707.009
Foundations of Knowledge Management „Knowledge-based Analysis“

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Overview

Agenda

• An Agent-Oriented Modeling Method to Analyze Knowledge Transfer Effectiveness

• Next week’s: Final Exam
  – Register via TUGonline!
  – „Einsichtnahme“: 29. Feb. 10:00-11:00
Overview

Previous Lectures:
• Knowledge Organization
• Broad Knowledge Bases
• Knowledge Acquisition
• Knowledge Transfer
• Org. Knowledge Repositories
• …
• Today: Knowledge based Analysis

The „Knowledge Aspect“

– Knowledge refers to
  • Skills, heuristics and experiences of actors
– Distinctions
  • Implicit vs. explicit
  • Pragmatic vs. scientific
  • Inter-subjective vs. objective
– Knowledge Management is concerned with the development of [organizational|technological|cognitive]… tools for
  • the identification, acquisition, generation, transfer application and storage of knowledge

Knowledge Transfer: Effective sharing of ideas, knowledge, or experience between units of a company or from a company to its customers. The knowledge can be either tangible or intangible. (MIT, Definitions for Inventing the Organization)
Knowledge Transfer
Background and State of the Art

Research on Knowledge Transfer focuses on:

- **Theories** [14, 21]
  - Focus on the Nature of Knowledge Transfer
  - Example: Knowledge Flow Theory

- **Modeling Languages** [10, 11]
  - Identification, Visualization and Analysis of Knowledge Transfer Situations
  - Examples: B-KIDE, KODA, KMDL

- **Instruments** [3, 6, 17]
  - Improve and Facilitate Knowledge Transfer
  - Examples: Wikis, mentoring, experience factories

The Problem

Why is Knowledge Transfer Effectiveness difficult to assess?
Questions Related to Knowledge Transfer Effectiveness

– Who depends on knowledge of others?
– How is knowledge transfer executed and facilitated?
– What is the purpose and structure of knowledge transfer instruments?
– Under which conditions can a knowledge transfer instrument fail?
– What are the effects of knowledge transfer failure?

Example: A Knowledge Transfer Instrument

– **Experience Factories** (EF) focus on the facilitation of Knowledge Transfer between Software Developers
– Experience Base
  • “Packages Experiences”
– Goals
  • Knowledge Transfer
  • Knowledge Reuse
Knowledge Flow Theory
[Nissen 2004]

Classification of different types of knowledge flows along 3 dimensions

- Explicitness
  - Tacit / Explicit
- Reach
  - Individual, Group, Organization, Interorganization
- Life Cycle
  - Evolve, Apply, Distribute, Formalize, Organize, Create, ...

Formalization:
Let $a = a_e + a_r + a_l$

within the coordinate system $e =$ expliciteness, $r =$ reach and $l =$ lifecycle

then the goal of e.g. an experience factory can be expressed as the vector $AB$ with $A = (implicit, group, share)$ and $B = (explicit, group, share)$.

Knowledge Transfer in Software Engineering
Barriers to Knowledge Transfer

- **Issues with the Experience Factory [7]:**
  - Lack of awareness, low information quality, low usage, expensive maintenance, context dependent

- **Issues with Knowledge Management in general [8]:**
  - Failure to align KM to org. goals, failure to connect KM to individuals, creation of repositories without defining the goals behind them, etc

Observations

- Knowledge transfer effectiveness is related to the participants of knowledge transfer, and their **goals**
- **Knowledge transfer instruments** themselves serve a purpose, and thereby pursue goals as well
- Therefore analyzing the goals of knowledge transfer participants is **critical to KM**, but difficult [9]
- However, goal-modeling and analysis has received little attention so far in this context
The Knowledge Transfer Agent Method

- Proposes a three tiered approach to modeling Knowledge Transfer (KT) Participants and Instruments as Agents
- Based on the intentional modeling framework i* [13]
- Which enables
  • Reasoning and arguing about KT participants’ goals
  • Evaluating different degrees of KT effectiveness
  • Understanding how and why KT instruments fail or succeed

The i* Framework [Yu 1995]

- An agent oriented early requirements modeling approach
  • Strategic Dependency Diagrams (Agents’ Externals)
  • Strategic Rationale Diagrams (Agents’ Internals)
- Beneficial to KM
  • Social actors
  • Implicit knowledge / ability analysis
  • Actor / Role Abstractions
- However, no specific notion of “knowledge”
  - Extensions necessary

i* Notation (Excerpt)
The i* Framework

- Excerpt of the i* framework meta model

Based on [Den06]

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i* Modeling Examples


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i* Modeling Examples

Proposal

How can we analyze effectiveness of knowledge transfer instruments?

