Futures of KM Technology in the Knowledge Economy

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Topics

- Where do we (want to) go in the knowledge economy?
- Smart organizations
- Smart people
- Smart things
- ….

Part I: Where do we (want to) go in the knowledge economy?

Knowledge as a Production Factor

Peter Drucker: Post-capitalist Society (1993)

- ***The change in the meaning of knowledge that began 250 years ago has transformed society and economy. Formal knowledge is seen as both the key personal resource and the key economic resource. Knowledge is the only meaningful resource today. The traditional 'factors of production' - land (i.e. natural resources), labour and capital - have not disappeared. But they have become secondary. They can be obtained, and obtained easily, provided there is knowledge. And knowledge in this new meaning is knowledge as a utility, knowledge as the means to obtain social and economic results.***

What if we take the knowledge economy seriously?

- KM = getting the right knowledge at the right time to the right place
- Aim: to enhance effectiveness and efficiency of knowledge as socio-economic production factor
- Should lead to
  - ➨ improved *human* performance
  - ➨ intelligent *service by systems*

What is the situation now?

- Internet/Web: large unstructured store of information and communication resources
- Rather dumb and slow
- Passive in service to us
- Overload of information
- Burden rests with the user

Trends

- Truly universal connectivity
  - ➨ More global
  - ➨ And more local
- Inherently distributed and heterogeneous structures remain inevitable
- More intelligence and more service to users

What should the situation be?

- Internet and Web should themselves become more knowledgeable
- Exploit available knowledge better
- Understand the user' task and context
- Become more supportive (e.g. no search but answers!) and more service-oriented
- **Thus: Perform useful tasks for us intelligently and proactively**

Take-Home Messages Part I

- New phenomenon: information and knowledge as "Ding an Sich"
- Human factor is central but enabled, pushed and pulled, by IT technology
  - ➨ Creates opportunities but also tensions
- Industrial revolution mechanized manual labour. Likewise, knowledge economy and information society will revolutionize intellectual labour
- Computer: steam engine for knowledge economy *(but we are still in the early 19th century!)*

Part II: Smart Organizations

The *On-To-Knowledge* Project

- European project in EU Information Society Technologies Programme: EU-IST-1999-10132
- ***Aim: innovative tools for knowledge management***
- Duration: 2.5 years, January 2000 - June 2002
- Total effort & cost: 26 personyears, 2.5+ M EUR
- EC funding: 1.34 M EUR

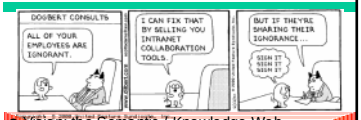
www.ontoknowledge.org

Take a look @

OTK Partners

- Free Univ. Amsterdam (VUA, coordinator), NL
- British Telecom, UK
- Swiss Life, CH
- Aidministrator, NL
- CognIT, NO
- EnerSearch, SE
- AIFB Uni-Karlsruhe, D

What is On-To-Knowledge?



- Vision: the Semantic / Knowledge Web
  - ***Ontologies as a key technology to achieve this***
- Results:
  - *OTK info service toolset*
  - *Ontology language plus web inference layer*
  - *Methodology: How-to guidelines for roll-out*
  - *Industry case study experiences*

Vision: Exploiting the World-Wide Information Resources

- IT, and especially Internet/WWW, have boosted potential for knowledge acquisition and sharing
- ***BUT:*** information resources are heterogeneous, distributed, semi-structured, & enormous in size
- ***HENCE:*** need for KM tools for selective semantic (meaning-oriented) access => *On-To-Knowledge*
- Move from keyword search to query answering
- Move upwards in the data-info-knowledge chain
- ***Vision:*** towards the next-generation ***"semantic"*** (Tim Berners-Lee, W3C) or ***knowledge web***

What is an Ontology?

- In philosophy: theory of what exists in the world
- In IT: ***consensual & formal description of shared concepts in a domain***
  - *Aid to human communication and shared understanding, by specifying meaning*
  - *Machine-processable (e.g., agents use ontologies in communication)*
- **Ontology = key technology in semantic information processing**
  - *Applications: knowledge management, e-business, industrial engineering*

The Contribution by On-To-Knowledge

- **Knowledge sharing issue:** hyperlink browsing and keyword search do not tell you much, and are *a waste of time*
- ***Much better:*** you ask questions to information resources, and *just get the answer*

OTK toolset: achieve selective & meaningful semantic user access

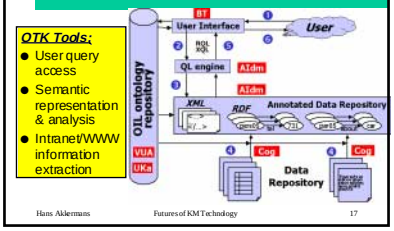
Hyperlink structure does not really help!

