# SUPPORTING KNOWLEDGE CREATION IN RESEARCH ORGANISATIONS THROUGH BIBLIOGRAPHICAL RESEARCH

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## 1    Introduction

Some scholars have recognized the benefits generated by publicly funded basic research [30], mainly in terms of an increase in "the stock of useful knowledge" [30] for innovation and economic growth [34]. That is why; we are interested in the research activities. To study them, we made a field work in order to know how, the quality management (QM) systems being implemented, influenced the formal knowledge management (KM) practices used by these organizations. The information gathered was used as bases for analyzing the way in which research projects are realized and propose an approach based on the capitalization of the bibliographical work done by researchers. Then, the analysis of some bibliography in sociology of science and our own observations, lead us to propose to focus on the support to the management of scientific concepts. Finally, by analyzing the development of research projects, we defined the specifications of a software tool. These were used for developing a prototype of it, which we are currently testing.

## 2  Quality management (QM) in the context of research

During the last years, some research organizations (industrial and academic) have started working on the implementation of quality management systems (QMS). Consequently, we study the approaches used, while paying special attention to the possible effects on knowledge management (KM). Our assumption is that quality management (QM) could help introduce the principles of KM as a way of improving the process followed when realizing research activities. To study the situation, we started by using a sociological approach in order to know the reality of research organizations and to collect information on the difficulties encountered when implementing a QMS. This work consisted in the collection of information over a four-month period, interviews in seven research laboratories, transcription of interviews and follow-up of the implementation process of quality management at a research organization (RO). The complete results of this phase are presented in [15].

The observation has allowed us to note that several characteristics of the research activity make difficult its management: diversity of activities, large quantity of records, multiplicity of working methods, large turnover of researchers/designers, unpredictability of results and difficulties in reconstructing previous projects. All these characteristics make difficult their management and the definition of a standardized instrumentation. Moreover, we observed that

when implementing QM, the organizations deal with the improvement of their processes and not directly with the improvement of their results. In addition, QM is primarily applied to the administrative and/or the technical activities and seldom to the basic research activities. Even if the main activity is the production of knowledge, the actual QMS are centred on the formalization of certain activities, mainly the support activities, and on the management of part of the documents, primarily the final research documents. Additionally, KM has not been formally introduced, though the organizations recognize its importance and possible benefits. Nevertheless, some of the actions that have been implemented could be classed as KM. Thus we have verified a relation between QM and KM, as we will see hereafter.

## 3    Addressing QM and Knowledge Management (KM)

Several authors have worked on joint approaches addressing both QM and KM. For that reason, we propose a typology of the different approaches we have found. It intends to facilitate the comprehension of the existing approaches and not to strictly separate them. Thus, we have found several works that could be grouped in four types:

1.  Those that propose approaches integrating QM and KM: Zhao [41], Rodríguez-Ortiz [29].

2.  Those that apply QM and show how QM supports KM: Johannsen [16], McAdam [21], Linderman [17], Bénézech [4], Molina [23].

3.  Those that use KM for improving the results obtained from QM: Galendere-Zile [11].

4.  Those that apply KM and claim that the use of QM can help achieving better results: Tsai [35], Pfeifer [28].

At the beginning of our project, our hypothesis was that QM, when applied to these activities, would require KM. Consequently, at that moment, we positioned ourselves in the first group. Nonetheless, the observation has not allowed us to see such an approach. Nevertheless, we have verified relations between QM and KM, because the implementation of QM involves the elucidation and sharing of knowledge. In this case, organizational knowledge related to the know-how concerning the support activities. Then, this work could be classified under the second group. The method used has basically consisted in the writing of documents (operational procedures and documents). For their management, information systems, often an Intranet, have been established [12]. However, these systems do not seek "the management and the circulation of distributed knowledge" [12]. They just make it possible to find documents or information (that guide the realization of activities). In general, the documents produced during the research process are not managed by these systems.

Nonetheless, our objective is to improve the research activities. For this purpose, a possibility is to use KM methodologies to manage the dynamic aspects of the research process, while using QM methodologies for organizing the stable aspects. The experiences observed, show us that it is possible to use QM for aspects such as the establishment of laboratory protocols, the implementation of databanks, the definition of means to keep the information about the publications made by the laboratory, and the management of technical instruments. This shows us that QM can indeed be used for structuring some aspects of the research activity. The question is if KM can also be used for improving the dynamic aspects of the research activity and defining, concretely, how to do it. This work could be then positioned within the third group, as the KM methodologies would complement the aspects addressed by the QM

system in order to obtain better results. Then, the question is how to do it. In the next section, we will describe the concrete aspects we consider in order to treat this question.

