A Knowledge Market Prototype: From Conception to Execution

Prof. Dr.-Ing. Wolfgang Maass

Faculty of Digital Media &
Research Center for Intelligent Media, Furtwangen University
http://im.dm.hs-furtwangen.de
Project Examples

Expert Network of Engineers

First Contact Expert

New Product Development Knowledge Space

Engineers

[EU Project INKASS, FP5, 2001-2003]

Product Communication at the Point of Sale

Product Knowledge

Product

Retailer

Smart Product

Customer

[German Ministry of Research (BMBF): SmaProN, 2007-2010]
Motivation

“Complexity of product description refers to the amount of information needed to specify the attributes of a product in enough detail to allow potential buyers to make a selection.” [Malone et al. 1987]

„Knowledge is a justified personal belief that increases an individual’s capacity to take effective action“ [Alavi&Leidner 1999]

„An electronic marketplace is an interorganizational information system that allows the participating buyers and sellers to exchange information about prices and product offerings. [Bakos 1991]
Pragmatic Classification of Knowledge

Tacit Knowledge
- Genes, subconscious knowledge

Implicit Knowledge
- Rational knowledge that can be explicated in principle, dogmas, social knowledge, technical knowledge etc.

Explicit Knowledge
- Knowledge that can be coded by information into (socially constructed) symbol systems, e.g.,
  - Process descriptions (TWI)
  - Consulting expertise (PLEY)
  - Regulations and procedures (ACCI)
  - Clinical study design
  - Design of eLearning documents (Klett)

Realm of individual knowledge

Electronic Knowledge Markets

Realm of shared knowledge
Explicit Representation of Knowledge

Ontological precision of knowledge asset representations

- Glossary
- Taxonomy
- Thessarus
- Database/ OO-Schema
- Axiomatised Theory

knowledge acquisition costs for receivers
automatic support of knowledge processes
costs for creation of explicit knowledge representations
Digital Information Good

Information objects are other social objects, encoded by codes, which are able to express descriptions and other social objects. Information objects are realized by entities whose properties match those required by the combinatorial system [Gangemi et al. 2004].

Digital Information Good ≡ Digital representation of an information object with associated economic value.

Characteristic anomalies:

- Purchase decision anomaly caused by information asymmetries
  → reduction by signaling and content projections
- Price anomaly: marginal costs tend to become negligible
  → market imperfections allow product and price differentiation strategies for information goods
- Copy anomaly: discrete (digital) representations of information objects are used for loss-free copies
Digital Knowledge Good

Digital Knowledge Good ≡
Digital information good with semantic self-descriptions
Representation of Knowledge Goods by Knowledge Objects

KO is a subclass of Information Object (DOLCE)

Meta Level Description

- Qualifying Elements
  - Author(s)
  - Ontological relations (domain ontologies, protocols)
  - History of modifications
  - Fields of application
  - Rating, Reviews and Evaluations
  - Content Type: by reference or by value

- Functional elements
  - Transitions (pre- and post-conditions of application)

- Economic elements
  - Types of applicable trading modes
  - Pricing
  - Legal terms and conditions (incl. trading and IPR)
  - Roles and rights

Content Description

- Content
## KO Schema

<table>
<thead>
<tr>
<th>Facets</th>
<th>Elements</th>
<th>Short Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content Description</td>
<td>Propositional Description</td>
<td>Central information about the content itself is formally described in propositional formats, e.g., NewsML format.</td>
</tr>
<tr>
<td></td>
<td>Content Classification</td>
<td>Keywords and concepts assigned to the content object based on a classification schema, e.g., Dublin Core or LOM.</td>
</tr>
<tr>
<td></td>
<td>Multimedia Characterization</td>
<td>This description includes information about the content format, such as encoding, storage, and location, e.g., MPEG7.</td>
</tr>
<tr>
<td>Business Description</td>
<td>Negotiation protocol</td>
<td>Business descriptions define requirements on trading situations of KOs. Negotiation protocols describe organisational and process requirements on business interactions, such as in electronic markets. Pricing schemes are internal representations of pricing strategies of KOs that cannot be accessed by potential buyers.</td>
</tr>
<tr>
<td></td>
<td>Pricing scheme</td>
<td>A plan that describes how a price is determined. A pricing model is an key element of an information object’s business model.</td>
</tr>
<tr>
<td></td>
<td>Contract</td>
<td>A contract is a digital representation of mutually agreed constraints that govern the use of an information object. Contract can have informal, semi-formal or formal representations.</td>
</tr>
<tr>
<td>Community Description</td>
<td>Organisation</td>
<td>Description of the organisation (roles, rights, obligations, prohibitions) and processes (plans, tasks and workflows).</td>
</tr>
<tr>
<td></td>
<td>Processes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Usage history</td>
<td>List of activities performed with the KO during its lifecycle.</td>
</tr>
<tr>
<td>Presentation Description</td>
<td>Spatio-temporal rendition</td>
<td>Descriptions of how the content of a KO is presented to users. Presentation includes the rendering, rendition as well as interaction models, e.g., SMIL.</td>
</tr>
<tr>
<td></td>
<td>Interaction-based rendition</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Services</td>
<td>Service descriptions are specifications on computational services that are required by KOs in usage situations, e.g., WSMO or OWL-S.</td>
</tr>
<tr>
<td>Trust &amp; Security</td>
<td>none</td>
<td>Enforcement of authorisation and evaluation of certifications are processed on application level.</td>
</tr>
<tr>
<td>Self-description</td>
<td>none</td>
<td>Specification of the (inner) structure of the KO (e.g., active facets, ontologies used) in machine-interpretable form.</td>
</tr>
</tbody>
</table>

