

# Model of Experience for Public Organisations with Staff Mobility

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**Abstract.** Public organisations with a high rate of staff rotation lose their valuable asset – experience of employees. Mobile employees, who have to face duties at new positions, would find computer assistance helpful in efficient beginning. The idea to support current work of employees on the basis of earlier gathered experience in past activities is driving the Pellucid project (IST-2001-34519). To serve experience-base assistance to the employees it is necessary to have experience modelled first. The comprehensive model containing user profiles, which defines experience in the scope of the organisation, is described in the paper. The representation of the business process items and employees expertise level in the domain of organisations activity is created on the basis of the organisation model. To represent experience an active hint approach is provided. Active hints are presented to employees spontaneously and on demand according to the their level of competence. Furthermore, the methods of experience gathering are discussed in detail on the basis of the platform development in the Pellucid project pilot sites.

## 1 Introduction

Nowadays, one of the most valuable assets of the organisations is experience of their employees. Organisations with high level of staff mobility suffer a significant

loss if experience is regarded only as an ability, which belongs to the employees. If the experience was accumulated by the organisation, e.g. in the computer system, it could be frequently reused.

The Pellucid project [1] is deriving from the idea of capturing and reusing of experience. Assistance to the novice employees at the initial stage of their work based on past gathered experience may be done by a dedicated software platform [2–4]. The Pellucid functionality is not limited to accumulation of experience only. The desired situation for the employees is to get an adequate and accurate piece of experience just in time. Such adaptation of experience to the individual needs is especially important in the case of mobile employees. The novices find helpful a selection of experience items allowing them simply to move forward. The Pellucid platform is designed to serve employee assistance in form of experience items spontaneously or on demand.

In the paper a model of uniform experience management for public organisation is described. The model is generic in its assumptions. All medium and large-size organisations with semi-structured business administration process and knowledge-intensive activities performed by the employees are addressed. At the initial stage three installations will be provided at the project pilot sites.

In Sect. 2 the state of the art is described. Models created in the stage of system analysis and design are presented in Sects. 3-5, together with brief presentation of the methodology. A description of the domain modeling for the pilot organisations is given in Sect. 6. The models are used for organisation ontology specification, which is discussed in Sect. 7. Finally, the proposed approach to the experience acquisition is introduced in Sect. 8. Conclusions in Sect. 9 are finishing the paper.

## 2 State of the Art

Knowledge management for public sector organisations has become a very important issue during the last decade. Several projects supporting public sector have been developed so far or are still in development. Scientific community tries to support employees by providing a service called Organisational Memory [5, 6]. Such a memory is treated as the collector of all kinds of organisational knowledge and is specially designed for the reuse in the future. The DECOR [7], FRODO[8], KnowMore[9] projects deal with such a knowledge repository.

The information and knowledge stored within the organisational memory is often described using the ontology [5], i.e., a kind of explicit specification of conceptualization [10]. The ontology has been found very useful especially in the knowledge management systems [2, 7–9, 11].

The Knowledge Management Community has noticed problems rising within the public sector organisations, that are derived from the nature of their business process. They can be characterized and described but they cannot be formalized fully. These types of processes are often called semi-structured [12]. Extensions to the traditional business process are necessary. Some approaches exist that integrate the workflow management system with delivering of knowledge [2, 13,

14]. In such a solution the workflow management system gives the context, and on the basis of that context the knowledge and/or information is delivered to the user. The collaborative nature of knowledge intensive tasks [15] and the distribution of several knowledge sources imply necessity to use the intelligent software agents in this area [8, 16–18]. Modern agent based systems are realized implementing object oriented programming languages, like Java, C++ or Smalltalk and use distributed objects environments, e.g., CORBA [19], DCOM [20], Voyager [21].

