707.009
Foundations of Knowledge Management
„Organizational Knowledge Repositories“

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Overview

Agenda

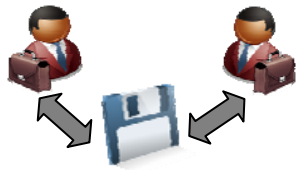
- Experience Factories
- Case Based Reasoning

In the context of Software Engineering

Overview

Previously:

- Knowledge Organization
- Broad Knowledge Bases
- Knowledge Acquisition



Systems Perspective

Last week:

- Knowledge Transfer

Today:

- **Organizational Knowledge Repositories**

Organizational Perspective

Schools of KM
[Earl 2001]

Table 1. Schools of Knowledge Management

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

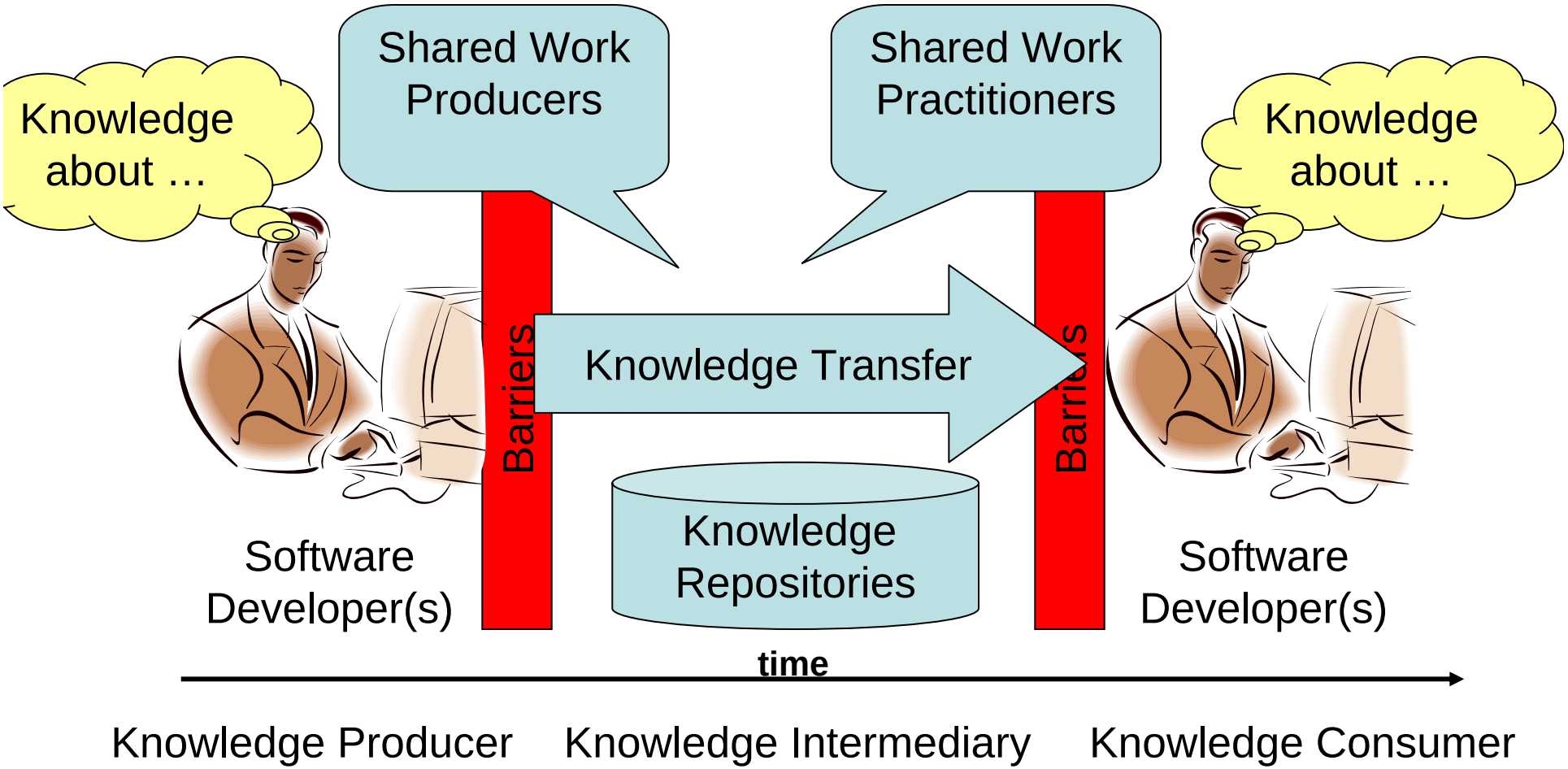
What kind of risks can you identify from a KM perspective?

