707.009
Foundations of Knowledge Management
„Overview and Motivation“

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Overview

Agenda

• Welcome
• Motivation
• About me
• Course overview
• KM Background
Motivation
[Yu 2007]

Why the recent interest in KM?

• Intellectual content in products and services
  – E.g., a pair of jeans, aluminum pop can, microchip

• Factors of production: land, labour, capital
  – Now, also: information and knowledge

• Success, survival rely on innovation, differentiation
  – Intangible asset – hard to “manage”

• “Intellectual capital”
  – Human resources – recruiting, training, learning, retention

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Knowledge Management - Motivation

"The 20th anniversary of the landing of an American on the surface of the Moon occasioned many bittersweet reflections. Sweet was the celebration of the historic event itself... Bitter, for those same enthusiasts, was the knowledge that during the twenty intervening years much of the national consensus that launched this country on its first lunar adventure had evaporated...” [Fries, S. 1992].

Courtesy of Dr. Paul Kwan, University of New England, [Knowledge Management Systems comp292/comp592] Copyright © NASA, Apollo 11 mission
**Why YOU should you learn about KM [Yu 2007]**

Most KM initiatives presuppose technology support.

- You (computer scientists) are expected to provide it.
- Do we have the right methods and tools?

There has actually been a “Knowledge” movement within the computer science area for a long time, since the ’70s, long before it became a management “fad” in the business community.

- How do knowledge concepts in technology systems help us understand knowledge in human social systems?

Software engineering work is itself knowledge-intensive.

- We should apply KM concepts to analyze and improve software engineering – software development, deployment, evolution, etc.

Often, software projects do not fail because of technological reasons

- Abandoned discussion forums, blogs, wikis, etc

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**About me**

**Education:**

- 2002 - 2004 PhD. in Knowledge Management, Faculty of Computer Science, TU Graz
- 1997 - 2002 M.Sc., Telematik, TU Graz

**Background:**

- July 2007 - present: Ass. Prof. (Univ.Ass.), TU Graz, Austria
- 2006 - 2007 Post-Doc, University of Toronto, Canada
- 2002 - 2006 Researcher, Know-Center, Austria
About me

Research Background:
• Business Process Oriented Knowledge Management
• Knowledge Infrastructure Development
• Agent-Oriented Early Requirements Engineering

Research Interests:
• Web Science with a focus on networks, Social Computing and knowledge transfer
• Intentional Structures and Representations on the Web

Interesting topics for projects, Bachelor/Master/PhD thesis:
• If you are interested in the topics of this course, it is likely that you are interested in doing a project / a thesis with me as well. Contact me to discuss opportunities.

Course Topics
• Knowledge types and processes
• Knowledge management strategies
• Knowledge organization
• Knowledge bases
• Knowledge acquisition
• Knowledge transfer
• Organizational knowledge repositories
• … and others
Goals I

At the end of the course, you should know about and understand different
• kinds of knowledge
• types of knowledge transfer
• Perspectives on knowledge management
• types of knowledge organization
• types of knowledge acquisition techniques
• types of knowledge repositories
• types of knowledge-based analysis techniques

And you should be able to distinguish between them, preliminarily assess their relevance for given contexts and apply them selectively.

Non-Goals

In the research community, there is no broad consensus regarding the theoretical foundations of a „Scientific Discipline of Knowledge Management“

So therefore, the topics of this course are subjectively selective.

Instead of giving an authoritative account of KM, this course aims to give an overview of prominent, interesting and powerful research results generated by the field of KM so far.
Course Context

- 707.009 Foundations of Knowledge Management
  - 1st year as a VL
  - Has been held before as a VU
- Part of studies „Software Engineering & Business“
  - Master studies, 7th semester
- This course is a pilot
- Your feedback is appreciated

Course Organization and Logistics

- **Lectures**
  Thursdays 13:15 - 14:45,
  October 2007 - January 2008,
  Room HS Modul (Infieldgasse 21a, Ground Floor)
  except for the first two weeks, where it is held in HS i7

- **Website:** [http://kmi.tugraz.at/staff/markus/courses/707.009_knowledge-management/](http://kmi.tugraz.at/staff/markus/courses/707.009_knowledge-management/)

  **Enroll!**
  In order to obtain a grade, you need to enroll for this course until Oct 10 2007 via TUG online!

- **Weekly Readings**
  Password to access protected documents on the course website:
Grading

So how do you receive a grade in this course?
- You are supposed to take the final exam at the end of the course.

