707.009
Foundations of Knowledge Management
„Knowledge Acquisition I

Markus Strohmaier

Univ. Ass. / Assistant Professor
Knowledge Management Institute
Graz University of Technology, Austria

e-mail: markus.strohmaier@tugraz.at
web: http://www.kmi.tugraz.at/staff/markus
Overview

Agenda

What is knowledge acquisition?
- The theory and practice of making implicit knowledge explicit
- Motivations and issues
- Implicit vs. explicit forms of knowledge
An Interaction View of Knowledge Management

[Rollett 2003]

Figure 2.2. The interaction view of knowledge management.

In the scope
Out of scope
of today’s lecture
Motivation

Can you give examples of knowledge acquisition?

What is the difference between implicit and explicit information?
How can we make knowledge accessible?

Motivations for Knowledge Sharing

Discretionary Databases:

A shared database is discretionary if users contribute to the database voluntarily.

What are other examples of discretionary databases?
Example: Online Forum

Forum-Software.org
Find the best forum tool for your community

Forums
- Login to post a new forum topic.

General discussion
This is the place where everyone can ask any questions about Forum-Software.org or anything he would like to know.

Problems and Bugs in demonstration websites
A forum software demo does not work? Post your messages here to help admins maintain them and find where is the problem.

About Forum-Software.org
Post your questions about Forum-Software.org here. Webmasters will answer you as soon as possible.

Demonstrations update requests
Post a message here if you want to ask Forum-Software.org webmaster to update one of the forum software demonstrations. Please specify the name and the version you would like to test.

PHP / MySQL Forum Software Troubleshooting
Please post your problem and solution in this category, to let the community answer and probably fulfill your request.

Beehive Forum
The forum dedicated to Beehive Forum software.

FUDForum
The forum dedicated to FUDForum software.

IceForum
...
The Tragedy of the Commons
[Garrett Hardin 1968]

http://www.sciencemag.org/cgi/content/full/162/3859/1243

Picture a pasture open to all, limited in space and food supply.

- Each herdsman will try to keep as many cattle as possible on the commons
- He will ask himself: **What is the utility to me of adding one more animal to my herd?**

  - The **positive component**: increment of 1 more animal to sell
  - The **negative component**: overgrazing – equally shared by all the herdsmen. Corresponds to only a fraction of -1
- **Conclusion**: add as much animals as possible
- **Therein lies the tragedy of the commons.** Each herdsman is locked into a system that compels him to increase his herd without limit – in a world that is limited.

Can you give examples of the Tragedy of the commons in today’s world?
The Tragedy of the Commons
[Garrett Hardin 1968]
http://www.sciencemag.org/cgi/content/full/162/3859/1243

Examples of the Tragedy of the Commons

• Depletion of fish stock in international waters
• Traffic congestion on urban highways
• Pollution
• Global Warming / Climate Change

• Can you find others?

Is knowledge as a form of a public good prone to the tragedy of the commons problem? If so, how?
Message Board in an Organizational Intranet

Let's start from zero!
Knowledge sharing and social dilemmas
[Cabrera2002]

Social dilemmas describe paradoxical situations in which individual rationality – simply trying to maximize individual payoff – leads to collective irrationality.

-> The tragedy of the commons

The Free-riding / Defecting Problem:
- to enjoy a resource (e.g. pasture, an information resource) without contributing to its provision

The Ramp up Problem:
- Without users providing resources, no additional users will be attracted

In Knowledge Sharing contexts (as opposed to classic public goods), the cost of the contribution of knowledge does not lie in the contribution itself. The cost has to do with the process of making that idea available. [page 9]

How could we tackle this problem?
Three Potential Solutions
[Cabrera2002]

1. Restructuring the payoff function
2. Increasing perceived efficacy of individual contributions
3. Establishing group identity and promoting personal responsibility
Restructuring the Pay-Off Function

= Reducing the perceived costs or increasing the perceived benefits of contributing.

If the cost of contributing to a discretionary database is lower, the benefits associated with defecting are also lower.

For a humorous example, see http://www.soledadpenades.com/2007/03/11/the-next-captcha-generation-for-myspace-forms/

Markus Strohmaier 2011
Restructuring the Pay-Off Function [Cabrera2002]

Two principle ways to increase individual payoffs:

- **Cooperation-contingent transformation**
  - A selective incentive or reward is offered which is contingent on an individual’s behavior
  - such as social recognition, can be extremely powerful incentives so long as they are public, infrequent, credible, and culturally meaningful

- **Public good transformation**
  - The perceived value of the collective gain is increased. If the value of the collective gain is greater for the individual than the cost, the incentive to cooperate will increase. (no direct rewards)
  - One way to increase the value of the collective gain is to combine a knowledge exchange program with a gain-sharing or profit sharing plan in which every individual receives a bonus based on the success of the knowledge-sharing program.

