MEnSA

Methodologies for the engineering of complex software systems: agent-based approach

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04/06/2007

MEnSA: The objective

- The aim of this project is to fulfil the **gap** between
  - the agent-oriented development methodologies
  - the multi-agent infrastructures
- We want to draw from the vast AOSE literature to
  - synthesize a new methodological framework for agent-based system
  - build up the infrastructures and development tools that actually support and promote such a framework.

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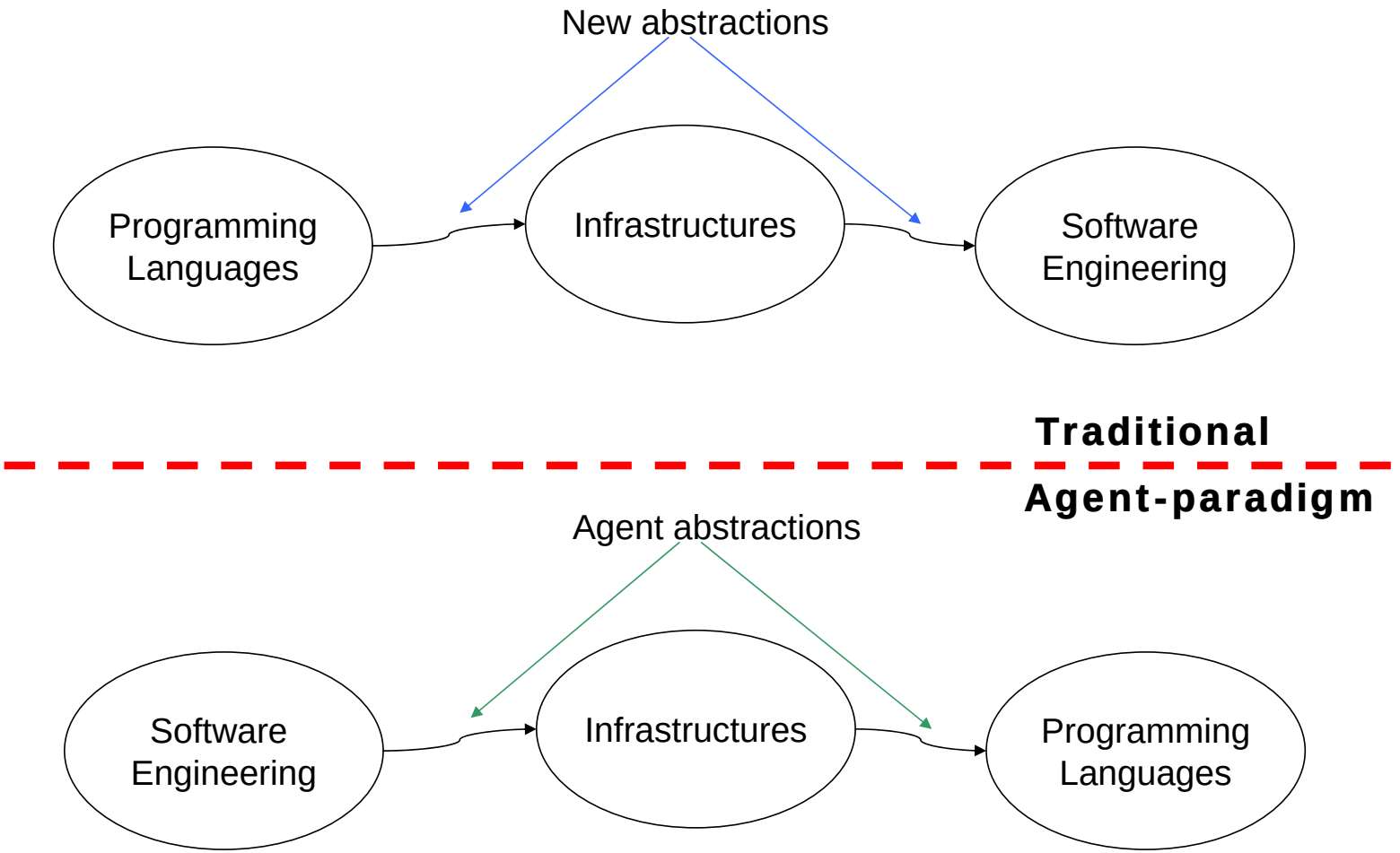
Informatics Technologies Evolution



