ERP Course: Knowledge Management and Learning
See articles at the course web site and in references

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E2-201
Information Systems
October 13, 2006
A Company

Material Resources → Human Resources → Production Technology → Production Process → Finances → Customer

DATA

Enquire, Evaluate, Manage, and Improve
Knowledge Management

Knowledge Management is

• A set of systematic and disciplined actions
• To get a greatest value from the knowledge available to it

Knowledge in this context include

• Experience and understandings of people
• IT artifacts (resources, digital objects, documents, …)

Knowledge Management involves:

• Organizational, social, and managerial actions
• Technology
Organizational Learning (Nonaka)

Conversion of knowledge between tacit and explicit forms (both important for organizational effectiveness)

Tacit knowledge
- known
- derived from experience
- embodies beliefs and values
- actionable
- source of innovation

Explicit knowledge
- represented by an IT artifact
- used in communication between several parties
## Conversions

<table>
<thead>
<tr>
<th>Tacit to Tacit</th>
<th>Tacit to Explicit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SOCIALIZATION</strong></td>
<td><strong>EXTERNALIZATION</strong> (conceptualization, elicitation, and</td>
</tr>
<tr>
<td>e. g. team meetings and discussions</td>
<td>articulation)</td>
</tr>
<tr>
<td></td>
<td>e. g. dialog within a team, answer questions</td>
</tr>
<tr>
<td>Explicit to Tacit</td>
<td>Explicit to Explicit</td>
</tr>
<tr>
<td><strong>INTERNALIZATION</strong></td>
<td><strong>COMBINATION</strong></td>
</tr>
<tr>
<td>e. g. learn from a report</td>
<td>e. g. e-mail a report</td>
</tr>
</tbody>
</table>
Tacit to Tacit

Tools which support communication
Supplementing or enhancing classical meetings
Replacing face to face meetings
Groupwares
Locating experts
Shared experience and knowledge

Asynchronous
- Listening to recorded presentation
- Using news and virtual discussion forums
- Tools to comment and annotate such presentation or a jointly created documents

Synchronous
- Virtual on line meetings
- Voice over IP
- Video conferencing
- Instant messaging
Finding a person

Common interest to create an innovation
Expert to help with a specific problem
Team creation for a specific assignment
A person for peer review
Search engines for people
Based on profiles
  • Explicit evidence
  • Extracted evidence from portfolios, projects, and activities
  • Derived evidence from social interactions
Tacit to Explicit

Creating a shared mental model
Describing/externalizing it in an IT artefact
Problem tickets in call centers
Their associations to problems
Frequent problems/questions
Metadata, conceptual models, ontologies
Formal concept analysis
Matching problem descriptions with existing solutions
http://www.saleslogix.com/
Explicit to Explicit

Combination
Capturing existing knowledge
- Rewarding people to make documents, problem and solution descriptions
- Use of documents, citations/references, links (page rank in google)

Multimedia analysis – speech recognition (call centers), image searching (design documents)

Search – information retrieval, digital libraries, similarity measures, exact database query, indexing, crawling

Taxonomies, Ontologies, Metadata, Text Classification, Summarization
Explicit to Tacit

Dealing with lost in information space
Information overload
Using ontologies to visualize
Hiding, summarization
Annotations
Automatic guidance
Shortcuts
Local navigation vs. global navigation
Task based navigation – association with business process or task to be supported
Adaptive Course Structure Presentation in Interbook

- Indication of your current position
- Recommendation annotations (traffic light metaphor)
- Visited pages
- Guidance

http://www2.sis.pitt.edu/~peterb/
Adaptive Link Annotation in Interbook

Current position and upper level content
Additional Guidance
Next items in subsequence
Outcomes and prerequisites
Learner Assessment
Learning on-line in organizational context
Smart (open) spaces
ELENA Personal Learning Assistant

Personalized Search Service

Select user: Type in concept name(s):

Select one or more concepts from the ontology:

- Computing Milieux
- BUSINESS AND SOCIETY
- Electronic Commerce
- Electronic data interchange (EDI)
- Payment schemes
- Intellectual property
- Distributed commercial transactions
- Security
- Cybercash, digital cash
- Social issues
- Employment
- Handicapped persons and special needs
- Assistive technologies for persons with disabilities
- Abuse and crime involving computers
- Organizational impacts
- Reengineering
- Automation
- Employment
- Computer supported collaborative work
- General
- Miscellaneous
- Public Policy Issues
- Use and abuse of power
- Transborder data flows
- Privacy

Search | Reset

Query results:

