

707.009
Foundations of Knowledge Management
„Organizational Knowledge Repositories“

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Overview

Agenda

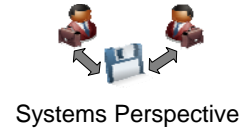
- Experience Factories
- Case Based Reasoning

In the context of Software Engineering

Overview

Previously:

- Knowledge Organization
- Broad Knowledge Bases
- Knowledge Acquisition



Last week:

- Knowledge Transfer

Today:

- **Organizational Knowledge Repositories**



Schools of KM [Earl 2001]

Table 1. Schools of Knowledge Management

SCHOOL ATTRIBUTE	← TECHNOCRATIC →			← ECONOMIC →	← BEHAVIORAL →		
	SYSTEMS	CARTOGRAPHIC	ENGINEERING	COMMERCIAL	ORGANIZATIONAL	SPATIAL	STRATEGIC
FOCUS	[REDACTED]	Maps	Processes	Income	[REDACTED]	Space	Mindsot
AIM	[REDACTED]	Knowledge Directories	Knowledge Flows	Knowledge Assets	[REDACTED]	Knowledge Exchange	Knowledge Capabilities
UNIT	[REDACTED]	Enterprise	Activity	Know-how	[REDACTED]	Place	Business
EXAMPLE	[REDACTED]	Bain & Co AT&T	HP Frito-Lay	Dow Chemical IBM	[REDACTED]	Skandia British Airways	Skandia Unilever
CRITICAL SUCCESS FACTORS	[REDACTED]	Culture/Incentives to share Knowledge Networks to connect People	Knowledge Learning and Information Unrestricted Distribution	Specialist Teams Institutionalized Process	[REDACTED]	Design for Purpose encouragement	Rhetoric Artifacts
PRINCIPAL CONTRIBUTION	[REDACTED]	Profiles and Directories on Internets	Shared Databases	Intellectual Asset Register and Processing System	[REDACTED]	Access and Representational Tools	Eclectic
"PHILOSOPHY"	[REDACTED]	Connectivity	Capability	Commercialization	[REDACTED]	Contactivity	Consciousness

KM as risk prevention in Software Engineering

I. Rus and M. Lindvall, Knowledge Management in Software Engineering, IEEE Software, 19(3)2002.

Addressing risks such as

- Loss of knowledge due to attrition
- Lack of knowledge and an overly long time to acquire it due to steep learning curves
- People repeating mistakes and performing rework
- Individuals who own key knowledge become available

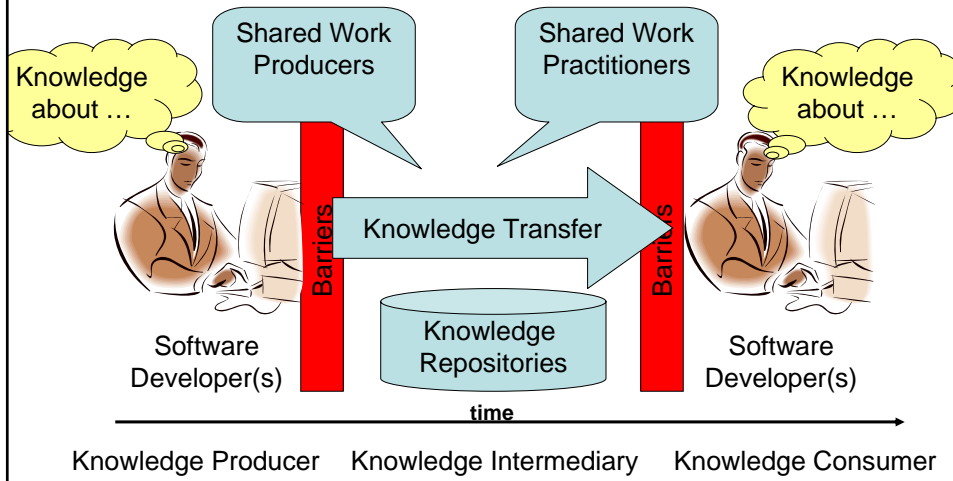
What kind of risks can you identify from a KM perspective?