# 4 An Approach for Addressing the Implementation of Knowledge Management

We are interested in finding ways to profit from the knowledge produced throughout the realization of research projects. However, Wunram [39] indicates that "the approaches that start with the goal of capturing all the knowledge of the employees are predetermined to fail". It is thus necessary to define the knowledge that can be more beneficial to research activities.

## 4.1 Which Knowledge to Capitalize?

We carried out an analysis of the activities done with developing research projects, paying special attention to the information used and generated by these projects. We concluded that the knowledge produced during the realization of research projects usually remains barely capitalized (in general, only the final results are capitalized). In this context, the concept of artifact seems useful to us. Hutchins [14] says that artifacts are "repositories of knowledge… constructed in durable media". Michaux and Rowe [22] add that "artifacts contain a part of the knowledge necessary to conclude a daily action with effectiveness: the other part being held in a complementary way by men." Therefore, for us, an artifact is an element having a material form (or a virtual form, as it can exist only in a computer system) which can convey a part of the knowledge held by its author, provided that its receiver knows the context in which it was conceived and has the necessary knowledge for its interpretation. In this sense, artifacts give a representation that can be stored and potentially, shared and re-used.

In the research context, we observed that within the realization of research projects there is a great quantity of artifacts produced. Given that those convey knowledge, we will focus on artifacts capitalization. The question is now: how to capitalize these artifacts like means to facilitate the realization of other research projects? In order to answer this question, we started by analyzing the means by which artifacts are produced during the realization of a research project. This analysis is shown in the next section.

## 4.2 How Are Artifacts Produced?

Based on the sociology of science literature and on our own observations, we propose a representation of research projects that is inspired on the SADT (Structured Analysis Design Technique) modelling (see Figure 1). We added some additional formalisms that allow us to differentiate, regarding the activities performed, between routine activities, semi-routine activities and intellectual activities and, regarding the outcomes obtained, among main results, secondary results and un-used documents.

In figure 1, we present one level of the model (in order to allow its visibility). It shows two main aspects. First, the non-linearity of research projects, as researchers are frequently obliged to go back to previous phases of the project. Second, the existence of routine and semi-routine activities, even though research projects as a whole are essentially non repetitive. This is very important for our purpose, because we can expect to be able to introduce practices or tools offering some support to these activities.
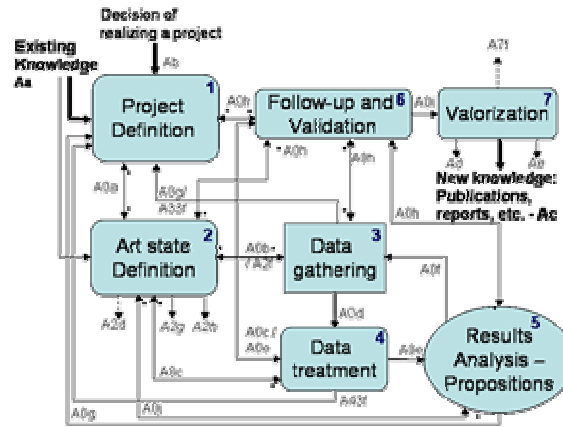
Figure 1.  Representation of Research Projects

Additionally, there are two important aspects to note about this model. First, it is purposely general and not centred in a specific research domain[1]. Moreover, as we are interested in the artifacts produced, we focus on the *arrows* and not in the *boxes* contained in the model, as the first ones show the artifacts produced during a research project. Second, thanks to the model, we where able to identify 102 artifacts. For comprehension purposes, we classified them into three categories: those related to the bibliography (publications, research reports, books, researchers' notes to documents, concepts found in documents, etc.), those related to the management of the project (project plan, meeting reports, etc.) and those related to the intermediate results (software and hardware developed for a project, data gathered and treated, etc.). This description should help us find ways to capitalize these three kinds of artifacts, which is the subject we will present hereafter.