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 advise 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:

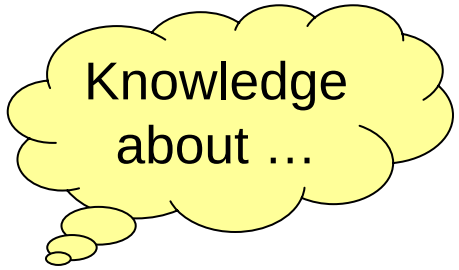
- „Prosumers“
- Producers of knowledge for their own later reuse

Shared Work Practitioners:

- Producers of knowledge for each others use

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
- …

Knowledge Repositories

M.L. Markus, Toward a Theory of Knowledge Reuse: Types of Knowledge Reuse Situations and Factors in Reuse Success
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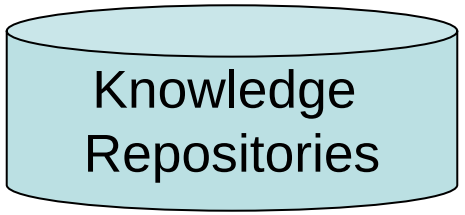
Types of Knowledge Repositories:



– Repositories of documents
– Repositories of data
  ➔ Fundamental differences for retrieval

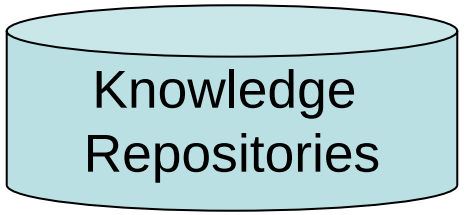
Can you give examples? [NOTES]

– 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

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

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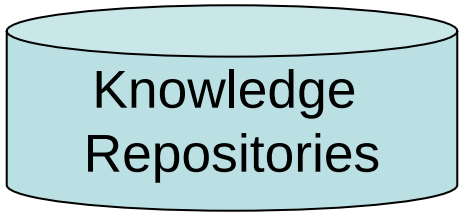

Goals of Knowledge Repositories:

- 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?

Skills Management

- Interviews mit Vorgesetzen 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	Diagnose-kompetenz
Fachliche Fähigkeiten				
Kenntnis der Basis-anwendungen	Anwendungskenntnis aller Basissysteme und Basisprodukte		O	
Kenntnis technischer Infrastruktur	Kenntnis technischer Infrastruktursysteme, wie Netzwerk, Router etc.			O
Systemknowhow	Entwicklerkenntnisse zu Systemen und Produkten			O
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 am Arbeitsplatz ein			O
Linienorganisation	Verwalten von Budgets, Stunden, Zusammensetzung des Stundensatzes, BAB, Termine Ressourcenplanung		O	
Problemlösungsfähigkeit	Krisenmanagement, Prioritäten setzen, Analyse von Problemen, vernetztes Denken			
Projektdurchführung	Systemlieferantensteuerung			O
Persönliche/Soziale Kompetenzen				
Gesprächstechnik	Kann Kunden am Telefon gut führen und sachlich Problemstellung herausarbeiten			O
Mitarbeiterführung	Personalaufbau und -weiterbildung: Findet Personal für den diagnostizierten Bedarf in seiner Abteilung. Systematisiert die Aufgaben in seiner Abteilung und ordnet Mitarbeiter effektiv			O

Skills Management

Einschätzung des IST Profils als Selbst- (**x**) und Fremd-einschätzung (x)

