

Kapitel 4

Case-based Reasoning (CBR)

4.1 Case-based Reasoning

4.1.1 CBR - basis

4.1.2 CBR scenario

4.1.3 CBR system - characteristics

4.2 CBR & Knowledge management

4.2.1 CBR as a subsystem in the KM system

4.2.2 Experience factory: a CBR-KM system

4.3 CBR applications

4.4 Conclusion

4.2.2 CBR system for Organisational learning

■ Learning in an organisation

„Knowledge is not created by people sitting and staring out their window. *Ideas* may be created [during such moments], but knowledge in the sense of capacity for effective action is created by working teams.“ - P. Senge

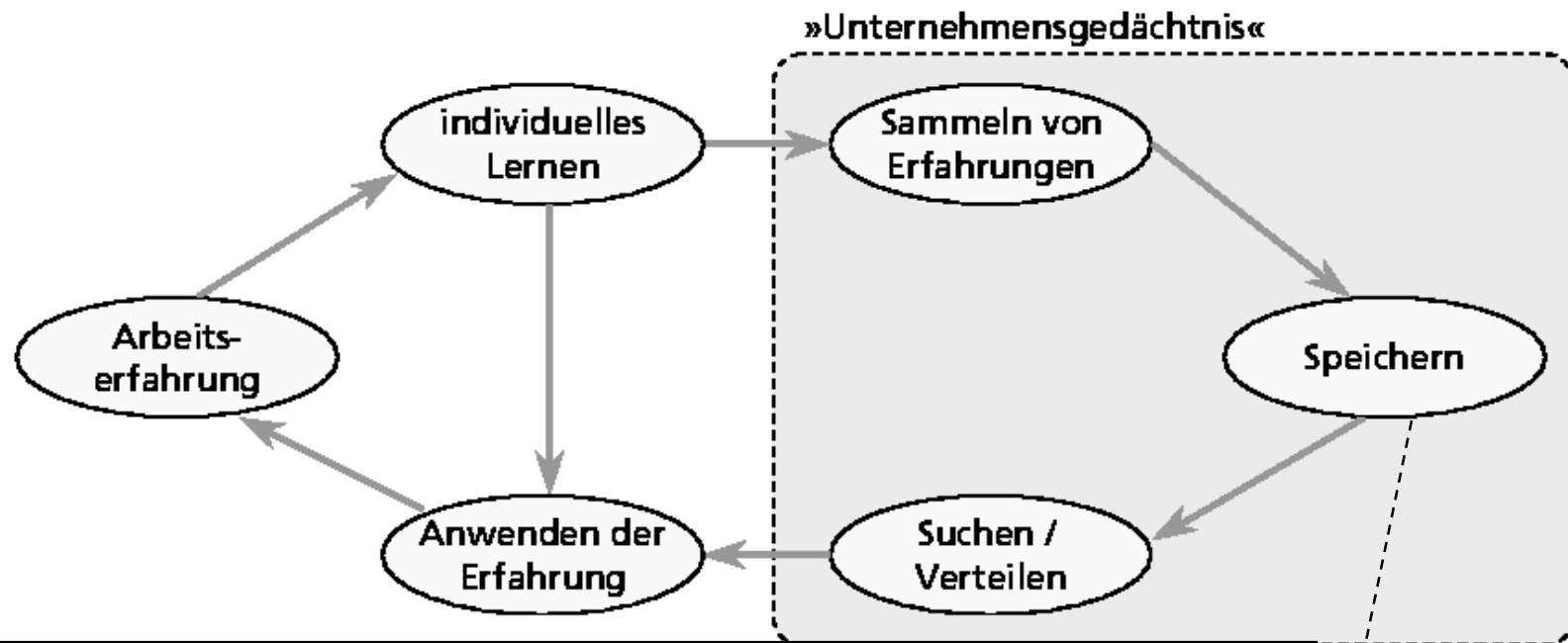


Organisational learning

- Learning is a dynamic concept and it emphasizes the continually changing nature of organizations
 - organizations want to be more adaptable to change
- **Organisational learning (OL)** is the process how companies
 - build, supplement, and organize knowledge and routines
 - around their activities and within their cultures and
 - adapt and develop organizational efficiency
 - by improving the use of the broad skills of their workforces
- A **learning organization** is a company that purposefully constructs structures and strategies so as to enhance and maximize organizational learning
- **Organizational learning** *anchors* the process of **knowledge management** in the core phenomenon of how new knowledge is generated - by working teams (Senge, 1999)