Ontology helps separate different meanings of "communication"

Implementing the Vision: OTK Toolset and its Use

OTK Tools:

- User query access
- Semantic representation & analysis
- Intranet/WWW information extraction

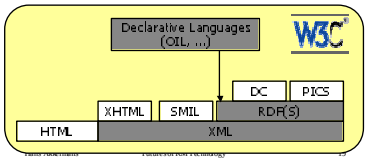


OIL: standard core language for ontologies on the Web

- Aim: core language to specify, interchange, and apply ontologies, and so achieve inferencing on the Web
- Key: Support for semantics and reasoning services on the Web
- Based on standard frame languages, and has frame "look and feel"
- Formalized by DL style logical constructs
- Has several syntaxes
  - ➨ presentation syntax (plain text)
  - ➨ XML based syntax
  - ➨ RDF(S) based syntax

Apply Ontologies to the Web

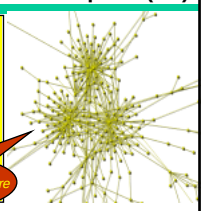
- Several ways
- The W3C vision of languages:



EnerSearch Case Study: Sharing in Virtual Enterprise (1/3)

- **How to do knowledge transfer via website?**
- ***Issue:*** hyperlinks or keyword search do not tell you much, and are a waste of time
- ***Much better:*** you want to ask questions and just get the answer

Note: EnerSearch website hyperlink structure does not really help



EnerSearch Case Study: What You ***Can*** Do (2/3)

- Annotate documents or webpages with meaning (through ontology)
- Note: taxonomy or type hierarchy is simple(st) form of ontology
- Next: semantic clustering of pages gives content-based organization
- Automatically done by one of the OTK tools

Note: EnerSearch website ontology gives organization of important topics (Excerpt)

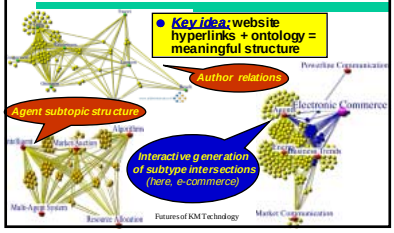
EnerSearch Case Study: Semantic Website Access (3/3)

- ***Key idea:*** website hyperlinks + ontology = meaningful structure

Author relations

Agent subtopic structure

Interactive generation of subtype intersections (here, e-commerce)



Latest developments on the Semantic Web

- Joint European-American committee for semantic web language definition
- OTK's OIL as the European contribution
- Strong interest and support of EU Commission
- DAML Darpa programme ($70M) as US partner
- Involvement of SUN and other companies
- Support of Tim Berners-Lee, director of W3C
- Official W3C working group on semantic web (standard = DAML + OIL)

Take-Home Messages Part II

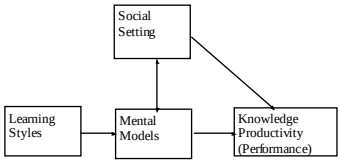
- The vision of the Semantic World-Wide Web
- The intelligent Web is to become proactive and info service oriented
- To enable smart and virtual organizations
- Reference point of systems must be domain and context of the user
- *Ontologies are a key technology to achieve this*
- Europe has a strong position and potential here
- *http://www.ontoknowledge.org*

Part III: Smart People

The Dutch Tax Authority as a knowledge-intensive organization

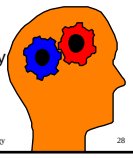
- Empirical studies on the role of learning styles and mental models in knowledge productivity
  - *(Tom van Engers, DTCA, t.m.van.engers@acm.org)*
- Knowledge Management and the individual element:
  - Individual learning styles
  - Mental models
  - Task context
  - Does it effect performance?

Overall empirical research design at DTCA



Empirical studies on individual variables

- Pask learning style theory (116 individuals):
  - Operational
  - Comprehensive
  - Versatile
- Mental Model Similarity (32 individuals)



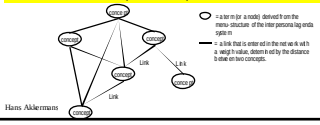
Some research results

Tested hypotheses at DTCA:

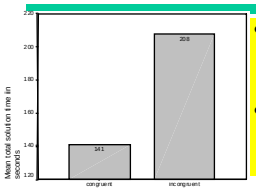
- **1. The higher the score on operational resp. comprehensive learning style, the more knowledge structure representations are concentrated around a few specific resp. several global concepts**
  - **Confirmed**
- **2. Learning styles do influence mental knowledge structures even when executing routine tasks.**
  - **Confirmed**
- **3. Versatile learners' networks differ from Operational and Comprehensive learners**
  - **Confirmed: Versatiles start with comprehensive learning and fill in details later**

(One of the other) Experimental studies

- interpersonal agenda system, with simple menu structure
- criteria for usability measurement
  - *e.g. total solution time*
- original version (congruent mental model designer - user)
- manipulated version (incongruent)
  - *Pathfinder conceptual network procedure*



Mental Models: Effect on total solution time



- Shared mental (conceptual) models correlate positively with task performance
- Lack of mental model similarity decreases user satisfaction with system

