Patterns to Adopt Knowledge Based Solutions to Software Management Problems

IST - 2000 - 25120

Presenter and STTF

STTF Oy

- Found in 1995
- Specialised in Project management and SPI
- Runs FiSMA network in Finland, 40 companies
- Experience Pro method, database and tool
- FiSMA SPICE method, database and tool

Risto Nevalainen

- >20 years in software project management
- 15 years in software quality and measurement
- ISO9001 lead assessor
- SPICE Competent Assessor
- riston@sttf.fi
- GSM +358-500-507750

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Topics of presentation

- Goals and main ideas of Patterns
- Main functional and technical components of Patterns
- Some examples to illustrate services of Patterns
- User community for Knowledge Management in software engineering?
- Discussion, comments!

Background of Patterns

- Many companies have Knowledge Management strategy in some areas of business

- Knowledge Management approach is now possible and realistic (tools and applications available)

- Quite much knowledge is in reference models, case libraries etc.

- Companies have knowledge in their documents and records

- ESI has collected Vasie case library of SPI projects

- Current experiences in SPI are difficult to use, because they are not explicit or not easily available

Patterns Objectives (1)

- Goal 1: PATTERNS solution usage will transform an organisation into a smart organisation
    - Real experiences used to solve old and new problems
    - Tacit (implicit) knowledge can become explicit
    - Explicit knowledge has much value for beginners in SPI
    - Learning cycle can shorten in adoption of knowledge
- Goal 2: Knowledge Modelling
    - SPI, PP and SE domains and their taxonomy that will be used for populating the database of cases.
    - Mechanism to retrieve a solution from the modelled knowledge based on similarities between the current problem and past solved experiences
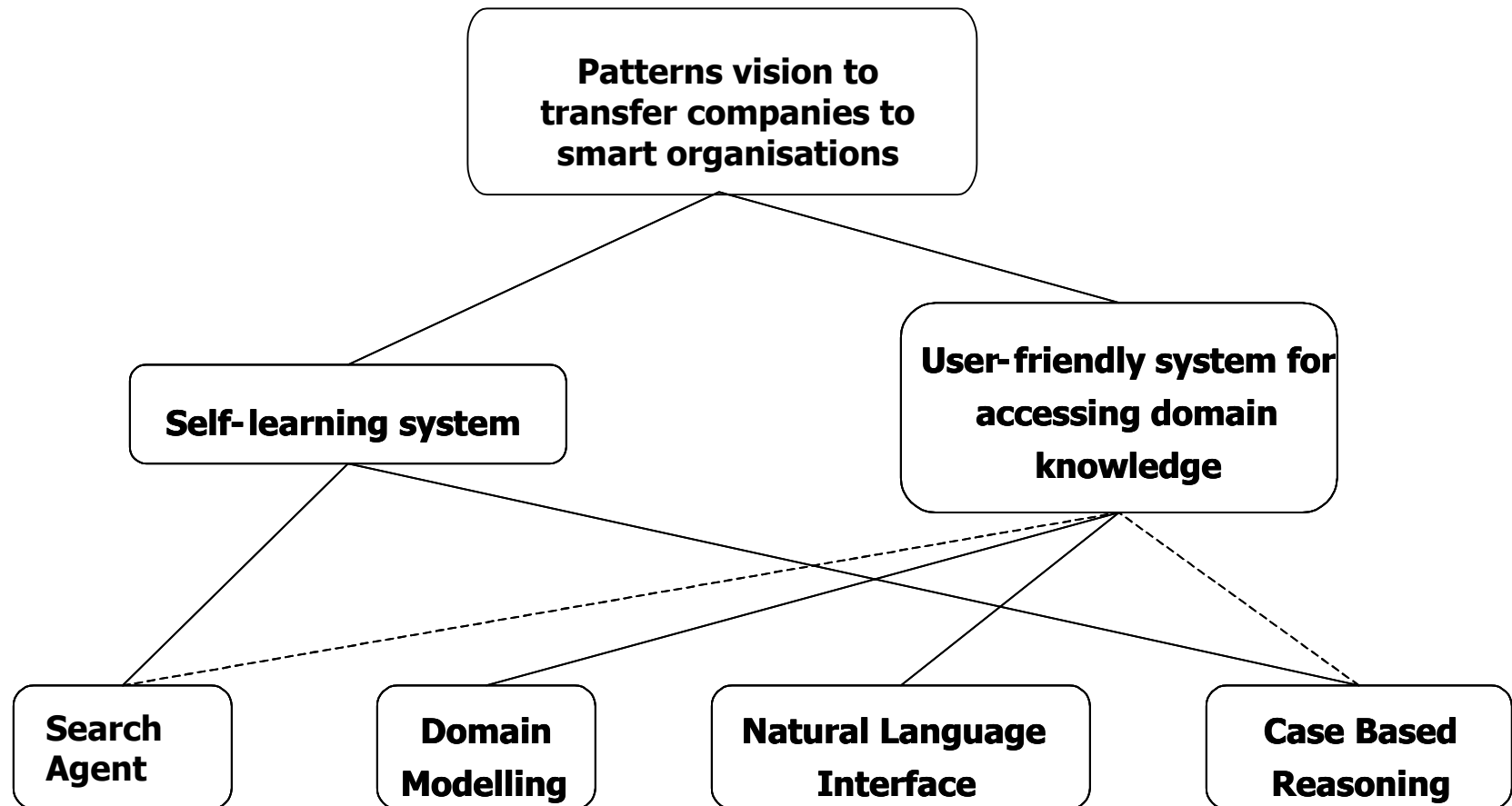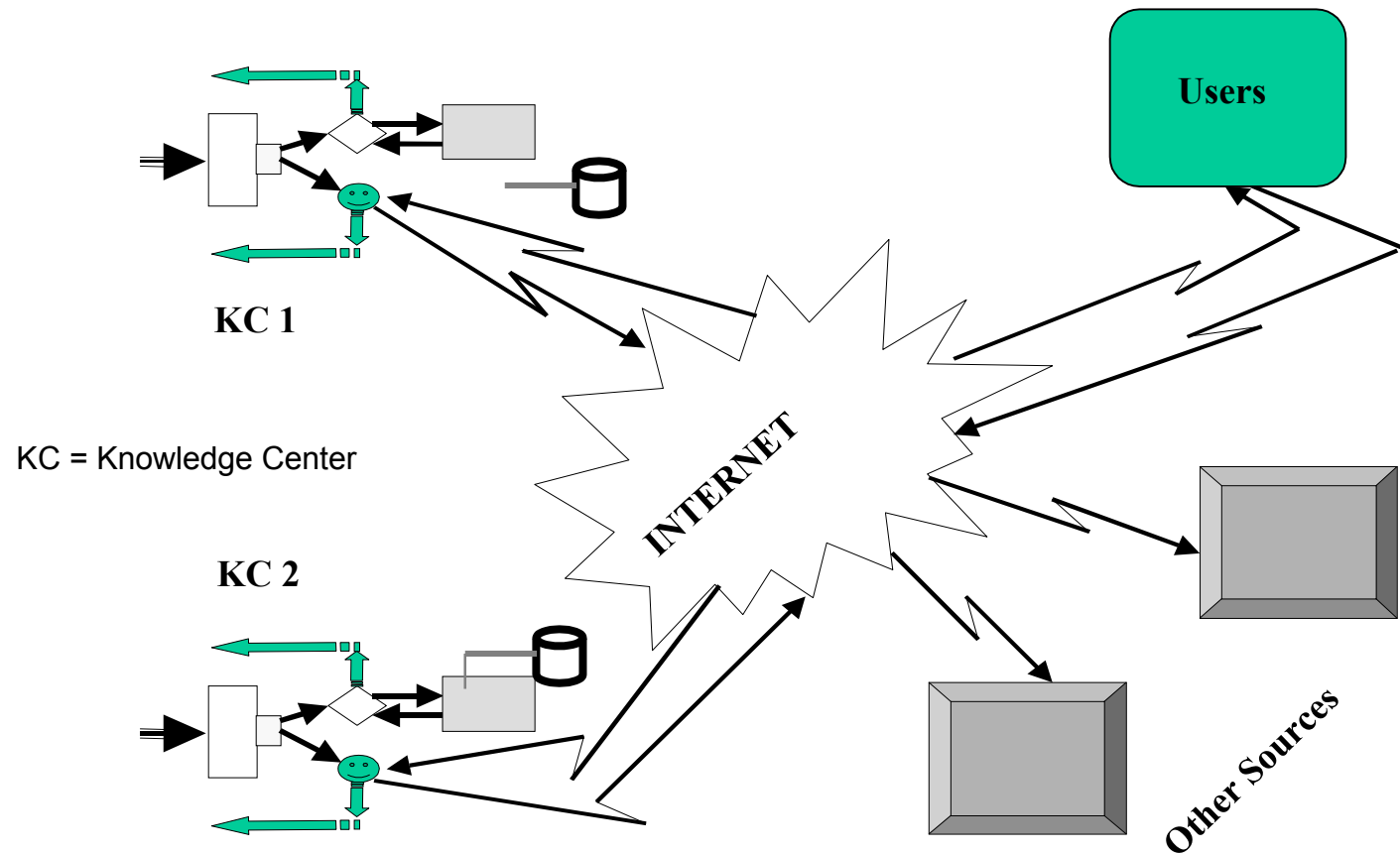
Patterns Objectives (2)

