

# Intelligent Agent-based Expert Interactions in a Knowledge Management Portal

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**Abstract.** The goal of the Structural Fund Project Knowledge Portal is to support organizations and individuals involved in the SF project proposal development processes to achieve the highest possible number of high quality eligible project proposals meeting the stringent EC criteria. Interactions among experts playing different roles within a project definition case, are an important element of all Knowledge Services that include manual (i.e. expert) interventions. Therefore we present a typical expert interaction workflow exploiting the negotiating capabilities of the ICONS intelligent agent environment that will typically appear in a knowledge portal.

## 1 Introduction

The Structural Fund projects represent a vital opportunity for the new Member States to join the European Community in May 2004 to close the social and economic gap between these countries and the European Community. The challenge recognized by all new Member State Governments is to create conditions for best possible use of the funds made available to them by the EC. The goal of the Structural Fund Project Knowledge Portal is to support organizations and individuals involved in the SF project proposal development processes to achieve the highest possible number of high quality eligible project proposals meeting the stringent EC criteria.

The secondary goal, consistent with the ICONS knowledge management paradigm, is to provide access to the structural funds benchmarking data to be used in the project proposal development processes to support the planning and cost estimation, as well as the cost-benefit and the risk analyses. The feedback loop ranging the project proposal development and the project execution phases represents the Knowledge Management Life-cycle underlying the ICONS knowledge management architecture [1]. An important characteristic of the SFP KP system is integration of Communities of Practice involved in the SF project proposal ecosystem. Support and partial automation of expert interactions as well as facilities for documenting, verifying and dissemination of knowledge generated by these processes provides for continuous improvement of the system knowledge services. A schematic view of the system architecture is presented in figure 1.

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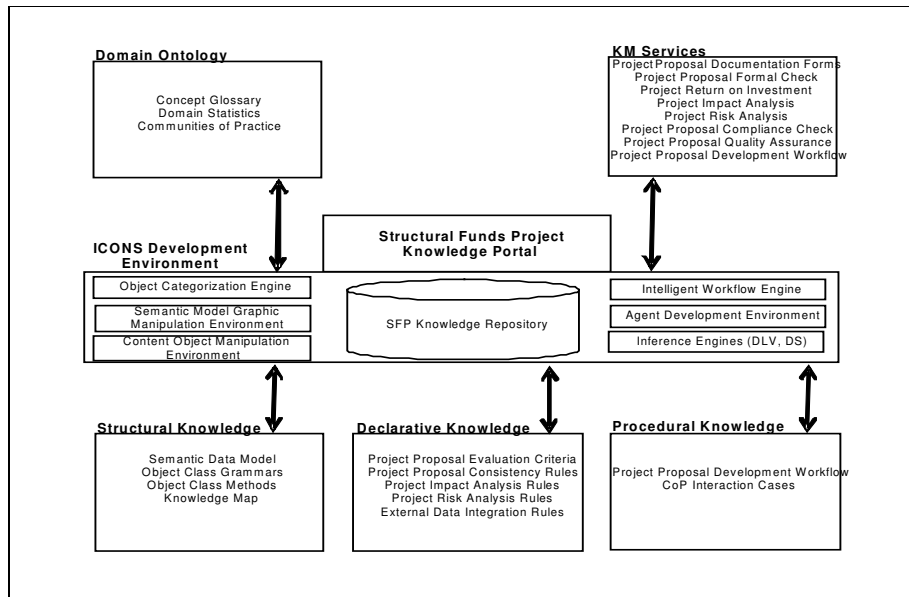


Fig. 1. The SF Project Knowledge Portal architecture.

## 2 Expert Interactions in the CoPs Interaction Processes

Interactions among experts of distinct Communities of Practice, or rather playing different roles within a SF project definition case, are an important element of all Knowledge Services that include manual (i.e. expert) interventions. Therefore we present a typical expert interaction workflow exploiting the negotiating capabilities of the ICONS intelligent agent environment [2] that will usually appear. Ontology of CoP interactions based on the negotiating intelligent agents is presented in Table 1. The negotiating agent environment is compliant with the FIPA Contract Net Interaction Protocol [3]. State graph of the Expert agents are shown in Figure 2.