Organisational learning

Nach Heist et al., 1998



- **experience-, Lesson Learned- archives / Best practice databases**

- document management

- **shared case bases**

- application specific problem/solutions archives

- **expert systems**

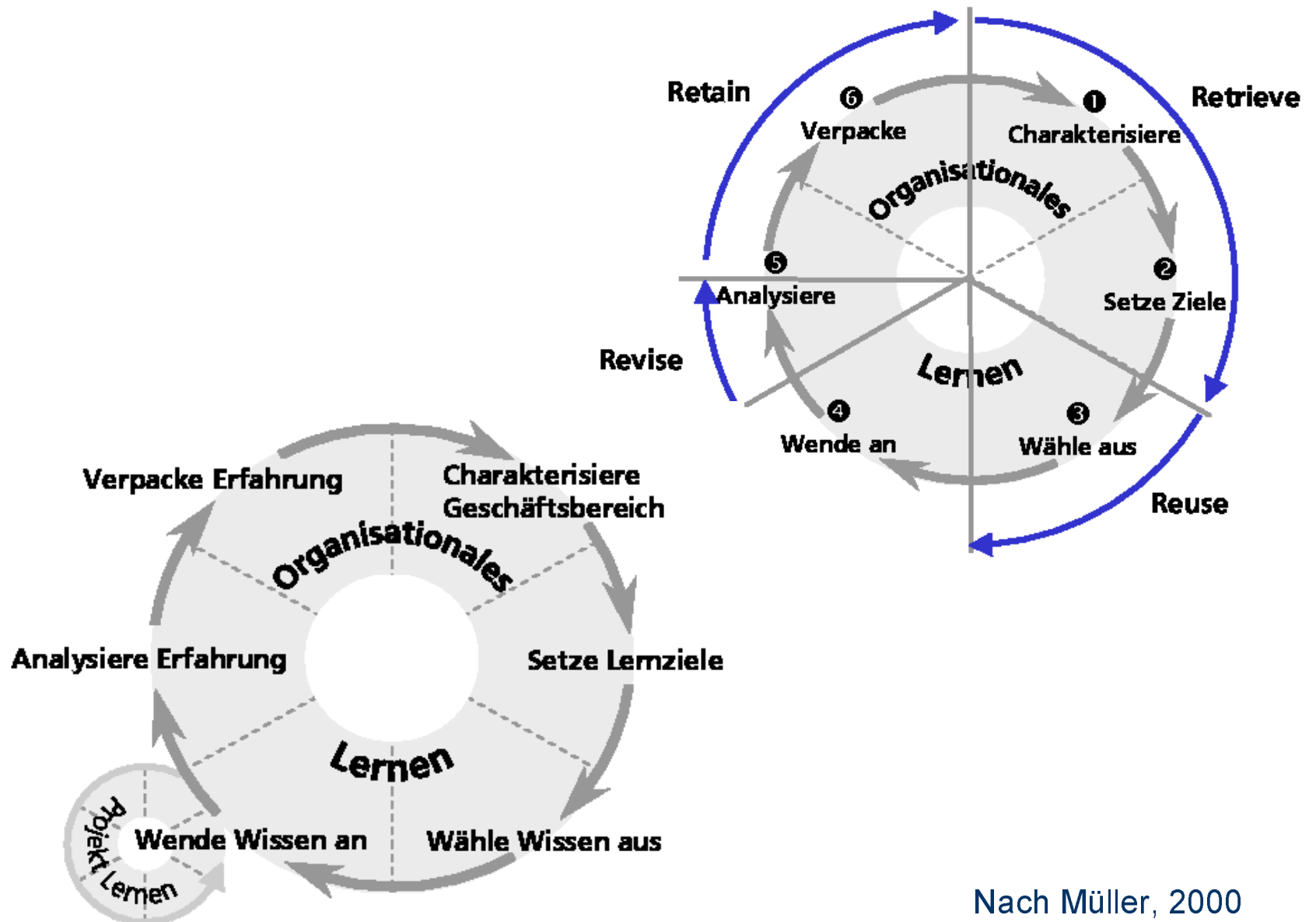
Nach Kühn/Abecker, 1998

CBR system for OL - Experience factory

- The experience factory approach aims to
 - establish an **organizational infrastructure** to
 - facilitate systematic and continuous **organizational learning**
 - through the **sharing and reuse of experiences** in software engineering