Examples:
- Make it easier for people to share information
- Information about the existence and rationale of systems
- Availability of training opportunities
- Assure that employees have the time and resources necessary
# Restructuring the Pay-Off Function

[Cabrera2002]

---

**Table 1**

Examples of interventions aimed at restructuring the payoff function

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced information technology</td>
<td>♦ Reduce cost of contributing</td>
</tr>
<tr>
<td>Rewards or selective incentives</td>
<td>♦ Increase benefit of contributing</td>
</tr>
<tr>
<td>Gain-sharing programs</td>
<td>♦ Increase perceived value of collective gain</td>
</tr>
<tr>
<td>Align human resource policies with participation</td>
<td>♦ Increase benefit of contributing</td>
</tr>
<tr>
<td></td>
<td>♦ Send clear message about importance of knowledge exchange and creation for the organization</td>
</tr>
</tbody>
</table>
Increasing efficacy
[Cabrera2002]

Information self-efficacy

• An employee’s belief that the information he or she has would be helpful to co-workers were they to receive it.

Connective efficacy

• is the belief that others will actually receive the information if it is contributed.

Examples:

• Provide feedback whenever others use their contributions
Increasing efficacy
[Cabrera2002]

Table 2
Examples of interventions aimed at increasing the efficacy of contributions

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Objective</th>
</tr>
</thead>
</table>
| Provide feedback to contributors      | ♦ Increase information efficacy  
                                         ♦ Increase connective efficacy  
                                         ♦ Create further opportunities for knowledge combination and creation through deeper processing of others’ contributions |
| Ensure a critical mass of participants| ♦ Make potential value of shared knowledge greater than individual cost  
                                         ♦ Increase information efficacy by reducing redundancies  
                                         ♦ Increase connective efficacy by reducing search difficulties |
| Advanced technology                   |                                                                                                                                            |
| Training                              | ♦ Increase information efficacy  
                                         ♦ Increase connective efficacy |

Markus Strohmaier 2011
Promoting group identity and personal responsibility [Cabrera2002]

A sense of group identity influences contributions to a public good, i.e. individuals share more information when common group identity was made salient [page 18].

Axelrod: the probability of cooperation increases when

• Interactions among participants are frequent and durable
• Participants are easily identifiable
• There is sufficient information available about each individuals actions
### Promoting group identity and personal responsibility [Cabrera2002]

#### Table 3

Examples of interventions aimed at increasing group identity and personal responsibility

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Encourage communication</td>
<td>♦ Increase sense of group identity</td>
</tr>
<tr>
<td></td>
<td>♦ Increase commitment</td>
</tr>
<tr>
<td></td>
<td>♦ Increase frequency of interactions</td>
</tr>
<tr>
<td></td>
<td>♦ Increase identifiability</td>
</tr>
<tr>
<td></td>
<td>♦ Increase expectations of others’ participation</td>
</tr>
<tr>
<td>Create knowledge sharing communities or communities of practice</td>
<td>♦ Increase sense of group identity</td>
</tr>
<tr>
<td></td>
<td>♦ Increase frequency of interactions</td>
</tr>
<tr>
<td></td>
<td>♦ Increase identifiability</td>
</tr>
<tr>
<td>Publicize information about employees’ contributions</td>
<td>♦ Increase identifiability</td>
</tr>
</tbody>
</table>
I am praying your baby is good and healthy as I am sure he/she will be.

Just want to send you hugs and say to think only positive here I know it's hard but the unknowing can stress us out and in the end it's all fine.
A look back