<table>
<thead>
<tr>
<th>#</th>
<th>Rec</th>
<th>Title</th>
<th>Description</th>
<th>Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>Aufgaben zum Thema intelligente Agenten</td>
<td>Aufgaben, um den Stoff des Moduls zu vertiefen</td>
<td>Intelligent Agents</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Einige Fragen zum Thema intelligente Agenten</td>
<td>Fragen, die Ihnen helfen sollen, den Stoff besser zu verstehen</td>
<td>Intelligent Agents</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Vorlesung Künstliche Intelligenz WS 2002 - Stichworte zur Themen Umgebung</td>
<td>Wir stellen die verschiedenen Grundtypen Intellgenter Agenten vor und ihre prinzipielle Programmierung</td>
<td>Intelligent Agents</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>Weisheitvolle Materialien</td>
<td>Eine Sammlung von weiterführenden Infos zum Thema Künstliche Intelligenz und Intelligente Agenten</td>
<td>Special purpose; Intelligent Agents</td>
</tr>
</tbody>
</table>
Knowledge Sea

http://www2.sis.pitt.edu/%7Eir/KS/home.htm?kt_sid=470&kt_user=demo

The material contained in this map came from the following web sites:

- Introduction to C Programming: An on-line tutorial from Leicester University
- Introduction to C Programming by Rob Miles: This is an online tutorial for learning to program in the C programming language. It assumes very little previous programming or computer experience.
- C Programming Tutorial by Brian Brown: This C Programming tutorial (Brown, 1994–1999) is an online introduction to the C programming language. It consists of a collection of web documents that are organized into chapters and subchapters. The concepts covered begin with variable declaration, arithmetic and relation operators, programming constructs, and end with dynamic memory allocation, pointers to functions, and Compiler options. Interspersed between chapters are optional interactive multiple-choice tests, which provide immediate feedback to each selection made by the user during this test. The feedback given takes the form of a one or two sentence response to the users selection in a popup window.
http://www.hcd-online.com

Search results are currently collected. Next update in 2 seconds.

Currently used search-term(s): economy

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To make the personalization process more flexible

To satisfy a user if no results are returned

To enable ranking on results based on document analysis
Our Approach

The adaptivity seen as decisions among variable resources where decisions are driven by information about a user Knowledge about:

- Resources with metadata seen as constraints on use
- Learner features used for comparing to the resource metadata

Horn logic oriented rules in TRIPLE used to perform the matching which concludes with personalization information

Horn logic oriented rules in TRIPLE used to construct and rewrite user queries over metadata with restrictions based on the user profile
eLearning Domain – Metadata Used

- Learning resource
  - Concepts/Competencies as learning outcomes
  - Prerequisites knowledge needed for understanding a resource
  - Prerequisites knowledge concepts/competencies to understand the concepts or to gain competencies
  - Language used in the resource

- Learner profile
  - Learner performance, competencies/concepts previously acquired and compared to prerequisites of either resource/concept/competency
  - Language/Concept preferences
Knowledge Structure for Resources

```
LearningResource
  hasPart Instance LearningResource
  dc:language String
  dc:title String
  provides Instance Competence
  has Instance LearningObjective

Competence

LearningMaterial
  accessedThrough Instance RepresentationObject

LearningObjective
  dc:identifier String
  dc:title String
  dc:description String

LearningService
  lom:typicalLearningTime String
  methodOfInstruction Symbol
    self-paced
    tutor-supported
    collaborative
  uses Instance Environment
  creates Instance Certification
    teachers
      school_students
      high-school_students
    ...
Knowledge Structure for Domain Concepts – the Java Tutorial
Examples in TRIPLE: Instance of a Learning Resource

kbs:'Praedikatenlogik3.pdf',
[dcq:isPartOf -> kbs:'Modul3',
dcq:isRequiredBy -> kbs:'Resolution.pdf',
dcq:requires ->
   kbs:'Praedikatenlogik2.pdf',
dc:subject -> acm_ccs:'I.2.4.2.1',
dc:language -> lang:de,
dc:description -> 'Wie wandele ich Sätze der Praedikatenlogik in Konjunktive Normalform um',
dc:title -> 'Vorlesung Künstliche Intelligenz WS 2002 : Umwandlung in KNF'].
Knowledge Structure For Learner Features

Performance
Portfolios
Goals
Preferences
Personal Information
Identification
Test Performance
Learner Performance and Competencies
Goals and Preferences
Example: An Instance of a Learner Performance

student:student1[papi:performance -> student:performance_1].
student:performance_bucket_1[papi:performance_bucket_value
-> '10min'].
student:performance_bucket_1[papi:performance_bucket_name
-> 'time_on_task'].
student:performance_1[papi:performance_bucket ->
student:performance_bucket_1].
student:performance_1[papi:performance_value -> '0.6'].
student:performance_1[papi:performance_metric -> '0-1'].
student:performance_1[papi:performance_coding ->
'number'].
student:performance_1[papi:granularity -> topic].
student:performance_1[papi:learning_experience_identifier
-> kbs:'Praedikatenlogik2.pdf'].
student:performance_1[papi:learning_competency ->
acm_ccs:'I.2.4.2.1'].
student:performance_1[papi:issued_from_identifier ->
kbs:'Test_Praedikatenlogik2.pdf'].

Peter Dolog, ERP Course, KMandLearning
Querying Metadata in Edutella

Datalog- and RDF-Based QEL
Common internal data model for Queries
Several wrappers implemented (file based, relational database, concept base, ...) to support several metadata storage types
Two kinds of wrappers:

- Implementing provision service
- Implementing consumer (query) service
Example: Edutella Query for Resources