The Gap

- Today the engineer often works with technologies that do not support the abstractions used in the design of the systems.
- For this reason the research on methodologies becomes the basic point in the scientific activity.
- There is a deep *gap* between the AOSE approach and the available technologies
  - the proposed AOSE methodologies have mostly followed a *top-down approach*, where the agent paradigm and the metaphor of the human organisation have been used to analyse, model and design a system
  - multi-agent languages and tools have followed a *bottom-up approach*, evolving out of necessity from existing programming languages and development environments.

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The Gap

- The gap between methodologies and infrastructures and languages can leads to *dangerous inconsistencies* between the design and the actual implementation of the system.
- These are the consequences of the use of concepts and abstractions in the analysis and design stages which are different from those used to deploy and implement the system.
- On one side the agent-based abstractions available in the design phase suggest high level of expressivity
- On the other side the development tools, that are still in the stage of academic prototypes, don't support these abstractions

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Challenges

- This suggests two important challenges that represent the principal objective of the project:
  - identification of the effective abstractions to model complex systems as multi-agent systems
  - integration of these abstractions in methodologies that support the whole software life cycle and fill the conceptual gap between agent-oriented methodologies and the infrastructures used to implement agent-based systems

Planning

- Starting from our experience in developing AO methodologies, infrastructures and development tools
  - we will draw from the many contributions in the AOSE literature to synthesise
    - a meta-model that fruitfully integrates the most effective AO abstractions and concepts
    - a new methodological framework that, starting from the previous meta-model, fruitfully integrates processes and practices
  - and correspondingly build up the infrastructures and development tools that actually support and promote such a framework

More in detail...

- We define a *common meta-model* where the most relevant concepts and abstractions used in methodologies and infrastructures will be integrated.
- We develop an *agent-oriented methodological framework* encompassing the common meta-model. The framework will be aimed at covering the whole process of the software development, from requirements analysis, along design, deployment, implementation and verification

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- We develop some *case studies* selected from a number of application projects where the proposing units are already involved in order to validate the methodological framework, and possibly verify the actual effectiveness and usability of the proposed abstractions and tools.