Types of Knowledge Reuse Situations [Markus 2001]

Four distinct types:

- **Shared work producers**
 - who produce knowledge they later reuse
- **Shared work practitioners**
 - who reuse each other's knowledge contributions
- **Expertise-seeking novices**
 - who seek advice from experts
- **Secondary knowledge miners**
 - who seek to answer new questions or develop new knowledge

Knowledge Transfer in Software Engineering



Knowledge Transfer Participants

M.L. Markus, Toward a Theory of Knowledge Reuse: Types of Knowledge Reuse Situations and Factors in Reuse Success
 Journal of Management Information Systems, 18(1): 57--93, 2001.

Shared Work Producers:

- „Prosumers“
- Producers of knowledge for their own later reuse

Shared Work Producers

Shared Work Practitioners:

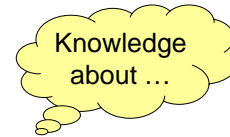
- Producers of knowledge for each others use

Shared Work Practitioners

What kind of knowledge is relevant in a Software Engineering context?

Knowledge about:

- Software architecture
- Functional and Non-Functional Requirements
- Design rationale
- Design Trade-offs
- Stakeholders and Stakeholder expectations
- Lessons learned
- ...



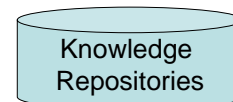
What kind of knowledge do you think is relevant?

Knowledge Repositories

M.L. Markus, Toward a Theory of Knowledge Reuse: Types of Knowledge Reuse Situations and Factors in Reuse Success
Journal of Management Information Systems, 18(1): 57--93, 2001.

Types of Knowledge Repositories:

- Repositories of documents
- Repositories of data
 - ➔ Fundamental differences for retrieval
- Repositories that store external knowledge (e.g. Customers, Competition)
- Repositories that store internal knowledge (e.g. Meeting transcripts, mails)
- Repositories containing general knowledge (e.g. scientific knowledge)
- Repositories containing specific knowledge (e.g. context sensitive)
- Repositories containing declarative / procedural / rationale / analytic knowledge



Can you give examples? [NOTES]

KM functions for document-based Knowledge Repositories

- **Autorentifizikation**
 - wer hat welches Dokument eingestellt
- **Datenbank-gestützte Verwaltung von Dokumenten**
 - Dokumente finden unabhängig vom Ablageort
- **Versionenverwaltung von Dokumenten**
 - Wer hat wann an welchem Dokument gearbeitet
- **Beziehungen zwischen Dokumenten**
 - Bi-direktionale, konsistente Verweise
- **Automatische Generierung von Abstracts**
- ...

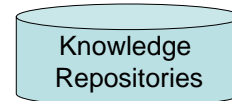
KM functions for document-based Knowledge Repositories

- **Informationsagenten**
 - Informationen über Veränderungen
- **Beziehung zwischen Dokumenten und Personen**
 - Wissensträger mit Wissen bestmöglich verknüpfen
- **Personalisierungsmöglichkeiten**
 - Benutzung entsprechend persönlicher Wünsche gestalten
- **Unterstützung unterschiedlicher Suchfunktionalitäten**
 - Volltext und/oder Metadaten, Ähnlichkeiten, Clustering
- **Groupwarefunktionalitäten** (z.B. Teamworkspaces)
 - Zusammenarbeit mit anderen erleichtern
- ...

Knowledge Repositories in Software Engineering

Related Concepts:

- Lessons Learned database
- Lessons to Learn database
- Project close-out / post-mortem repositories
- Experience factory
- Knowledge base
- Etc.

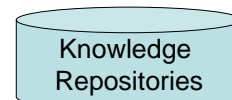


Knowledge Repositories in Software Engineering

I. Rus and M. Lindvall, Knowledge Management in Software Engineering, IEEE Software, 19(3)2002.

Goals of Knowledge Repositories:

- Reduce software defects
- Sharing knowledge about local policies and practices
 - E.g. through Document management
- Capturing knowledge and knowing who knows what
 - E.g. through competence management and expert identification
- Software process improvement
 - Decrease time and cost and increase quality
 - E.g. through software reuse
- Making better decisions
- Accessing domain knowledge
- Supporting learning and feedback



What are different purposes knowledge repositories can serve?