```
Example: Edutella Query for Resources

<s(X, <dc:subject>, <java:variables>).
```
Adding Restriction on Language

```xml
<rdf:Description rdf:about="&n4;genid0">
  <n1:type rdf:resource="&n4;RDFReifiedStatement"/>
</rdf:Description>

<s(X, <dc:subject>, <java:variables>),
<s(X, <dc:language>, <lang:de>).</n1:subject>

<rdf:Description rdf:about="&n4;genid0">
  <n1:predicate rdf:resource="&n3;language"/>
</rdf:Description>

<rdf:Description rdf:about="&n4;genid0">
  <n1:object rdf:resource="&n7;de"/>
</rdf:Description>
```
A Rule for Adding Such Restriction

\[
\text{FORALL QUERY, VAR, PRED, OBJ, NEWLIT} \\
\text{QUERY[edu:hasQueryLiteral} \rightarrow \text{edu:NEWLIT]} \text{ AND} \\
\text{edu:NEWLIT[rdf:type} \rightarrow \text{edu:RDFReifiedStatement;}} \\
\text{rdf:subject} \rightarrow \text{VAR; rdf:predicate} \rightarrow \text{PRED; rdf:object} \rightarrow \text{OBJ]} \\
\text{<- EXISTS LITERAL, ANY (QUERY[rdf:type} \rightarrow \text{edu:QEL3Query;edu:hasQueryLiteral} \rightarrow \text{LITERAL]} \text{ AND} \\
\text{LITERAL[rdf:type} \rightarrow \text{edu:RDFReifiedStatement;}} \\
\text{rdf:subject} \rightarrow \text{VAR[rdf:type} \rightarrow \text{edu:Variable]; rdf:predicate} \rightarrow \text{dc:ANY]} \text{ )} \\
\text{AND EXISTS A} \\
\text{A[rdf:type} \rightarrow \text{edu:AddSimpleRestriction;}} \\
\text{rdf:predicate} \rightarrow \text{PRED;}} \\
\text{rdf:object} \rightarrow \text{OBJ}@PP \\
\text{AND unify(NEWLIT, lit(VAR, PRED, OBJ)).}
\]
A Rule to Generate Recommendation Annotation on Results

\[
\text{FORALL } U, D \\text{ recommended}(U, D) \leftarrow \text{user}(U) \text{ AND document}(D) \text{ AND } \\
\quad \text{FORALL } D_1 (\text{prereq}(D, D_1) \rightarrow \\
\quad \quad \quad \text{(FORALL } T (\text{topic}(D_1, T) \rightarrow \\
\quad \quad \quad \quad \quad \text{(EXISTS } P \\\n\quad \quad \quad \quad \quad \quad (U[papi:performance-} \\
\quad \quad \quad \quad \quad \quad \quad \rightarrow P}@uli:learner \rightarrow P[papi:learning_competency-} \\
\quad \quad \quad \quad \quad \quad \quad \rightarrow T}@uli:learner))) \text{ AND EXISTS } D (\text{prereq}(D, D_1))))).
\]

Extending the Knowledge Structure of the Resource by at Least Additional Attribute \( \Rightarrow D[\text{hasAnnotation}\rightarrow\text{recommended}] \).
Recommendation in the Search Results

Mapping the value of the hasAnnotation attribute to a visual representation

hasAnnotation -> recommended => GreenBall

hasAnnotation -> not_recommended => RedBall

...
Example: A Rule for Generating Examples for Presented Learning Material

\[
\text{FORALL } R, E \ \text{example}(R, E) \leftarrow \\
\quad \text{LearningResource}(R) \ \text{AND} \ \text{example}(E) \ \text{AND} \\
\quad \text{EXISTS } C_1 \ (R[\text{dc:subject} \rightarrow C_1]) \ \text{AND} \\
\quad \text{FORALL } C_2 \ (R[\text{dc:subject} \rightarrow C_2] \\
\quad \quad \rightarrow E[\text{dc:subject} \rightarrow C_2]).
\]
The Personal Reader

Similarly to the Example Rule, Summaries, Details, Generalizations, and Exercises are generated.

Mapping to Visual Representation as Separate Boxes

www.personal-reader.de
Adaptive Hypermedia Technologies

Adaptive Hypermedia Technologies

Adaptive Presentation

Adaptive Multimedia Presentation

Adaptive Text Presentation

Adaptation of Modality

Natural Language Adaptation

Canned Text Adaptation

