What is implicit/explicit information? How can computers support it?

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]

In the scope
Out of scope
of today's lecture

Figure 2.2. The interaction view of knowledge management.
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

![Forum-Software.org Interface](image)

#### Forums

- **Login** to post a new forum topic.

<table>
<thead>
<tr>
<th>Forum</th>
<th>Topic</th>
<th>Posts</th>
<th>Last Post</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General discussion</strong></td>
<td>1</td>
<td>2</td>
<td>1 year 15 weeks ago by lastrico</td>
</tr>
<tr>
<td><strong>About Forum-Software.org</strong></td>
<td>1</td>
<td>1</td>
<td>1 year 15 weeks ago by shepherdcrane</td>
</tr>
<tr>
<td><strong>Demonstrations update requests</strong></td>
<td>3</td>
<td>6</td>
<td>24 weeks 23 hours ago by tsrnusl</td>
</tr>
</tbody>
</table>

#### PHP / MySQL Forum Software Troubleshooting

Please post your problem and solution in this category, to let the community answer and probably fulfill your request.

<table>
<thead>
<tr>
<th>Forum</th>
<th>Topic</th>
<th>Posts</th>
<th>Last Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beehive Forum</td>
<td>0</td>
<td>0</td>
<td>n/a</td>
</tr>
<tr>
<td>FUDForum</td>
<td>0</td>
<td>0</td>
<td>n/a</td>
</tr>
<tr>
<td>IceForum</td>
<td>0</td>
<td>0</td>
<td>n/a</td>
</tr>
</tbody>
</table>

Welcome to Wikipedia,
the free encyclopedia that anyone can edit.
3,102,952 articles in English

Today's featured article

Grover Cleveland (1837–1908) was both the 22nd and 24th President of the United States. Cleveland is the only President to serve two non-consecutive terms (1885–1889 and 1893–1897) and therefore is the only individual to be counted twice in the numbering of the presidents. He was the winner of the popular vote for President three times—in 1884, 1888, and 1892—and was the only Democrat elected to the Presidency in the era of Republican political domination that lasted from 1860 to 1912. Cleveland’s admirers praise him for his honesty, independence, integrity, and commitment to the principles of classical liberalism. As a leader of the Bourbon Democrats, he opposed imperialism, taxes, subsidies and inflationary policies, but as a reformer he also worked against corruption, patronage, and bossism. Critics complained that he had little imagination and seemed overwhelmed by the nation’s economic disasters—depressions and strikes—in his second term. Even so, his reputation for honesty and good character survived the troubles of his second term.
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?
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 forum dedicated to IceForum software.

Topics Posts Last post

General discussion

Problems and Bugs in demonstration websites

About Forum-Software.org

Demonstrations update requests

PHP / MySQL Forum Software Troubleshooting

Beehive Forum

FUDForum

IceForum

0 0 n/a

0 0 n/a

0 0 n/a
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/
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

Example: Siemens Sharenet

Can you give examples?
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 user 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                  | ♦ Increase information efficacy  
♦ Increase connective efficacy |
| Training                             | ♦ Increase connective efficacy |
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>
Just want to send you hugs and say to think only pos here I know its hard but the unknowing can stress us out and in the end its all fine.

I am preying your baby is good and healthy as i am sure he/she will be.
A look back
## MedHelp

Welcome to the Heart Support Forum!

This forum is for questions and support regarding heart issues such as Angina, Angioplasty, Arrhythmia, Bypass Surgery, Cardiomyopathy, Coronary Artery Disease, Detrimental Heart Attack, Heart Disease, High Blood Pressure, Mitral Valve, Pacemaker, PAD, Zoom, Stress Tests.

### Sort By: Last Post | Date Started

<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><strong>Heart Palpitations - 16 yr old Athlete</strong></td>
<td>1</td>
<td>11/20/07 maggiemag</td>
</tr>
<tr>
<td>11/19/07</td>
<td><strong>Dilated Cardiomyopathy</strong></td>
<td>3</td>
<td>11/19/07 maggiemag</td>
</tr>
<tr>
<td>11/17/07</td>
<td><strong>Low HDL and LDL</strong></td>
<td>13</td>
<td>11/19/07 trademah</td>
</tr>
<tr>
<td>11/20/07</td>
<td><strong>Chest pain Mockup</strong></td>
<td>2</td>
<td>11/20/07 Jack64</td>
</tr>
<tr>
<td>11/20/07</td>
<td><strong>losing weight</strong></td>
<td>2</td>
<td>11/20/07 Jack64</td>
</tr>
<tr>
<td>11/20/07</td>
<td><strong>Anticardiolipin antibodies</strong></td>
<td>2</td>
<td>11/20/07 pop25</td>
</tr>
<tr>
<td>11/20/07</td>
<td><strong>my medication</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11/20/07</td>
<td><strong>wasted</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11/20/07</td>
<td><strong>in a lot of pain/help</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11/20/07</td>
<td><strong>Golf after by pass</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11/19/07</td>
<td><strong>Low of</strong></td>
<td>3</td>
<td>11/19/07 maggiemag</td>
</tr>
<tr>
<td>11/19/07</td>
<td><strong>Heart is too weak</strong></td>
<td>1</td>
<td>11/20/07 viennal3</td>
</tr>
<tr>
<td>Topic</td>
<td>Posted</td>
<td>Views</td>
<td>Poster</td>
</tr>
<tr>
<td>-------</td>
<td>--------</td>
<td>-------</td>
<td>--------</td>
</tr>
<tr>
<td>why it won't stop?</td>
<td>18/11/2007 08:06:22</td>
<td>0</td>
<td>black_butterfly</td>
</tr>
<tr>
<td>A guy sitting next to me is bullying me....</td>
<td>17/11/2007 22:22:21</td>
<td>11</td>
<td>Rose1</td>
</tr>
<tr>
<td>the ruler of the school</td>
<td>17/11/2007 13:58:16</td>
<td>35</td>
<td>single2er</td>
</tr>
<tr>
<td>need help</td>
<td>16/11/2007 23:21:06</td>
<td>19</td>
<td>me_ne</td>
</tr>
<tr>
<td>How can I get people to grow up, and leave me alone?</td>
<td>16/11/2007 23:44:15</td>
<td>14</td>
<td>Smilejohnna</td>
</tr>
<tr>
<td>questions about bullying...</td>
<td>16/11/2007 19:58:11</td>
<td>0</td>
<td>kosome</td>
</tr>
<tr>
<td>there's this girl</td>
<td>16/11/2007 13:36:52</td>
<td>27</td>
<td>jojo101</td>
</tr>
<tr>
<td>I HATE THEM</td>
<td>15/11/2007 21:56:08</td>
<td>16</td>
<td>weirdboy</td>
</tr>
<tr>
<td>tired of this</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Example
Exam
Bonus Task

• Select a specific Social Software Application
• Based on Knowledge Sharing Dilemmas
  – Describe how the Social Software Application fits the dilemma
  – Describe how the Social Software implements the 3 potential solutions (list specific functionalities)
  – Describe potential improvements of the social software service based on KSD considerations

• Submit
  – A Din A4 page (one page!) containing your observations
    • Name the File using the following Syntax: „GWM10-BT1-YOURMATR-YOURLASTNAME.pdf“
    – To me via e-mail using subject „[GWM10-BT1-YOURMATR]“
    – before the beginning of next week‘s Monday class
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 x 10,000 explicit?

7. Is the answer to „Why does the pop star Pink 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

[Kirsh1990]

**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

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 (independant 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 on Wednesday!