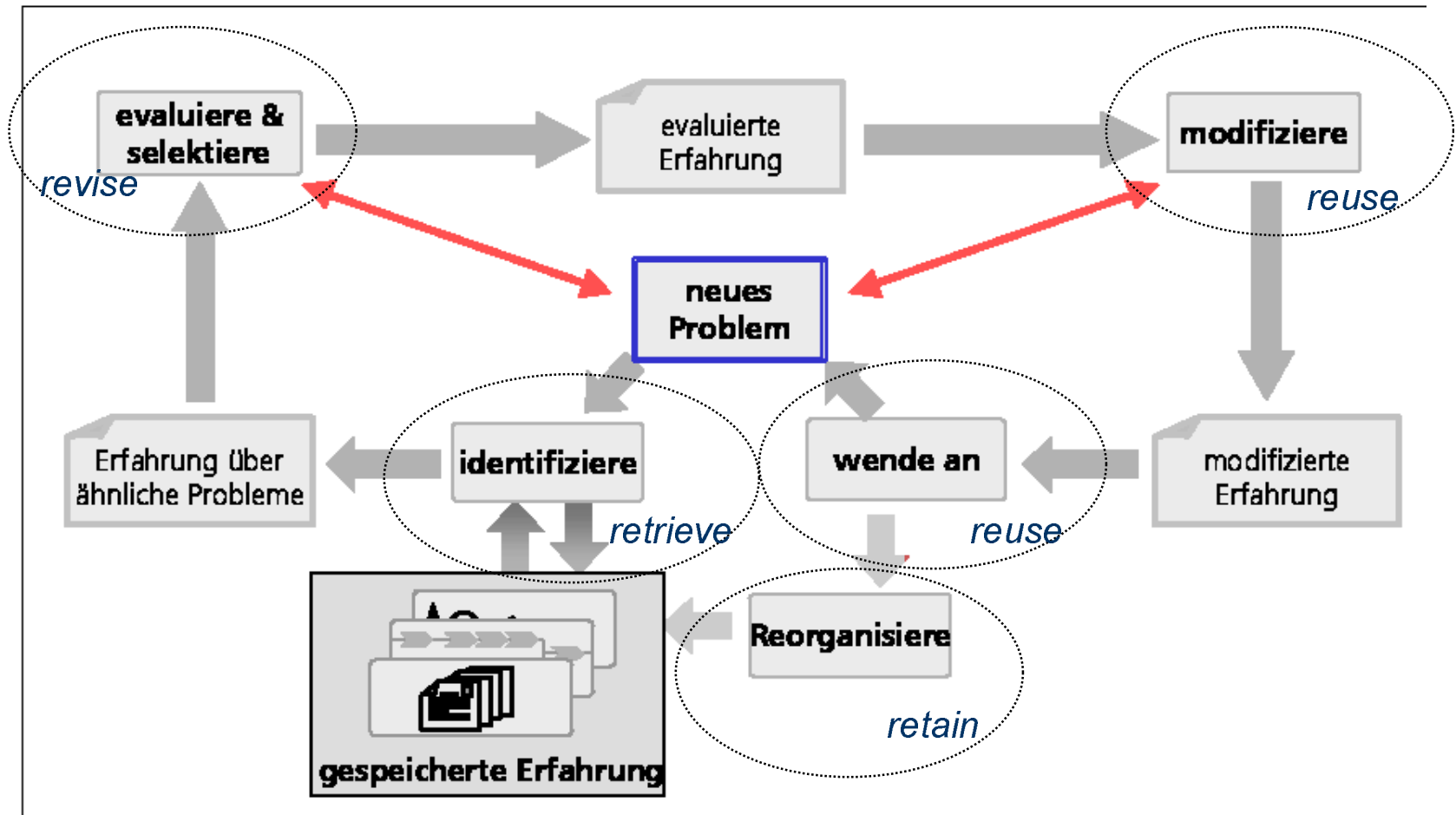
- It involves setting up a group separate to the development teams, called the experience factory, which is responsible for
 - *characterising* the problem domain and *setting* goals of learning
 - *selecting* knowledge that could be applied and *applying*
 - *collecting* and *validating* experiences from development projects,
 - *packaging* the experiences by building empirical models and structuring informal knowledge, and
 - *spreading* experience packages into development projects.

Organisational learning and CBR



Nach Müller, 2000

Experience factory - reuse of experience



Experience factory - benefits

- Support for incremental, continuous learning
- Support for maintenance of experience
- Learning from examples (natural approach)
- Context sensitive retrieval
- Support for evaluation of experience -quality, -applicability, -benefit of use
- Structuring and storage of diverse kinds of experience
- Retrieval based on incomplete information
- Retrieval of similar experience

4.3 CBR Applications

Knowledge about a problem-domain is:

A) contained in the **documents**

B) represented as a set of **business rules**

A)

Documents are cases. There are three approaches to refer to the knowledge contained in the cases

- conversational
- textual
- structural

B)

Business rules are in the form of IF-THEN rules. This case requires structural approach

CBR Applications

Conversational approach – Conversational CBR

- To each case is associated one (or more) „questions-tree“
 - „questions-tree“ corresponds to case-features

Characteristics:

- User is navigated to the related solution (case, document) by the set of questions
 - question are organised in the form of decision tree
- Case-base has to be developed and maintained by expert
- The number of question should be optimal (not too much)
- Used for shallow diagnosis, product selection, planning.
- Main money earner for CBR

CBR Applications - Conversational CBR

Example: HP Printer Helpdesk - troubleshooting hp LaserJet 5si

troubleshooting hp LaserJet 5si series printers - Microsoft Internet Explorer von Lycos Bertelsmann

Datei Bearbeiten Ansicht Favoriten Extras ?