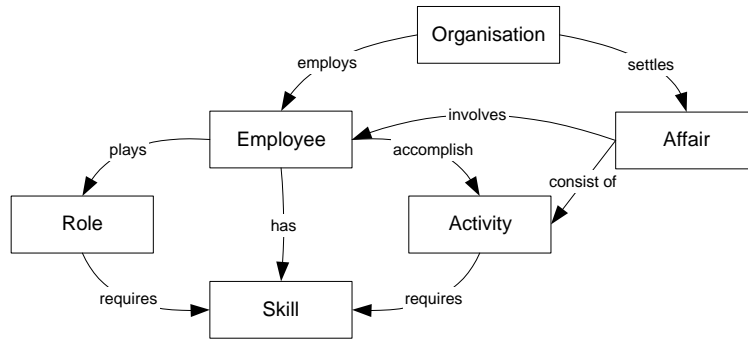
### 3 Organisation Model

The Pellucid system modeling has been highly influenced by the CommonKADS methodology for developing knowledge-based systems [22]. In CommonKADS, the development of a system entails constructing a set of engineering models of problem solving behaviour in its concrete organisation and application contexts. This modeling concerns not only the expert knowledge, but also various characteristics of how that knowledge is embedded and used in the organisational environment. We have followed a similar approach in the Pellucid project, borrowing some of the CommonKADS components.

The CommonKADS organisation model describes the organisation in a structured, systems-like way, by representing aspects such as organisation structure, processes, staff, and resources. All these aspects were taken into account in our organisation model. The main CommonKADS model is the knowledge model, which specifies the knowledge and reasoning requirements of the prospective system. It consists of the domain-specific knowledge and information types that we want to talk about in an application, and the task/inference knowledge, which describes what goal(s) an application pursues and how these goals can be realized through a decomposition into subtasks and ultimately inferences. We have followed a similar approach in the experience model, where the working context deals with domain-specific characteristics of an organisation and active hints formalize the inferences needed in helping employees to realize the organisation goals.

Modeling of an organisation took into account structure, employees and administration business process in of a public sector organisation. Below, a piece of modelling work is presented.

The ORGANISATION is defined by structure, employees and goals oriented toward serving citizens. The public sector organisation achieves its goals by settling a set of AFFAIRS (see Fig. 1). The affair engage EMPLOYEES. The employees work to accomplish ACTIVITIES, which are necessary to settle the whole affair. Each activity requires from the employee SKILLS to be performed efficiently. A set of skills that the employee possesses does not necessarily contain each skill needed to perform the specific activity. The employee is chosen to work with affair on the basis of a ROLE played in the organisation. However, the role of employee may change dynamically according to current needs. The employee

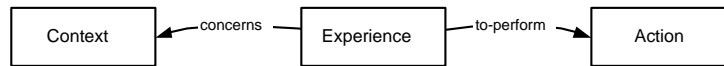


**Fig. 1.** Fragment of the organisation model

who is subject to frequent changes of skills required to play efficiently changing role in the organisation is a mobile employee.

#### 4 Experience Model

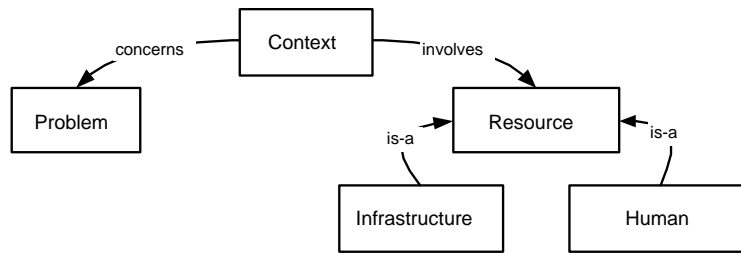
In the Pellucid system, the experience is understood as an ability to perform an ACTION according to the given CONTEXT (see Fig. 2).



**Fig. 2.** Definition of experience

The context is composed of tasks to be performed, actors to cooperate and resource to be exploited. It should describe all circumstances in which a particular activity is taken. The accomplishment of activity requires a PROBLEM to be solved (see Fig. 3). The problem is described in terms of the domain specific ontology. Moreover, some external factors may influence the way of activity accomplishment such as RESOURCES that are involved in the problem solution, both the HUMAN beings and elements of INFRASTRUCTURE, e.g., Workflow Management System or Workflow Tracking System.

