Weakly-structured Workflows for Knowledge-intensive Tasks: An Experimental Evaluation

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Agenda

- Concept: Weakly-structured workflows for BPOKM
- Design of experimental evaluation
- Experimental results
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• Experimental results
Knowledge workers are involved in complex processes.

Process models and their enactment provide context information and facilitate proactivity.

Ontologies are the explicit basis for the knowledge-level description.

Access to various information sources relies on formal knowledge-item descriptions.

Knowledge management addresses context-specific, proactive delivery of information.

Background/History: KnowMore (Abecker et al., 1998)
Framework for Organizational Memory Information Systems
FRODO creates a conceptual and technical framework to build a distributed OM for knowledge-intensive work

• From **central** to **distributed** Organizational Memories
  – A monolithic, central OM is *seldom feasible*
  – Central OMs neglect the reality (and opportunities) of the *distributed nature of knowledge* in companies

  ➔ The FRODO framework facilitates *societies of cooperating agents* as a basis for distributed organizational memories, especially
    • distributed ontology management and
    • cooperative specialists for information retrieval

• From **strict** process models to **weakly-structured** workflows
  – Traditional models for business processes are ill-suited for knowledge-intensive work
  – Users are ignored as source for process knowledge

  ➔ FRODO supports complex, dynamically configured processes
Knowledge-intensive work processes are modelled by weakly-structured workflows

- A weakly-structured workflow consists of knowledge-intensive tasks
  - which are not necessarily defined a-priori
  - but abstract structures are usually known

- Weakly-structured workflows evolve over lifetime
  - they can - but need not to - follow the structure of underlying models
  - exact structural repetitions are seldom, but there is a multitude of 'similar' tasks
  - workflow instances can be modeled and refined during runtime
    i.e., lazy modeling, late modeling
  - hierarchical refinement of tasks leads to structured workflow instances

- Workflow instances represent valuable process knowledge
  - tasks are worth to be supported and preserved (e.g., for best/worst practices)
  - typical instances are generalised to 'templates', i.e., task models

FRODO TaskMan exhibits the core functionalities needed to support knowledge-intensive work
Life- and use cycle of process models can be described as variant of a standard case-based reasoning cycle.

### Process Models & Process Instances
(i.e., task structure & relevant information items)

**Application Phase**
- **Retrieve**
- **Instantiate**
- **Reuse**
- **Revise**

**Maintenance Phase**
- **Restore**
- **Review**
- **Retain**

*New (Root) Business Task*

*task at hand*  
*other instances*  
*subtask refinement*
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Of course, there are a lot of questions to such an approach

- Are weakly-structured workflows a useful basis for support of knowledge-intensive activities?
- Is integration of process execution and information support accepted and considered of benefit?
- Is process-embedded information a means of knowledge sharing and transfer?
We chose visit planning as the knowledge-intensive activity to be supported

- **Scenario 1:** Prepare a visit for a prospective *student* to get familiar with the future work/living environment
- **Scenario 2:** Prepare a visit for a guest *professor* at the university, including tourism aspects

- Characteristics of the scenarios:
  - They include room for flexible interpretation
  - Ultimately, a time schedule needs to be produced
  - They can be understood and processed in reasonably short time
  - There is plenty of relevant information in the web
  - Both scenarios are “structurally equivalent”
Both scenarios lead to structurally similar initial workflows

**Student scenario**

**Requirements analysis**

**Professor scenario**

**Search relevant activities**
*(information about location & environment)*

**Commit & plan**
In the evaluation, subjects used a restricted version of the FRODO TaskMan

- Expressive power of the workflow language:
  - hierarchical decomposition
  - sequential dependency
- Dynamic refinement of workflows at execution time
  - integration of modeling & enactment
- Enriching workflow tasks with information needs
  - dynamic & static
- Support of task execution by linked information items
  - context-specific information support
The user can add and use relevant information items in the workflow context

- choosing **concepts from domain ontologies**
  - study and tourism ontologies
  - used as task annotation and for searching the web
  - also adding keywords
  - search the web with given concepts/keywords

- adding **relevant web pages**
  - explicitly and by surfing the web

- adding **memos**
  - resemble notes, remarks, results for a specific task

- investigate task information
  - provided in a browser
  - also inherited (i.e. from the task hierarchy) information is shown
Task in progress

Sub-Task (finished)

current task

Task Info Browser:
Information Items attached to the current task

Work control: model, start & finish
The Experimental Design Comprised Four Factors