My shiny brandnew message board

No articles found

Title: My shiny brandnew message board
Description: 
Time Modified: 22/11/2007 11:52:49
Available starting: 
Expires on: 
Subdocuments: 0
<table>
<thead>
<tr>
<th>Date</th>
<th>Title</th>
<th>Replies</th>
<th>Last Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>11/20/07</td>
<td>Heart Palpitations - 16 yr old Athlete</td>
<td>1</td>
<td>11/20/07 magglemag</td>
</tr>
<tr>
<td>11/19/07</td>
<td>Dilated Cardiomyopathy</td>
<td>3</td>
<td>11/19/07 magglemag</td>
</tr>
<tr>
<td></td>
<td>angelnote</td>
<td></td>
<td>11/19/07 sjennal</td>
</tr>
<tr>
<td>11/19/07</td>
<td>Low HDL and LDL</td>
<td>13</td>
<td>11/19/07 tradern3</td>
</tr>
<tr>
<td></td>
<td>Dominicz70</td>
<td></td>
<td>11/19/07 tradern3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>11/20/07 tradern3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>11/20/07 tradern3</td>
</tr>
<tr>
<td>11/12/07</td>
<td>Chest pain</td>
<td></td>
<td>11/12/07 tradern3</td>
</tr>
<tr>
<td></td>
<td>Mockip</td>
<td></td>
<td>11/12/07 tradern3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>11/12/07 tradern3</td>
</tr>
<tr>
<td>11/12/07</td>
<td>losing weight</td>
<td>2</td>
<td>11/20/07 Jack54</td>
</tr>
<tr>
<td></td>
<td>011372</td>
<td></td>
<td>11/20/07 Aney0525</td>
</tr>
<tr>
<td>11/12/07</td>
<td>Anticardiolipin antibodies</td>
<td>2</td>
<td>11/20/07 Jack54</td>
</tr>
<tr>
<td></td>
<td>Andy0525</td>
<td></td>
<td>11/20/07 Jack54</td>
</tr>
<tr>
<td>11/12/07</td>
<td>my medication</td>
<td></td>
<td>11/20/07 Jack54</td>
</tr>
<tr>
<td></td>
<td>Colly923</td>
<td></td>
<td>11/20/07 Jack54</td>
</tr>
<tr>
<td>11/12/07</td>
<td>worried</td>
<td></td>
<td>11/20/07 Jack54</td>
</tr>
<tr>
<td></td>
<td>cummisforale</td>
<td></td>
<td>11/20/07 Jack54</td>
</tr>
<tr>
<td>11/12/07</td>
<td>In a lot of pain/help</td>
<td>2</td>
<td>11/20/07 Jack54</td>
</tr>
<tr>
<td></td>
<td>croyllynn</td>
<td></td>
<td>11/20/07 Jack54</td>
</tr>
<tr>
<td>11/12/07</td>
<td>Golf after by pass</td>
<td></td>
<td>11/20/07 Jack54</td>
</tr>
<tr>
<td></td>
<td>rozhich</td>
<td></td>
<td>11/20/07 Jack54</td>
</tr>
<tr>
<td>11/12/07</td>
<td>Low ef</td>
<td></td>
<td>11/20/07 Pat_Crouch</td>
</tr>
<tr>
<td></td>
<td>Pat_Crouch</td>
<td></td>
<td>11/20/07 Pat_Crouch</td>
</tr>
<tr>
<td>11/12/07</td>
<td>Heart is too weak</td>
<td>3</td>
<td>11/19/07 magglemag</td>
</tr>
<tr>
<td></td>
<td>viennal13</td>
<td></td>
<td>11/20/07 viennal13</td>
</tr>
</tbody>
</table>
### Back to Topics:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Posted by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Why wont it stop?</td>
<td>black_butterfly</td>
</tr>
<tr>
<td>A guy sitting next to me is bullying me.</td>
<td>Rose1</td>
</tr>
<tr>
<td>The ruler of the school</td>
<td>singletear</td>
</tr>
<tr>
<td>Need help</td>
<td>me_ne</td>
</tr>
<tr>
<td>How can I get people to grow up, and leave me alone?</td>
<td>SmiloJohnna</td>
</tr>
<tr>
<td>Questions about bullying...</td>
<td>kosame</td>
</tr>
<tr>
<td>There's this girl</td>
<td>jojolol</td>
</tr>
<tr>
<td>I hate them</td>
<td>weirdboy</td>
</tr>
<tr>
<td>Tired of this</td>
<td></td>
</tr>
</tbody>
</table>
Motivation

What is the difference between implicit and explicit information?
Implicit vs. Explicit Knowledge
Motivation [Kirsh1990]

• Information is explicit when
  – „It is there“
  – „For all to see“

  – E.g. explicit encoding in sentences in a natural language

  – „Graz is the capital of Styria“
Implicit vs. Explicit Knowledge

naive distinction [Kirsh1990]

Four naive properties of explicit representations [Kirsh1990]:

- **Locality**: visible structures with a definite location
- **Movability**: no matter where in a book a word is to be found, the word retains its meaning, words maintain meaning across time and space
- **Meaning**: words have a definite semantic content
- **Availability**: the semantic content of a word is directly available to cognizers, no translation or interpretation is necessary, immediate readability

Explicit
- Knowledge outside the head
- Examples: A book, a sentence, a piece of code, a database entry

Implicit
- Knowledge inside the head
- Examples: experiences, skills, gut feelings

Information is explicit when it is local, movable, available and when it has a definite meaning.