Links » Adresse <http://pawnt139.external.hp.com/servlet/Setec?product=LaserJet5si&page=cpd&thecpd=cpd2> Wechseln zu

hp home products & services support solutions how to buy

hp invent

hp customer care

→ search
→ contact hp
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troubleshooting hp LaserJet 5si series printers

1. Question

Which of the following best describes your question?

- ☐ Error messages, irregular control panel or no power
- ☐ Print quality
- ☐ Printer noises
- ☒ Unable to print or slow print
- ☐ Unable to open tray
- ☐ Setup and installation
- ☐ General information
- ☐ Printing on a network

→ NEXT

→ START OVER

Problem description

<http://pawnt139.external.hp.com/servlet/Setec?product=LaserJet5si>

Internet

CBR Applications - Conversational CBR

troubleshooting hp LaserJet 5si series printers - Microsoft Internet Explorer von Lycos Bertelsmann

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troubleshooting hp LaserJet 5si series printers

2. Question

Which best describes the issue you have?

☐ Unable to print

☒ Slow printing

☐ Unable to print from a specific tray

☐ Unable to print duplex

→ NEXT

→ START OVER

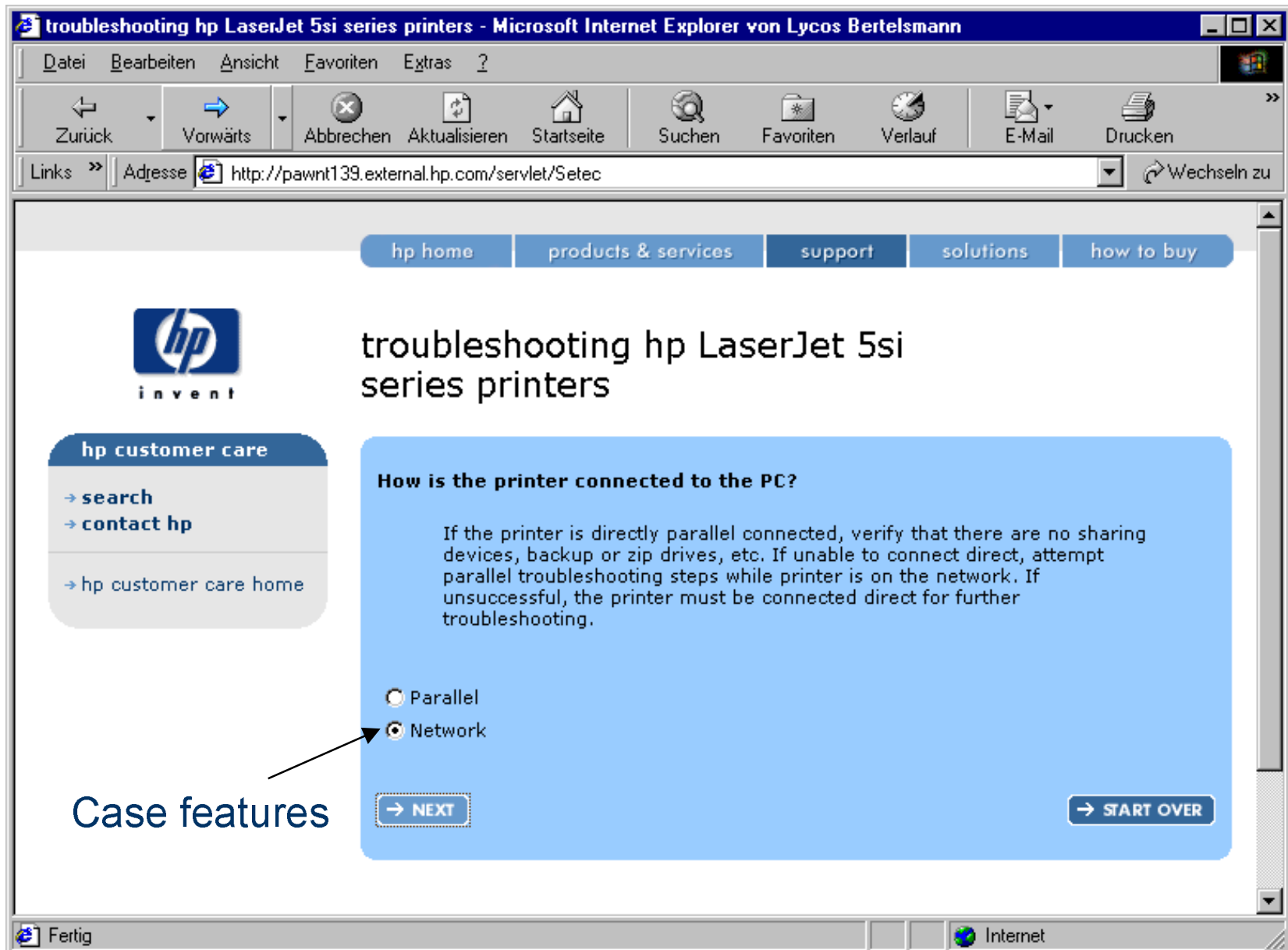
→ printing instructions

→ feedback to the webmaster

Fertig Internet

Case features

