Model-based Integration of Knowledge and Technology

September 28, 2004

Dimitris Karagiannis

University of Vienna
Institute for Computer Science and Business Informatics
Department Knowledge Engineering
Brünnnerstr. 72
A-1210 Vienna
Tel.: ++43-1-4277-38 481
Fax: ++43-1-4277-38 484
Email: dk@dke.univie.ac.at
Web: http://www.dke.univie.ac.at
Overview

1 Motivation

2 Business, Knowledge and Technology: An Application Scenario

3 Model-based Integration: A Realization Approach

4 Conclusion
Overview

1 Motivation

2 Business, Knowledge and Technology: An Application Scenario

3 Model-based Integration: A Realization Approach

4 Conclusion
The BPMS Paradigm

- Which *products* do we offer?
- How do we design our *business-processes*?
- How do we *operate* our business processes?
- How do we *control* our (daily) business?
- How do we *evaluate* our business?

Companies

Products

Business Processes

Executed

Evaluated

IT

Plants

Employees

operated by

Strategic Decision Process
Re-Engineering Process
Resource Allocation Process
Workflow Process
Performance Evaluation Process

© BOC and DKE
Modelling Levels According to the BPMS Paradigm

- Strategy
  - Business Models
  - Scorecards

- Design
  - Business Processes
  - IT Services
  - Actors/Roles
  - Domains

- Implementation
  - IT Architecture Management
  - IT Service Management
  - Skill Management
  - Knowledge Management

- Execution
  - Operational Runtime Environment

- Evaluation
  - Audits
From Integration to Interoperability

Integration of A and B

Create Community

Accept Diversity

Interoperability of A and B
What's about Knowledge?

A vision for Europe

"To become the most competitive and dynamic knowledge-based economy in the world by 2002"

© Rosalie Zobel, European Commision

- capable of sustainable economic growth
- with more and better jobs and
- greater social cohesion

"Make the European Union the most competitive and dynamic knowledge-based economy in the world by 2010".

http://www.cordis.lu/fp6/stepbystep/era.htm
What is Driving this Vision?

The **growing** power of knowledge.

Knowledge is becoming the world´s main economic resource.

The main added value of a product or service is the knowhow required to design, market and implement it.

© Rosalie Zobel, European Commision
What does the Transition to a Knowledge Economy mean for Business?

Relations between organisations are changing

↓ organisations as hierarchies

↑ organisations as networks
What does the Transition to a Knowledge Economy mean for Business?

The network is the organisation

More Opportunities
More Interactions
More complex & changing Roles
Quicker Faster

© Rosalie Zobel, European Commision
What's about Technology? Some Attempts of Prediction

Emerging Technologies Hype Cycle

Linux at Desktop: 2 to 5 Years

Semantic Web: 5 to 10 Years

Web Services-based Business Models: 5 to 10 Years

RFID: 5 to 10 Years

and more than 10 Years

Internal Web Services less than 2 Years

Source: Gartner Group, 2004
Integration Perspectives: Business, Knowledge and Technology

Business

Model-based Integration

Knowledge

Technology
Core Elements of Corporations in Manufacturing and Services

- Business Processes
- Products
- Plants
- Information Technology
- Organization

Knowledge

Product X
Product Component Y

Technology
Overview

1 Motivation

2 Business, Knowledge and Technology: An Application Scenario

3 Model-based Integration: A Realization Approach

4 Conclusion
An Application Scenario

AKOGRIMO

Access to Knowledge through Grid in a Mobile World

Video

FP6-IST2-4293
An Application Scenario
AKOGRIMO – Sample Business Model
E-health scenario, for more information see video on http://www.mobilegrid.org
An Application Scenario
Ontology-based Integration

Single Ontology Approach

Global Ontology

Multiple Ontology Approach

Local Ontology

Local Ontology

Hybrid Ontology Approach

Shared Vocabulary

Local Ontology

Local Ontology

Local Ontology

Example:
Integration of heterogeneous product and service catalogues in inter-organisational business processes.
An Application Scenario
AKOGRIMO - Sample Interaction Process

References to interaction process models

Modeling with "Swimlanes"
(= organizational units, roles etc.)

Uses (calls) applications

Processes are simulatable

State transitions

Interfaces
An Application Scenario
E-Business Transformation

as-is processes

business models

E-Business processes
Overview

1 Motivation

2 Business, Knowledge and Technology: An Application Scenario

3 Model-based Integration: A Realization Approach

4 Conclusion
The Notion of Technological Space

- Any TS is organized around an explicit or implicit "meta-meta-model".
- TSs are linked by bridges.
- A technological space is organized around a set of concepts.
- Spaces are similarly organized and operationally interoperable.
Model-based Integration – 2/3
The Notion of Meta$^2$-Model

<table>
<thead>
<tr>
<th>Language Level</th>
<th>Models</th>
<th>Language Name</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 3</td>
<td>Meta$^2$-Model</td>
<td>created with Meta$^2$-Modelling Language</td>
<td>Instanciation</td>
</tr>
<tr>
<td>Level 2</td>
<td>Metamodel</td>
<td>created with Metamodelling Language</td>
<td></td>
</tr>
<tr>
<td>Level 1</td>
<td>Model</td>
<td>created with Modelling Language</td>
<td></td>
</tr>
<tr>
<td>Level 0</td>
<td>Original</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Model-based Integration – 3/3
The Notion of Metamodel
Realization Approach: Pattern-based Integration - 1/5

"Integration Patterns for Model Integration"

⇒ Capture Integration Knowledge

- Syntax-Semantics-Notation Pattern
- Delegation Pattern
- Observer Pattern
- Reference Pattern
- Cause-Effect Pattern
- Transformation Pattern
- Extension Pattern
- Jump-Abstraction Pattern
- Layer Pattern
- Merge Pattern
- Single-Definition Pattern
- Concept-Mapping Pattern
- Common-Baseclass Pattern