[Maass, Behrendt, Gangemi 2007]
Advantages of Knowledge Object (KO) Representations

• Low transfer costs due to web-based representation formats

• Extended application scope by using formal ontologies and meta-data → eases ontological alignment, supports automatic inferencing and adaptation to user and system requirements

• Coding by usage of open semantic representation formalisms (e.g., RDF(S), RDFa, OWL)

• Transfer of KOs by open protocols (e.g., SOAP, HTML, SMTP etc.)

• Potential integration into CMS/KMS → Integrated Project IKS, EU FP 7
Classification of Knowledge Markets

Nature of Trading

- Commercial
- Non-commercial

Nature of Community

- Closed
- Open

Knowledge supply

General knowledge trading

Membership-Based KM

Intra-Organizational KM

Learning KM

Open knowledge source

[Maass et al. 2001]
Extended Media Reference Model

Community View

Business Community (Roles, Protocol)

Logical Space View

Vocabularies, information objects, common sense knowledge

Implementation View

Processes

Transaction View

Information
Supply
Demand
Contracting
Settlement

ICT- and Transaction Infrastructure

Infrastructure View

Knowledge
Intention
Contract
Settlement

Community View of Knowledge Markets

Stereotypical Roles

- expert
- knowledge author
- knowledge reviewer
- knowledge broker
- buyer
- seller
- knowledge user
- escrow agent
- lawyer

simple consulting

Open Source communities

complex product design consulting
Example: Innovation Service for TWI
Service Level of Knowledge Markets

Information Knowledge → Intention → Negotiation → Execution

- Search
  - Catalogue
  - Text mining
- Evaluation
  - Web 2.0/tagging
  - Rating
  - Consulting
  - Legal advice
  - IPR clearing

- Signaling

- Negotiation
  - Fixed price
  - Auctioning
  - Exchange
  - Contracting
  - Validation
  - Signing
  - Archiving
  - Enforcement
  - Mediation

- Contract execution
  - Knowledge object delivery
  - Financial logistics
  - Legal advice/mediation
  - IPR clearing
  - Service&support
Core Ontology for Electronic (Knowledge) Markets
Based on DOLCE D&S

Key Concepts
- Agent
- Role
- Community
- Organisation
- Communication
- Task
- Situation
- Protocol
- Contract
- Service
- Medium
- Channel
- Message

[Maass, Behrendt, Gangemi 2007]
KM for Trading Consulting Expertise

Example

- Please specify your request:
  The computer skills of my employees are very low. Can you help us?

- Please specify preferred type of solution material (optional):

<table>
<thead>
<tr>
<th>Case Study</th>
<th>Questionnaire</th>
<th>Training material</th>
<th>Presentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Report</td>
<td>Expert advice</td>
<td>Project</td>
<td>Tool</td>
</tr>
</tbody>
</table>

You asked: help for improving computer skills
Not recognized: employees
Your preferred IOs: training material

- Training material 100% show similar IOs
- Case Study 70% show similar IOs
- Presentation 45% show similar IOs

- Please answer the following questions:
  - Do you need basic computer skills? Yes No
  - Which applications do you use? ... 
  - Do you want to see other IO types? Yes No
  - Do you want to see associated subjects? Yes No

List of your selected items:
- Training material 100 € More information
- Course Word 1 260 € More information
- Course Excel 1 270 € More information

Please select some items or confirm all

- Submit order
- New Search

Request for Project Proposal

- Project description:
  - General description

- Expected deliverables
- Milestones
- Time frame
- Indicative budget

- Seller qualification requirements:
  - List of experiences
  - Sample of work
  - C.V.s
  - Competencies
  - Past similar projects

Submit RFP
Technical Architecture (KCCA)

[Diagram showing the architecture with User, External System (KCTP), Presentation, Authentication, Workflow Engine, Session Management, Metokis System Registry, Domain Specific Rule Layer, Inference Engine, Service Container (Request Broker), KCO Services, DB, Ontology, Senior Ex., Edu., Clin. Tr., RDF Data Views, RDF Data Schemas, Relational DB, RDF DB, DB, Goyal et al. 2004]
Summary and Open Issues

Summary

• Representation of information goods by semantically annotated Knowledge Objects grounded in foundational and domain ontologies.
• Reference model for Electronic Knowledge Markets

Open Issues

• Standardisation of the KO representation format(s), corresponding vocabularies and knowledge market services (→ Reference Architecture for KM infrastructures).
• Better understanding of technology acceptance of KM systems, including OSS communities and other systems of collective intelligence
• Semantic technology integration into standard CMS suites → Integrated Project Interactive Knowledge Stack (IKS) (2009-2013)
• Better understanding of the knowledge worker and his/her social working environment
• More action research and field studies (more bottom-up; small → large)
Prof. Dr.-Ing. Wolfgang Maass

Research Center for Intelligent Media
Furtwangen University
http://im.dm.hs-furtwangen.de
wolfgang.maass@hs-furtwangen.de
skype: w_maass