CBR Applications - Conversational CBR



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How is the printer connected to the PC?

If the printer is directly parallel connected, verify that there are no sharing devices, backup or zip drives, etc. If unable to connect direct, attempt parallel troubleshooting steps while printer is on the network. If unsuccessful, the printer must be connected direct for further troubleshooting.

☐ Parallel

☒ Network

→ NEXT

→ START OVER

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Case features

CBR Applications - Conversational CBR

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troubleshooting hp LaserJet 5si series printers

What type of network do you have?

If in a server environment, test from the workstation and then from the server. It may be necessary to complete the following procedures: 1) Pause printing at the server to check for spooling issues from the workstation to the server. 2) Install the driver locally on the workstation. 3) Test printing directly to the printer by installing a Jetdirect port. 4) Direct parallel connect to the printer for additional testing.

☒ Windows NT
☐ Novell or Peer to Peer

→ NEXT

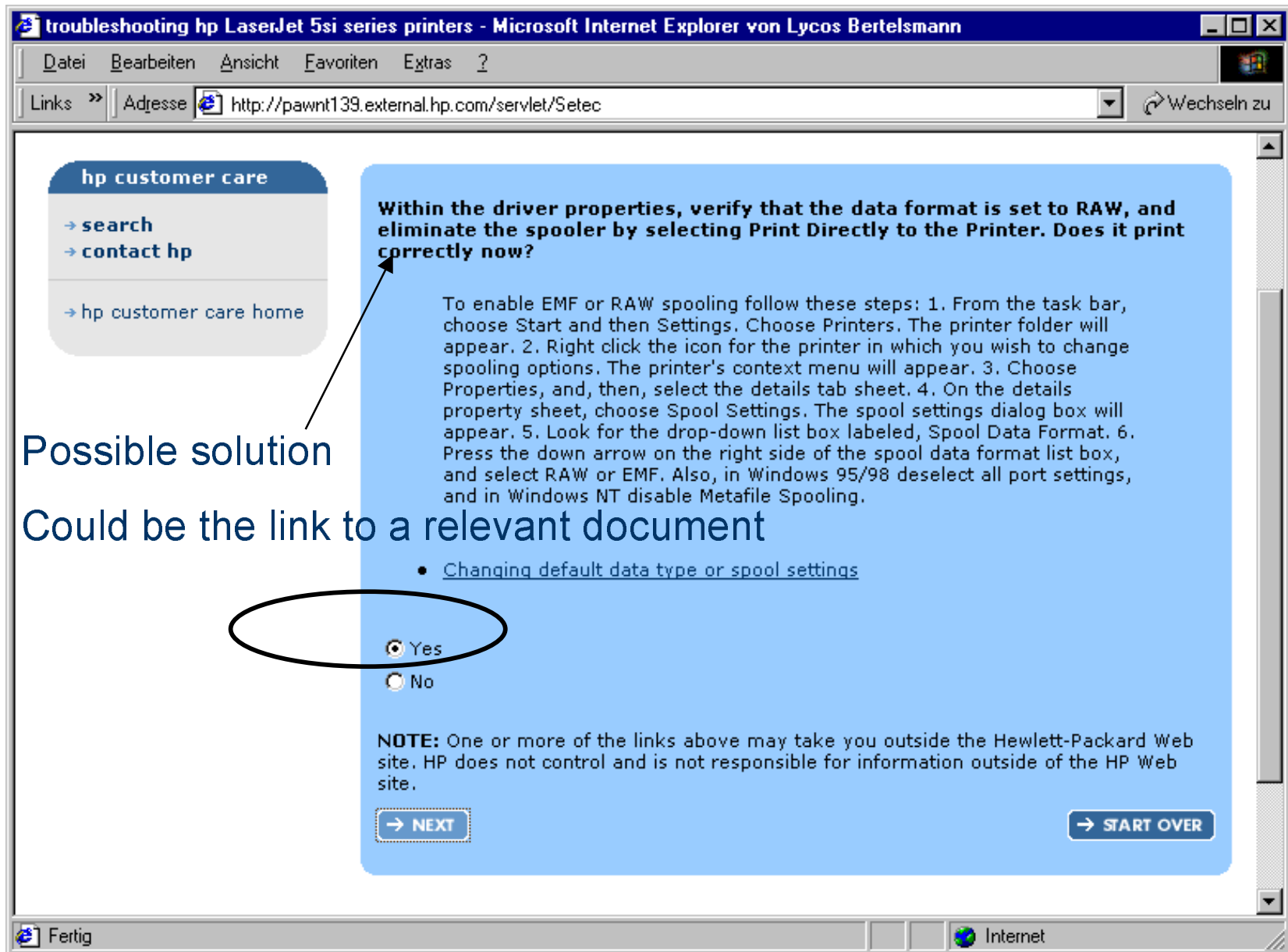
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Fertig Internet

