An Operational Knowledge Management Framework

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Abstract

In the present paper we shall present our methodology to manage the Operational Knowledge (OK). The OK could be defined as a set of procedures or norms used by telecommunication operators to construct a genuine strategy tailored to the peculiarities of a given situation. Therefore, we have defined an Operational Knowledge Management Framework (OKMF) which has been developed taking into account some requirements derived from the operational knowledge and context. Moreover, we have developed an Operational Knowledge Management System (OKMS) called Remoter based on this framework. This OKMS has been used in a telecommunication context, to support the Telecom Italia's technicians during their day-by-by activities. Remoter integrates multiple technologies to support telecommunication operators who need "operational-knowledge" to perform their activities. Remoter could be used in several different Telecommunication contexts. In particular, it has been used and tested in the Asymmetric Digital Subscriber Line (ADSL) context, where operators have to rapidly react and reach the best decision. The aim of Remoter is to enable ADSL technicians to share, capture and apply their collective OK to take optimal decision in real time.

1 Introduction

The primary goal of Knowledge Management (KM) is to *"improve organizational performance by enabling individuals to capture, share, and apply their collective knowledge to make optimal decision in real time"* [1]. In fact KM is becoming more and more an important discipline in a variety of contexts, such as business, IT, telecommunication and so on. The problem of KM can be faced in three different ways:

1. *Local:* there are specific needs that have to be solved;
2. *Coordinated:* there are coordinated operations (a small group of people who share task, or work together on a product, also called Communities of Practice) that permit to solve a specific problem;
3. *Global:* i.e. the management of the entire cognitive patrimony of a company.

In general, the Global one is a quite theoretical approach while the Local one is more pragmatic and more suitable for companies needs. Moreover, local solutions are quite simpler than the global ones because they have to manage just a part of corporate's knowledge. In fact, most companies have argue that KM should begin on a small scale, with the objectives focused on improving the effectiveness of a single knowledge-oriented function or process. Davenport and Prusak claim that "*a common sense about KM are both starting with high-value knowledge and with a focused pilot project (and let demand drive additional initiatives)*"[2]. The most important factors in deciding where to start are the importance of the specific knowledge domain to the firm and the feasibility of the project. In the telecommunication field the operational knowledge (OK) is moving up from pure and simply knowledge of procedures to awareness of competencies. The former are usually standard actions which are created by management and then used by technicians, whereas the latter are associated with individual knowledge and experience developed by technicians by applying procedures during their day-to-day activities. Therefore, the OK is becoming more tacit than explicit for companies like Telecom Italia and the management of OK is seen as fundamental to competing in the knowledge economy. The topic of this paper is the definition of an Operational Knowledge Management Framework (OKMF) for the management of the Operational Knowledge (OK). I shall also sketch an instantiation

of the OKMF to support technicians during their day-to-day activities of provisioning and assurance of the ADSL (Asymmetric Digital Subscriber Line) services [3] [4]. This research was born and developed in collaboration with Telecom Italia Lab which is the research laboratory of Telecom Italia, an Italian company of telecommunication. Section 2 is devoted to explore the main differences between the traditional knowledge management approaches and the management of the operational knowledge. In section 3 we describe the OKMF developed in order to answer to requirements derived from the operational contexts. Finally, section 4 briefly shows an OKM system (OKMS), called Remoter, which is used to manage the OK developed by skilled technicians performing daily assurance and provisioning activities on the ADSL services.

2 Knowledge Management vs Operational Knowledge Management

The Operational Knowledge Management (OKM) is a local approach to KM specifically focused on Operational Knowledge (OK). Operational Knowledge is mainly based on individual competence and experiences developed by skilled knowledge workers during their day-to-day activities [3] [4]. In particular the Operational contexts have several characteristics which lead to some requirements for the management of knowledge. These requirements get across that a traditional approach of KM is not sufficient. In the traditional views of KM, knowledge is regarded as a commodity that needs to be captured, stored, and indexed to allow efficient retrievals in the future. The underlying assumption is that future needs most likely to be the same as those of today. The responsibility of creating adequate knowledge structure to enable future retrievals from shared repository of knowledge object is delegated to some sessions between specialists (e.g. knowledge engineers) and the management, who at design time (when a KM system is designed and developed) create such structures [2]. In other words, once that all the domain's knowledge is stored into a repository, the user of KM system are able to access and retrieve the stored knowledge at least till it become obsolete (such as for a strong innovation in the domain). This is what we called "one-way flows" (see fig. 1.a) [3][4]. Instead the requirements of an operational context say that knowledge should be treated as an object created, integrated, and stored by knowledge specialists at use time (when the KM system is deployed and used), when they encounter problems and knowledge become necessary. It is one of the by-product of getting work accomplished, as enacted in collaborative practices by a network of skilled workers. In this network, also called Community of Practice (CoPs), these stakeholders, such as engineers, architects, governments representatives, telecommunication technicians and so on, engage in the design of a joint solution to a common problem, and collaboratively constructing the knowledge necessary to address the problem at hand. Knowledge should be integrated into potential solutions at use time by means of user-driven tasks, rather than being predefined at design time through a series of canonical (system-driven) tasks [12].