Inserting/Removing Fragments

Altering Fragments

Stretchtext

Sorting Fragments

Dimming Fragments

Adaptive Navigation Support

Natural Language Adaptation

Canned Text Adaptation

Inserting/Removing Fragments

Altering Fragments

Stretchtext

Sorting Fragments

Dimming Fragments
Roles of Concepts in a Resource
The technical approach
Retrieving Resources

Distributed content
Distributed standard based metadata descriptions about:

• Content
• Relationships between the content
• Learner
• Logic Programs
• Query and adapt content delivery and its links
• Visualize adaptive navigation support
**Search results are currently collected. Next update in 2 seconds.**

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<td>Illicit: How Smugglers, Traffickers and Copycats are Hijacking the Global Economy</td>
</tr>
<tr>
<td></td>
<td>2.70 (5)</td>
<td>Basic Economics: A Citizens Guide to the Economy, Revised and Expanded</td>
</tr>
<tr>
<td></td>
<td>2.70 (6)</td>
<td>Twilight in the Desert: The Coming Saudi Oil Shock and the World Economy</td>
</tr>
<tr>
<td></td>
<td>2.70 (7)</td>
<td>The Macro Economy Today with DiscoverEcon with Salman Videos</td>
</tr>
<tr>
<td></td>
<td>2.02 (9)</td>
<td>How We Compete : What Companies Around the World Are Doing to Make it in Today's Global Economy</td>
</tr>
<tr>
<td></td>
<td>2.02 (10)</td>
<td>The Wal-Mart Effect : How the World's Most Powerful Company Really Works --and How It's Transforming the American Economy</td>
</tr>
<tr>
<td></td>
<td>1.66 (11)</td>
<td>3843 Advanced Novel Network Administration NetWare 6.5</td>
</tr>
<tr>
<td></td>
<td>0.3 (12)</td>
<td>China Reise Taijiqiao Qi Gong</td>
</tr>
<tr>
<td></td>
<td>0.3 (13)</td>
<td>Scenario-Technik</td>
</tr>
<tr>
<td></td>
<td>0.3 (14)</td>
<td>The Wisdom of Crowds: Why the Many Are Smarter Than the Few and How Collective Wisdom Shapes Business, Economies, Societies and Nations</td>
</tr>
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</table>

**Remote service status:**

- Executive Academy (WIEZ): ✔
- Language: ❌
- Seminarshop.com: ✔
- CLIC: ❌
- Knowledgebase: ❌
- EduSource: ✔
- American University (KUD) Database: ✔
- Amazon: ✔
- ifh-vienna: ❌
- EuclidText-UPF: ❌

**http://www.hcd-online.com**
Semantic Annotation

Annotator is activated from repository administration interface (for all or only new resources)
Loads (linguistically annotated) ontology/ontologies that can be used to annotate this repository
Loads textual parts (title, description, key words, content if available) of resources and stores them in full-text (Lucene) index
Finds (new) annotations
  • Linguistic expressions of ontology are used as queries against full-text index to find (new) annotations
  • Text classification techniques are used to find additional annotations (e.g., use combined and pruned term frequency vectors of all resources of one concept as new query)
Sends new annotations back to repository administration interface where user checks correctness
Technological Issues

Exact Match – not always work – similarity measures considered already in Personal Reader, more doc. Analysis in HCD-Suite online

Heterogeneity (inconsistencies, contradictions)

Ordering

Opposite situation – not too many results/links but too few

Performance
Questions?

Additional References to those at the course web site: 