## 4.3   How to Capitalize the Artifacts?

In our quest for means to capitalize the artifacts, we identified mainly two possibilities: methodological tools and software tools. Regarding the methodological tools, we centred our attention on the methods of capitalization such as the one proposed by Bekhti and Matta [3]. However, in spite of the existence of several methods for the capitalization of project memory, those are not adapted to the characteristics of research projects, especially because of the dynamic environment and the non repetitiveness of the projects. That is why we were interested in the possibilities offered by information technology to capitalize artifacts as a mean to facilitate the realization of research projects.

The Existing Software Tools for Knowledge Management:

In our quest for ways to structure artifacts, we started by looking at the KM tools actually available on the market. Baroni de Carvalho R and Araújo Tavares M. [2] have defined knowledge management (KM) software as "a kind of software that supports any of the three basic KM processes (Davenport & Prusak, 1998): generation, codification and transfer". The result of this work is presented in [15]. Here, we will only state that, we see that the situation regarding KM tools could be briefly presented as follows:

- There are a number of interesting tools offering functionalities for project management,

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[1] Nevertheless, this model is based on observations made mainly at an engineering laboratory.

- there are a few tools offering functionalities for data management, which could support the management of data gathered and treated;

- finally, some tools manage particular aspects of the management of the bibliography: Document management, management of references and visualization of references

Some Software Tools Developed by Research Institutions for Managing Research Knowledge:

We have been able to identify some of the efforts done by researchers for the capitalization of knowledge in scientific activities. Among these works, we find[2]: The Digital Document Discourse Environment [6] that facilitates the process of peer review by allowing adding annotations to scholarly documents and turning them into "a structured discussion website";ScholOnto [6], an ontology "designed to support scholars in making claims by asserting relationships between concepts"; and ANITA [13], a tool that allows annotating scholarly documents or parts of it. These tools present some very interesting features. However, most of them don't take into account the capitalization of the artifacts used and produced while doing bibliographical research. For this reason, we decided to work towards the definition of a tool that could support this activity.

## 5 The Design of a Tool for Capitalizing Knowledge from Bibliographical Research

Given the absence of a tool allowing managing and capitalizing the artifacts used and produced through the realization of bibliographical research, we have decided to concentrate on the definition of a tool supporting this aspect. By bibliographical research we mean all the relation a researcher, a project team and even a laboratory as a whole, have with bibliographical sources. For that reason, we start by studying this relation and then, use it as a basis for performing some analyses for defining the specification of the proposed tool.

### 5.1 The use of bibliographical documents in the scientific activity

In this section, we will look into some studies about the practices of scientists regarding bibliographical documents. A first work we find useful is the one of Meho and Tibbo [20]. They propose a model of the information-seeking behaviour of social scientists, which we will slightly modify for using it as a framework for analyzing the scientists' practices related to the bibliographical documents. Thus, we will analyze it at three stages: The identification, the processing and the use of documents.

- The identification of bibliography: The first stage in the bibliographic research process is the identification of possibly useful documents. The studies focused on this stage show the importance of journal articles [9], [33], [5], particularly in electronic format [33], as well as other sources of information, such as personal contacts [37], [5], [33]. In addition, it shows the importance of personal collections of articles, maintained by researchers as bases for their activities [37], [5].

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[2] Other interesting works are: Epistheme [26], the Software for Technology Intelligence System – STIS [18], the Knowledge Sharing System being developed at Nectec [38] and the architecture proposed by Sarini et al. [31] for supporting biologists work by using a system based on electronic notebooks.

- The processing of bibliographic information: This processing involves the reading of the information gathered in order to assimilate its contents. The works on this stage show that scientists spend increasingly important time reading [33] and that the basic element for tracing the impressions had while reading is the annotations[3] [25], [19], [27].

- The use of bibliographic documents: The works studying this stage show the importance of bibliographic research for: positioning the work, acknowledging colleagues' works, improving experimental design [40] and writing new documents, among others. Additionally, it may help as one of the bases for conferring confidence in the new documents written [40]. The latter is a process of re-aggregating pieces of information [27] that may be collaboratively achieved by a group of researchers [8].

These aspects reflect the bases of the scientists' practices regarding bibliographic documents. We will use these practices as an input to take into account for establishing the specifications of the tool. For that purpose, the first analysis we have attempted is the functional analysis, which we present hereafter.

## 5.2   The Functional Analysis

In order to start our search for a way of capitalizing the artifacts produced when carrying out bibliographical research, we made a functional analysis (see Figure 2). We identified three actors: The researcher working on an individual basis, the project team, where the researchers interact and the laboratory as a whole, where the different project teams interact and share the knowledge acquired. These three actors interact mainly with two entities for doing the bibliographical work: The external and the internal sources of information; both of them are continually enriched through the work done by the project teams for allowing its sharing.