- **Domain**: Preparing a schedule for a professor in Saarbrücken vs. for a student in Munich
- **Flexibility mode** of the workflow: Strict vs. weakly-structured
- **Complexity** of given workflows: “small” vs. “big” model
- **Re-use of information**: With/Without Given Information Items

A full (2x2x2x2)-factorial design was not feasible. This led to a restricted design with two experimental groups and the following features:

- Both groups process both **domains** and both **flexibility modes**.
- Complexity and re-use of information is tested only in one domain and with flexible workflows (between groups).
The experiment comprises the model-work-refine phases of the workflow lifecycle

**Phase 1: Practice**
- **Task:** Model
- **Domain:** Professor
- Flexibility Mode: -
- Model Complexity: -
- Given Info Need: -

**Task:** Model
- **Domain:** Student
- Flexibility Mode: -
- Model Complexity: -
- Given Info Need: -

**Phase 2: Work I**
- **Task:** Work
- **Domain:** Professor
- Flexibility Mode: Flexible
- Model Complexity: Low
- Given Info Need: -

**Task:** Work
- **Domain:** Student
- Flexibility Mode: Strict
- Model Complexity: Low
- Given Info Need: YES

**Phase 3: Work II**
- **Task:** Work
- **Domain:** Professor
- Flexibility Mode: Flexible
- Model Complexity: High
- Given Info Need: YES

**Task:** Work
- **Domain:** Student
- Flexibility Mode: Strict
- Model Complexity: Low
- Given Info Need: -
Four hypotheses are investigated in the experiment

- Knowledge workers feel better supported with late/lazy modeling facilities
- Lazy/late modeling in weakly-structured workflows leads to a more precise classification of information items than strict workflows
- Proactive information support is (demonstrably) useful
- Weakly-structured workflows are better suited than strict ones to deal with unexpected task situations
The evaluation trials gathered direct and indirect measurements

- **direct measurements**: The test persons were asked for subjective assessments via questionnaires
- **indirect measurements**: data collected during the experiment were evaluated
  - modified workflow models
  - attached information items
  - web logs, representing search activities

We performed 5 trial runs with 25 students in total. The first run was considered a pre-study.
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Evaluation of the questionnaires proves: Knowledge workers feel better supported with late/lazy modeling facilities

- All groups appreciate the flexibility of weakly-structured workflows
- Appreciation is significantly higher in the groups who started with the weak workflows
  - people appreciate the benefits after they lose them

The inverse question gave an identical result.
Analysis of the modified workflow models shows: Dynamic modeling is used intensively.
Analysis of enriched workflow models demonstrates: Lazy/late modeling in weakly-structured workflows leads to a more precise classification of information items than strict workflows.

- Weak workflows result in less information items per task.
- This is interpreted as a more precise classification.
Proactive information support is (demonstrably) useful

Evaluation of web access logs shows:

- About 30% of all information access result from pre-given information
- User profit from pre-given information elements
- Nevertheless, additional information sources are visited
Weakly-structured workflows are better suited than strict ones to deal with unexpected task situations

- After 1 hour’s work, an additional task was introduced in each condition:
  - Weakly-structured workflow: “The professor indicates that his wife intends to do sightseeing & wellness. Check possibilities and make relevant suggestions”
  - Strict workflow: “The student intends to earn money by giving music instructions. Check possibilities and contacts”

- The analysis of the work results shows the advantage of weakly-structured workflows:
  - Weakly-structured workflow: The task is integrated into the process
  - Strict workflow: The task is
    - partially ignored
    - wrongly classified
Unexpected task in a weakly-structured workflow: Sound integration of the additional task and information related to it.
Unexpected task in a strict workflow: Relevant information is (inadequately) linked to ‘town’
Summary & Conclusion

- **Concept of weakly-structured workflows for information support for knowledge-intensive work**
  - Late/lazy modeling deal with the need for flexibility of knowledge workers
  - Attached information needs provide the context for precise information delivery (what & when)

- **Experimental evaluation**
  - sound experimental design was difficult
  - sound example was hard to construct
  - design, performance and evaluation were time-consuming
  - first experiment runs discovered previously unknown deficiencies in various tool implementations
  - But:
    - approach was supported by data (wrt. original hypotheses)
    - interesting additional insights and aspects
    - software was consolidated

- **Hope: More “comparable” work in KM community**

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IR like evaluations (high inner, low external validity)  this work  Real-life case studies (high inner, low external validity)
Thank you for your attention!

http://www.dfki.uni-kl.de/frodo