- Goal 3: Self-learning mechanism

  - Questions are recorded and good solutions are available for new situations

  - User feedback mechanism improves content

  - Knowledge Engineer concept improves and increases content

- Goal 4: User friendliness

  - Natural language interface (in English)

  - Open, free questions can be used

Main components of Patterns

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                    │  Patterns vision to │
                    │ transfer companies to│
                    │ smart organisations │
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Patterns vision to transfer companies to smart organisations

Self-learning system

User-friendly system for accessing domain knowledge

Search Agent

Domain Modelling

Natural Language Interface

Case Based Reasoning

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Patterns Global Architecture

KC 1

KC = Knowledge Center

KC 2

INTERNET

Users

Other Sources

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PATTERNS

Work Packages

PATTERNS

WP0	WP1	WP2	WP3	WP4	WP5	WP6
PROJECT MANAGEMENT	**BASELINE**	**DOMAIN MODELLING**	**TOOLS DEVELOPMENT**	**INTEGRATION & ACCEPTANCE**	**OPERATION & MAINTENANCE**	**MARKETING & EXPLOITATION**

WP0 — PROJECT MANAGEMENT

- **T0.1** Infrastructure Provision
- **T0.2** Administrative Issues management
- **T0.3** Tracking
- **T0.4** Communication

WP1 — BASELINE

- **T1.1** Goals Alignment & Agreement
- **T1.2** Assessment & Evaluation
- **T1.3** Exploitation Rules Definition & Agreement

WP2 — DOMAIN MODELLING

- **T2.1** Case Structure Definition
- **T2.2** Cases Derivation
- **T2.3** Pattern Mining Process & Pattern Structure Notation Definition
- **T2.4** Pattern Structure Notation Completion
- **T2.5** Patterns Generation

WP3 — TOOLS DEVELOPMENT

- **T3.1** NLP Front-end Development
- **T3.2** CBR Tool Development
- **T3.3** Intelligent Agent Development
- **T3.4** Tools Development Co-ordination

WP4 — INTEGRATION & ACCEPTANCE

- **T4.1** Local Solution Integration and Testing
- **T4.2** Local Solution Validation
- **T4.3** Networking Solution Integration and Testing
- **T4.4** Final Solution Validation

WP5 — OPERATION & MAINTENANCE

- **T1.1** Patterns Solution Operation
- **T1.2** Corrective Maintenance
- **T1.3** Potential Enhancements Definition

WP6 — MARKETING & EXPLOITATION

- **T6.1** Market Analysis
- **T6.2** Exploitation Plan Definition
- **T6.3** Dissemination
- **T6.4** Clustering

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What is Case in Patterns?

A CASE IS: Commonality and variability among the actions performed in different experiences

Piece of Knowledge (SOLUTION)

User Request (PROBLEM)