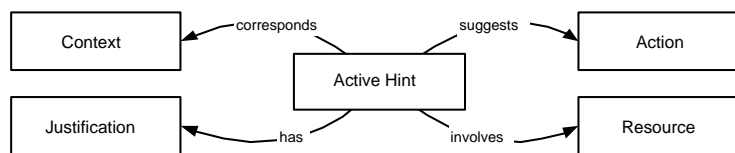
The idea of knowledge delivery through active user support, triggered according to the context in a workflow, was developed by the DECOR project [7]. The Pellucid project has borrowed the idea of "active hints" as conveyors of experience, and is working it out in a somewhat different direction. Active hints are regarded as suggestions to the user to perform some actions that will assist with his/her current activity in the process instance. An active hint is a special element of knowledge which consists of action, resource, and justification (cf. Fig. 4), together with a context against which the current working context is



**Fig. 3.** Context modelling

matched and which will trigger the presentation of the hint. This context covers both the context in the work process (starting or completing a task, opening a document) as well as domain-specific representation (relevant similarity of the case in hand to prior cases). An additional context is the characteristics of the employee (whether experienced or novice) at the most basic level.

The action part of the hint is what the employee is suggested to do, e.g., examine some documents, contact a person or use a template. The resource is the "subject" variable of the action. The justification presents a reason why the hint is being suggested. This model of active hints is very general, since it can encompass hint types built up from templates (similar to the generic query templates of DECOR) as well as retrieval of free-text notes entered by expert users and of documents accessible in organisational repositories. One of the central threads of work within the Pellucid project is the development of an ontology of the hints themselves, which is a basis for linking them the representation of the work process.



**Fig. 4.** Active hint modelling

The active hint is a formal representation of organisational experience (see Fig. 4). The example of the active hint elements is presented below:

*Context:* Creating a quarterly report

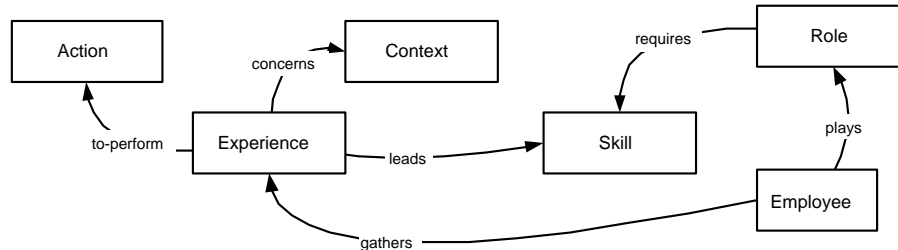
*Action:* Use

*Resource:* QuarterlyReportTempl.doc

*Justification:* It is a template

## 5 Mobility Model

A mobile employee changes his position within the organisation as a normal progress of his career. Each position requires some skills. Accomplishment of tasks at the particular position or in the scope of particular role leads to new experience accumulation and consequently to the skills (cf. Fig. 5). It is important



**Fig. 5.** Mobile employee gains required skills by gathering experience

to note that most of skills are common for all roles within the organisation. They could correspond to the nomenclature, documenting techniques, procedures, etc. For this reason an employee who is changing position cannot be treated as a novice. A mobile employee should not be bothered with hints concerning the skills already possessed. The system should recognise current needs of the employee and provide only suggestions relevant to the employee's experience and skills.

## 6 Domain and Context Modelling

Trying to define the domain for each of the Pellucid pilot site application it is necessary to find a general and simple criterion that could be used to model other applications which follow a defined workflow. In this section we explain our method, that is very simple and does not require any particular formalism. Our approach is to describe the domain according to two aspects: the procedure and the dossiers.

Indeed, at the first level of approximation we can see the domain as a space (the dossier space) where dossiers are distributed along two axes:

1. the technical data description,
2. the procedure description.

Each dossier is represented by a point on the axis 1, its life is represented by a line parallel to axis 2. However, each value on the two axes is represented by a multidimensional vector in the two spaces of dossier description and procedure description. This could be a general approach. From this point we started to

model the two spaces. To do this we identified, for each application, some parameters that, in a univocal manner, characterize the procedure and the dossier. A point in this bi-dimensional space can therefore represent the characteristic part of a case, in case-based reasoning. The action, that leads to the subsequent point (the dossier fixed), is the lesson part. The context (cf. Fig. 3) is therefore described both by the procedure and the particular problem to face (the dossier), which, in turn, are described by a set of parameters that are dependent on the application. Therefore we have a procedural part, that can inherit some general concepts about workflow and activities, and a more specific part which is described by very technical concepts. Thus we simplified the problem of context modelling, by dividing it into a domain specific component and a generic one.