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Skills Management

Interviews mit Vorgesetzten zu Stellenanforderungen der Mitarbeiter

Erstellung eines SOLL Profils

Abstimmung der Profile mit Stelleninhabern

Skills	Beschreibung	Know-how für einfache Fragestellungen	Know-how für komplexe Probleme	Diagnosekompetenz
Fachliche Fähigkeiten				
Kennntnis der Basisanwendungen	Anwendungskennntnis aller Basissysteme und Basisprodukte		0	
Kennntnis technischer Infrastruktur	Kennntnis technischer Infrastruktursysteme, wie Netzwerk, Router etc.			0
Systemknowhow	Entwicklerkennntnisse zu Systemen und Produkten			0
Management, Methoden				
Innovationsfähigkeit, Lernfähigkeit, Reflexionsfähigkeit	Methodenentwicklung, Kontakte zu Kompetenzträgern ist ständig auf der Suche nach Verbesserungen, informiert sich regelmäßig über neue Entwicklungen im Fachgebiet und bringt diese Informationen an Arbeitsplatz ein			0
Linienorganisation	Verwalten von Budgets, Stunden, Zusammensetzung des Stundensatzes, BAB, Termine Ressourcenplanung		0	
Problemlösungsfähigkeit	Krisenmanagement, Prioritäten setzen, Analyse von Problemen, vernetztes Denken			
Projektführung	Systemlieferantensteuerung			0
Persönliche/Soziale Kompetenzen				
Gesprächstechnik	Kann Kunden am Telefon gut führen und sachlich Problemstellung herausarbeiten			0
Mitarbeiterführung	Personalaufbau und -weiterbildung Findet Personal für den diagnostizierten Bedarf in seiner Abteilung, Systemisiert die Aufgaben in seiner Abteilung und ordnet Mitarbeiter effektiv			0

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15

Knowledge Management Institute TU Graz

Skills Management

Einschätzung des IST Profils als Selbst- (x) und Fremdeinschätzung (x)

Abstimmung der unterschiedlichen Sichtweisen

Skills	Beschreibung	Know-how für einfache Fragestellungen	Know-how für komplexe Probleme	Diagnosekompetenz
Fachliche Fähigkeiten				
Kennntnis der Basisanwendungen	Anwendungskennntnis aller Basissysteme und Basisprodukte		x 0 x	
Kennntnis technischer Infrastruktur	Kennntnis technischer Infrastruktursysteme, wie Netzwerk, Router etc.	x x		0
Systemknowhow	Entwicklerkennntnisse zu Systemen und Produkten			x 0 x
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Problemlösungsfähigkeit	Krisenmanagement, Prioritäten setzen, Analyse von Problemen, vernetztes Denken			
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16

Barriers to Knowledge Transfer

– **Issues with the Knowledge Repositories [7]:**

- Lack of awareness,
- Lack of trust,
- Lack of time,
- low information quality,
- low usage,
- Preparing entries is time consuming,
- expensive maintenance,
- context dependency



Barriers

Three Potential Solutions [Cabrera2002]

A look back to our last class:

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

But organizational knowledge repositories
are not necessarily discretionary databases

The Experience Factory

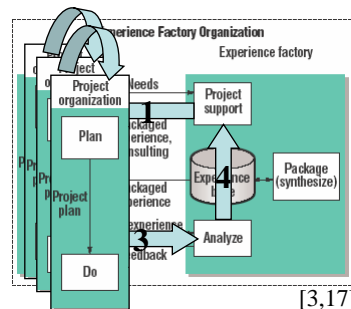
V. R. Basili and G. Caldiera and D.H. Rombach, Experience Factory
 Encyclopedia of Software Engineering, : 469-476, 1994.
 I. Rus and M. Lindvall, Knowledge Management in Software Engineering, IEEE Software, 19(3)2002.

- The **Experience Factory** is a logical and/or physical **organization** that **supports project developments** by analyzing and synthesizing all kinds of **experience**, acting as a **repository** for such experience, and supplying that experience to various projects on demand (Figure 2).
- It **packages experience** by building informal, formal or schematized, and productized models and measures of various software processes, products, and other forms of knowledge via people, documents, and automated support.

The Experience Factory

V. R. Basili and G. Caldiera and D.H. Rombach, Experience Factory
 Encyclopedia of Software Engineering, : 469-476, 1994.
 I. Rus and M. Lindvall, Knowledge Management in Software Engineering, IEEE Software, 19(3)2002.