suggestion

Case features

CBR Applications - Conversational CBR



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Within the driver properties, verify that the data format is set to RAW, and eliminate the spooler by selecting Print Directly to the Printer. Does it print correctly now?

To enable EMF or RAW spooling follow these steps: 1. From the task bar, choose Start and then Settings. Choose Printers. The printer folder will appear. 2. Right click the icon for the printer in which you wish to change spooling options. The printer's context menu will appear. 3. Choose Properties, and, then, select the details tab sheet. 4. On the details property sheet, choose Spool Settings. The spool settings dialog box will appear. 5. Look for the drop-down list box labeled, Spool Data Format. 6. Press the down arrow on the right side of the spool data format list box, and select RAW or EMF. Also, in Windows 95/98 deselect all port settings, and in Windows NT disable Metafile Spooling.

- [Changing default data type or spool settings](#)

☒ Yes
☐ No

NOTE: One or more of the links above may take you outside the Hewlett-Packard Web site. HP does not control and is not responsible for information outside of the HP Web site.

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Fertig Internet

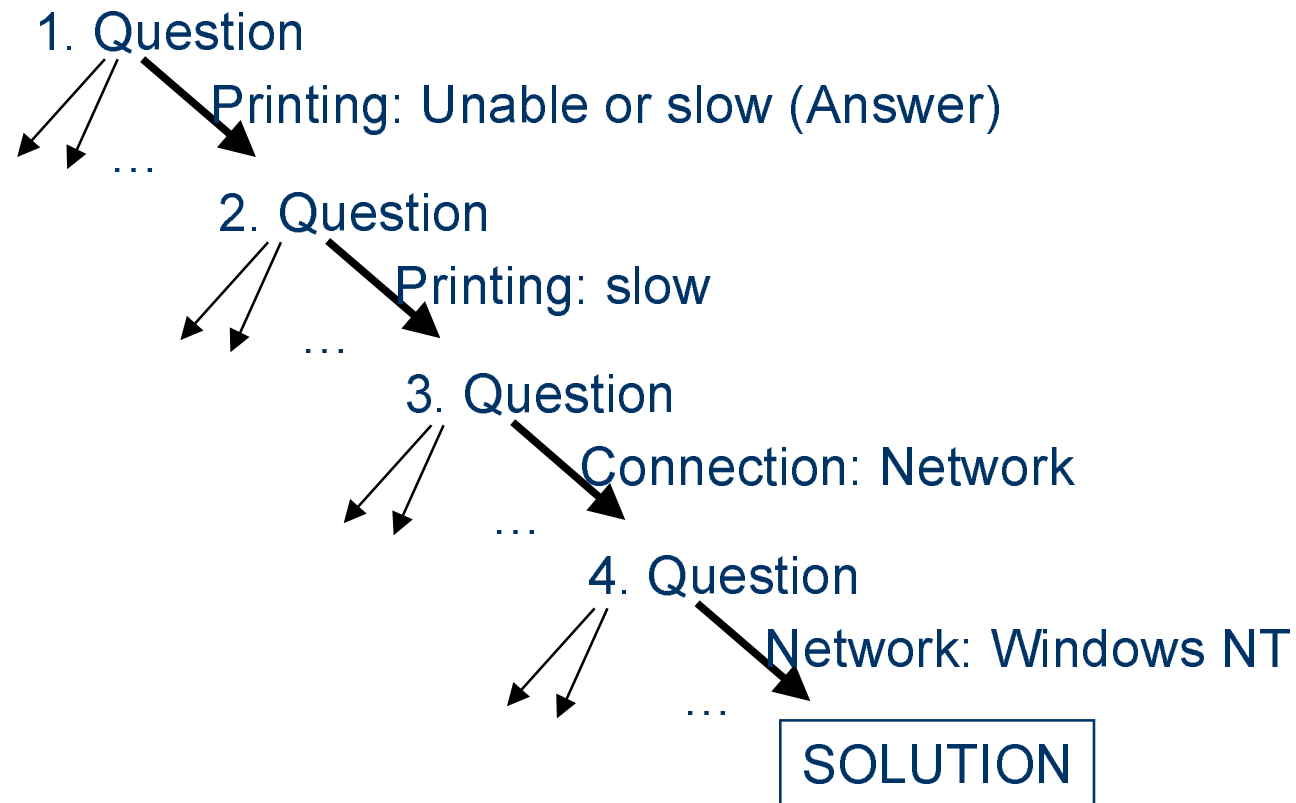
Possible solution

Could be the link to a relevant document

CBR Applications - Conversational CBR

Discussion (I)

- Used question-tree structure



CBR Applications - Conversational CBR

Discussion (II)

- retrieve phase (CBR cycles) does not use any similarity measure
- reuse phase has no possibility for adaptation of retrieved solution
- revise phase is not supported

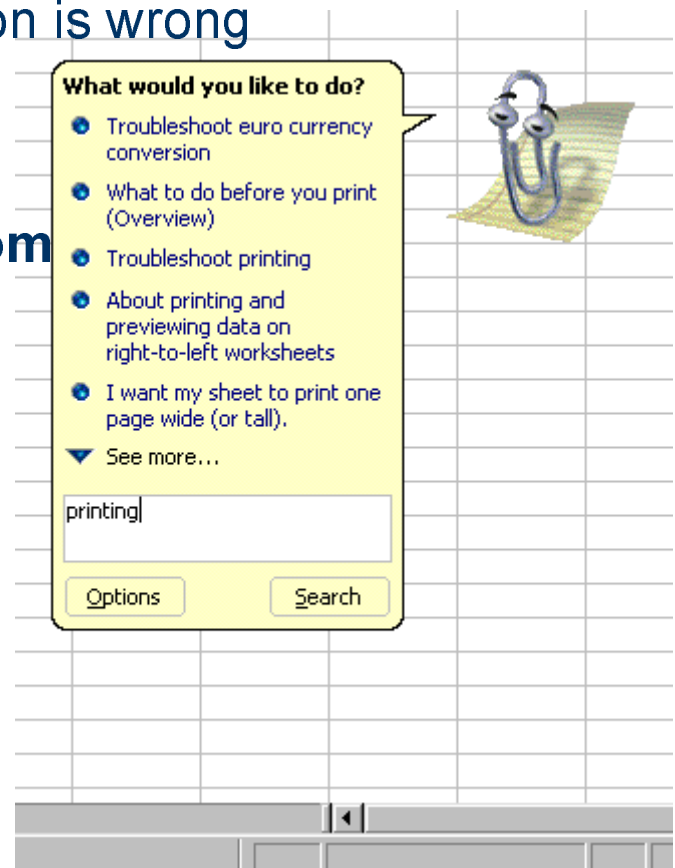
- user could not explain why the solution is wrong