Functions:
F1: To locate and analyze interesting information in the external information sources.
F2: To choose and to analyze interesting information available in the internal information sources.
F3: To bring relevant information to a project in progress
F4: To allow the enrichment of the information available in the internal information sources.
F5: To share the bibliographical information collected and produced.
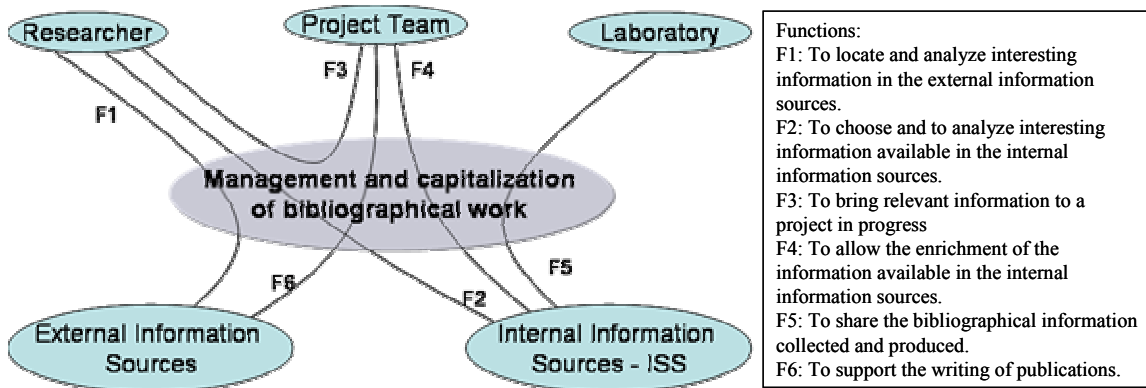F6: To support the writing of publications.

Figure 2.  Functional Analysis of a tool for managing and capitalizing bibliographical work.

With this specification of the functions the system should respond to, we verified if the KM tools already identified (see section 4.3) could respond to them. We concluded that there exist tools that support some of the functions identified. However, they only offer a partial support to all the interaction of a researcher with the bibliographical artifacts and they do not manage them as a support to the development of research projects. Moreover, they do not address the

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[3]   Sohn et al. [32] write: "annotation in a document environment consists of text added for the purpose of explanation, description or emphasis on the subject of a document (Marshall, 1997, 1998b; Ovsiannikov et al., 1999). They are illustrated with style types such as underline, symbol, and note (Marshall, 1997; O'Hara and Sellen, 1997). Nowadays annotation technique is used widely in the electronic document environment (Roscheisen et al., 1995; Dymetman and Copperman, 1998)."

management of the scientific concepts that appear in the bibliographical sources, which is very important for the research activity. In fact, according to Dunbar [10] "many researchers have noted that an important component of science is the generation of new concepts and modifications of existing concepts." That is why we intend to support this process by supporting the bibliographical work linked to it.

It is important to note that what we intend is to facilitate the process that allows researchers acknowledge the diversity of approaches found in the scientific literature for a same concept. In fact, we have noted that part of the work a research project team has to do is precisely accounting this diversity and defining if one of the identified approaches can be used or if it is necessary to develop a new one. This process allows the team to build the conceptual framework of the project and serves as a support to the other activities carried out during its realisation. The objective is to share this work with other members of the organization as a way of building a more comprehensible view of the domains in which the organization develops its research. Nonetheless, it is important to mention that we do not intend to build domain ontologies, but quite the contrary, we want to provide researchers a way of acknowledging diversity.