Moreover, traditional KM solution do not usually pursue the Nonaka's model for knowl-

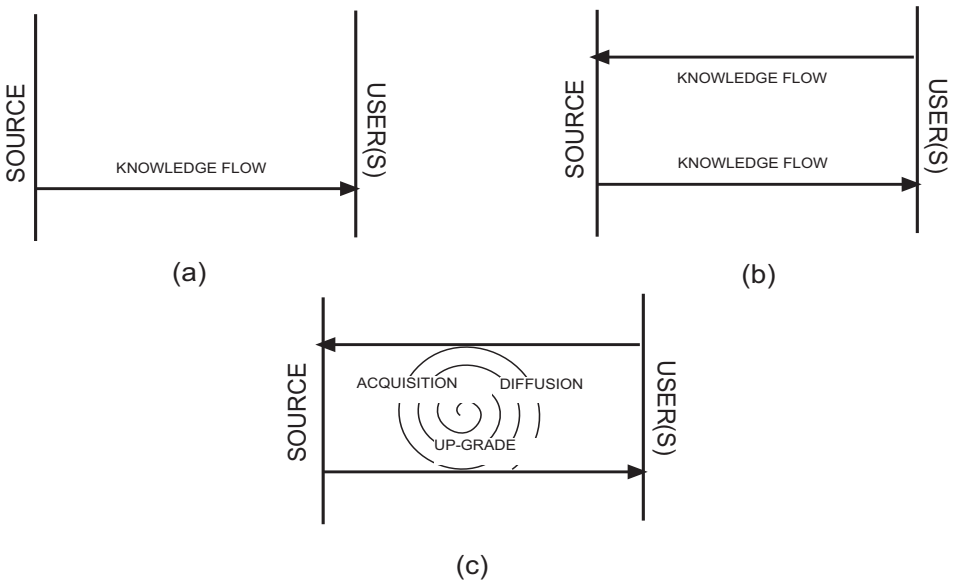

Figure 1: One-way flows vs double-way flows.

edge creation. Nonaka analyzes knowledge creation with a $2 * 2$ matrix, where each cell represents the transition from tacit or explicit knowledge to tacit or explicit knowledge [5]. Tacit knowledge is all the implicit information we have created by personal reasoning, relationship, experiences and so on. Explicit knowledge is all the information that we can find in books, courses, internet and so on, namely knowledge expresses with in a formal ways, easy to transmit and conservable. Each transition requires different kind of thinking and interaction. When viewed as a continuous learning process, the model becomes a clockwise spiral. Nonaka claims that *"the dynamic interaction, between the two types of knowledge, is the key to organizational knowledge creation"* [6]. In order to obtain a clockwise spiral is necessary to add into a KM solution specific knowledge flows following the opposite direction (from user to knowledge repository) at the same intensity too. This is what we called "double-way flows" (see fig. 1.b) [3] [4]. The double-ways flows is what is needed in the operational context in order to capture and store solutions that come from the collaborative work among stakeholders.

3 Operational Knowledge Management Framework

In our Operational Knowledge Management Framework (OKMF), we have characterized the *"double-way flows* through three distinct phases (see fig. 1.c):

1. Acquisition: is the phase of capturing existing domain's knowledge and storing it into a repository (in a structured manner);

2. Dissemination: is the phase where the repository of knowledge is accessed and used by the users;

3. Upgrade: is the phase of monitoring and up-grading of knowledge repository during people's day-to-day activities (such as interacting with other people and computer system).

From the temporal point of view, we have the Acquisition of knowledge. Then it will be possible to use it, during the Dissemination phase. Afterwards, there could be a cycle of use and upgrade of knowledge. This means that, the users will be able to add new knowledge to the repository during the knowledge use as well. In this way we do not need to acquire this new knowledge during a 'formal' phase (Acquisition), but we derive it directly by the usage of the OKM solution itself. Sometimes it could be necessary to go back to the Acquisition phase, usually when the knowledge into the repository will become out-of-date or inconsistent (see fig. 2). For example, in the telecommunication field, when there is a big technological innovation (such as from GPRS to UMTS technology). Subsequently, we have described deeper the phases in terms of activities. In particular, we have identified the following seven activities:

1. *Acquisition:* capturing existing knowledge mainly through knowledge engineer-expert user session;

2. *Codify:* placing knowledge in a structure repository using a knowledge model;

3. *Explicitation:* sharing knowledge mainly through person-to-person contacts;

4. *Application:* using of stored knowledge for supporting activities (problem solving, decision making, and so on);