- Similar system with user-feedback

Philips Product Catalog Search

<http://www.homeandbody.philips.com/indexie.asp>

- retain phase only in off-line mode
(new documents = new cases)
- Microsoft uses this style of CBR in Office Assistant
(Decision-Theoretic CBR)



CBR Applications

Textual approach

- Cases are represented as:

Documents + short document description

- Problem description is in the form of free text

Characteristics:

- Case-base is created very easily
- Suitable in the case of a lot of documents (FAQ, manuals)
- Retrieval is based on string-comparison
 - could be improved using Information Retrieval methods
- Quality is measured by:
 - recall: the number of retrieved cases
 - precision: the number of relevant cases (for given problem)

CBR Applications – textual approach

SIMATIC Knowledge Manager - customer support system for industrial automation systems

Service and Support for Siemens Automation and Drives - Microsoft Internet Explorer

Address: http://www4d.ad.siemens.de/skm/index.asp?lang=en&Access=inter

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Show Search Options A&D Search Interactive Catalog

Please type in your question:

AG95 (DP master) goes into STOP with QVZ

Search

Problem description

Recognized terms:

AG95 (DP DP master master) goes into STOP with QVZ

Used terms for searching - case features

powered by tec:inno

relevance

ReL	Date	ID	Title
100%	3/29/00	2021578	AG95-8ME (DP master) goes into STOP with QVZ [FAQ]
83%	10/18/00	264755	Incorporating AG95U DP Slave as Slave on the Master CPU315-2DP [FAQ]
67%	11/10/00	2792880	Operating system updates for S7-412-CPU's [Download]
67%	11/20/00	2850229	Operating system updates for S7-414-CPU's [Download]
67%	2/12/01	2855123	Operating system updates for S7-417-CPU's [Download]