Filter (CONTEXT)
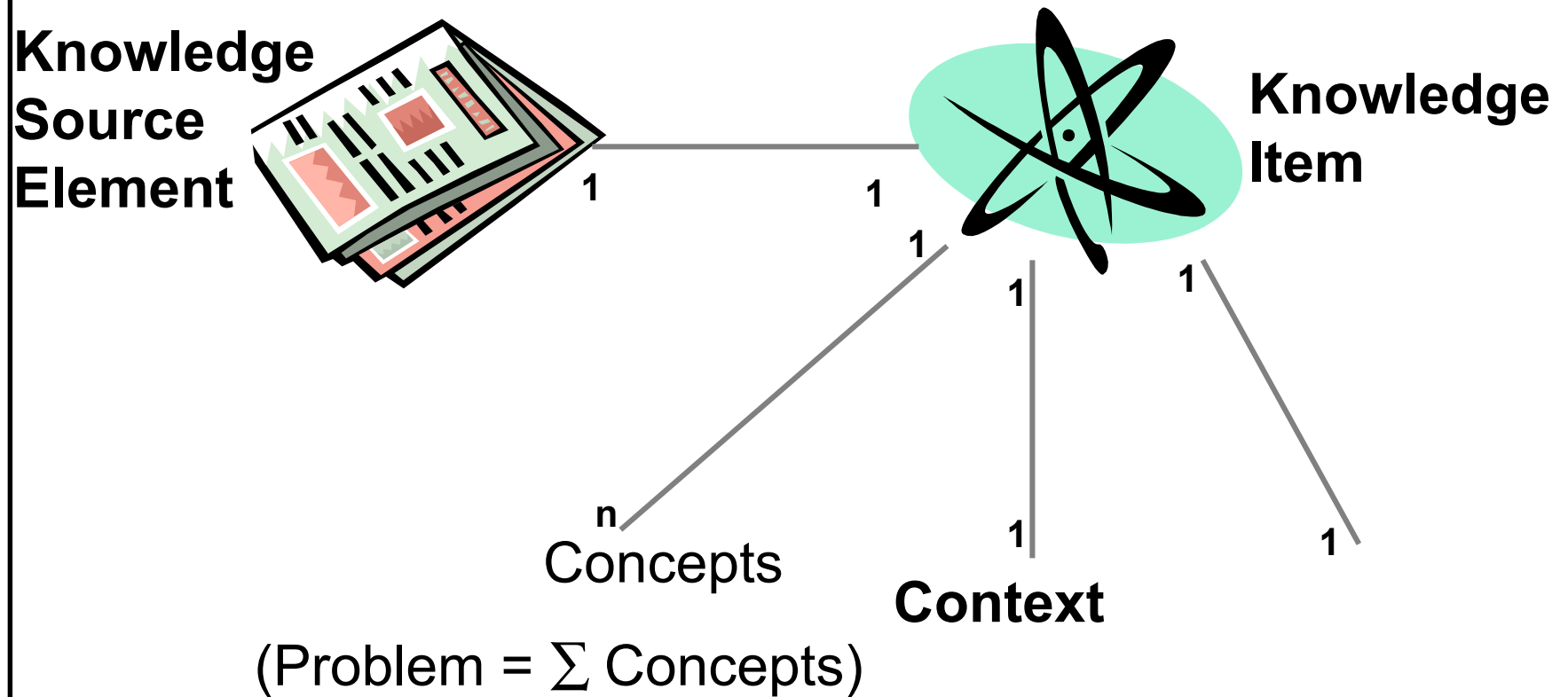
Some elements of domain modeling in Patterns

- Two domains will be modeled in Patterns: Software Process Improvement (SPI) and Project Management - System Engineering (SPM-SE)

- Each domain has some common elements:

  – Context definition

  – Taxonomy of content

  – Concepts related to domain and context

- In SPI domain also Roadmap and Improvement goals are defined for each case
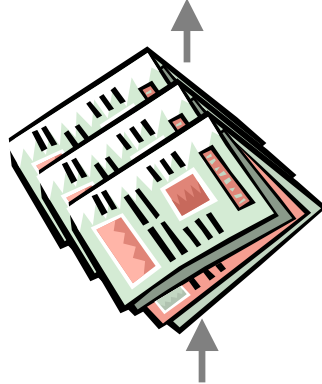
Domain modeling