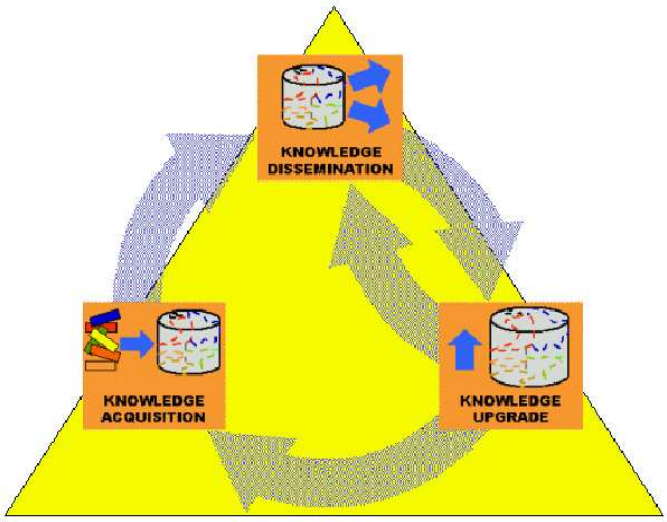

Figure 2: OKM phases

5. *Discovery:* increasing stored knowledge as people carry on their normal tasks;

6. *Monitoring:* monitoring and evaluating of knowledge usage;

7. *Creation:* generating new knowledge.

The relation between activities and the three phases is shown in fig. 3. As the Creation activity is independent from the three phases (by the temporal point of view), we assume that it could be stand out of the two cycles. The creation of new knowledge is a side effect of the application of the three phases and could be performed anytime.

3.1 OKM roles and skills

In the description of the activities and phases of OKM Framework is easy to recognized different 'actors'. Each of them has a different characteristics and interacts with the systems using different ways. The existing actors are the following:

1. *Knowledge Engineer:* she/he has the task to build the knowledge repository. Therefore, she/he is only present in the knowledge acquisition activities;

2. *Knowledge Manager:* represents the main expert in the domain of knowledge which has to perform the tasks of upgrading, updating, modifying the knowledge repository. In particular, she/he has the following tasks to perform:

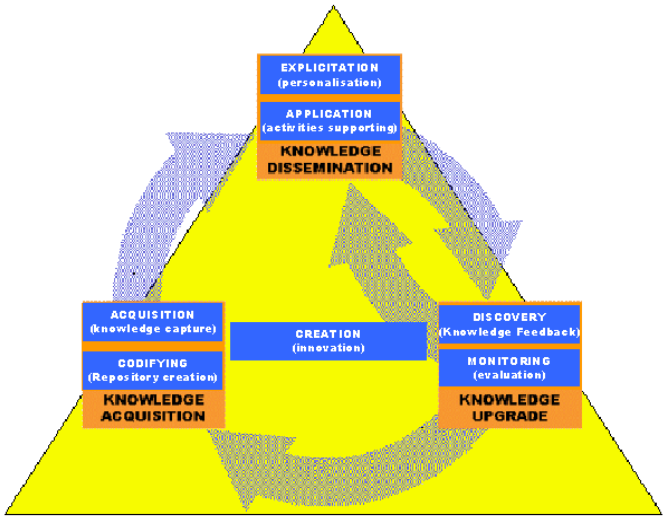

Figure 3: Activities distribution through the knowledge flows phases.

- navigating of the knowledge repository as a basic user;
- analyzing and eventually modifying of the knowledge repository;
- validating and deploying of the knowledge repository;

3. *Expert user:* it means user who is 'skilled' in the domain knowledge. She/he has the same task and policies of the basic users. Moreover, she/he could evaluate new pieces of knowledge that will be proposed by the basic users.

4. *Basic user:* she/he may navigate, retrieve and use knowledge stored into the knowledge repository. Moreover she/he can submit new pieces of knowledge that will be evaluated by the expert users.

3.2 OKM modules

Once we have defined the activities of the OKM framework, we have divided them in one or more modules which is responsible of a part of the knowledge flow (see table. 1). Activities modularization is a remarkable features of our OKM framework because it allows having a modular architecture which may be instantiated taking into account the specific context and OK to be managed. This means that an OKM systems could not include each module but at least one for each of the three phases should be an element of the system. Due to the space limitation, in this paper I will only describe the most innovative modules of

Table 1: Activities modularization

OKM Activities	**OKM Modules**
Knowledge Acquisition	Knowledge Acquisition
Knowledge Codify	Knowledge Codify
Knowledge Explicitation	Knowledge Explicitation
Knowledge Application	Knowledge Retrieval, Just In Time Knowledge Handling
Knowledge Discovery	Knowledge Feedback, Knowledge Interception
Knowledge Monitoring	Knowledge Evaluation, Best-Practices Identification
Knowledge Creation	Simple Knowledge Creation, Best-Practices Creation

the OKMF. The description of these module have the objectives to underline information flows, roles, concepts, and relations which have been identified as useful to implement the functionality of the module.