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

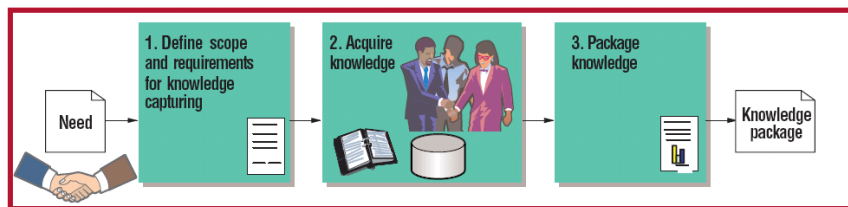


The Experience Factory

S. Komi-Sirviö and A. Mäntyniemi and V. Seppänen, Toward a Practical Solution for Capturing Knowledge for Software Projects, IEEE Software, 19(3)2002.

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 - Knowledge Transfer
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Examples: Know-Center Processes, Post-Mortem Process and LL Documents



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 $a = [a_1e + a_2r + a_3l]$

within the coordinate system $e =$ explicitness, $r =$ 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).

Case Based Reasoning [Aamodt 1994]

- A problem solving paradigm
- Utilizing the specific knowledge of previous experiences

- A new problem is solved by
 - Finding a similar past case and
 - Reusing it in the new problem situation

- An incremental approach to learning –
- experience is retained each time a problem has been solved

Case Based Reasoning Applications

Example: Salesforce – Customer support by call centre agents

http://www.salesforce.com/democenterapp/en/democenter/democenter_win.jsp?demo=support&d=70130000000CowK

What type of knowledge repository is this system?

Case Based Reasoning [Aamodt 1994]

In CBR terminology

- A **case** denotes a problem situation
- A **past case** denotes a previously experienced situation, which has been captured and learned in such a way that it can be reused in solving future problems (also previous case, stored case, retained case)
- A **new case** (or unsolved case) is a description of a new problem to be solved

Case-based reasoning is a cyclic and integrated process of solving a problem, learning from this experience, solving a new problem, etc

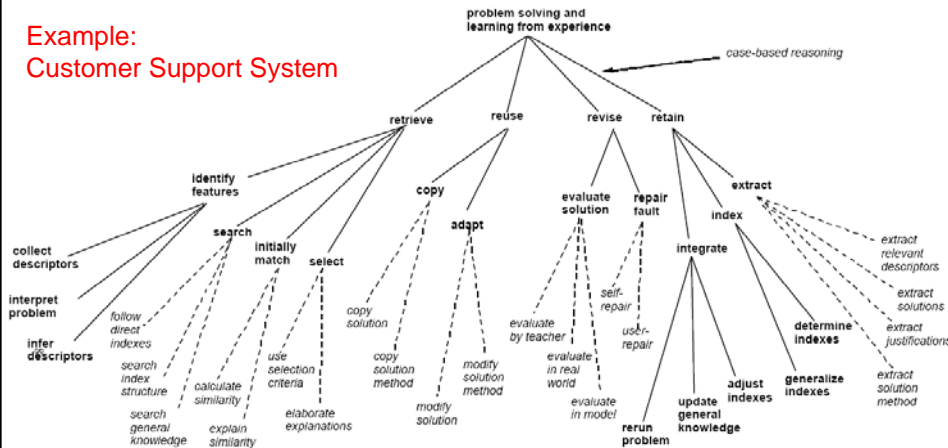
Case Based Reasoning [Aamodt 1994]

Learning in CBR occurs as a natural by-product of problem solving
When a problem is solved, the experience is retained in order to solve similar problems in the future

CBR favours learning from experience, i.e. Learning from concrete problems

Case Based Reasoning [Aamodt 1994]

Example:
Customer Support System



Case Based Reasoning [Aamodt 1994]

Core problems addressed by CBR researchers:

1. Knowledge representation (How to represent cases?)
2. Retrieval methods (How to identify relevant cases?)
3. Reuse methods (How to translate knowledge from old to new case?)
4. Revise methods (How to improve cases?)
5. Retain methods (How to increase and improve the case base?)

A very broad field of current research:

See, for example, <http://www.iccbr.org/iccbr07/>

Any questions?

Coming up: Two guest lectures

Week 9	6.12.2007	Psychology in Knowledge Management (slides)	In this class, we will discuss some fundamental psychological concepts in the context of knowledge management, including for example Knowledge Space Theory. Guest Lecture: T. Ley, Know-Center Readings: TBA
Week 10	13.12.2007	Multimedia & Semantic Metadata (slides)	In this class, we will discuss different forms of semantic annotation of multimedia documents. Guest Lecture: M. Lux, Klagenfurt University Readings: TBA