Knowledge Item

Knowledge Source Element

Explicit knowledge

Knowledge Source
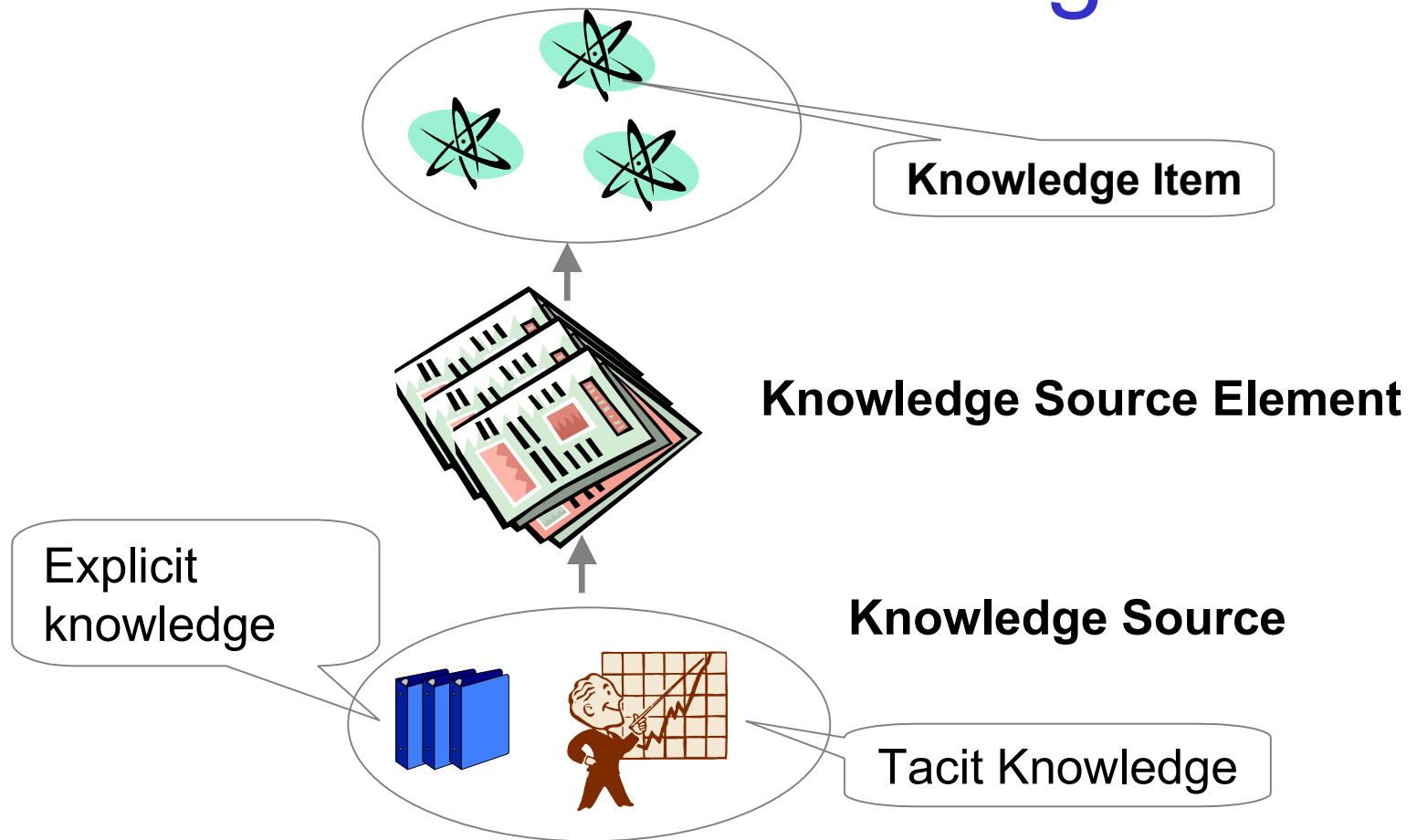
Tacit Knowledge

Knowledge Source and Item

Knowledge Source Element

1

1

1

Knowledge Item

1

1

1

n

Concepts

1

1

Context

1

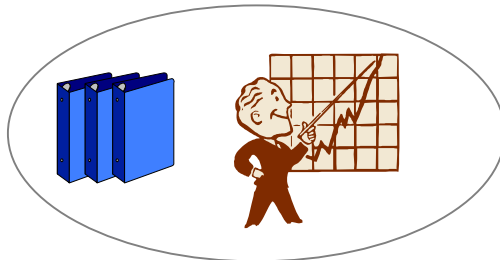(Problem = $\sum$ Concepts)