BUT...
Implicit vs. Explicit Knowledge
Explicit or Implicit? [Kirsh1990]

1. Is 5 as the solution to $\sqrt{125}$ explicit in $\sqrt{125}$?

2. Is the $200^{100}$ digit of $\pi$ explicit?

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

4. An element is a member of a set iff it satisfies $0 \leq x \leq 7$. Is this set explicit in $\{1,3,9\}$?

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

6. Is $(6754, 9629)$ in a matrix of $10,000 \times 10,000$ explicit?

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

Questions: Do we count accessing times as part of the reading process (availability)? Should we differentiate between locating (e.g. index) and computing (e.g. decode) information? What is immediate readability?
Explicit or Implicit? [Kirsh1990]

Displayed: if there is a process which can extract that information

Explicitly represented: if there is a process which can immediately grasp the information

Information that is displayed lies just beneath the surface (it is *recoverable*), Information that is explicitly represented lies on the surface.

Symbols which are on the surface in a structural sense may be below the surface in a process sense

From a structural perspective, information is explicit when it has a definite location and a definite meaning. Confusion arises when a representation viewed structurally turns out to be in a non-immediately usable form procedurally.

What is *implicit* information? What if the information is *not recoverable*? Is implicitness a matter of degree? What about equivalence of implicitness?

Can we at all encode information explicitly in systems?
Locality

**Locality**: visible structures with a definite location (naive)

**Problem**: Overly restrictive. Why exclude distributed information? Can information never be explicit on a distributed network?

  e.g. an mp3 file on a distributed peer-to-peer network

**What is important is that information can be separated from surroundings by a host system.**
Movability  
[Kirsh1990]

**Movability:** no matter where in a book a word is to be found, the word retains its meaning (naive)

Transmitting information across space (storage) and across time (communication). Words should maintain their meaning.

**Problem:**
- Does 5 in 105 carry the same meaning as 5 in 501?
- „Police police police police police“  
  *(Police who are policed by policemen are themselves policers of policemen)*

(Syntax needs to be taken into account.)
Availability
[Kirsh1990]

Availability: the semantic content of a word is directly available to cognizers, no translation or interpretation is necessary (naive)

Problem:
What is explicit in a structural sense may not be explicit in a procedural sense.

Example:
• A book without index
• Encrypted messages (is „hans“ explicit in „ibot“?)

We cannot decide what is explicit without knowing in detail how a system works.
Meaning
[Kirsh1990]

**Meaning**: words have a definite semantic content (naive)

**Problem**:
- **polysemous** words (Homonyms)
  e.g. bank (river bank, financial institution)
- “Then John read *him* his rights”. Who is him?
- A symbol explicitly encodes a certain semantic if a system S can immediately recognize its meaning.

*We need to take the semantic context into account.*
Implicit vs. Explicit
[Kirsh1990]

Four Conditions revisited

1. The states, structures or processes („symbols“) which explicitly encode information must be **easily separable** from each other (Locality)

2. An ambiguous language may explicitly encode information only if it is **trivial to identify** the syntactic and semantic identity of the symbol. (Movability)

Trivial: if there is a mechanical process that identifies the relevant property in constant time (independent of the size of the problem instance) or within a given attention span

Example: is a given binary number (100010101) even or odd?
Answer: Depends on the system’s algorithm and the operators attention span to determine it
Implicit vs. Explicit
[Kirsh1990]

Four Conditions revisited

3. Symbols explicitly encode information if they are either:
   A) readable in constant time or
   B) sufficiently small to fall in the attention span of an operator (Availability)

4. The information which a symbol explicitly encodes is given by the set of associated states, structures or processes it activates in constant time (Meaning)
Implicit vs. Explicit Summarization [Kirsh1990]

„Explicitness really concerns how quickly information can be accessed, retrieved or in some other manner put to use. It has more to do with what is present in a process sense, than with what is present in a structural sense.“

„Representations are inert unless coupled with processes which interpret them.“

„It is the union of structure and process which can explicitly encode information.“

If a symbol takes longer than constant time to interpret, then its meaning is not on the surface.

Example:
Q: Is the year you started your studies explicit in your Matr. Nr.?
A: Again, this depends on the system’s algorithm and encoding system, the operator and the operators attention span to determine it.
Implications

*What are the implications of the dependencies on*

- Algorithms runtime
- Operator / User attention span

for Software Engineering / Software Engineers?

- Access and processing times determine the extent to which knowledge can be regarded to be explicit
- Different attention spans of different users yield different degrees of explicitness
Tacit, Implicit, Explicit

• Tacit: can not be made explicit
  – Examples: Gut feeling, expert knowledge, etc

• Implicit: not explicit, but can be made explicit
  – Key criteria: time
  – Examples: Why does P!nk perform 4 Non Blondes songs on stage?

• Explicit: easily recoverable and cognitizable
  – According to the four conditions
  – Example: Is any given binary number even or odd?

But, the ultimate distinction depends on the system processing the information and the operator‘s attention span

No consensus in the literature!
Any questions?

- See you next week!