Situated Process Engineering for Integrating Processes from Methodologies to Infrastructures

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The creation of a single universally-applicable development process is a recognised chimera.

→ Software designers tend to define their own problem-specific process by means of the Method engineering technique.
→ New process can be created starting from existing process parts (method fragments).

A unified meta-model and a specific AO Method Engineering technique are needed, allowing existing methodologies/processes to be represented and integrated in a uniform way.

The Software Process Engineering Metamodel (SPEM) 2.0 [Object Management Group, 2008] and the Agent-Oriented Situational Method Engineering [Cossentino et al., 2008] seem to be the natural candidates.
Objectives

→ Understanding the semantics of the infrastructures’ processes
→ Exploring SPEM 2.0 applicability to the AOSE methodologies and infrastructures
→ Exploring the applicability of Agent-Oriented Situational Method Engineering for composing methodologies and infrastructures
→ A simple case study
  ▶ methodology: SODA
  ▶ infrastructure: TuCSoN
AOSE Methodologies & MAS Infrastructures: The Gap

AOSE methodologies: top-down evolution

- Most AOSE methodologies have mostly followed a top-down evolution path, where abstractions and metaphors (models and structures) from human organisations have been used to analyse, model and design software systems.
- This is the case of methodologies like Gaia, Tropos, PASSI and SODA.
AOSE Methodologies & MAS Infrastructures: The Gap

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MAS infrastructure: bottom-up evolution

- Many MAS infrastructures have mostly followed a **bottom-up evolution path**, evolving out of necessity from existing programming languages and development environments, “stretching” the agent paradigm on top of more traditional paradigms and technologies.
- Despite JADE, TuCSoN, TOTA, among the many others, introduce specific agent-oriented abstractions, yet, the imprint of the object-oriented paradigm is still visible—for instance, in agents taking the form of Java threads.
Previous Work

- [Cabri et al., 2008] and [Molesini et al., 2008] explore a mapping between methodologies’ meta-models and infrastructures’ meta-models.
- Such investigations have paved the way towards a more precise mapping between the concepts supported by methodologies and infrastructures leading to the definition of infrastructures’ meta-models.
- However, this is still not enough for a software development process aimed at covering all the stages of the software lifecycle.
- In fact, this approach provides only guidelines on abstractions’ mapping.
- ...but says nothing about the process resulting from such an integration and how to use it.
Infrastructure Process

- The presence of a specific infrastructure clearly affects the engineering process [Molesini et al., 2009]
  → There would be no need to design a function if it is already provided by the services/functionalities of the selected infrastructure
- The methodologies processes could be influenced by the adoption of an infrastructure instead of another
- Infrastructures represent a *key piece of the software development process*
  → Infrastructures *do* have a process behind them
    - it is usually ‘silent’ and unspecified
  → To define a complete software development process, we believe that such an infrastructure process needs to come ‘out of the water’, so as to be first explicitly detailed, and then clearly integrated with the methodologies’ process
Key Idea

- We mean to re-use
  - Agent-Oriented Situational Method Engineering (AO-SME) technique [Cossentino et al., 2008, Cossentino et al., 2007]
  - Software Process Engineering Meta-model (SPEM) [Object Management Group, 2008]
- For integrating methodologies and infrastructures
  → We consider methodology and infrastructure as two fragments to be integrated in order to obtain a new software process
  → We use the integration between SODA and TuCSoN as a case study
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SODA: Societies in Open and Distributed Agent spaces

SODA ...

- ... is an agent-oriented methodology for the analysis and design of agent-based systems
- ... focuses on inter-agent issues, like the engineering of societies and environment for MAS
- ... adopts agents and artifacts – after the A&A meta-model – as the main building blocks for MAS development
- ... introduces a simple layering principle in order to cope with the complexity of system description
- ... adopts a tabular representation
The SODA meta-model

Actor

Requirement

Relation

LegacySystem

ExternalEnvironment

Task

Dependency

Function

Topology

Action

Interaction

Operation

Role

Rule

Resource

Space

Workspace

Agent

Composition

Artifact

Uses

Links to

Autonomous Behaviour

Society

Aggregate

Functional Behaviour

Spokes to

performs

constrains

participates

connects

connects

participates

perceives

is allocated

exhibits

exhibits

exhibits

constrains

participates

participates

constrains
The SODA Process

Requirements Analysis

Analysis

Is the problem well specified?