Knowledge domain, example
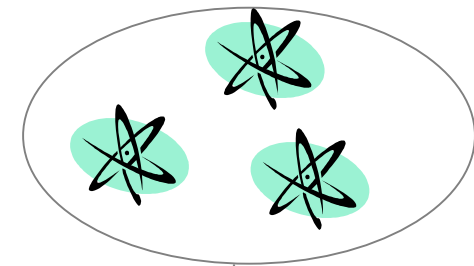
Knowledge Item:
Context+Problem+Solution (Roadmap +Tips and Tricks) for each VASIE Final Report

Knowledge Source Elements:
VASIE Final Reports Classified

Knowledge Sources:
ESSI Improvement Experiments Documentation
ESSI Final Scenario Questionnaire

A short example of Knowledge Item

- Context: Process automation for electricity power plants
- Knowledge source: SPICE assessment report + others
- Improvement goal: Traceability of requirements
- Roadmap:
  - Requirements elicitation, CUS.3
  - System requirements definition, ENG.1.1
- Knowledge item component:
  - Process: System requirements definition process
  - Concept Path: Requirements baseline, traceability
  - Partial solution 1: Give ID for each requirement
  - Partial solution 2: Use RM tool
  - ....

An example of taxonomy and concepts

A. Requirements
   elicitation   B1. Business requirement   C1. Customer
                                                           expectation
                                                       C2. User requirement

               B2. Analysis of customer needs
               B3. Customer needs monitoring C3. Change control
                                               C4. Communication
                                               C5. Customer query
                                                      mechanism

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PATTERNS

Natural language interface

- To allow users to interact with a Knowledge Centre using Natural Language (English); that means that the NLFE has to provide generic functions of user interfacing, and application specific functions that manage input processing and interaction with users.

- Automatic lexical acquisition process.

- To provide the users possibility to give feedback about their experience applying the solutions suggested by the system.

An example of user and NLFE dialog

User gives context and problem: What is the right level of details in process descriptions and what elements are enough in process model diagrams?

NLFE: Gives list of words which are unknown and could be replaced with better words

User: Replaces word "Process Description" to "Process Modeling" and accepts the search

NLFE: Gives a list of Improvement Goals and asks for acceptance

User: Accepts some improvement goals and modifies some

NLFE: Gives a list of found KI´s and their Knowledge Source

User: Reads some KI´s and gives rating about their relevance

NLFE: Records session and user profile

Case Based Reasoning

- Provides possibility to enter and store Knowledge Item = (*Context, Problem, Solution*) based on VASIE reports or INDRA project experiences

- Interacts with the NLFE by means of an interface to get a *Problem* as defined by the user

- Takes into account the user's profile when retrieving a solution

- Makes decisions about the specified *Problem* Interfaces in NLFE in order to give the user a relevant *Solution*

- Learns from experience, i.e. retains new KI resulting from feedback from knowledgeable users.

- Retains new KI resulting from SA's search in KS.

Search Agents

- ~ Very good search engine

- ~ Intelligent Agent in Internet

- *Primary Search*, i.e. access to all documents available in the Knowledge Centres. Documents are catalogued and indexed.

- *Secondary Search*, i.e. documents found in particular Internet sites, and which are most applicable or similar to the defined user's query. These documents are also indexed.

- Definition of input filters for HTML, MS Word, PDF and Plain Text formats. These filters will allow SA to scan the document text, to search for relevant terms and to calculate relevance indices.

Potential users of Patterns

- End users, "consumers of knowledge". For example quality managers in small software companies. Main criteria is relevant and useful content in KC´s.

- Service providers and consultants in defined domains. For example STTF in Finland in SPI area. Main criteria is extra value of KI´s for their services in defined domain.

- Patterns system adopters, for example large software companies. Main criteria is relevance, integrity and validity of Knowledge Management approach.

- Knowledge Content providers, for example domain modelers in safety critical systems area. Main criteria are knowledge domain modeling, presentation and search capabilities (technical components of Patterns).

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What happens next?

- Knowledge Domain modeling and creation of Knowledge Items (ESI, INDRA)
- Technical development of main components (NLFE, CBR, SA)
- Pilot use and first trials (TEKKVA, STTF)
- Further enhancement of technical solution
- Improvement of content via knowledge engineering and user experiences
- ?

Summary

- Knowledge management is relevant topic for software community and has much potential

- Main elements of KM (in SPI and SE) are well understood and modeled in Patterns

- Patterns provides services for limited community during development phase, commercial potential to be seen

- Patterns develops some knowledge domains, hopefully more domains would be available in future