© Dissertation Harald Kühn, 2004
Realization Approach: Pattern-based Integration - 2/5

"The Merge Pattern"

- Syntactic Constraints
- Semantic Constraints
- Notational Constraints

Merge Actions

Part of Source Metamodel

input for

2..* 1

Part of Target Metamodel

merge rule

output of

0..* 1

Merge Constraints

- Consist of
- Determine
Realization Approach: 
Pattern-based Integration - 3/5

"The Fragment Pattern"

Diagram:
- Modelling Technique
- Mechanisms & Algorithms
- Procedure Model

- Method Element
  - makes available
  - reused via
- Method Fragment
  - publishes
- Interface
- Package

© Dissertation Harald Kühn, 2004
Realization Approach: Pattern-based Integration - 4/5

"Merging of Metamodels"

Metamodel for Strategy Management

Metamodel for Process Management

Metamodel for IT Management

Integration Hotspots
Realization Approach: Pattern-based Integration - 5/5

"Integrated Metamodel"

"Integration Patterns" (extract of used patterns)
Realization Approach: Enterprise Model Integration

**Data structures**
- DB-2-DB (replication & transformation)
- "Meta databases"
- Data interfaces

**Methods**
- Distributed Objects
- Application Server
- Frameworks

**APIs**
- Business Services
- Date Services
- Objects

**Profiles**
- PIM
- PSM

**Process-oriented AI**
- intra-organisational
- inter-organisational

**Portal-oriented AI**
- Frontend-User-Interface

**Workflows, OPC, etc.**

**Business Architecture**

**Interfaces, function catalogs**

**Data catalogs & -models**

**ADL, FDL, XPDL**

**APIs to integration tools**
- Interfaces

**EAI**

**Enterprise Application Integration**

**XML**

**EAI**

**Enterprise Integration Architecture**

© BOC and DKE
Technology-driven Integration: Example "Transformation-based Integration" – 1/2

- Meta² model for definition of domain-specific meta models.
- Definition of transformation rules between meta models.
- Organisational rules for using transformation approach/process.

Example: MDA

- CIM (Computation Independent Model)
- BTM (Business Transformation Model)
- PIM (Platform Independent Model)
- PDM (Platform Description Model)
- PSM (Platform Specific Model)
- CDM (Code Description Model)
- Code (Platform Specific Code)
- Execution Design

Conforms to
Technology-driven Integration: Example "Transformation-based Integration" – 2/2

- Integration and mapping of model parts on a specific service layer \(\rightarrow\) horizontal integration

- Integration/transformation between service layers \(\rightarrow\) vertical integration

- Automation level increases, the more concrete and technical a service layer is.
Initial XML Standards for Interoperability

<table>
<thead>
<tr>
<th>Domain</th>
<th>Standard(s)</th>
<th>Domain</th>
<th>Standard(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accounting</td>
<td>XFRML</td>
<td>Electronic forms</td>
<td>XFDL</td>
</tr>
<tr>
<td>Architecture</td>
<td>aecXML</td>
<td>Electronics,</td>
<td>RNIF</td>
</tr>
<tr>
<td></td>
<td></td>
<td>computers</td>
<td></td>
</tr>
<tr>
<td>Automotive</td>
<td>SAEJ2008</td>
<td>ERP</td>
<td>OAGIS</td>
</tr>
<tr>
<td>Banking</td>
<td>IFX</td>
<td>Financial</td>
<td>FpML, FinXML</td>
</tr>
<tr>
<td>Communication</td>
<td>WAP, WML</td>
<td>Food recipes</td>
<td>DESSERT</td>
</tr>
<tr>
<td>Computer graphics</td>
<td>SVG, X3D</td>
<td>Human resources</td>
<td>OAGIS, HR-XML</td>
</tr>
<tr>
<td>Data mining</td>
<td>PMML</td>
<td>Multimedia</td>
<td>SMIL</td>
</tr>
<tr>
<td>Directory services</td>
<td>DSML</td>
<td>Science</td>
<td>XSIL, XDF, MathML, BSML</td>
</tr>
<tr>
<td>eCommerce</td>
<td>ebXML, cXML, OTP, PDML</td>
<td>Voice</td>
<td>voiceXML</td>
</tr>
</tbody>
</table>

Source: XML.ORG, 2000

http://www.xfrml.org/
Overview

1 Motivation

2 Business, Knowledge and Technology: An Application Scenario

3 Model-based Integration: A Realization Approach

4 Conclusion
Future Service-Based (IT)-World

Internet

Service

Service

Service

Service

Service

Service

Service

Knowledge-Worker

Order System

Payment Management

Help-Desk

Tele-College

Supplier

Best-Practice

Conference
Future Applications Scenarios for Mobile Grid and Service on Demand

- Disaster Handling and Crisis Management
  - Fighting against large fires
  - Coordination of forces for large public events or disaster scenarios

- Logistics
  - Combined planning between different transport companies and transport vehicles (train, car, …)

- Tele Working
  - Corporate Mobile Grid (expert in the field with backend groups and services)
  - Cultural Heritage experts in the field (analysis of damage, access to remote databases, …)

- Forecast application
  - Traffic, Weather, Sea condition, …
Project Trilogy: Methods, Concepts and Technology

Evolution Level

“Improve your business”

“Educate and train your people”

“Manage your enterprise knowledge”

1995

1998

2000

2002

200x

© BOC and DKE
Thank you very much for your attention!

Dimitris Karagiannis
dk@dke.univie.ac.at

Slides:
http://www.dke.univie.ac.at/mmp