3.2.1 Just In Time Knowledge Handling

This module represents the main innovative part of our OKM framework. In particular, the Knowledge Handling module leverages to one of the most important feature of the OK, that is OK is usually used in decision making and problem solving activities. Therefore, whereas users through the Knowledge Retrieval module actively decide which knowledge records to be consult, thanks to the Knowledge Handling module users receive from the OKM system advice and suggestions to follow in order to solve problems or to make decisions. In fact, starting from some indicators (which may be data measures or alarms coming from legacy systems or parameters provided by the users) and using an Automatic Handling Engine, it consults the Structured Knowledge Repository and provides one or more suggestions to the users (see fig. 4). The idea of the Just In Time Knowledge Handling

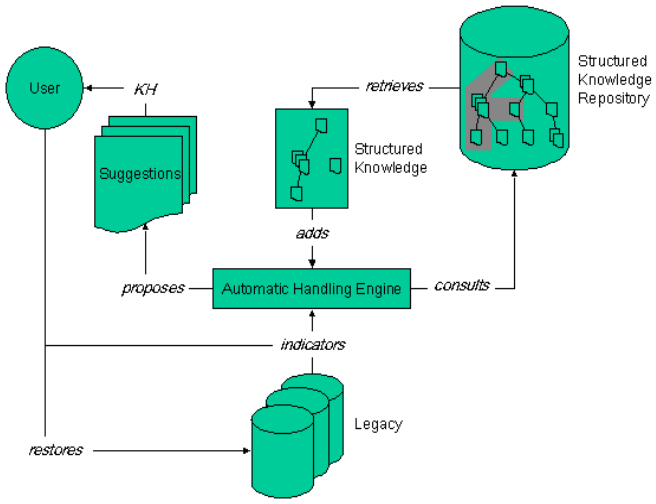

Figure 4: Just in Time Knowledge Handling module.

module is to bake the right and specialized knowledge into the jobs of skilled workers in order to access and use important knowledge when he needs to make decisions or solve problems.

3.2.2 Knowledge Feedback

In a context of problem solving and decision making one of the most important things to do is to capture the real impact of the suggestions provided by the OKM system on the users activities. Therefore, the aim of this module is to allow users to provide their own feedbacks on the suggestions which may be:

- structured feedback: thanks to this kind of feedback the users will be able to provide a sort of grading of the suggestions (taking into account several factors of the suggestion). For instance the problem solving capacity, problem solving time performance, the resource optimization and so on.

- unstructured feedback: the users give a natural language evaluation of the suggestions.

The module drives the users in the submission of their own feedbacks. This is very important because the system has to guarantee that the evaluation on the suggestion will be sent by the users only then the suggestion has been applied (see fig. 5). Moreover,

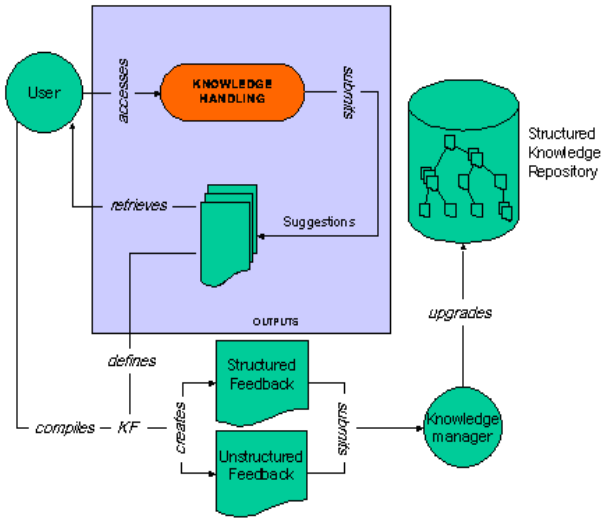

Figure 5: Knowledge Feedback module.

each user will have an own personal configuration of the system in order to easily manage feedbacks. The personal configuration of the system is based on users profiles which are stored in a User Customization Database. Finally, the knowledge manager exploits some tools provided by the OKM system will have the task to analyze these feedbacks.

3.2.3 Best Practices Identification

This module is devoted to a distribute context constitutes by different CoPs (Communities of Practice). In a distribute environments different CoPs may access to Structure Knowledge Repository of others CoPs (usually when they do not find useful knowledge in their own Structured Knowledge Repository). In that case, they can also import new knowledge from different OKM system into their Structured Knowledge Repository and use it. When a piece of knowledge is imported by several CoPs, it could become a best-practice candidate. Therefore the import-export mechanisms must be managed by the Best-Practice Analyzer using several indicators like % of access, % of import, % of re-use (see fig. 6).

3.2.4 Simple Knowledge Creation

Thanks to this module users are able to add new knowledge to the Structured Knowledge Repository. In order to maintain the integrity of the Structured Knowledge Repository the

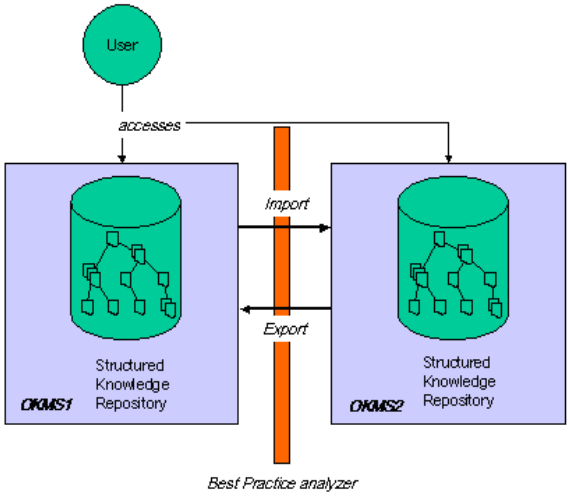

Figure 6: Best Practice Identification module.

new piece of knowledge must follow a refereeing process. Therefore, once a new knowledge record is sent by the users, an Expertise Locator Engine consults the Competence/Skill Repository and sends t to the new piece of knowledge to one or more expert users. Then each expert users may give a judgment about the quality of the new knowledge records which is stored in a Knowledge State Table. At any moment, the knowledge manager can check the Knowledge State Table and decide to publish the new knowledge record or not (see fig. 7).