## 5.3   The Model of the System with UML

In order to build a proposition of a functional specification of the system, we modelled the system with UML (Unified Modelling Language – See Figure 3).
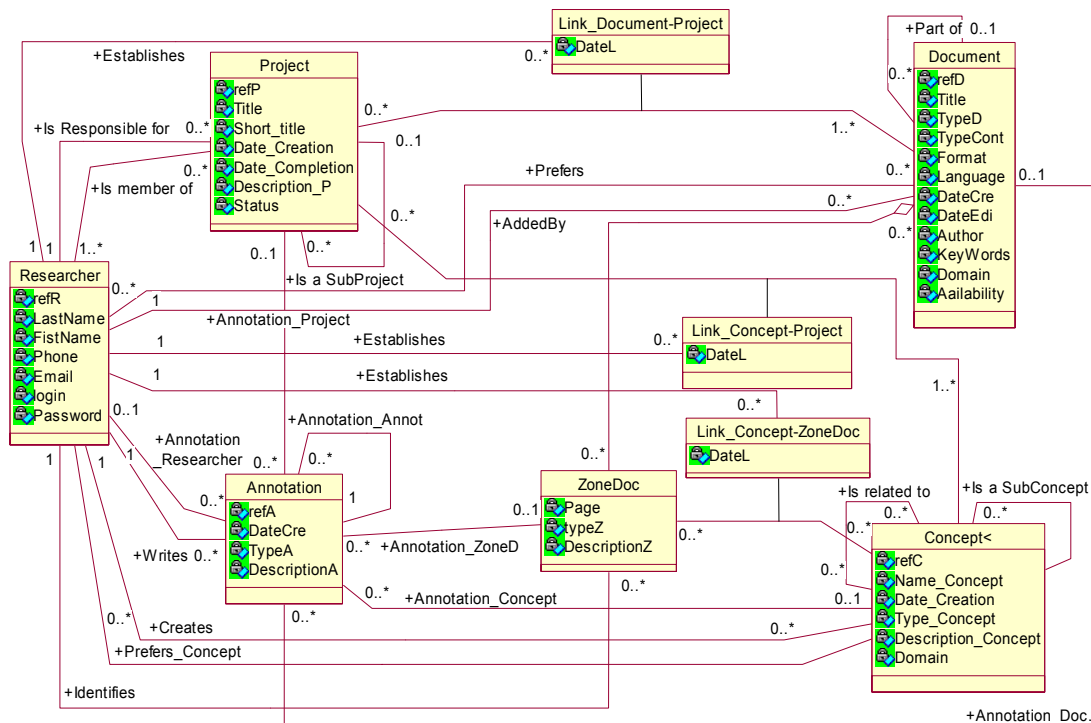


Figure 3.   Class Diagram for a support system for the realization of bibliographical work

We started by identifying the users as follow: (i) Individual Researcher, who locates the contents containing interesting scientific concepts according to his/her area of research; (ii) Researcher member of a project team, who uses concepts for treating a scientific question; (iii) Administrator, who might modify the information contained in the system.

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For each user identified we constructed its corresponding use case diagram. This allowed us to establish the different classes interacting in the system. The identified classes are: (i) Researcher, who represents the users; (ii) Document, represents the documents that can contain concepts, (iii) Document zone, the zones of a document containing a concept or any information considered interesting for the researcher; (iv) Concept, a definition or the description of a concept, (v) Annotation, an annotation about one or more instances of the identified classes; (vi) Project, which represents the spaces where the instances of the other classes are used in order to produce new. When developing a research project, researchers use these elements identifying, choosing, interiorizing and reconfiguring them according to the phenomenon being studied through a research project. This process is represented through the some additional elements representing the links among the identified classes. The interactions among these classes are represented in the diagram shown in figure 3.

This model allows us to establish the basis for the specifications of the software tool proposed. We will now present the scenarios of utilization we have foreseen in order to arrive to a greater degree of detail in the specifications of the tool.

## 5.4 The Scenarios of Utilization

We have analyzed the scenarios where the tool would probably be used. For doing so, we have started by looking at the activities already done by researchers when doing bibliographical research, without any special tool for supporting their activity. This allows us to identify eight scenarios:

- Researcher searching for documents

- Researcher reading documents: Identifies scientific concepts (may find similarities with other scientific concepts), reads annotations previously done by other researchers, writes annotations (to previous annotations, to the document, to specific document zones, to scientific concepts)

- Researcher writing documents: Uses concepts, incorporates parts of other documents, cooperates with other researchers, formats the document

- Researcher searching for concepts: finds documents containing the concept, finds projects using or having used the concept, finds researches using or having used the concept

- Researcher developing concepts: Uses concepts and documents

- Researcher searching for other researchers: Finds researchers matching the research criteria

- Researcher searching for projects: Finds the concepts and the documents used at different stages of the project, finds the researchers that participate at its development

- Researcher participating at projects: Identifies scientific concepts and documents useful for the project in general or for specific aspects of it