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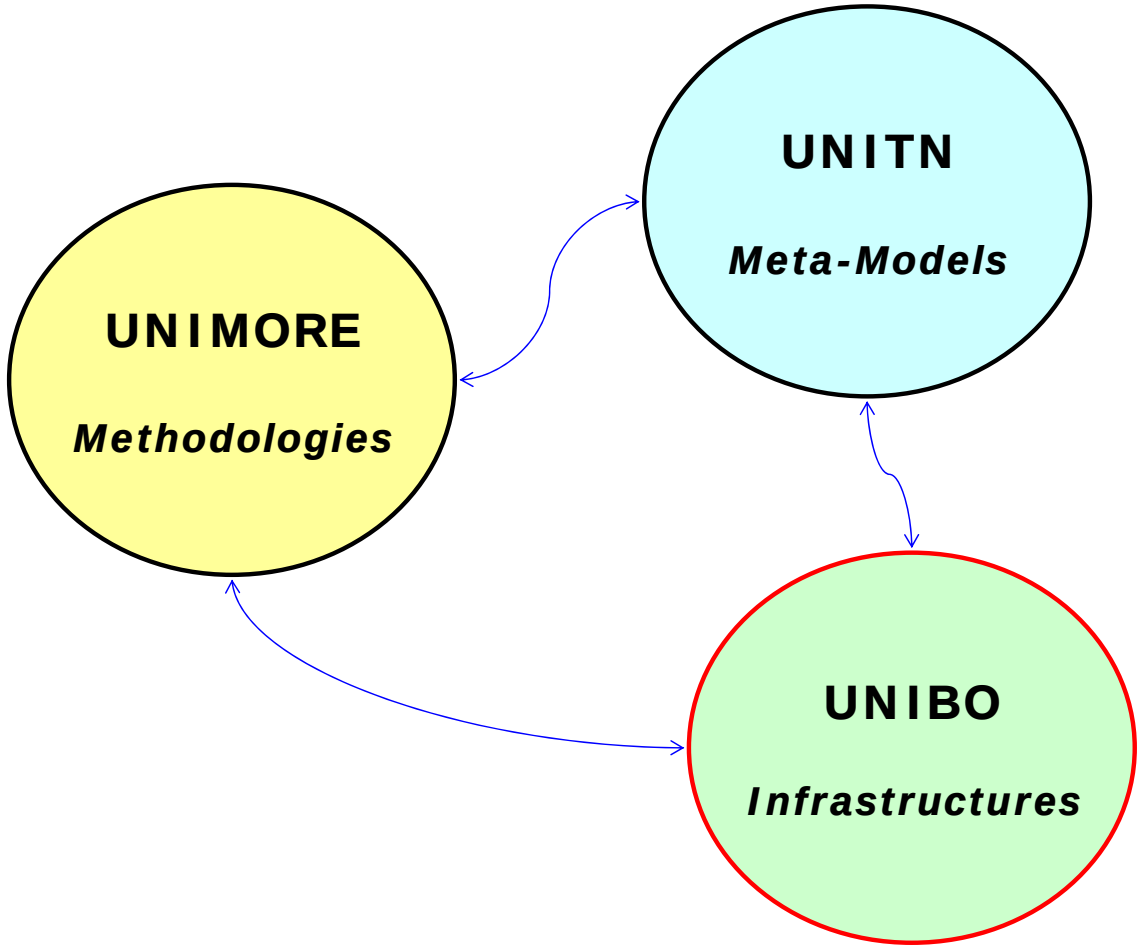
A simple Overview



UNIBO: People involved

- Prof. Andrea Omicini (National Coordinator)
- Ing. Ambra Molesini (Ph.D Student)
- Ing. Elena Nardini (future Ph.D Student)
- Ing. Giulio Piancastelli (Ph.D Student)
- Ing. Matteo Casadei (Ph.D Student)

UNITN: People involved

- Prof. Paolo Giorgini (Local Coordinator)
- Prof. John Mylopoulos (Full Professor)
- Ing. Yudistira Asnar (Ph.D Student)
- Dr. Volha Bryl (Ph.D Student)
- Dr. Sameh Abdel-Naby (Ph.D Student)
- Dr. Aliaksandr Birukou (Ph.D Student)