Abstimmung der unterschiedlichen Sichtweisen

Skills	Beschreibung	Know-how für einfache Fragestellungen	Know-how für komplexe Probleme	Diagnose-kompetenz
Fachliche Fähigkeiten				
Kenntnis der Basis-anwendungen	Anwendungskenntnis aller Basisysteme und Basisprodukte		**x** o x	
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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

Three Potential Solutions [Cabrera2002]

A look back to our last class:

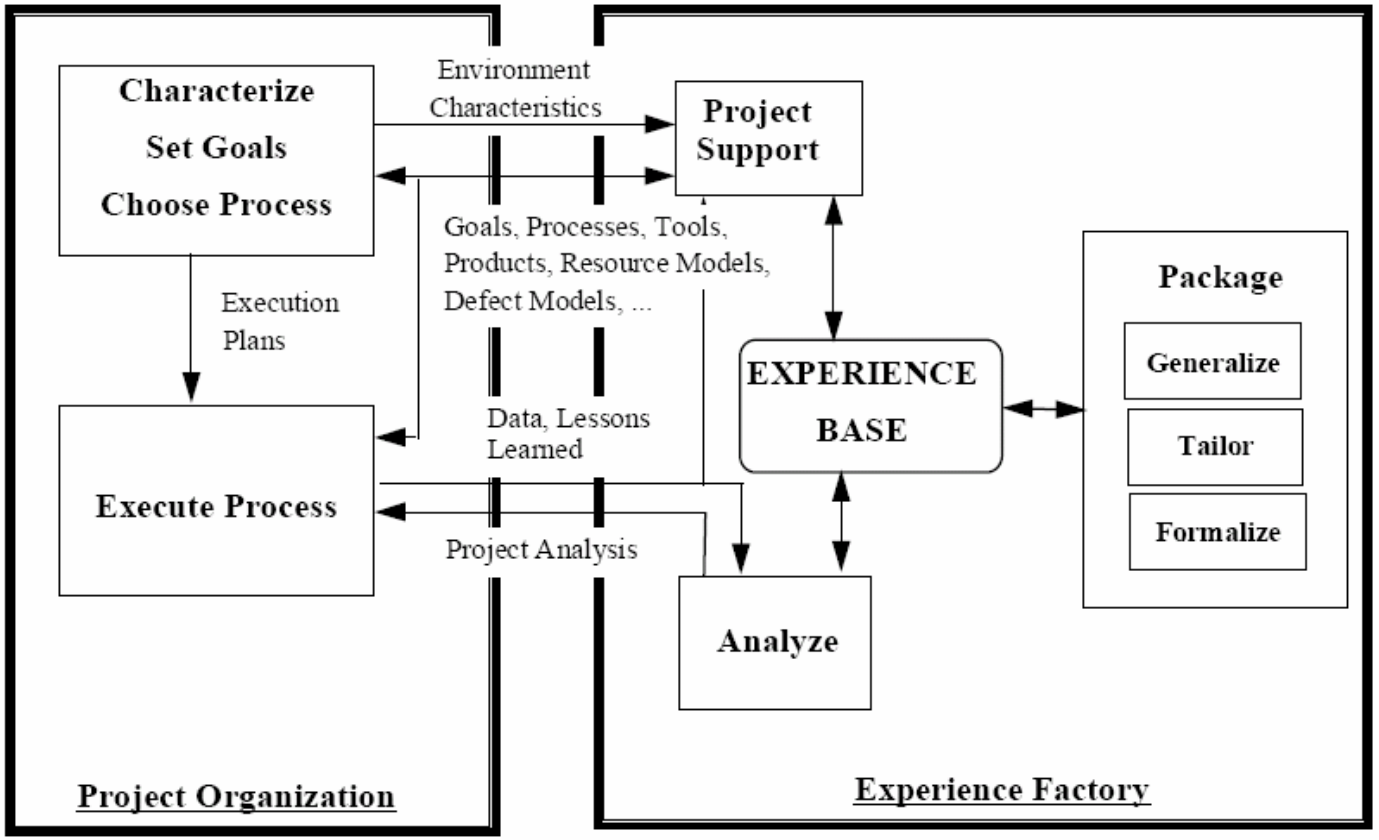
1. Restructuring the payoff function
2. Increasing perceived efficacy of individual contributions
3. Establishing group identity and promoting personal responsibility

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.

