* of Artifacts

- Modelling management of coordination artifacts
 - TuCSoN tuple centre *behaviour specification actions* as FIPA *Physical Acts*
 - `set_spec` / `get_spec`
- Need for a suitable ontology
 - to define FP / RE of behaviour specification primitives

Benefits for FIPA Agents

- Advantages of Obj. Coordination in Subj.
 - uncoupling for openness and dynamism
 - specific / efficient abstractions
 - controlled / automated interaction
- Runtime support for Coordination
 - Dynamic inspection of coordination laws
 - Dynamic change / adaptation of coordination strategies & activities

Research Plan

- FIPA ontologies & formal semantics
 - ACC negotiation
 - Role-Based Access (RBAC) to coordination artifacts
- ACC for semantic interoperability
- Infrastructure integration
 - JADE + TuCSoN
 - Currently, tuProlog on JADE
- Verification
- Agent & Law
- Models & infrastructures for trust

Coming Soon

- LeTop



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