Evolving Personal to Organizational Knowledge Spaces
-
Project's Vision

German Research Center for Artificial Intelligence
Knowledge Management Department

http://www.dfki.de/epos

version: June 2003

© 2002 DFKI GmbH KM/EPOS P. 1

EPOS - Introduction

- The goal of EPOS is to leverage the user's personal workspace with its manyfold native information structures to his personal knowledge space and in cooperation with other personal workspaces contribute to the organizational knowledge space represented in the organizational memory.
- The project is funded by the German federal ministry of education, science, research and technology (bmb+f) under contract 01 IW C01
- Duration: January 2003 - December 2005
- The DFKI Department for Intelligent Visualization and Simulation Systems is partner for the visualization research topic
- contact: **Heiko.Maus@dfki.de**
- **http://www.dfki.de/epos**

© 2002 DFKI GmbH KM/EPOS P. 2

Knowledge-Intensive work asks for flexible, collaborative information support

- To illustrate this we sketch a situation from re-insurance business:
  - characterized by highly individual, knowledge-intensive solutions
  - well known from previous co-operation in a joint EU project on earthquake risk assessment
- Developing a product/contract requires precise risk assessment
- Numerous specialized experts develop and update know-how on specific aspects; each working on his own, e.g.:
  - geology and seismic know-how
  - information on building codes and habitation structures
  - influence of disturbances on financial networks
- Contract preparation includes querying all the experts for specific contributions

Support is needed in locating relevant information across personal repositories without disturbing the individual work

© 2002 DFKI GmbH KM/EPOS P. 3

Knowledge Management has to cope with contradictions between personal and organizational goals

- Organizations introduce central organizational memories (OMs) to improve access to and use of critical knowledge
- Individuals do not and do not want to realize any benefit
- The introduction in almost all cases requires new duties
  - document activities
  - describe skills
  - categorize and structure information
  - answer additional questions
  - learn and accepts pre-given access modalities
  - formulate requests

However, knowledge workers often do not accept knowledge management technology in order to keep their subjective productivity

© 2002 DFKI GmbH KM/EPOS P. 4

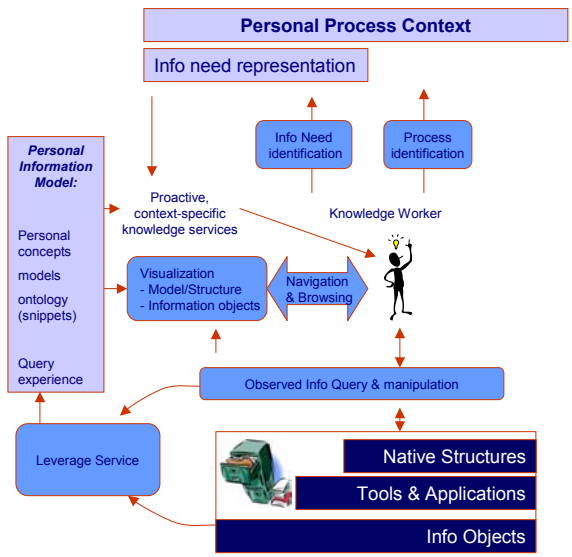
The personal workspace reflects the user's activities, concepts, views and way of thinking

- observable elements
  - files, names, content
  - file / folder structures
  - classification mechanisms (bookmarks, mail folders)
  - inter-dependencies
- observable actions
  - generation, access / use, modification
- observable context
  - task context
  - weakly-structured workflows
  - activity modeling, time tracker

Exploitation of these elements & structures results in the personal knowledge workspace (where knowledge / relations are made implicit)