What will be part of the exam?
- Contents of slides AND weekly readings.

How does class attendance affect your grade?
- Each week we will discuss issues from the weekly readings.
- The papers discussed in the weekly readings will be part of the final exam.
- Participating will likely increase your understanding of the subject.

Course Information

Please find everything about the course at

- http://www.kmi.tugraz.at/staff/markus/courses/
Recommended Literature

There is no required text book for this course, however you might find it helpful to have a look at the following resources:

- An Illustrated Guide to Knowledge Management (For Practitioners), Knowledge Management Forum Graz, 2003
- Plus literature listed on the course website (weekly readings)

Questions?

Raise them NOW!

Or ask them later:
- At the end of each class
- Via e-mail: markus.strohmaier @ tugraz.at

(now would be a good time though)
Let’s start!
- Knowledge Management -

Knowledge in Computing & Info Systems [Yu 2007]

Trend is toward (increasingly explicit) “knowledge representation” in systems:

- Programs 1960’s-
- Database schemas (data independence from programs) 1970’s-
- Conceptual data modeling (domains, enterprises) 1980’s-
- Knowledge-based systems (knowledge about world separate from inference engine) 1980’s-
- Knowledge sharing among systems (“ontologies”) 1990’s-
- Software agents 1990’s-
- Semantic web 2000’s-
- …
How much information is being produced?
http://www2.sims.berkeley.edu/research/projects/how-much-info-2003/

- Print, film, magnetic, and optical storage media **produced about 5 exabytes of new information in 2002**. Ninety-two percent of the new information was stored on magnetic media, mostly in hard disks.

- We estimate that the amount of new information stored on paper, film, magnetic, and optical media has about **doubled in the last three years**.

- Information flows through electronic channels -- telephone, radio, TV, and the Internet -- contained almost 18 exabytes of new information in 2002, **three and a half times more than is recorded in storage media**. 98 percent of this total is the information sent and received in telephone calls -- including both voice and data on both fixed lines and wireless.

In 2003

- The World Wide Web contains about **170 terabytes** of information on its surface; in volume this is **seventeen times** the size of the Library of Congress print collections.

- Instant messaging generates **five billion messages a day** (750GB), or 274 Terabytes a year.

- Email generates about **400,000 terabytes** of new information each year worldwide.

- P2P file exchange on the Internet is growing rapidly. Seven percent of users provide files for sharing, while 93% of P2P users only download files. The largest files exchanged are video files larger than 100 MB, but the most frequently exchanged files contain music (MP3 files).
How much information is being produced?

http://www2.sims.berkeley.edu/research/projects/how-much-info-2003/

Table 1.2: Worldwide production of original information, if stored digitally, in terabytes circa 2002. Upper estimates assume information is digitally scanned, lower estimates assume digital content has been compressed.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper</td>
<td>1,534</td>
<td>327</td>
<td>1,200</td>
<td>240</td>
<td>36%</td>
</tr>
<tr>
<td>Film</td>
<td>420,254</td>
<td>76</td>
<td>431,900</td>
<td>56,000</td>
<td>3%</td>
</tr>
<tr>
<td>Magnetic</td>
<td>51871.30</td>
<td>3,416,200</td>
<td>2,773,700</td>
<td>2,073,700</td>
<td>9%</td>
</tr>
<tr>
<td>Optical</td>
<td>103</td>
<td>61</td>
<td>81</td>
<td>28</td>
<td>20%</td>
</tr>
<tr>
<td>TOTAL:</td>
<td>5,509,121</td>
<td>3,146,281</td>
<td>3,212,731</td>
<td>2,132,238</td>
<td>74.5%</td>
</tr>
</tbody>
</table>

Source: How much information 2003

Markus Strohmaier 2007

How much information is being produced?

http://www2.sims.berkeley.edu/research/projects/how-much-info-2003/

Table 1.1: How Big is an Exabyte?