Layering

yes

no

Architectural Design

Is the system well specified?

yes

no

Detailed Design

Are there problems in the system?

yes

no

Layering

Is the system well specified?

yes

no

Layering

no

Is the problem well specified?
Layering in SODA as a Capability Pattern

- new layer?
  - no: Select Layer
  - yes: increases detail
    - In-zoom
    - increases abstraction
      - Out-zoom
    - Projection
Detailed Design Process

- Carving
- Mapping
- Agent design
- Environment design
- Workspace design
- Interactions design

is the system well specified?

yes
no
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TuCSoN: Tuple Centres Spread over the Network

TuCSoN ...

- ... is a MAS infrastructure for the communication and coordination of agent-based systems
- ... adopts ReSpecT as a language for expressing the behaviour specification of tuple centre
- ... introduces Agent Coordination Context as the conceptual boundary between an agent and its organisational environment
Events can be both internally generated and perceived from the tuple centre.
TuCSoN Process
Our approach is based on the composition process approach by Cossentino et al. [Cossentino et al., 2008]

- **process analysis** → kind of process & a set of MAS Meta-model elements (MMMEs)
- **process design** → method fragments selection and assembly
- **process deployment** → process instantiation
Analysis Outcome

- Since both SODA process and TuCSoN process are iterative and incremental

→ SODA + TuCSoN will be iterative and incremental

- MMMEs mapping
Key Questions

- The integration between a methodology process and an infrastructure process raises a new peculiar problem
  - the impact of the infrastructure process onto the software engineering process
- So, a process designer should be prepared to answer several key questions before facing the process integration
  - Where does the infrastructure process intervene?
  - Does the integration change the methodology or infrastructure – and if so, how – and the format of their Workproducts?
  - ...
The SODA+TuCSoN Integrated Process

- The TuCSoN process can be naturally located at the end of the SODA process
  - SODA is neutral with respect to the implementation technologies
  - The MMMEs involved in the assembly are just either SODA abstractions that belong to the Design phase, or TuCSoN abstractions belonging to the Organisation Definition phase
  - Since neither SODA nor TuCSoN make any assumption on the nature of agents, TuCSoN does not influence the SODA process in its early stages, nor does SODA influence the TuCSoN process’ late stages
- SODA does not change its nature in the integration
  - SODA Workproducts could change
The SODA+TuCSoN Integrated Process

SODA

- Requirements Analysis
- Analysis
- The problem is well specified
  - No
  - Yes
  - Layering
  - Is the system well designed?
    - No
      - Organisation Design
  - Architectural Design

TuCSoN

- New Iteration?
  - Yes
  - Organisation Test
  - no
    - Is the Organisation designed well?
      - yes
        - Organisation Implementation
Organisation Design Process

Carving
Mapping
Agent design
Environment design
Workspace design
Interactions design
Society Class Definition
Society Instance Definition
TC Behaviour Definition
Topology Definition
Agent Behaviour Definition
TC Behaviour Definition
Topology Definition
Is the system well designed?
yes
Organisation Test Definition
no
Organisation Design Process

1. Carving
   - Mapping
      - Society Class Definition
      - Society Instance Definition
      - Workspace design
      - Environment design
      - Agent design
      - Interactions design
      - Agent Behaviour Definition
      - TC Behaviour Definition
      - Topology Definition

2. Is the system well designed?
   - no
   - yes
       - Organisation Test Definition
Conclusions

- Since this research is still in its early stage, we are well aware that our current approach opens many questions, which are only partially addressed
  - the role and the impact of the MAS infrastructures in the software engineering process
  - the meaning of a process of an infrastructure

Future work

- a generalisation of our study about of the methodologies and infrastructure integration
- the improvement of the description of the TuCSoN process
- a better understanding of the adequacy of the SME technique and of the prioritisation algorithm to evaluate whether they could cover “as they are” also the integration among methodologies and infrastructures fragments that present the new issues highlighted or they need some extension
- we also plan to make the same experiments with other methodologies and infrastructures


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