© 2002 DFKI GmbH KM/EPOS P. 5

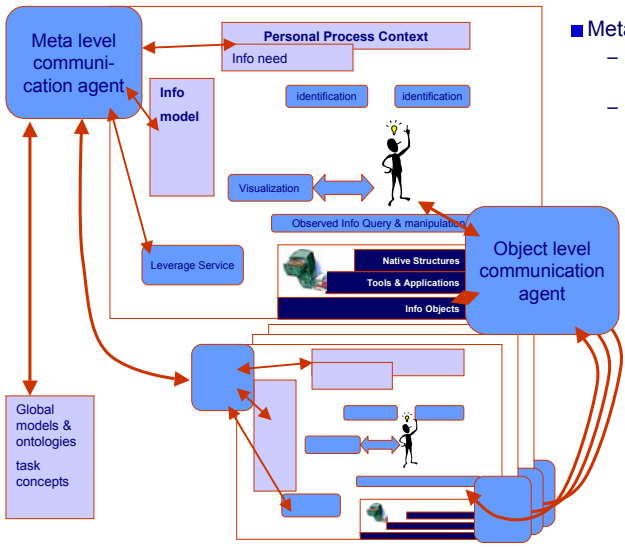
The Personal Knowledge Workspace transforms individual work traces into explicit knowledge support



- The Knowledge Worker handles Information Objects
  - search, access, modification, creation
  - using tools & applications
  - creating & modifying native structures
- Formal representations of personal information models and context enable proactive knowledge services
- Personal information models are leveraged from native structures and observed user interaction
- The Personal Process Context and associated information needs can be identified by user observation
  - explicit representation of context and information need
- Visualization lets the user keep track
  - of models & structures
  - of retrieved info objects
  - enabling navigation & browsing

© 2002 DFKI GmbH KM/EPOS P. 6

Communication between workspaces facilitates the generation of global ontologies and organization-wide knowledge exchange



- Meta level communication
  - facilitates exchange & negotiation of personal information models
  - allows use of and contribution to global models and ontologies
- Object level communication
  - facilitates information access and exchange across workspaces
  - is based on P2P information retrieval

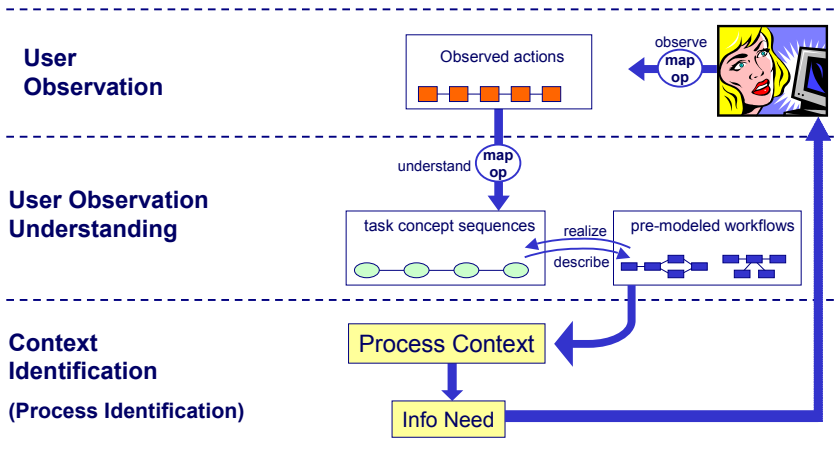
EPOS emphasizes four central research topics

- Observing the user's workspace for rich context elicitation
  - Identify work processes and infer generalized information needs based on manipulation and query action sequences
- Precise satisfaction of information needs in interacting knowledge workspaces
  - Transgress from individual, local information support to collaborative organizational knowledge exchange
- Leveraging individual and shared ontologies from native structures
  - Create formal representations of local and global models as well as ontologies based on individual structuring
- Visualizing individually structured knowledge
  - Provide the user with an appropriate interface to keep track in a dynamic and collaborative information world

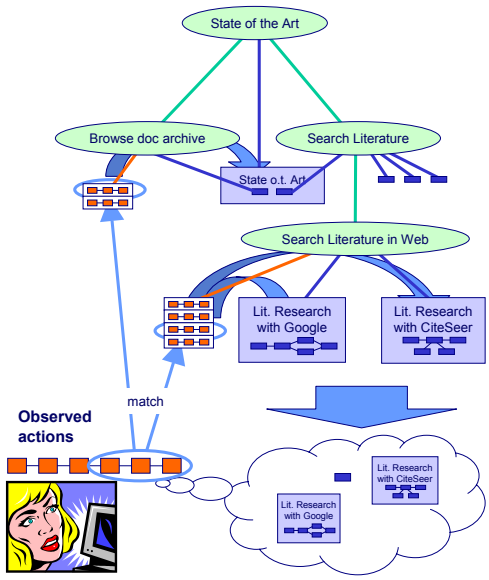
Research question I: Rich Context Elicitation from the user's workspace