These scenarios can be represented by figure 4. This figure shows the different ways in which a researcher could interact with the tool when doing its bibliographical research. We have also represented the relations among the different elements that appear in this activity: Researchers, projects, documents, concepts and annotations. This analysis, together with the previous one we have performed (mainly the UML modelization and the functional analysis),

has allowed us to define the main functionalities that the tool should have for supporting the researchers' activities.
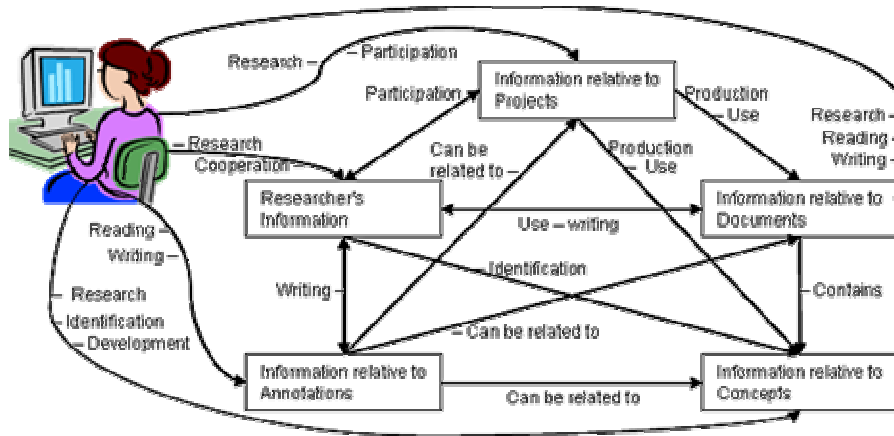


Figure 4.  Scenarios of utilization of a tool for supporting bibliographic research

## 5.5   The Functionalities of the Tool

We have started by defining three levels at which the interaction among the identified elements can appear. That is: At an individual researcher level, at a project level, and at the laboratory level as a whole. This means that a researcher may be working by himself or as part or a project and in doing so he may share the result of his own bibliographical research and profit from the one done by his fellows at the organization. This is coherent with the position of Anell [1] about the three levels at which learning must occur[4]. At each of these levels it is necessary to manage documents, concepts and annotations. For supporting the researcher with these tasks, we have identified the main functionalities he would need and we have represented them in a graph-like form. In figure 5 we show the identified functions for the project level.
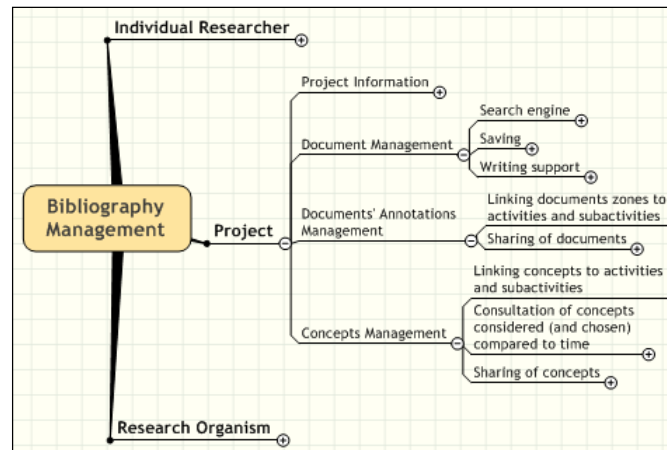


Figure 5.  Tool's main functionalities

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[4]  According to Anell [1] "learninig must occur at at least three levels. The first level is the individual level… The next level is the group level....Learning must also occur on a third level which is, of course, the organizational level. If acquiring and sharing new knowledge do not permeate the whole organization, it will become unbalanced and not be able to use the new knowledge learning has created."

These functionalities reflect some basic principles we consider fundamental: The tool should support the researcher working individually, support the development of research projects and improve knowledge sharing among all the members of a research organization. Additionally, there are some features we think are essential. They are: Flexibility, easiness of use, adaptation to the general researchers' practices and maintainability. These features should help us overcome some of the barriers that appear when introducing a software tool.

We have established the main functionalities, features and scenarios of utilization the envisioned tool should have. The next stage is then the development of a prototype, which should serve for demonstrating, in a practical way, the functioning of the tool.

## 6    The Prototype of the Tool

The analyses we have done have allowed the establishment of the specifications of the tool, which we use for the development of a prototype. In this section, we will present the technical aspects of the prototype and the results we have had in the first essays we have done with it.