<table>
<thead>
<tr>
<th>Kilobyte (KB)</th>
<th>1,000 bytes or 10^3 bytes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Megabyte (MB)</td>
<td>1,000,000 bytes or 10^6 bytes</td>
</tr>
<tr>
<td>Gigabyte (GB)</td>
<td>1,000,000,000 bytes or 10^9 bytes</td>
</tr>
<tr>
<td>Terabyte (TB)</td>
<td>1,000,000,000,000 bytes or 10^12 bytes</td>
</tr>
<tr>
<td>Petabyte (PB)</td>
<td>1,000,000,000,000,000 bytes or 10^15 bytes</td>
</tr>
<tr>
<td>Exabyte (EB)</td>
<td>1,000,000,000,000,000,000 bytes or 10^18 bytes</td>
</tr>
</tbody>
</table>

Source: Many of these examples were taken from the Wikipedia Data Files of Ten Exabyte at http://en.wikipedia.org/wiki/Exabyte
Knowledge Management [Maier 2002]

Related Research Domains

Knowledge Infrastructure

Knowledge Portals

Goals:
- Improve environments
- Enable role-oriented access
- Enable autonomous routing
- Standardize the execution
- Increase transparency

Knowledge Portals

Role Portal HR

Role Portal Div. Mgr.

Role Portal Top Mgt.

Knowledge Infrastructure

- "Arrow 3" Functionality
- Business Process Network
Knowledge Portals

Agent A

Store

Generate

Apply

Agent B

App

Store

Generate

Apply

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2007

Designing Knowledge Infrastructures

Role Portal HR

Generation, Storage

Role Portal TL

Transfer

Role Portal VPE

Application

other Sources

Knowledge Processes

other Ports
als
Corporate Weblogs as a KM instrument

I'm pleased to announce that Version 2.3 of WordPress is now ready for the world. This release includes improved tagging support, plugin update notifications, URL handling improvements, and much more. The release is named for the great techie saxophonist Dexter Gordon.

The entire team is really proud of this release, and I'm happy that this is our second time release under our new development schedule. The grand experiment of a micro-spike WordPress with significant features in the bundle of various users is now working. I could write a blog post about each new feature, but I'll try to be brief:

1. **New tagging support** allows you to use tags in addition to categories on your posts. If you like, we've included imports for the Ultimate Tag Manager, Genesis Keywords, Simple Tags, and BuddyPress tags plugins so if you've already been using a tagging plugin you can bring your data into the new system. The tagging system is also vectorized, so your browser won't crawl.

2. **New update notifications** let you know when there is a new release of WordPress or when any of the plugins you use have new update available. It works by sending your blog URL, plugins, and version information to our new API, which then notifies you when new plugins are available.

Corporate Wikis as a KM instrument

The satellite reports clearly the intensity of big atmospheric piers by their daily changes and positions on radio signal distributions throughout the earth's surface. Because it is a medium which pools the intuition, it also permit closely the satellite's position, so it is a great database for the user. On the other hand, the system's position can include a lot of numbers. It is usually an exploration of the system's history in the United States and includes the so-called Space Race where the Cold War.
KM failures

• Under which conditions can such instruments fail?
• Do you know of failed projects where blogs/wikis/portals/etc did not achieve the desired effect?
• What was the cause to that?

KM failures

• Lack of motivation
• Lack of ability
• Low/wrong quality of communication channel
• Lack of awareness
• Lack of management support
• Lack of purpose
• …
### Preliminary Schedule I

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Title / Slides</th>
<th>Comments and Links</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.6</td>
<td>11.10.2007</td>
<td>Overview and Motivation</td>
<td></td>
</tr>
</tbody>
</table>
|      |         | (slides) | In this class, we will discuss the course organization and give a basic motivation for and introduction to the course. 
| 2.6  | 11.10.2007 | Knowledge Types and Processes | 
|      |         | (slides) | What is knowledge? What forms of knowledge can we identify? We will discuss some basic distinctions and characteristics. 
| 3.6  | 18.10.2007 | Knowledge Management Strategies | 
|      |         | (slides) | A review of different tools of knowledge management. We will discuss the main components and potential applications of knowledge management. 
| 4.6  | 25.10.2007 | Knowledge Organization | 
|      |         | (slides) | How does knowledge be organized? We will discuss some basic principles of knowledge organization. 
| 5.6  | 1.11.2007 | Broad Knowledge Bases | 
|      |         | (slides) | What kind of knowledge bases exist? We will discuss different types of knowledge bases and representations, such as metaphors, worldviews, theories, etc. 
|      |         |         | Readings: T. M. Faber and J. Faber, Knowledge, The Seventh: Scientific American, 184 (1) 301. |
| 6.6  | 15.11.2007 | Knowledge Acquisition | 
|      |         | (slides) | How can knowledge be acquired in a way that is accessible to computers and/or analyzed? 
| 7.6  | 22.11.2007 | Knowledge Transfer | 
|      |         | (slides) | How can knowledge be transferred and what factor can influence knowledge transfer? We will discuss these and further issues. 
Why Knowledge Management?