- The user's current context is basis for our pro-active knowledge services.
  - Precise identification of the current process allows for relevant support
- Observed user actions are interpreted as evidences for process hypotheses
  - A sequence of observations incrementally narrows possible interpretations
- Association of observations to identified contexts enriches the available process models
  - Current process models are augmented by specific information needs

User observation, interpretation, and support realize a continuous dialog cycle

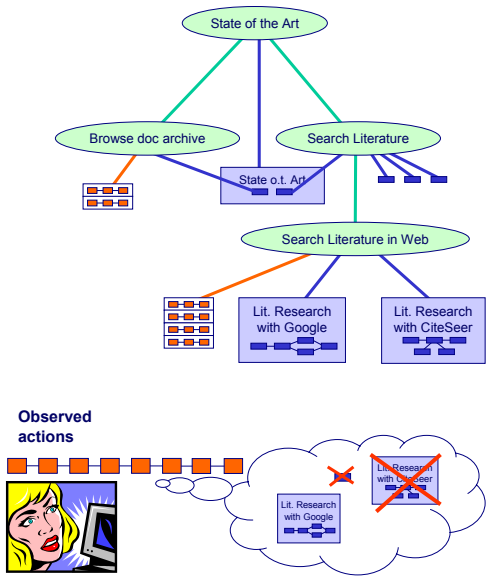


Representations of process structures and the information space facilitate the interpretation of observed actions



- User actions are observed in the personal workspace
  - An information space model represents actions which are suitable for observation & reasoning
- Task concepts structure possible workflows and associated action sequences
  - This forms a basis for mapping action sequence → possible task concepts → possible Wf tasks

Representations of process structures and the information space facilitate the interpretation of observed actions



- User actions are observed in the personal workspace
  - An information space model represents actions which are suitable for observation & reasoning
- Task concepts structure possible workflows and associated action sequences
  - This forms a basis for mapping action sequence → possible task concepts → possible Wf tasks
- Further observed actions are (continuously) giving evidence for possible workflow tasks.
  - The search space of possible interpretations is continuously narrowed
- The estimated Workflow task is presented as a possible interpretation.
  - This elicited context can be used for storage, retrieval, annotation and as info-need provider.

Research question II: Precise satisfaction of information needs in interacting knowledge workspaces

- Improve user satisfaction by collaborative information retrieval
  - exploit query experience resulting from previous queries together with user feedback on the query results
  - associate query experience with the appropriate context and model elements
  - re-use query experience to improve new user queries in a way that the results will better fit to the current context and the assumed user intentions
- Tap personal knowledge workspaces as an organizational memory resource
  - communicate information needs across workspaces
  - integrate answers from different workspaces to satisfy the query

Reuse query experience in order to improve search in collaborative workspaces

- Relevance feedback allows to save positive examples of query results as reusable experience
  - Learn about successful query-result-concepts based on term occurrence
- Retrieved information objects are associated with the personal information models and the retrieval context. This association is transferred to the corresponding query experiences
- Current information needs are better satisfied by using stored query experiences for query reformulation
- The exchange of stored query experiences between individual workspaces helps to identify and build thematic communities
  - other users in similar situations profit from previous experience
  - particular queries are routed to appropriate partner workspaces to retrieve information across workspace boundaries

Research question III: Leveraging individual and shared ontologies from native structures

- The personal workspace reflects individual ad-hoc models of the world
  - file & folder names, file system structures, mail folders ...
  - document content & types
- Native structures can be leveraged into more formalized representations
  - making hidden semantics explicit and accessible to automatic processing
- Exchange and mapping of personal models reach shared understanding
- Negotiation about concepts and their interpretation is needed to agree on global ontologies

Acquisition of personal models and mapping between models require integration of evidence

- Native structures give multiple evidences for model generation
  - e.g. folder names are hints for the *existence* of concepts
  - e.g. attribute values with known semantics (like `from:` in a mail) give hints for the *definition* of a concept (like: is-a person)
- Mapping between models exploits multiple sources of evidence
  - term-based evidence exploits concept names
  - topology-based evidence is based on model structure
  - instance-based evidence results from content associated with the model
- EPOS will apply a sound theory for the integration of evidence about relations between models
- Aggregated evidence allows to express partial orders between relations
  - This enables the argumentation / negotiation about models based on different levels of agreement