Done Internet

Start Personal ad... Yahoo! Mail... loesung3.ppt The CBR H... kap4.cbr-w... Service a... 3:46 PM

CBR Applications – textual approach

Service and Support for Siemens Automation and Drives - Microsoft Internet Explorer

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67%	5/3/01	7360799	Operating system updates for S7-316-2 DP CPUs [Download]
67%	6/6/01	7360936	Operating system updates for S7-614 CPUs [Download]
67%	12/20/99	1694878	CPU remains in STOP after resumption of power supply [FAQ]

The following terms could enhance your search:

Which CP do you use?

☒ cp 516

Which operator panel do you use?

☐ op

Which S7-300 CPU do you use?

☐ s7-300 cpu 312

☐ s7-300 cpu 313

☐ cpu 314

☐ s7 cpu 314 ifm

☐ s7-300 cpu 315-1

☐ cpu315-2dp

☐ cpu 316

☐ 316-2 dp

☐ cpu 614

Add to Query

Start Internet

Personal ... Yahoo! M... loesung3... The CBR... kap4.cbr... Servic...

3:47 PM

Questions to add more feature-value pairs
=> Better precision

CBR Applications – textual approach

Service and Support for Siemens Automation and Drives - Microsoft Internet Explorer

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Please type in your question:


AG95 (DP master) goes into STOP with QVZ
cp 516

Search

Recognized terms:




AG95 (DP DP master master) goes into STOP with QVZ cp cp 516

Search in Catalog for: cp 516

powered by  tec:inno

Rel.	Date	ID	Title
80%	3/29/00	2021578	AG95-8ME (DP master) goes into STOP with QVZ [FAQ]
73%	11/10/00	2858911	Operating system updates for S7-416-CPU's [Download]
67%	11/10/00	2792880	Operating system updates for S7-412-CPU's [Download]
67%	11/20/00	2850229	Operating system updates for S7-414-CPU's [Download]
67%	5/3/01	7345582	Operating system updates for S7-313 CPU's [Download]
67%	5/3/01	7360491	Operating system updates for S7-315 CPU's [Download]

Internet

Start    Personal ... Yahoo! M... loesung3... The CBR... kap4.cbr... Servic...

3:48 PM

CBR Applications - textual approach

Discussion

- retrieve phase (CBR cycles) is realized in Information Retrieval algorithm
 - ⇒ similarity measure has to be incorporated in that “string-comparison”
- reuse phase has no possibility for adaptation of retrieved solution
- revise phase is not supported
 - no feedback from user
- retain phase only in off-line mode (new documents = new cases)

CBR Applications

Structural approach

- Cases are represented as:

Documents + ontology-based document description

- Problem description is in the form of ontology-based queries

Characteristics:

- Requires formally represented background knowledge about problem domain - domain ontology
- Case-base has to be developed and maintained by expert
- Suitable in the case that knowledge is represented in the form of business rules
- Retrieval is based on ontology-based search
 - similarity could be defined (e.g. in hierarchy)

4.4 Conclusion

- Case-Based Reasoning (CBR) technology is increasingly employed for some processes in the Knowledge Management
 - knowledge access:
 - contextual retrieval is supported
 - users should be able to articulate exactly what they want
 - knowledge sharing: it could be empowered by relevance-based retrieval, case reuse, and learning

- Knowledge Management opens itself as an application area for CBR of high current interest
 - certain problems-area from KM have already been successfully addressed by using CBR technology, such as
 - product experience bases,
 - help desk systems, and
 - user profiling and product recommendations for E-Commerce.

Research activities CBR&KM

- Workshop on Supporting Organisational Learning:
Knowledge Management and Case-based Reasoning
 - SOL'2000, Tokyo, Japan, October 2000

- Knowledge Management by Case-Based Reasoning: Experience
Management as Reuse of Knowledge (GWCBR 2001)
 - WM 2001, Baden-Baden, First German conference on
Knowledge Management - Experiences and Visions

- Workshop on Case-Based Reasoning Approaches for Process-
Oriented Knowledge Management
 - ICCBR-2001
International Conference on Case-Based Reasoning
Vancouver, British Columbia, Canada 30 July - 2 August 2001

Information sources on the Web

- ai-cbr
 - members mailing list, features, news, bibliography, software, etc...
 - www.ai-cbr.org (<http://ai-cbr.cs.auckland.ac.nz/>)

- the cbr web
 - news, projects, publications, etc...
 - www.cbr-web.org