Framing Coordination: Early Notes

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Motivations (1)

- The Whole Mess of Coordination
  - Possibly one of the most surveyed topics in the last ten years
  - Typically, no points of contact between two different surveys
  - People tend to take religious standpoints
  - YACS???
    - Yet Another Coordination Survey???
- Coordination is neither an AI nor a CS problem
  - (Nor a MAS, if you ask)
    - Malone & Cronston 1994
  - It concerns complex systems
    - where both *complexity* and *system* are notions of heterogeneous nature according to the field of interest
  - There are branches of science that work on complex systems since long before we (AI, CS, SE, MAS, whatever) did
    - They are to some extent more *science* than we are
    - They have results

Motivations (2)

- The Lack of a Unitary View causes
  - Weak scientific debate
    - Separated clusters of coordination scientists
    - Fragmented results
  - Feeble spreading of relevant results
    - No impact on other communities
      - That may even need them…
    - Sporadic trans-disciplinarity
    - People re-invent the wheel
      - Microsoft Orchestration?
  - No transfer to industry
    - Unmarketable concepts and technologies
    - No impact, in the end
- Is "Unitary View" what we really need?

Motivations (3)

- New people are not encouraged to face the issue
  - New students?
- Some popular journals start refusing to talk about coordination
  - “It is one of the key issues, but not perceived as such by our readers”
- This “science” is meant understanding and building complex systems
  - Not make it even more complex

Goals (1)

- Make it simpler
- Understand all relevant approaches and results
  - Help other people understand
- Do not "unify" approaches and results
  - Instead put each of them in the place it deserves
  - By interpreting them as different "views" on complexity
- Make cross-fertilisation a solution, rather than a problem
  - The problem is not writing huge "Related papers" sections
  - Nor finding someone else asserting what I do not dare to say
  - This issue already raised in many different places
    - Schmidt & Simone "Mind the Gap" (CSCW -> Workflow)
    - Mamei & Zambonelli Co-fields
    - Parunak's Stigmergy coordination

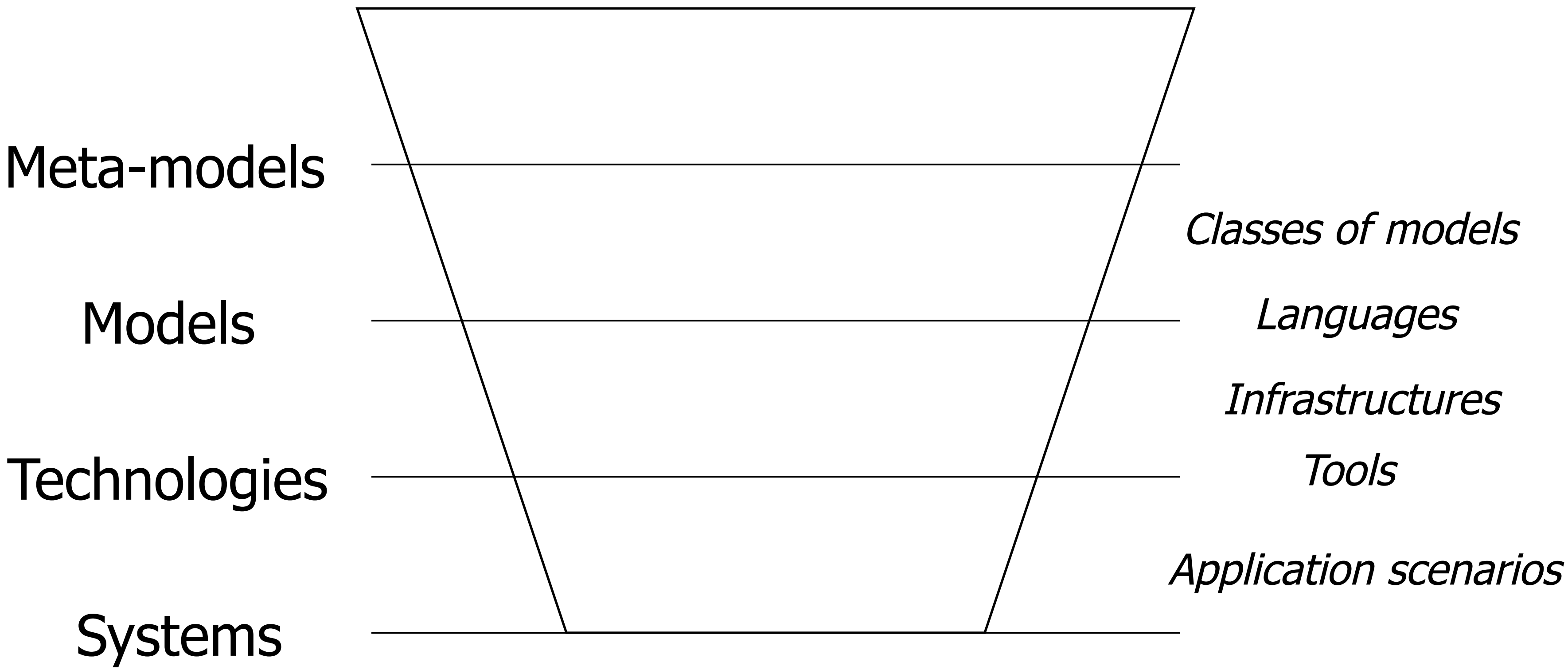
Goals (2)