3.2.5 Best-Practices Creation

Once an imported piece of knowledge reaches a specific threshold, it becomes a Best-practice candidate which must be validate. Therefore, it is involved in a formal validation process. The validation process includes some expert users of the domain of the candidate Best-practice which will be find out by an Expertise Locator Engine consulting the Competency/Skill Repository. Each expert user may submit an own judgment about the candidate Best-practice which will be stored in a Best-practices State Table. At any moment, the knowledge manager can check the Best-practice State Table and decide to publish the candidate Best-practice as a new Best-practice or not(see fig. 8).

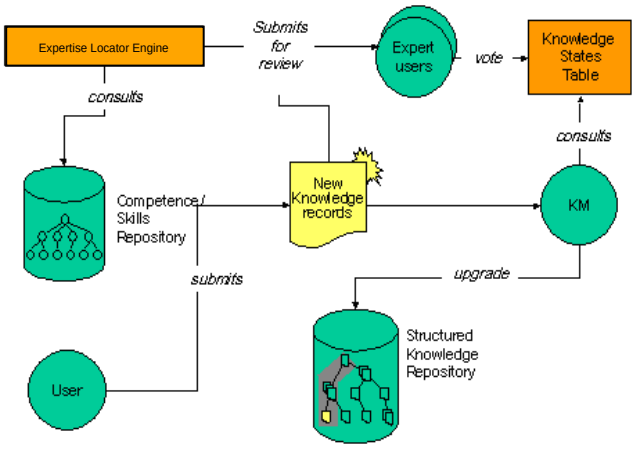

Figure 7: Simple Knowledge Creation module.

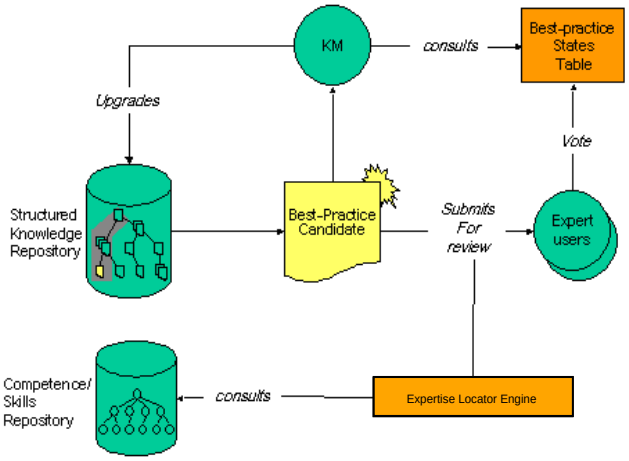

Figure 8: Best Practice Creation module.

4 Remoter: an Operational Knowledge Management System

Remoter is a web-based application developed in order to support technicians involved in provisioning and assurance activities of the ADSL (Asymmetric Digital Subscriber Line) context [13]. In this context, two groups of technicians have been identified:

1. *help desk/back office technicians:* people working in an office, whose main activity is to help the on-the-field technicians when troubles related to the ADSL context arise;

2. *on-the-field/front-end technicians:* technicians mainly involved in provisioning and maintenance activities, for example ADSL components installation, troubleshooting, etc.

When a customer wants to install a new ADSL component or some troubles arise, call the ADSL customer care center of Telecom Italia who arranges an appointment between the customer and a front-end technician. Then the front-end technician goes to the customer in order to perform his work request. In some cases, on-the-field technicians call help desk/back office technicians for advice. However, both the back office and on-the-field technicians usually access to technical documents, knowledge spread on different web-sites in order to perform their activities. They often do not have on their desk the last version of a technical manual about an ADSL component and waste their time searching it on the web. Therefore, we have developed Remoter which allows technicians to share, fast access, and manage of knowledge regarding the ADSL services in order to take optimal decision in real-time. Moreover, Remoter allows also aligning the technical performances to organizational best-practices.