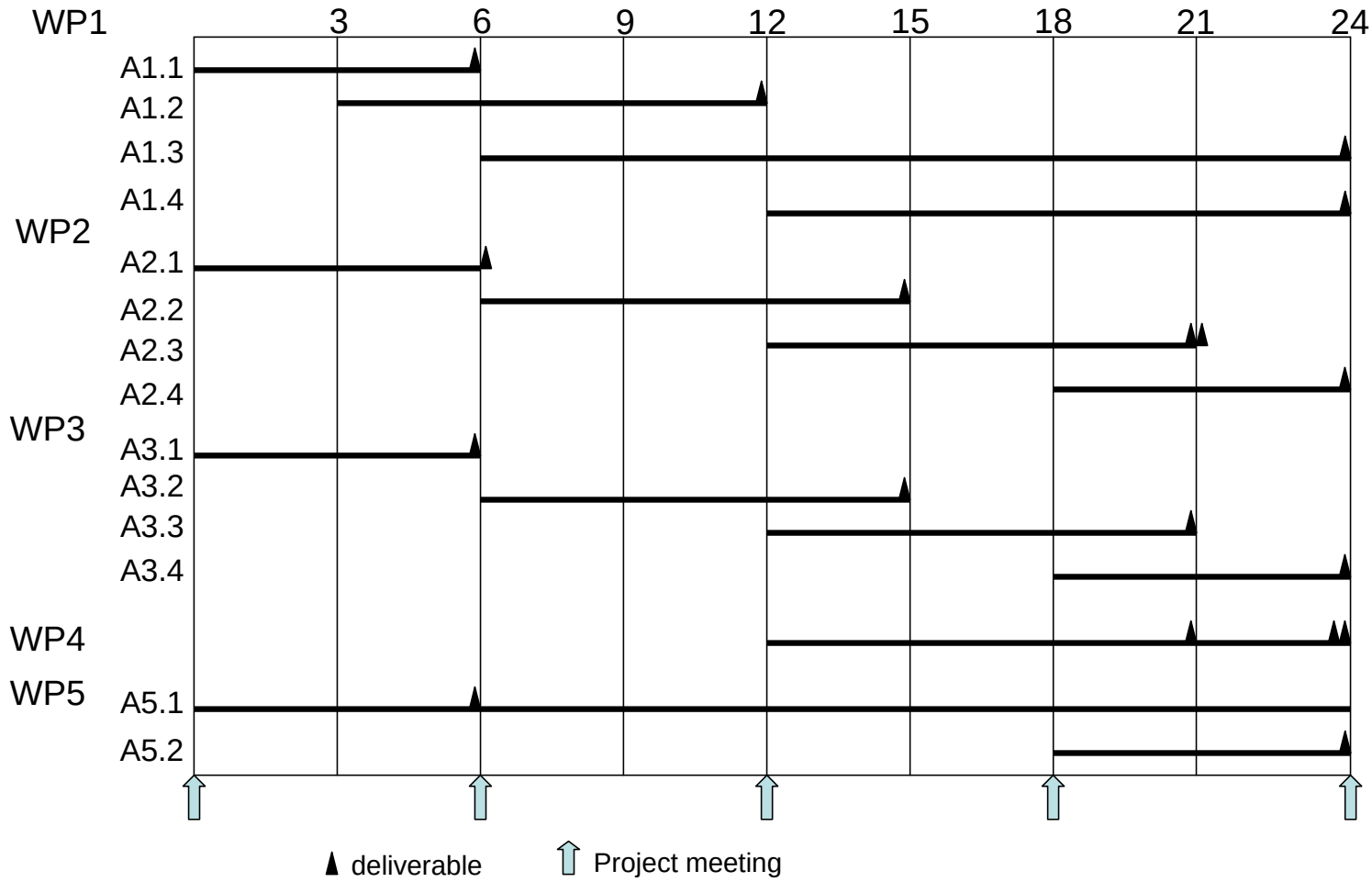
UNIMORE: People involved

- Prof. Giacomo Cabri (Local Coordinator)
- Prof. Letizia Leonardi (Full Professor)
- Ing. Cernuzzi Luca (Ph.D Student)
- Ing. Quitadamo Raffaele (Ph.D Student)
- Ing. Piuvani Mariachiara (Ph.D Student)
- Ing. Francesco De Mola (Ph.D)
- Ing. Luca Ferrari (Ph.D)

Workpackages

- MEnSA is articulated in five different workpackages:
  - WP1 Meta-Model
  - WP2 Methodology
  - WP3 Agent Infrastructures Development
  - WP4 Case study
  - WP5 Dissemination

Gantt Diagram



Outline

WP1: Meta-model

- Responsible: UNITN
- The main objective: defining a *meta-model* that
  - integrates the meta-models of the major agent-oriented methodologies
  - with abstractions and extensions introduced by multi-agent languages and tools.
- Starting from the review of the state of art in the AOSE field
  - the most appropriate meta-models "fragments" will be selected
  - and possibly adapted from existing methodologies and MAS infrastructures to form the integrated meta-model.
- To represent a meta-model we need an appropriate framework. Choice between:
  - OPEN Process Framework (OPF)
  - OMG SPEM (Software Processing Engineering Meta-model)