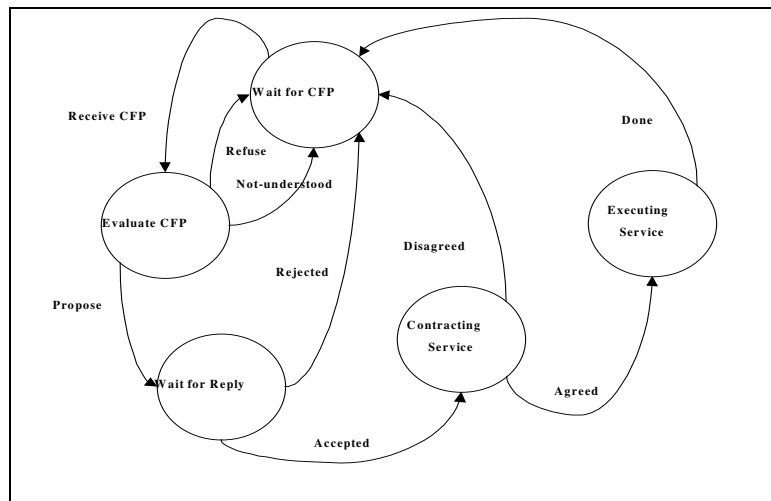
The agent interaction protocol is to be implemented by an automatic process allowing the Initiator (the User proxy) agent to send a Call for Proposal (CFP) to a set of Responders, evaluate their proposals and then accept the preferred one. The Initiator solicits proposals from other agents by sending a CFP message that specifies the action to be performed and, conditions upon its execution. The Responders may then reply by sending a PROPOSE message including the pre-conditions that they set out for the action, for instance the service price or the service execution time. Alternatively Responders may send REFUSE message to refuse the proposal or, eventually, a NOT-UNDERSTOOD message to signal communication problems. The Initiator can then evaluate all received proposals and choose agent proposal to be accepted. The accepted Responders, who receive an ACCEPT-PROPOSAL message, will enter the manual contracting protocol via an appropriate channel (e.g. e-mail).

**Table 1.** The CoPs intelligent agent-based interaction ontology.

| CoP interaction state                | Output (Protocol)  | Meaning   |
|--------------------------------------|--|---|
| Wait for CFP                         |  | The Expert agent has registered the Service availability and awaits a message from interested service seekers (i.e. User agents). This state may be entered by at least one thread, if a limit for the number of parallel services is not exceeded for an Expert.                           |
| Preparing a Call for Proposals (CFP) | Prepare the CFP.<br>Post the CFP through intelligent agent (IA)  | The CFP is represented by a parameter set (deadline, max. price, etc.) prepared by the User to be communicated via the interface to the corresponding IA representing the user. The CFP may also be prepared as a complete requirements document to be used during the manual interactions. |
| Assembling Proposals                 | Collect all proposals received from IA's representing the Experts eligible for this proposal.<br>Notify the IA whose proposal has been selected. | All proposals are collected and evaluated for the compliance with the CFP preconditions. Eligible proposals are evaluated by an inferential method (Datalog) and the "best" proposal is selected.   |
| Evaluate CFP                         | Reject the CFP conditions.<br>Issue the not-understood message.<br>Accept the CFP conditions.  | The CFP preconditions, represented by the parameter set, are evaluated, and, if they are accepted, the "accept" message is generated. Otherwise the CFP is rejected by the agent.   |
| Contracting Service                  | Prepare a contract document defined in the manual interaction process.   | Contracting Service is the manual interaction of negotiations between the contracting parties. Negotiations are expected to stay within bound of the automatically selected proposal's preconditions.   |
| Executing Service                    | Service results are transmitted via the system or rendered manually.   | The manual process of execution of the contracted service. The corresponding thread of the intelligent agent is waiting on the Service completion message.  |
| Wait for Service Result              | Confirmation of Service completed.   | The User Agent thread corresponding to this particular Service is blocked until a notification arrives (manual or automatic) that the service results have arrived and have been accepted.  |

Note: Interactions that entail manual actions (i.e. human agent interaction) are indicated by the grey background.

Note, that Contracting Service and Wait for Service Results states suspend the agent in a WAIT generic state on messages that inform about the respective outcomes of the manual actions. The scope of agent decisions based on CFP and the corresponding proposal contents depends on the contents of received messages as well as the properties of the corresponding content objects (i.e. the Service Case) as defined the structural knowledge schema. Thus, the agent code implemented as a Java Class has access to all content object procedural and inferential methods. Definition of these methods, in particular execution of the inferential methods, supports intelligent agent behaviours. Since agents may be migrated to different execution platform, an appropriate connectivity structure must be put in place to provide support for the RMI protocol executions between agents and the ICONS content object methods. For each Service Case an independent thread of the User or the Expert agent is to be invoked, hence care must be taken in entering the generic WAIT state in order not to block the entire agent rather than the current thread. Appropriate programming techniques and the FIPA agent ontology are presented in [2, 3, 4].



**Fig. 2.** The Expert Agent FSM states.

The contracting protocol is performed entirely manually, although appropriate communication services of the SFP KP system may be used, so are the ensuing services that have been negotiated for. In most cases results of services, such as for example a project proposal review report, will be stored in the knowledge repository and the state of the corresponding role agent may be changed. This will normally be accomplished by sending an INFORM message to signal the successful completion of a service or the FAILURE message if the expected results have not been reached.

### 3 Conclusions

Presented solutions are currently implemented within the IST ICONS project to demonstrate the ICONS platform knowledge management features as well as to propose a feasible knowledge management application. The partial results already obtained are encouraging and it seems that the proposed knowledge portal architecture may be used in different application domains that require tapping expert's tacit knowledge and to organize expert interaction processes.

### References

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