4.1 Remoter Architecture

The proposed system is a three tier web-based architecture, which allows managing and sharing of the OK (norms, technical documents, procedures, personal experience, links to web-site etc...) (see fig. 9). The presentation layer contains some GUI modules that provide the user-interface. This layer provides not only a graphical interface so that users can interact with the application, insert data, and view the results of requests, but it also

manages the manipulation and formatting of data once the client receives it. A client device can communicate with Remoter using a web-browser with Java^{TM} technology. In fact, the presentation layer consists of either a set of HTML with JavaScript or ASP and JSP pages. The second tier is a Web application server running the logic of the disciplined development process on the Web server. In particular, it supports some Logical Modules, which have been developed integrating different technologies as Autonomy^{TM} Search and Retrieval Engine [1], eGain^{TM} Knowledge [2], Snitz Forum [3]. Autonomy Search and Retrieval Engine allows content to be searched and presented with summaries and hyperlinks to similar information, automatically and in real-time. eGain^{TM} Knowledge is a conversational Case-based Reasoning (CCBR) shell. Conversational Case-based Reasoning is a problem-solving paradigm that is able to utilize the specific knowledge of previously experienced, similar problem situation (case) to solve a new problem [7]. eGain^{TM} Knowledge stores knowledge in the form of cases in a case base. Snitz Forum is a freeware interactive discussion environment that allows different people on the Internet or an Intranet to leave messages for each other, and then to reply. Moreover, the middle-tier is responsible of the users authentication and causing client devices to display the applications. A database server and a document repository constitute the third tier. The database server is used to store either messages posted by the users or the eGain^{TM} case base. The document repository is used to store all knowledge records (i.e. technical documents, pieces of technical information, norms, software etc...).

The benefits of a three-tier architecture are significant. Being a web service, the system can be accessed and used from any system with Internet access and a suitably capable web browser. Systems like Laptop, Palmtop, Smart Phone, Wearable Computer, which are used by the users of Remoter, can be used without any additional software.

4.2 From OKMF to Remoter

According to Davenport[8], knowledge projects are more likely to succeed when they can take advantage of a broader infrastructure of both technology and organization. Technology infrastructure consist of technologies that are knowledge-oriented. If these tools and

[1] www.autonomy.com

[2] www.egain.com

[3] www.snitz.com

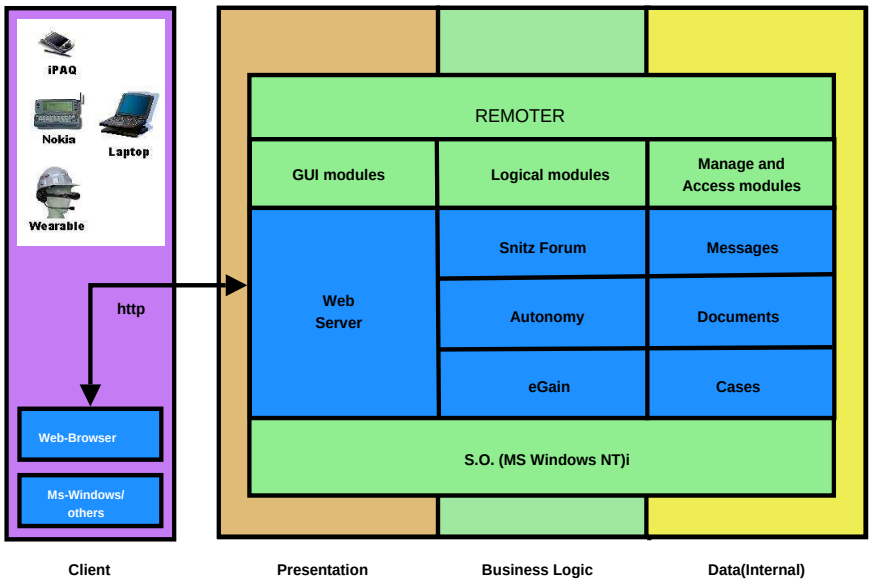

Figure 9: Remoter tree-tier Architecture.

the skills to use them are already present, a particular initiative will have an easier time getting off the ground. The above technicians usually access and retrieve documents and software by searching them on different intranet web-sites. Such intranet web-sites contain hundreds of thousands of documents (white papers, technical specification and manual), forums and software about ADSL components, that help technicians in the provisioning and assurance activities. Therefore, because technicians were skilled using intranet web-sites, forums and search engine we chose to implements both *Knowledge Explicitation and Retrieval modules* of our OKM framework using a unique web-site with Autonomy^{TM} and Snitz forum facilities. Moreover, one of the peculiarities of the provisioning and assurance activities of the ADSL context is to be characterized by problem solving activities. For instance let us consider the activities of the help-desk technicians. They usually help on-the-field technicians by providing them with some technical documents, asking to expert for advice or submit a new trouble tickets to some ADSL experts. In such cases, the time is usually of the essence because the on-the-field technician is on the telephone in real time. Therefore, we have also implemented the *Just In Time Knowledge Handling module* by leveraging on eGain ^{TM} tool which is based on a CBR technologies. CBR application require someone to input a series of "cases", which represent knowledge expressed as a series of problem characteristics and solution. Then, when a problem arise its character-

istics can be compared against the set of cases in the application and the closed match is selected. Unlike rule based systems, which require that rules are well structured with no overlaps, case structure can reflect the fluid thinking that goes in the ADSL technicians minds. In fact, help-desk technicians, typically spend much of their time trying to connect new problems with known problems and resolving them with known solutions rather than devising new solutions. Finally, we have also recognized that the ADSL provisioning and assurance context is characterized by an high dynamic value of the knowledge. ADSL devices are continually changing or upgrading and then also knowledge related to them. For instance, there are different documents version for a single device and many different solution to a single device fault. Therefore, we have also implemented the Knowledge Feedback, Evaluation and Simple Knowledge Creation modules. Table. 2 summarizes which modules have been implemented in Remoter system. Due to the space limitation, in this paper I will only describe the most innovative modules of Remoter. It's worth noting that the OK in Remoter has been represented in form of documents, messages, and cases. In particular the knowledge representation formalism used to structure the case base is based on the language provided by eGain which is a CCBR shell [14]. CCBR is a problem solving paradigm that is able to utilize the specific knowledge of previously experienced, similar problem situation (case) to solve new problem. A case is a list of question and answer pairs. Therefore, the case base, that is a set of cases, can be thought as a tree. Finally, in order to get a consistent and efficient list of question and answer pairs we have followed some sample CCBR guidelines [7].

