ONTOLOGIES BASED COMMUNICATIONS through MODEL DRIVEN TOOLS:
FEASIBILITY of the MDA APPROACH in UCE projects

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• Introduction
• The MDA approach
• The MDD interoperability framework
• Application of MDA techniques to the management of ontologies in UCE projects
• Issues - perspectives
Introduction

- The productivity problem
- The portability problem
- The interoperability problem
- The documentation problem
The Productivity Problem:

Iterative process (in theory) → Requirements
  → analysis
  → Design
  → coding
  → testing
  → deployment

Iterative process (in practice)

Requirements
  → Text
  → Text and diagrams
  → Text and diagrams
  → Code
  → Code
The Portability Problem:

- Increase of new technologies

- Need to follow these new technologies
  - Technology required by customers
  - Can solve real problems (XML)
  - Only new technologies supported by tool vendors

Software tools need to interoperate
The Interoperability Problem:

- Existing software need to communicate with new ones
- Increase of modular tools
- Modules built according to specific technologies

Increase of need for interoperability
The Documentation Problem:

- **Documentation:**
  - often considered as a by-product
  - time consuming
  - slows down the development process

- **Result:**
  - need to generate documentation directly from the source code
The MDA approach

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- The MDA framework
- The MDA development life cycle
- The MDA benefits
- Inside the MDA Framework
- Model transformation
Object Management Group

- Is a consortium
  - Created in April 1989
  - By 11 companies (3Com, American Airline, Canon, HP, Philips, Sun, Unisys, …)

- Over than 850 members
  - Contributors (Boeing, Borland Software Corporation, Sun Microsystems, W3 Consortium…)
  - Platforms (BEA Systems, Fujitsu, Hewlett-Packard, Nokia, SAP AG)
  - Universities (INRIA, EURESCOM, …)
Object Management Group

- **Main goals**
  - Setting standards in the area of distributed object computing

- **OMG’s specifications**
  - UML
  - CORBA/IIOP
  - MDA
  - CWM,...
MDA (Model Driven Architecture)

Attempt to solve the previous problems ....
The MDA development life cycle

Enterprise requirements
- CIM
- Text
- PIM
- PSM
- Code

Software requirements
- PIM
- Code

Analysis

Design

Coding

Testing

Deployment

MDA process
Computation Independent Model (CIM)

- Specifies business processes, stakeholders, departments, dependencies between processes, ...
- Represents the system requirements
- Does not show details of the structure
- Made of two subdivisions:
  - Business Model
  - Business Requirements for Systems.
Platform Independent Model (PIM)

- Shows a high level of abstraction
- Independent of any implementation technology
- Describes the software system
Platform Specific Model (PSM)

- Describes the system in one specific implementation technology
- A PIM is transformed into one or more PSMs
- For each specific technology platform a separate PSM is generated
- Example:
  - Relational Database PSM for (column, foreign key…)
  - EJB PSM (entity bean, home interface, session bean…)
Code

- Represents the final step of the development process
- Automatically generated
The MDA transformation steps

- PIM
  - Transformation
    - PSM
      - Transformation
        - Code
    - Transformation
      - PSM
        - Transformation
          - Code
MDA benefits

- Interoperability
- Portability
- Productivity
- Documentation
The interoperability benefit

Class diagram

Database

PSM Bridge

SQL

Code Bridge

Java

Java
Productivity gains

- Minimize the development time
- Focused on PIM development
- Improved functionalities
- Reduced development time
Portability benefits

- A PIM can be transformed into multiple PSMs
- A PIM describes a portable specification
Maintenance and documentation benefits

- Documentation always up-to-date
- The PIM provides the high level documentation
- Consistency checking between a high level documentation and the code
Inside the MDA Framework:

Modelling and metamodelling
Metamodelling and Meta-Language

1. Metamodell is defined by Metamodel.
2. Model is written in Language.
3. System is described by Meta-Language.
The OMG’s metamodeling architecture

Layer M3  Meta-Metamodel
Layer M2  Metamodel
Layer M1  Model
Layer M0  The real world

Meta-class
Meta-association
Class
Attribute
reference: Integer
colour: Text

[MDA, Hubert Kadima]
Inside the MDA Framework:

Transformations
Some definitions

- A **transformation** is the automatic generation of the target model from a source model, according to a transformation definition.

- A **transformation definition** is a set of transformation rules that together describe how a model in the source language can be transformed into a model in the target language.

- A **transformation rule** is a description of how one or more constructs in the source language can be transformed into one or more constructs in the target model.
Role of the transformation tool

PIM → Transformation tool → PSM → Transformation tool → Code

UML → Transformation tool → SQL
Requirements for a transformation rule:

- Knowledge of the source language reference
- Knowledge of the target language reference
- A set of source language model elements
- A set of target language model elements
- The source language condition
- The target language condition
- A set of mapping rules

NEED OF ONTOLOGIES
Application of MDA Techniques: Management of ontologies in UE projects

Example of a generic urban development application using several ontology-based software tools:

- Urban ontology
- Water ontology
- GIS Ontology
- Energy ontology
- Ontology X
- Service X
- Urban Modeller
Model transformations based on ontologies:

[Diagram showing relationships between Urban modeller, Ontology Models, GIS model, System Models MDD, Urban system, and GIS system.]
Model transformations based on ontologies:
Model interoperability
Issues - Perspectives

Specificity of the sector:

- Important coordination activities in UCE projects among numerous software tools: need of sharing a common knowledge about the project
- Not all the activities are computerised: need of a common knowledge understandable by humans
- Numerous informal relations among the partners: an important part of the knowledge is not formalised: important implicit knowledge
- Important variations between countries – or else between regions

Importance of model driven approaches
Role of ontologies for model transformations
Model Driven Architecture

Developed by PARTNER for INTEROP Project
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QUESTIONS ?