The 3 Levels of Analysis
Extending the i* Framework

**Level 1:**
Identification of Knowledge Dependencies

**Level 2:**
Identification of Supportive Means per Knowledge Dependency

**Level 3:**
Reconceptualizing Supportive Means as Agents

Extension to "standard" i*
KM Extensions to i* Modeling Notation
(based on [Str04])

Knowledge refers to tacit/implicit knowledge

Knowledge about Similar Cases

Knowledge Dependencies refer to situations, where an agent depends on the knowledge of others. It is assumed that the knowledge is provided by the dependee and is applied by the depender.

Communication Channels refer to the way knowledge is transferred between two actors. The receiver is assumed to reliably receive the knowledge.

Knowledge Storage Objects refer to the explicated part of a corresponding knowledge domain. Knowledge is assumed to be publicly available.

Knowledge resides within Actors

Knowledge dependencies are modeled between actors

Knowledge dependencies are refined through means-ends links

Knowledge domains can be related to softgoals
Knowledge Transfer Agents

- A reconceptualization of Knowledge Transfer Instruments as Agents:

  • **Definition**: A knowledge transfer agent is an intentional human, organizational or technological actor that focuses on the facilitation of knowledge transfer between two or more other actors.

The Experience Factory Case

- Experience Factories (EF) focus on the facilitation of Knowledge Transfer between Software Developers

- EF constitute a **Knowledge Transfer Agent**

<table>
<thead>
<tr>
<th>KTA Concept</th>
<th>Experience Factory Concept</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intentional Actor</td>
<td>„Separate Organizational Entity“</td>
</tr>
<tr>
<td>Goal</td>
<td>„Facilitate Knowledge Transfer“</td>
</tr>
<tr>
<td>Participants</td>
<td>„Two or more software developers“</td>
</tr>
</tbody>
</table>
The Experience Factory Case

Questions

- Who depends on knowledge of others?
- How is knowledge transfer executed and facilitated?
- What is the purpose and structure of the experience factory concept?
- Under which conditions can the Experience Factory concept fail?
- What are the effects of failure to providing experiences?

Questions that cannot be answered with traditional approaches

Level 1 Analysis

- Identification of Knowledge Dependencies

Who depends on the knowledge of others?
Level 2 Analysis

- Identification of Supportive Means per Knowledge Dependency

How is knowledge transfer executed and facilitated?

Level 2 “Supportive Means”

Level 1 “Knowledge Dependencies”

What are the effects of failure to providing experiences?

Initial Assessment Label

1st Label Propagation

2nd Label Propagation

nth Label Propagation

Label values:

- Highest value: Goal achievable
- Lowest value: Goal not achievable

Satisfied, Weakly satisfied, Conflict, Undecided, Weakly denied, Denied.
Under which conditions can the Experience Factory concept fail?

The Experience Factory Case
Additional Analysis

Experience Factory

- Plan project
- Inter-Project Experience Transfer
- Execute project
- Provide project support
- Analyze projects
- Package experience packages
- Experience Base
- Transfer experiences

Experience consumer

- Develop and maintain software efficiently
- Analyze project characteristics
- Select adequate experience package
- Provide project characteristics

Experience provider

- Develop and maintain software efficiently
- Experience provider
- Experience Base
- Lessons Learned
- Transfer experiences
- Execute project
- Develop software

Experience factory

- Develop and maintain software efficiently
- Experience consumer

The KTA Method
Contributions

Enables Knowledge Analysts to
- Analyze knowledge transfer effectiveness in the light of (potentially conflicting) stakeholder goals
- Analyze how knowledge transfer instruments work, and why they can succeed or fail
- Transform KM problems into requirements engineering problems
Limitations

- Application so far only on a conceptual level
- Conclusions already known about the experience factory concept
- Validity of models
- Scalability

The KTA Method

Applications

An Empirical Case Study
- In cooperation with Bell Canada / Kids Help Phone
- Applying the KTA Method to the Kids Help Phone Counseling Centre Toronto (~100 employees)
- Deduction of implications for the design of the Kids Help Phone’s knowledge infrastructure,
  - incl. organizational and technological aspects
KT Agents are “intentional actors that focus on the facilitation of knowledge transfer between two or more other actors”.

KT Agents depend on others in order to be successful.

Any questions?

- See you at the exam!
Literature 1/2


Literature 2/2