4.2.1 Remoter Just In Time Knowledge Handling module

It provides to the users the capability for finding out a solution related to diagnosis troubles. This module of Remoter is based on a CCBR approach [7]. It interacts with a user in a conversation to solve a complex query, defined as the set of questions selected and answered by the user during a conversation. At each step of the conversation new questions are presented to the technician and a list of cases which could be possible solutions. Each of them have a measure of similarity and the number of times they were accepted or refused by technicians. The match between the users answers and the question and answer pairs that make up a particular case, determinants which case scores the highest,

Table 2: Remoter modules

OKM Phases	**OKM Modules**
Knowledge Acquisition	Knowledge Acquisition, Knowledge Codify
Knowledge Dissemination	Knowledge Explicitation, Knowledge Retrieval, Just In Time Knowledge Handling
Knowledge Upgrade	Knowledge Feedback, Knowledge Evaluation
Knowledge Creation	Simple Knowledge Creation

and therefore, which resolution or action the search recommends [14](see fig. 10) .

4.2.2 Remoter Knowledge Feedback module

Thanks to this feature, technicians could send to Remoter their feedbacks related to the solutions proposed by the Just In Time Knowledge Handling module. Once the operator reaches a solution, Remoter asks her/him to submit a feedback related to the solution. In the feedback form, the users can insert a textual feedback, upload a file and select a vote for the adequacy of the proposed solution. However, they could forget to fill in the feedback form or they can also close the Web Browser or the connection in order to apply the solution proposed by Remoter. The connection could close itself because of session ended or a network trouble. Therefore, at every log on, a list of forgotten feedbacks is proposed to the user. The operator can choose to fill in or to skip the feedback form. In this way, the users have always the chance to submit their feedbacks even if the connection failed or is closed. Moreover, the user is able to see all feedback related to the selected solution. The user feedbacks are very important because allow the knowledge manager to upgrade and maintain the case base (see fig. 11).

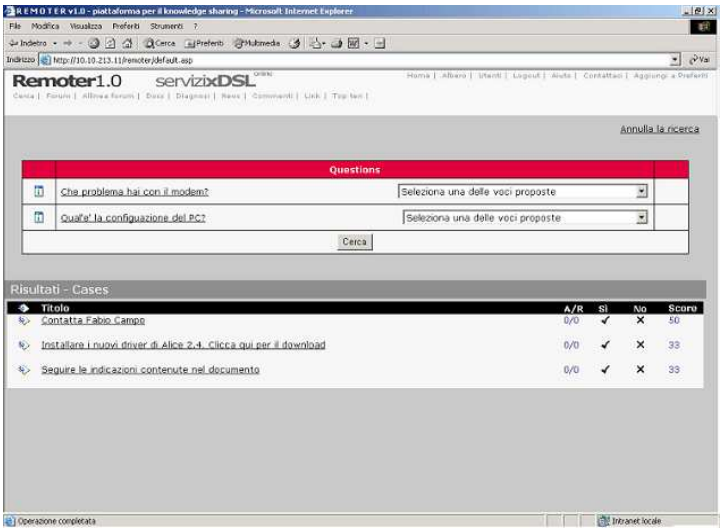

Figure 10: Remoter Just In Time Knowledge Handling module.

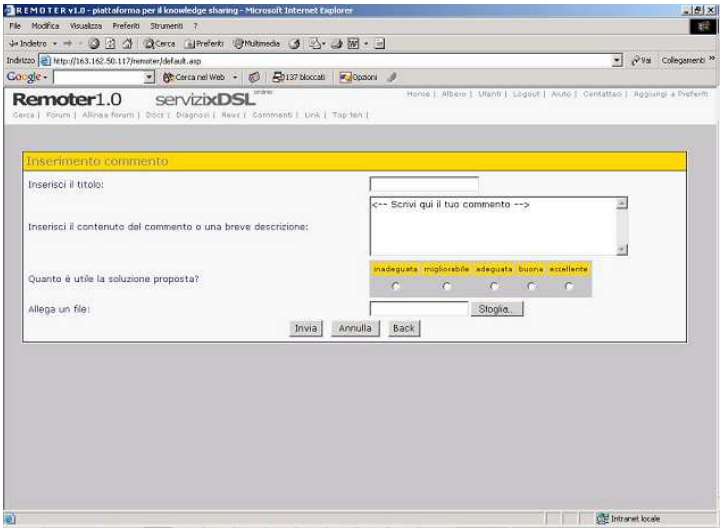

Figure 11: Remoter Knowledge Feedback module.