Figure 2



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Improving the software process and product requires the continual **accumulation of evaluated experiences** (learning)

- in a form that can be **effectively understood and modified** (experience models)
- into a **repository** of integrated **experience models** (experience base) that can be accessed and modified
- to meet the **needs of the current project** (reuse).

The paradigm implies the **logical separation** of project **development** (performed by the Project Organization)

- from the **systematic learning and packaging** of reusable experiences (performed by the Experience Factory).

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- 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.

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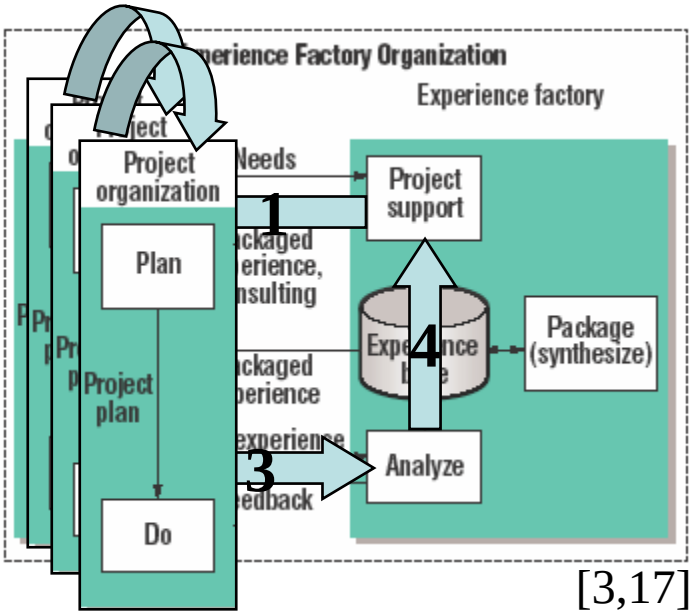
- **Experience Factories** (EF) focus on the facilitation of Knowledge Transfer between Software Developers
- Experience Base
  - "Packages Experiences"
- Goals
  - Knowledge Transfer
  - Knowledge Reuse



[3,17]

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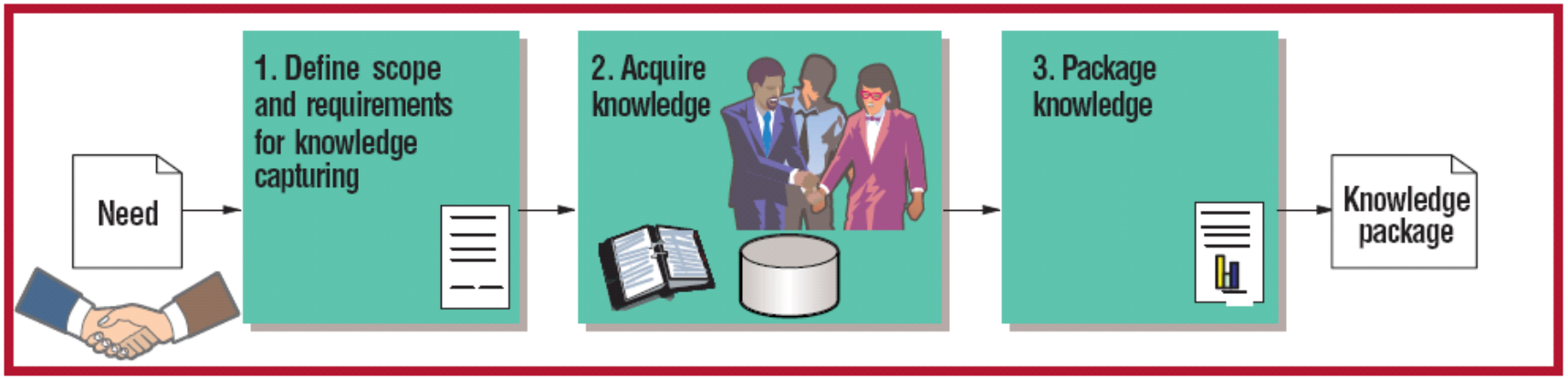
Examples: Know-Center Processes, Post-Mortem Process and LL Documents