### 6.1    The technical aspects of the prototype

One of the first aspects we defined regarding the prototype was that it should function as a Portal. This allows avoiding inconveniences in the installation (as it is done only once), facilitates maintenance and provides transparency for the users (as the prototype should work through the Internet navigator, independently of the actual location of the application and the documents potentially incorporated in it). This also facilitates the collaborative work.

Another important aspect was ease of development. In fact, in the actual stage of our research we aim at analysing if the proposed approach could be helpful for researchers. We do not aim the development of the actual tool. This, we hope, will be undertaken at a future stage. For that reason, we chose the PHP language. In addition, we use MySQL for the storage of the artifacts. This is one of the Data Base Management Systems commonly used for Web applications. The combination PHP – MYSQL, was done by using EasyPHP. Additionally, we used Macromedia Dreamweaver MX for the development of the portal.
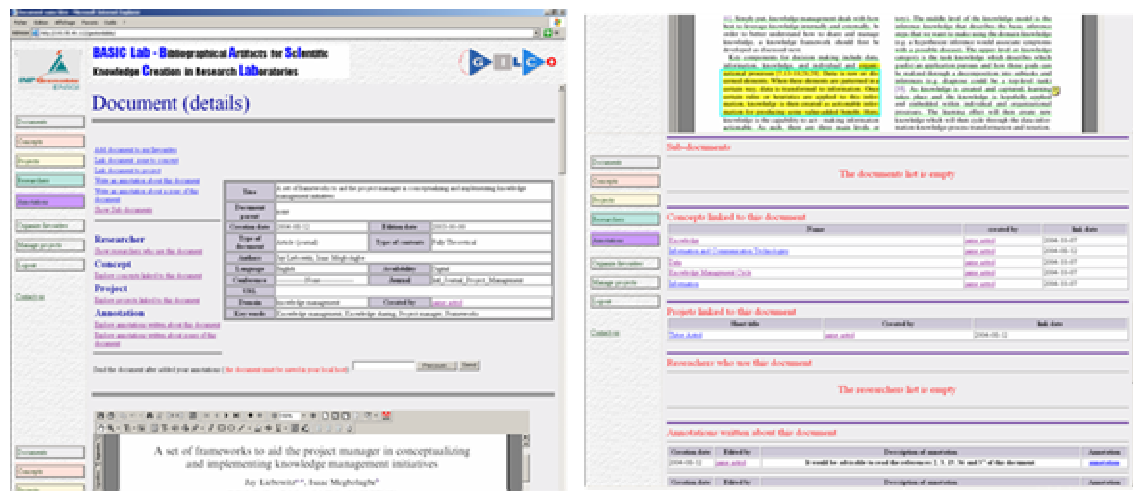


Figure 6.   One of the screens of the prototype

Additionally, for the management of annotations, we took advantage of the functionalities offered by Adobe Acrobat 5.0 to add annotations to a PDF document. In this way, the graphic aspect of the annotation can be managed with the functionalities offered by Acrobat, while their contents (free text) are managed through the data base, in order to allow operations such as registry, search, select (to a favourites list) and establish links among the different artifacts contained in the data base. Figure 6 shows one of the screens of the prototype.

## 6.2 The results of the firsts tests of the prototype

The prototype allows adding documents and annotations to a centralized repository, to create projects and concepts and to define document zones. These elements can be linked together in order to use them for a particular interest. For example, a researcher can add a document judged interesting. Then, he may define the zones of the documents considered to be the most interesting ones, establish where in the document are the explanations of the scientific concepts used by the author(s) and add comments to the document or to zones of it. The researcher could also select some elements to keep in his personal list of favourites and choose the ones thought to be potentially valuable for a particular project. The other team members of a project could also include other artifacts thought to be useful for studying a phenomenon, sharing in this way a part of their knowledge. Additionally, the elements in the prototype are hyperlinked, to facilitate the navigation among them and the access to the different artifacts. Nowadays, the prototype is installed on a server, which allows that several users access it at the same time.

Until now, the essays have being done individually. For this purpose, we have presented the tool and its functionalities to a potential user, who can then use it for a short period of time (usually, no more than half an hour), then give us his impressions and afterwards continue using it if he wants to. This procedure has been done with two senior researchers and six graduate students. They all express a positive impression of the tool and the available functionalities. Its functioning is easily grasped and learning the bases for using it is done in only a few minutes because it is mostly intuitively understood. However, most of them have chosen not to continue using the tool do so because of the "capture bottleneck" [24]. This, in spite of the recognized possibilities of the tool and the current inconveniences faced. Thus, one very important improvement would be to facilitate the capture of the references in order to diminish the time spent in this task and motivate researchers to exploit its full functionalities.