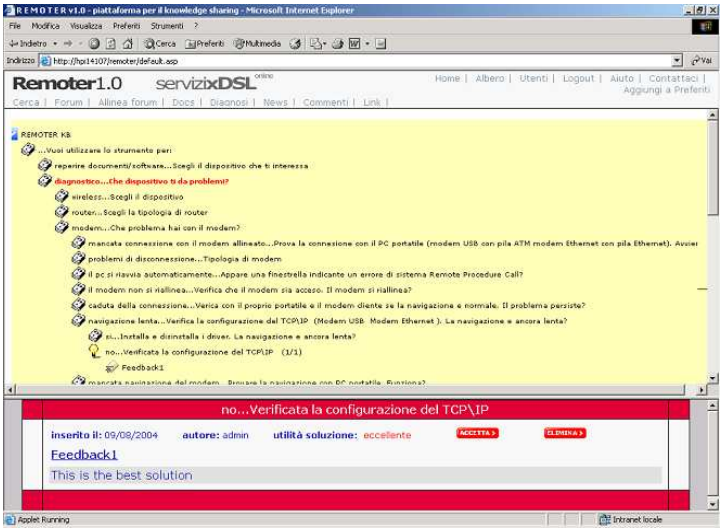

Figure 12: Remoter Knowledge Evaluation module.

4.2.3 Remoter Knowledge Evaluation module

Our OKM perspective is based under assumption that knowledge workers create new knowledge during their work and mainly when they use knowledge of the KMS. Therefore, Remoter allows telecommunication operators to integrate new knowledge at use time. Thanks to the Knowledge Feedbacks module technicians are able to send feedbacks related to the solution proposed by Remoter. These feedbacks have to be evaluated in order to update the case base. Therefore, this module provides to the knowledge manager a tree representation of the case base. The leaves of the tree are the solutions of the case base. For each solution all submitted feedbacks have been appended. In this way, the knowledge manager could see all the information about feedbacks and how many times technicians have attached a feedback to a specific solution. Then he can validate or reject feedbacks which will be useful for the knowledge engineer in order to upgrade the knowledge base (see fig. 12).

4.2.4 Remoter Simple Knowledge Creation module

This module is devoted to the creation of new knowledge records. As we have seen, knowledge records have been classified according to an ADSL hierarchy. Moreover, each user must register her/himself to Remoter specifying in which ADSL thematic area she/he is an expert. Then, once new knowledge record (candidate) is added by the knowledge

manager it will be reviewed by a set of expert users. Each user can be an expert in one or more thematic areas of ADSL context. In particular, this methods can be divided into steps.. Once a user uploaded a candidate knowledge record, he/she must check the thematic areas whose the knowledge record belong to. Afterwards the candidate will be send to all expert users belong to thematic areas of the candidate. The expert users can voice a vote, attach a comment and send an e-mail to the user who sent the new candidate knowledge record. At any moment, the knowledge manager can check the grand total of expert users who reviewed the candidate and the average of its votes. In this way the knowledge manager can publish the new knowledge record or not.

5 Conclusions and Experiments

In this paper we have shown our Operational Knowledge Management Framework (OKMF) whose aim is to define one of the possible way to manage the Operational Knowledge (OK). Therefore, we have defined characteristics both the OK and the operational context, which have leaded to define requirements for the management of the OK. In particular these requirements may be summarized as follows: (a) need to capture the operational knowledge developed by knowledge workers during their day-to-day activities; (b) need to make actionable the operational knowledge baking the right and specialized knowledge into the jobs of skilled workers; (c) need to manage best-practices. In order to answer to these requirements we have defined our OKMF which implements what we have called "double-way flows" by the cyclic application of the three phases: Knowledge Acquisition, Knowledge Dissemination, and Knowledge Upgrade. Afterwards, these phases have been characterized in term of seven activities. Moreover, roles have been defined identifying required skills and tasks for each role. Then, each activity has been characterized in terms of modules. Activities modularization is a remarkable features of our framework because it allow a modular architecture which may be instantiated taking into account the specific contexts (for instance context in which is important to collaborate with one peers, problem-solving and decision-making contexts, distribute contexts and so on).

Afterwards, we have described an specific application of our OKMF, called Remoter. Remoter is an Operational Knowledge Management System (OKMS) that enables telecom-

munication technicians from ADSL context to share, capture and apply their collective operational knowledge (OK) to take optimal decision in real time. Initial assessment of Remoter has been very positive. In particular Remoter has been field proved for the last six months of the 2004 in several Telecom territorial areas (TA) of Italy. Significant saving in the energy, time and number of phone calls from on-the-field to help/desk technicians has been realized with the help of Remoter. Each TA had about 30 technicians (one sixth of them were help/desk technicians) which used Remoter. At the beginning of the trial, remoter contained about 50 cases, 400 knowledge records and 60 messages posted. After six months, the OK in Remoter has been extended to incorporate more than 100 cases, 700 knowledge records and 250 messages.

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