VOM: a Service-Oriented open MAS Meta-model

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Agreement Technologies Issues

- **Virtual Organizations**
  - Organisational Modeling Languages
  - MAS Methodologies based on Organizational Concepts
  - MAS Development Environment
  - Organisation Management Infrastructure

- Norms

- Argumentation and Negotiation
Guidelines for Organizational Multi-Agent Systems

Integrates Organization Theory and relevant MAS Methodologies:
- INGENIAS, MOISE, OMNI, AML

Provides a selection method for a suitable structure of the organization

Describes system functionality from a Service-Oriented perspective
- Services offered by the organization
- Services required that have to be supplied by external agents in a regulated way
Organisational Modelling Language

- Model open societies
- Focuses on integration of Web Services and MAS Technologies
- Considers main aspects of an organization:
  - Structural
  - Functional
  - Dynamical
  - Environmental
  - Normative
MAS Development Environments

- **emfGORMAS Tool**: case base tool in Eclipse
THOMAS Framework

- Multi-agent framework for development of Virtual Organizations with a service-based approach
Researching issues

MAS Modelling Languages

Virtual Organizational Model

Case Study Example

Conclusions
Evolving MAS Modelling Languages

State-of-art
Organizational Dimensions

Evolution of MAS Modelling Languages

YEAR
1995-99
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009

AALADDIN (98)
PASSI
UML (99)
Gaia
AUML
MOISE+
TROPOS
i* (95)
MAS-CommonKADS (98)

AGR
AGRE
PROMETHEUS
AOR
TAO

ROADMAP

Gaia

PASSI

AML

ROADMAP

PASSI

Unifying MMM

HoloPASSI

AMAS-ML

AMOLA

ASEME

FAML

VOM

GORMAS

Model Language
Model & Method
Method

Extension, Revision
Usage
Recent Modelling Languages

- **MENSA**: integrates relevant models; identifies requirements, design and implementation concepts
- **O-MASE**: defines systems structure and capabilities for reorganization
- **MOISE+**: organisational model for structural, functional and deontic aspects
- **AGRE**: specifies organisation as a role-group structure imposed on agents
- **OMNI**: details organisational, social and interaction models
- **FAML**: meta-model intended to standardize MAS modeling. Defines Design-Time and Run-Time concepts
Organizational Dimensions

- **Structural**: describes components of the system and their relationships.
- **Functional**: details the system functionality (i.e. system requirements, goals and tasks)
- **Dynamical**: considers interactions between the different elements of MAS and their effects.
- **Environment**: details resources and agent perceptions.
- **Normative**: defines mechanisms used by society to influence member behaviors.
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VOM: Virtual Organizational Model

- **VOM approach**
  - Integrates INGENIAS (ANEMONA), AML, OMNI and MOISE
  - Takes into account **Organizational Dimensions**
  - Adopts **SOMAS Standards**
  - Only FAML Design-Time concepts, mainly at System-Level, are considered => **Organization Level Concepts**

SOMAS: Service-Oriented Open Multi-Agent Systems

- MAS with computing model based on services
  - Employs Web Service Standards
VOM simplified meta-model

Structural Dimension

Functional Dimension

Environment Dimension

Dynamical Dimension

Normative Dimension
Structural Dimension

Organizational Unit

- Formed by agents or other OUs
- Regulates access to environment elements
- Contains norms affecting member behaviors
Functional Dimension

Services

- Following Web Service Standards
  - Profile: service interface
  - Process: service implementation
  - Grounding: services published in service ports
Dynamical Dimension – (i) Interactions

- Based on INGENIAS
  - Message Schemas
Dynamical Dimension – (ii) States

State Evolution

- Expected state for Roles
- Role enactment (Activation & Leave Conditions)
Environment Dimension

**Port**
- Restricts resource usage and service publication
- Based on AML
Normative Dimension

Norm

- Deontic restrictions on Agents, OUs or Roles
- Defines members in charge of:
  - Monitoring restriction
  - Applying sanctions
  - Applying rewards
- Based on OMNI
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Examples of VOM Diagrams

Functional Dimension Model diagram

Environment Dimension Model diagram
Using emfGORMAS
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Conclusions

- **VOM: Organizational Modelling Language**
  - Characterization of the Virtual Organization
    - Structure, Functionality, Dinamicity, Environment, Regulations
  - Normative regulation of service usage
    - Web service standards: Profile, Process, Grounding
    - Control on requesting, using and publishing services