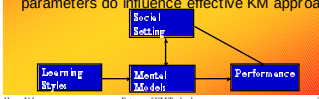
KE&M Methodology

CommonKADS

- ***KE&M* methodology such as CommonKADS is successfully used to**
- **carry out task/context and problem analysis**
- **and to build intelligent support systems (e.g. POWER): knowledge capitalization and codification**

Take-Home Messages Part III

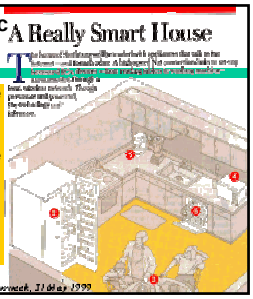
- Is KM useful to affect smart people?
  - *KM and tax evasion/reduction?*
- Empirical results are needed and possible to make KM into a science
- Answer: Yes, but individual features and parameters do influence effective KM approach



Part IV: Smart Things

New Strategic Roles of IT

- Internet-based home networks (>> computers)
- "Smart" equipment
- Enables new service bundles: energy, security, comfort, education, entertainment, ...
- Delivery "real-time" and "at a distance" (cf. e-business)



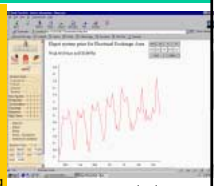
Source: Newsweek, 31 May 1999

Universal Connectivity

- Information Society leads to a world of "pervasive (tele)-computing" (it happens, but the computer is "invisible")
  - ***Through networked microprocessors, appliances can 'talk to', 'negotiate', 'make decisions', and 'cooperate' with each other.***
- Exploit this for large-scale agent-based e-services
- Application examples: (peak) load management, smart building control, comfort management, and other services.
- Benefits:
  - *handles much larger scale*
  - *automation of business processes*
  - *decentralized and flexible approach*
  - *proactive for the customer*

Innovative Forms of e-Business and e-Service

- Potential for many new value-added customer services
- E.g. *comfort* can be delivered as an electronic service
- From distributor to "energy solution provider"
- Electronic billing
- Real-time pricing
- Combination/bundling of different services

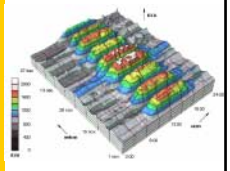


Source: www.nordpool.no

e-Applications: How can we realize cost and energy savings?

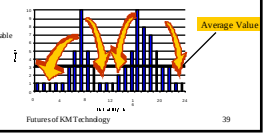
Energy: real-time match between production and demand

Demand shows big (and costly) fluctuations

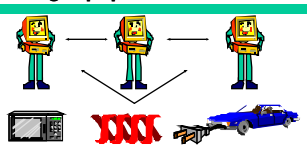


Electronic service: intelligence in network and energy management

Smart Solution:
Intelligent Internet-based Energy Management



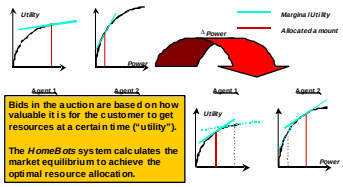
The *HomeBots* technology: making equipment smart



A "Society" of Intelligent Devices

Every appliance is made smart by equipping it with a software "agent" program. This agent, called a *HomeBot*, acts as its representative.

How does the electronic market work? - Economic utility theory



Bids in the auction are based on how valuable it is for the customer to get resources at a certain time ("utility").

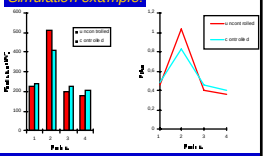
The *HomeBots* system calculates the market equilibrium to achieve the optimal resource allocation.

Energy savings due to the electronic market service

Peak hour cost is reduced by 35%, total cost by 15%.

Hence, significant savings are

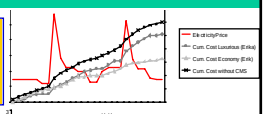
Simulation example:



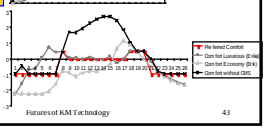
And: electronic market gives excellent climate control

Economic agents on e-market provide comfort at lowest cost

- ***Winter*** **scenario**
- **Up to 45% lower cost by adapting to price without compromizing comfort**



- ***Summer*** **scenario:**
- **Better comfort by cheap, natural means (use blinds and ventilation)**



SMART project: large-scale field experiment in office building

- **Exemplify intelligent Internet solutions for building control and energy management**
- **Realized by agent-mediated e-markets**
- **in real-life built environment (ECN, Petten, NL)**
- **Field experiment runs for full year (including all seasons)**

Take-Home Messages Part IV

- Intelligent Internet and Web will have many *local* applications and services
- Such as smart, collaborative things in homes
- Knowledge of task and context brought within intelligent devices
- Note: a lot of intelligent functionality resides in network *as a whole*
  - ➨ Knowledge is not only individual but also collective

In Sum

- Where do we (want to) go in the knowledge economy?
- Smart organizations
- Smart people
- Smart things
- KM technology reference point must always be the human domain, task, and context
- KM and the mechanization of intellectual labour