- Knowledge-based theory of the firm
- Knowledge based economy
- The digital age
- Rising levels of education
- Drastic increase of human knowledge
- Different forms of knowledge
- Increasing dependency on knowledge

What do enterprises think?

- Survey of CEOs
- Why do you think is KM regarded to be so crucial?

Which of the following areas of activity offer the greatest potential for productivity gains over the next 15 years?

<table>
<thead>
<tr>
<th>Area of Activity</th>
<th>(% Responders)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge management</td>
<td>42</td>
</tr>
<tr>
<td>Customer service and support</td>
<td>15</td>
</tr>
<tr>
<td>Operations and production processes</td>
<td>12</td>
</tr>
<tr>
<td>Strategy and business development</td>
<td>15</td>
</tr>
<tr>
<td>Marketing and sales activities</td>
<td>22</td>
</tr>
<tr>
<td>Human resource management and training</td>
<td></td>
</tr>
<tr>
<td>Corporate performance management</td>
<td>22</td>
</tr>
<tr>
<td>Product development</td>
<td>16</td>
</tr>
<tr>
<td>Financial management and reporting</td>
<td></td>
</tr>
<tr>
<td>Supply-chain management</td>
<td>17</td>
</tr>
<tr>
<td>Risk management and compliance</td>
<td></td>
</tr>
<tr>
<td>Procurement</td>
<td>11</td>
</tr>
</tbody>
</table>

Source: Econsult Intelligence, Link survey, 2005.
Motivation

Organizational work becomes increasingly knowledge intensive and complex. [Eppler 1999]

Knowledge Intensity:
- Learning time
- Half life
- Decision scope
- Agent impact

Complexity:
- Process steps
- Involved agents
- Interdependency
- Process dynamic

Factors determining Knowledge Work [Drucker 1999]

- Knowledge about the task
- Autonomy
- Continuing innovation
- Continuous learning and teaching
- Quality at least as important as quantity
- Motivation
  - It requires that knowledge workers want to work for the organization
Roles in Knowledge Management

Based on [Schreiber et al. 02]
Knowledge Management [Maier 2002]

Knowledge management systems

Knowledge management

- knowledge as production factor
- knowledge as product
- knowledge-intensive organization

Knowledge

- organization-internal
- organization-external
- insecure
- secure
- collective
- group
- individual
- unstructured
- structured
- formal
- informal
- explicit
- tacit
- technical
- social
- external
- internal

Knowledge life cycle

Support by knowledge management

- identify, develop, and acquire strategic/strategic organizational core competencies
- identify “knowledge gaps” and “knowledge gaps”
- value capability differentials in comparison with competition
- support dynamics of organizational learning cycle (identify “learning cycle path”)
- support application of core competencies

Knowledge Management [Maier 2002]

FIGURE B-15. Relationship between knowledge management and strategic management
Knowledge Management Architecture

Knowledge Management Institute

Knowledge Management Systems

Success [Maier 2002]
Knowledge

Explicit and Implicit Knowledge

Some Course Highlights
Explicit or Implicit? [Kirsh 1990]

1. Is 5 as the solution to \( \sqrt[3]{25} \) explicit in \( \sqrt[2]{25} \) ?

2. Is the 200th digit of \( \pi \) explicit?

3. Is 3 explicit in \( A: \{1,5,3,7,4,4\} \)?

4. Is the cardinality of \( A \) explicit in \( A: \{1,5,3,7,4,4\} \)?

5. Is (6754, 9629) in a matrix of 10,000 x 10,000 explicit?

6. Is the answer to „Why does the pop star P!nk perform 4 Non Blondes songs at her concert“ explicit on the web?
Some Course Highlights

- **Experience Factories** (EF) focus on the facilitation of Knowledge Transfer between Software Developers
- Experience Base
  - “Packages Experiences”
- Goals
  - Knowledge Transfer
  - Knowledge Reuse
Some Course Highlights

Experience Factory

- Develop and maintain software efficiently
- Transfer experiences
- Execute project
- Learn experiences

Under which conditions can the Experience Factory concept fail?

Common Sense Knowledge

ConceptNet, MIT, 2007
Some Course Highlights

Check

- Is there anything else you want to know w.r.t. this course?
- What aspects are you most interested in?
- Anything else?
Any further questions?

Have a good start in the new semester!
- See you next week