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WP1: Meta-model

- The workpackage will be articulated in four different activities:
  - A1.1 Study of the state of the art
  - A1.2 Definition of an integrated meta-model
  - A1.3 Comparison with the methodological framework
  - A1.4 Evaluation and revision of the meta-model

WP1: Expected Results

- As a result of this workpackage, papers will be produced describing the meta-model.
- Deliverables:
  - *D2.1* Document describing the state of art
  - *D1.2* Document describing the meta-model
  - *D1.3* Document present the comparison between the meta-model and the developed methodology
  - *D1.4* Document describing the evaluation of the meta-model and the description of its revised version

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WP2: Methodology

- Responsible: UNIMORE
- This workpackage aims at the proposal of an *innovative methodology* that
  - allows to design agent based applications
  - provides a concrete support during the whole software life cycle
- The methodology will
  - take into account also the existing approaches based on infrastructures that support the implementation and the execution of agent based applications
  - remove the gap between methodologies and infrastructures
- The methodology will be based on the meta-model proposed in WP1

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WP2: Methodology

- The workpackage will be articulated in four different activities:
  - A2.1 Study of the state of the art
  - A3.2 Development of the methodology
  - A3.3 Development of a supporting tool
  - A3.4 Methodology evaluation

WP2: Expected Results

- As a result of this workpackage, papers will be produced describing the methodology and the tool.
- Deliverables:
  - *D2.1* Document describing the state of art
  - *D2.2* Document describing the methodology
  - *D2.3* Document describing the prototype tool
  - *D2.4* Prototype tool
  - *D2.5* Document describing the evaluation results

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WP3: Agent Infrastructures Development

- Responsible: UNIBO
- The objective of this workpackage is the *identification of suitable infrastructure* supports for agent-based systems and MAS, for the engineering of complex software systems, in particular for their runtime and on-line management.
- We will
  - consider existing infrastructure models, approaches, and their extension and integration
  - develop a framework that will cover the main infrastructure issues of interest and support the methodological framework developed in WP1 and WP2

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WP3: Agent Infrastructures Development

- The workpackage will be articulated in four different activities:
  - A3.1 Study of the state of the art
  - A3.2 Definition of an infrastructural model
  - A3.3 Design and Development of Prototypes
  - A3.4 Infrastructures evaluation

WP3: Expected Results

- As a result of this activity, technical reports and papers will be produced describing the infrastructure(s) and the tool(s).
- Deliverables:
  - *D3.1* Document describing the state of art
  - *D3.2* Document describing the infrastructural model
  - *D3.3* Infrastructure prototypes and related documentation
  - *D3.4* Document describing the evaluation results

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WP4: Case Study

- Responsible: UNIBO
- This stage will investigate the adoption of the infrastructure for the engineering of some *case studies*, both theoretical and real-world.
- Among the possible application domains:
  - logistics
  - e-learning
  - intelligent environments
  - virtual enterprises
  - distributed workflow management
- The engineering of the case studies will stress the synergy between the methodological framework and the developed infrastructure.

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WP4: Expected Results

- As a result of this activity, technical reports will be produced describing the engineering of the case studies, along with simple prototypes developed on top of the infrastructure(s).
- Deliverables:
  - *D4.1* Document describing the case study
  - *D4.2* Document(s) describing the analysis and design according to the methodological framework resulted from WP2
  - *D4.3* Experimental prototypes on top of the infrastructure(s) and tools resulted from WP3

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WP5: Dissemination

- Responsible: UNITN
- The goal of this workpackage is that of guaranteeing the adequate *dissemination* of the project results.
- Other than via publications and participation in the main international conferences
- Activities:
  - A5.1: Creation of a project website
  - A5.2: Organisation of an international workshop
- Deliverables:
  - *D5.1* Project Web site
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