As an example of this approach we present the non-formal description of one application of our project: the design and installation of traffic lights by the mobility and transport department of one municipality in Italy.

#### **Procedural data** General information

- activity status
- notes written within an activity
- documents attached to the activity
- mail sent during each activity
- history of approvals and rejections of one dossier
- ...

#### Information related to each activity

- Input
- Preliminary analysis
- Data collection
- Design
- Installation
- Economical evaluation
- External evaluation
  - request for external evaluation
  - response from district and municipal police
  - elapsed time from the request and the response
  - users who worked in the activity
  - ...

#### **Technical data.** Technical data describe the attributes of dossiers.

- type of request
- applicant
- dates
- location
- crossing shape
- ...

## 7 Model Formalisation - Ontology

Ontologies can be represented using UML standard, in any object oriented language (OOL) or in special ontology languages such as DAML+OIL[23] or OWL[24]. DAML, DARPA Agent Markup Language is developed by DARPA organization. One of the W3C activities is to create a standard for ontology description - just OWL has been created, which started out from DAML+OIL. DAML+OIL and OWL are based on XML and RDF, thus ontology represented by DAML+OIL or OWL is easier to integrate with existing commercial technologies. The ontology represents structure of knowledge. The knowledge itself is mainly a set of instances of ontology elements which need to be stored and manipulated. When representing ontology by OOL we need to store knowledge into object oriented database. Ontology represented by OWL can be stored in XML-based databases. OWL is quite easily readable by humans and computer system. XML parsers are available in any development environment. XML interfacing with other systems can be done easily based on XML-RPC or SOAP technology. Presentation of knowledge to the user can be done by using XSLT which transform OWL/XML data to HTML. OWL ontology can be manipulated by Java based Jena library[25] which provides several storage models, methods for ontology manipulation, RDF manipulation and query engine for RDF query language (RDQL).

When developing the ontology we can have two types of relation between entities: inheritance (“is a”) and properties (“has”), thus we need to simplify the real relation from CommonKADS model to inheritance, properties and instances.

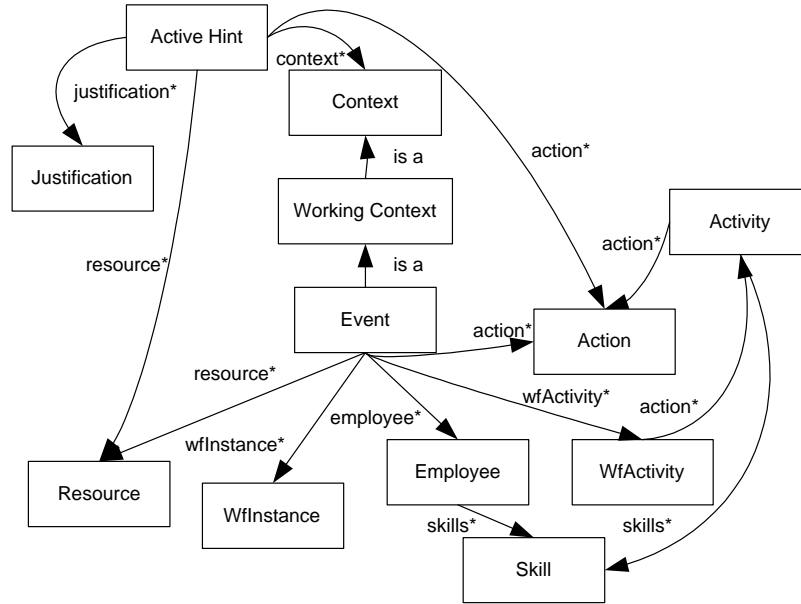
In Fig. 6 a fragment of experience model mapped to the ontology is shown. Some elements of the experience model such as active hint, resource, action and context and interconnections between are adapted to the ontology requirements.