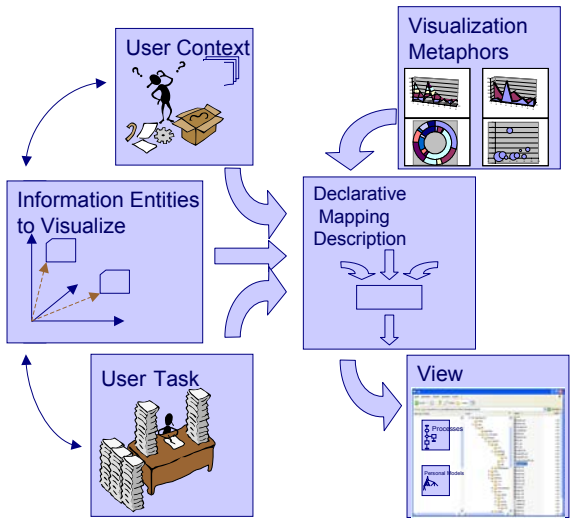
Communication across personal workspaces for exchanging individual models and integrating them into global structures

- Basic communication patterns between Personal Information Models (PIMs) and global OM Models comprise
  - Collaboration for solving actual information problems
    PIMs and OM Models typically remain unchanged
  - Negotiation for evolving shared conceptualizations
    "give & take" may lead to reworked models influenced by possibly conflicting goals
- Collaboration requires
  - speech acts for expressing needs, explanations/explications
  - which integrate techniques for finding mappings between parts of models
- Negotiation requires
  - speech acts for argumentation
  - based on the representations which allow for various levels of agreement
  - feasible goals (optimization criteria)

Research question IV: Visualizing individually structured knowledge

- The integration of personal knowledge workspaces into a collaborative network results in complex information spaces
  - distinction between personal and global structures
  - different quality, reliability, trustworthiness of information sources ...
- Adequate visualization techniques will enable the individual user to keep orientation in the information space
- Visualization research aims at a flexible and individually configurable solution
  - Development of ontologies of visualization objects and declarative mappings
  - Visualization tools for individual knowledge comparison

A flexible visualization approach employs declarative descriptions to select appropriate metaphors



- Information objects and visualization-relevant context characteristics are formally described
- Various Visualization Metaphors support specific objectives
- Declarative Mapping Descriptions define which visualization metaphor shall be used
- For each class of information entities an appropriate view is created

Knowledge elements and structures from different sources are made comparable by specific presentations

- Using additional dimensions in the information visualization
  - reflecting the various sources and their characteristics
- Identifying similarities and differences in structures
  - e.g. highlighting of deviations in ontology trees of different workspaces
- Consistent presentation of multiple and contradictory views
- Presentation and browsing of historical sequences of knowledge and information structures
  - e.g. illustrating concept shifts of changes in focus of interest over time

To conclude, EPOS shall develop an adaptive information assistant offering „knowledge on the fly“

- Generate innovative knowledge arising from observing users when interacting with information through processes
- Build shared static and shared dynamic structures from individual work spaces in collaborative task situations
- Communication between workspaces shall facilitate the generation of global ontologies and organization-wide knowledge exchange
- Combine various visualization metaphors in order to support interaction with and through structures
- While the focus of FRODO has been on knowledge reuse, EPOS will concentrate on knowledge evolution

© 2002 DFKI GmbH KM/EPOS P. 21

EPOS contributes to challenging AI topics

- Context identification from observed user activities
  - matching of known patterns in the observation stream
  - learning of new patterns from user feedback
- Exploitation of query experience across personal workspaces
  - association of statistical results and concepts
  - learned query improvements can be found and used via ontological classification
- Ontology creation and mapping based on aggregation of evidence
  - native structures are modeled and assessed wrt. their evidence contribution
  - sound combination of different evidence sources
- Goal-oriented visualization
  - visualization metaphors are seen as problem solving methods
  - goal/context ontologies allow the classification of actual problems
  - declarative mapping leads to the intended solution

© 2002 DFKI GmbH KM/EPOS P. 22