- Provide people a tool (a *frame*)
  - Supporting the scientist and the engineer
  - Allowing them to understand and compare the different views on coordination
  - Enabling them to exploit all (most) benefits and pluses of every different view
  - Promoting cross-fertilisation
- Not labelling, but extracting
  - Different views should not be “labelled” and classified according to some Linneus-like hierarchy
  - They should instead by “sieved” trying to extract any useful notion, idea and contribution that could help
    - We frame their conceptual content, rather than the whole views

The Coordination Sieve (1)

- A tool for
  - Input a view on coordination
    - Be it a model, a mechanism, a system, an application scenario, even a survey
  - Extracting / filtering out (*sifting*) whatever interesting / useful content
    - Both explicit and implicit content
  - Being careful not to forget the context altogether
- A Multi-level sieve
  - Contributions can come at different levels
    - Should be sifted at different levels
  - First check
    - If the sieve works, different “seeds” sifted at the same level by different views should be inherently *comparable*

The Coordination Sieve (2)



Meta-models

- Ontologies for coordination
  - either explicit or implicit
  - either conceptual or pragmatic
    - a priori (construction) / a posteriori (observation)
- Basic notions / questions
  - What is a system / a component?
  - How can we distinguish a system / a component within – ?
    - criteria a priori (construction) / a posteriori (observation)
  - When does a component belong to a system?
    - relation between system and components
  - How do components relate each other?
    - static, structural relationship
      - architecture
    - dynamic, behavioural relationship
      - interaction
- A meta-model provides a key to interpret *coordinated systems* at a chosen level of abstraction

Models

- A set of conceptual and linguistic abstractions
  - enabling the representation / construction of coordinated systems
- Every model typically comes along with its own primary meta-model
  - the *embedded* meta-model
  - however, any other meta-model providing a useful interpretation of a model is "allowed" in principle
- A model of coordination is concerned with both the *syntax* and the *semantics* of architecture and interaction
  - the syntax in particular is what we usually call *coordination language*
    - "linguistic reification of a coordination model"
- Often, coordination models are only partially specified
  - classes of models

Technologies

- Reification of a coordination model / language
  - at development time
  - at run time
- Specifications
  - explicitly / implicitly embedding models
    - e.g. CORBA, JavaSpaces
- Infrastructures
  - e.g. T Spaces, SOLACE
  - run time abstractions
    - coordination as a service
    - e.g. TuCSoN tuple centres
- Tools
  - development
    - libraries, packages, API
    - IDE
  - monitoring / verification
- From analysis down to deployment

Systems

- Individual systems
  - from a single application scenario, an *ad hoc* solution that embeds some coordination
    - intelligent heating (Gustavsson 1998)
- Classes of systems
  - from a common application scenario, with specific requirements and features, a (locally) general purpose approach to coordination
    - WfMS
    - CSCW
- Classes of problems
  - from conceptually wide application scenarios, sharing a few characteristic features, some complex coordination problems
    - pervasive / ubiquitous computing
    - ambient intelligence
    - …

Examples (1): Theory of Coordination

- (Malone Crowston 1994)
  - very famous for its vision of coordination as an interdisciplinary issue
  - so often cited…
- Meta-model
  - *activity* and *dependency* as the basic brick
    - entities in charge of activities are not addressed as first-class
  - managing dependencies between activities is a c*oordination process*
    - coordination is fine grained
  - despite what they say, mainly a bottom-up approach
- Some models are extracted using the meta-model from Organization Theory, Biology, Computer Science
  - and that is enough

Examples (2): Activity Theory

- Context
  - social / organization sciences
  - from ‘20 to ‘90
- Meta model
  - activity
    - individual, social (collective)
  - artifacts
    - as the mediators of any interaction
    - as the results / goals / tools of any activity
- What do we learn?
  - the role of artifacts and mediated interaction
    - modelling / engineering social acitvity

Examples (3): CSCW towards WfMS

- Mainly, technologies and systems
  - languages
    - Ariadne
  - agent architectures
    - ABACO, MILANO
  - software components
    - AW-Manager
- Basic notions
    - articulation
    - coordinative protocols and artifacts
    - mutual awareness
    - …
- Mind the gap (Schmidt Simone 2000)
  - gap between need for flexibility and need for automatization
  - need for adjustable coordination abstraction

What should we learn?

- Each view / approach over coordination
  - was conceived in a context where it worked
  - given certain pre-conditions, it solved problems
- Complex systems tends to offer multi-level, multi-faceted problems
  - there is no tool for every problem
  - the problem is not only to have all the tools available
  - the problem is to understand which tool and when
    - and how to make them work together
- Different coordination views are to be seen as a multiplicity of sources
  - of ways to understand problems
  - of tools to solve problems
  - in the modelling / engineering of complex systems

to be used altogether whenever needed / useful

Expected Impact on MAS

- Modelling
  - Meta-models providing multiple, original viewpoints to interpret observations
    - conceptual tools for understanding / modelling complex systems
  - Multi-level, multi-source abstractions
    - cross-fertilisation
      - inter-disciplinary / trans-disciplinary
    - more articulated models
      - well-founded via media between simplicity and expressiveness
- Engineering
  - Meta-models providing multiple, original viewpoints to define requirements
    - conceptual tools for analysis and design of complex systems
  - Multi-source, multi-purpose models / technologies
    - well-founded selection / positioning of models / technologies
  - Mediated interaction
    - the role of artifacts