## 8 Experience Gathering

In the Pellucid framework, Experience Management is organised around three phases: the capture, the capitalisation and the return phases. The capture phase is an essential for the experience management because it enables gathering of experience and ensures the growth of the memory. Moreover, the enrichment of the Organisational Memory (OM), is a fundamental aspect when Experience Management aims to knowledge learning/maintenance. Thus, the objectives, the channels and the involved actors of the capture phase are outlined below.

**Objectives.** The employees’ experience captured in the Pellucid system (cf. Fig. 5) is twofold: explicit and tacit. The explicit experience is the formal knowledge found in manuals, documentation and other accessible sources. The tacit or implicit experience is the personal context-specific knowledge, which is ”found” in the employees’ minds and consists of the mental representations or models (cognitive dimension) and of the skills and expertise of the employees (technical dimension). As shown in [26], four conversions have been defined to describe the





**Fig. 6.** Active hint ontology.

interactions between tacit and explicit knowledge. The capture phase was focused mainly on two of them: the externalisation, i.e. the "tacit-explicit" conversion and the combination, i.e. the "explicit-explicit" conversion. In our approach, the experience gathering stage will allow:

- to capture of explicit experience (such as a document or a potential contact) by means of an automatic process,
- to capture explicit knowledge (such as a contact) by means of a human process and more precisely by combination,
- to transform tacit into explicit experience by means of a human process. The externalisation will provide active hints (cf. Figs. 4 and 6).

**Experience Gathering Channels.** The capture phase deals with the experience collected during different activities of the employees. In Pellucid, only the individual experience is considered. Hence, the approach focuses on those gathering channels that are designed for individual use as opposed to those designed to group use. Two types of process will support these different channels: automatic process and human process. In the case of an automatic process, i.e. through the workflow tracking system, two channels are identified: the channel enabling the capture of the documents and the channel enabling the capture of the potential contacts. The potential contact is a description of an actor, which is currently working on the workflow. In the case of a human process, three channels can

be identified: the channel enabling the capture of the contacts, the channel enabling the capture of the active hints and the channel enabling the capture of the indexing elements (see Tab. 1).

**Table 1.** Experience gathering channels

<b>Channel Type</b>	<b>Channel Mode</b>	<b>Description</b>	<b>Gathered Knowledge Elements</b>
Automatic process	WfTS	The channel dedicated to capture of the explicit knowledge e.g. through WfTS	Documents Potential contacts
Human process	Combination	The channel allows the capture of the contacts (a new internal or external contact) by the combination conversion.	Contacts
Human process	Externalization (1)	By this channel users can provide active hints regarded as a formalization of the tacit experience.	Active hints
Human process	Externalization (2)	The key channel for Organisational Memory (OM) enrichment. Should be user friendly. The channel allows the user to define and underline some aspects of experience by using pre-defined elements of description such as keyword, tags, or sentences.	Indexing Elements

**Actors.** The concept of an Actor refer to the principal types of users. Two types of actors are taken into account in the capture phase: the experienced employee regarded mainly as an actor enriching the organisational memory and the new employee. Some sub-types of new employees can be distinguished:

1. The novice: a new employee who has just graduated and is starting his career.
2. The skilled new-hire: a new employee who already has some experience on the same tasks, because had come from another company.
3. The relocated employee: a new employee who comes from the same company and therefore knows the internal procedures but has been previously involved in others tasks.

Identification of employees types at the experience gathering phrase is important to promote the evaluation feedback among the employees of the same type at the experience reuse phase (e.g. when a novice has evaluated a document as very good for his purposes, it make sense to presume that this document is interesting for another novice).

## 9 Conclusions

In the paper, some results of development of experience management system for solving problems arising from high level of employees mobility within organisations were presented. The concept of experience was modelled for the purposes of organisation. There was specified experience representation and some domain-specific applications. The approach to the experience gathering within organisation was introduced. Finally, implementation in form of ontologies was introduced. Next stages of development of the Pellucid experience management platform are going to be presented in further papers [27].

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