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 = $a_1 e + a_2 r + a_3 l$

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 $\overrightarrow{AB}$ 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

When an attempt to solve a problem fails, the reason for the failure is identified and remembered in order to avoid the same mistake in the future

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

Case Based Reasoning [Aamodt 1994]

Central tasks are

1. Identify the current problem situation
2. Find a past case similar to the new one
3. Use that case to suggest a solution
4. Evaluate the proposed solution
5. Update the system by learning from this experience

Case Based Reasoning [Aamodt 1994]

A descriptive Framework for CBR systems

The CBR Cycle

1. RETRIEVE most similar case
2. REUSE the knowledge in that case
3. REVISE the proposed solution
4. RETAIN relevant parts of this experience

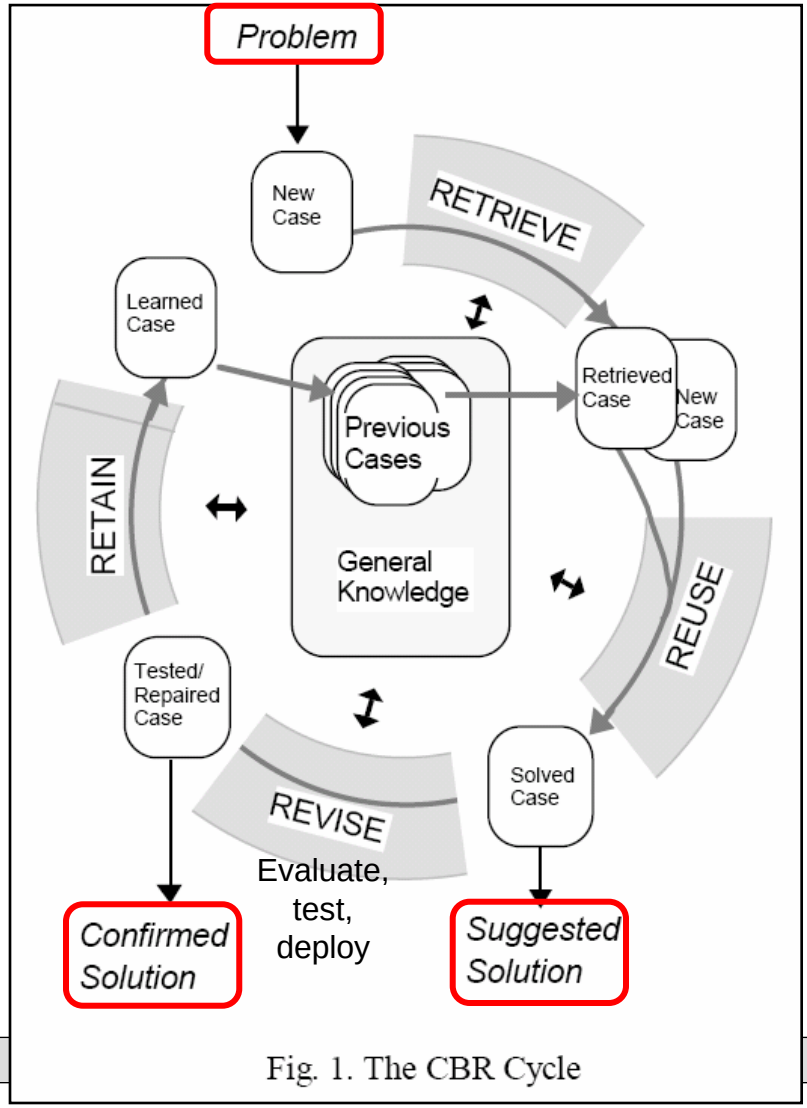
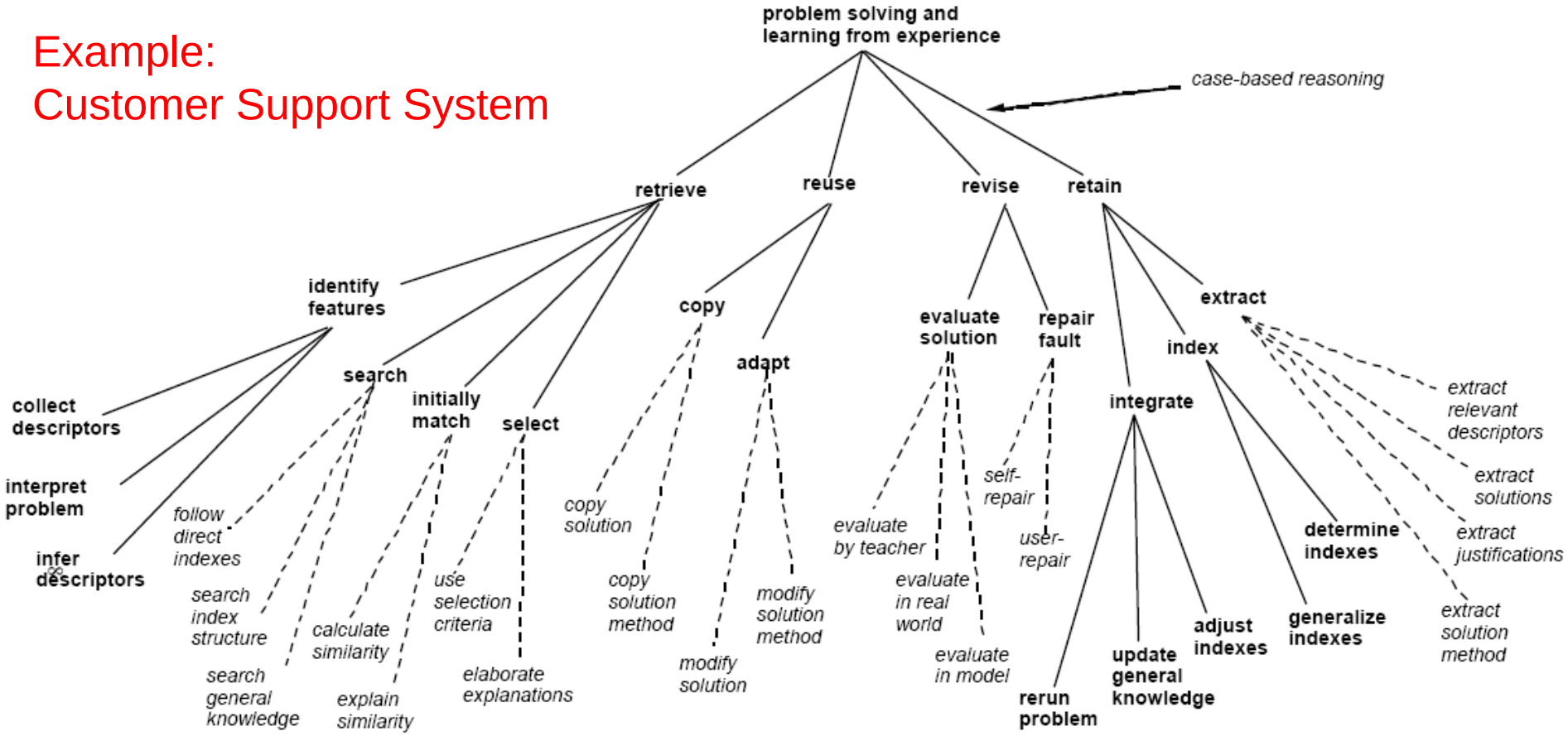


Fig. 1. The CBR Cycle

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 reasearch:

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

Any questions?

Coming up: A guest lecture by T. Ley

Tomorrow!

10	2.12.2009	**Cognitive Psychology Theories for 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: Tobias Ley, Know-Center and Karl-Franzens-University Graz