## 7   Conclusion

We are interested in research organizations, as institutions committed to the creation of new knowledge. We did a fieldwork to know the influence that QM implementation could have on the introduction of KM practices. We observed a weak use of KM practices and a focus on the capitalization of the final results obtained from research activities. However, we acknowledge the importance of the capitalization of the knowledge produced and acquired during the realization of a project Therefore, we propose an approach for addressing KM in this kind of organizations focused on the capitalization of the artifacts produced when carrying out bibliographical research, including the manipulation of scientific concepts. We established the basis for the specification of the tool through the modelling of the system with UML and a scenario-based analysis. We have used these specifications for developing a

prototype of the tool. The first tests are encouraging and verify the possibilities the tool offers for the capitalization of the bibliographical work done in the framework of a research project.

## Acknowledgments

## References

[1]   Anell B., "Patterns of Success and Failure in Renewal Projects. A Study of Eight Projects for Developing a Learning Organisation", In: Lundin R. and Midler C. (Edited by), Projects as Arenas for Renewal and Learning Processes, Kluwer Academic Publishers, Boston (USA), (1998), pp. 99 – 113.

[2]   Baroni de Carvalho R, Araújo Tavares M., "Using Information Technology to Support Knowledge Conversion Processes", Information Research, Vol. 7 No. 2, January 2002, (http://informationr.net/ir/7-1/paper118.html, accessed on September 16th, 2004).

[3]   Bekhti S., Matta N. "Project Memory: An Approach of Modeling and Reusing the Context and the Design Rationale", Proceedings of the Knowledge Management and Organizational Memories Workshop, Eighteenth International Joint Conference on Artificial Intelligence, IJCAL 2003, Mexico, August 11, 2003, pp. 20 – 25.

[4]   Bénézech, D., Lambert, G., Lanoux, B., Lerch, Ch. and  Loos-Baroin J., "Completion of knowledge codification: an illustration through the ISO 9000 standards implementation process", Research Policy, Vol. 30, 2001, pp. 1395-1407.

[5]   Brown, C. M. "Information seeking behavior of scientists in the electronic information age: Astronomers, chemists, mathematicians, and physicists", Journal of the American Society for Information Science, Volume 50, Issue 10, 1999, pp. 929-943.

[6]   Buckingham Shum S., Motta E., Domingue J., "Managing Research Knowledge in Distributed Communities: Two Approaches to Argumented Web Infrastructures", Proceedings. IEEE 8th International Workshops on Enabling Technologies: Infrastructure for Collaborative Enterprises, WET ICE'99, Stanford, CA, USA. 16-18 June 1999, pp. 259 – 266.

[7]   Chalmers A. "La Fabrication de la Science", Editions La Découverte, Paris, 1991.

[8]   Cronin, B. "Bowling Alone Together: Academic Writing as Distributed Cognition" (Brief Communication), Journal of the American Society for Information Science and Technology, Volume 55, Issue 6 , 2004, pp. 557 - 560.

[9]   Davis, P. M. "Information-Seeking Behavior or Chemists: A Transaction Log Analysis of Referral URLs", Journal of the American Society for Information Science and Technology, Volume 55, Issue 4, 2004, pp. 326 – 332.

[10]  Dunbar,        K.        "Scientific        Thinking        and        its        Development", (http://www.dartmouth.edu/~kndunbar/DunbarMITECS.pdf, accessed on Oct. 27/2004).

[11]  Galandere-Zile, I., Vanags, J., Kirikova, M. "Towards knowledge management system for quality management: improving effectivity of organizations". In Haav, H-M., Kalja,

A. (Eds.), Databases and Information Systems, Proceedings of the Fifth International Baltic Conference. vol.2, 2002, pp. 27-38.

[12] Gandon F., Dieng R., Corby O., Giboin A., "Web Sémantique et Approche Multi-Agents pour la Gestion d'une Mémoire Organisationnelle Distribuée", Proceedings of the IC'2002 Conference, 13ème journées francophones d'Ingénierie des Connaissances, Rouen, May 28 – 30, 2002, pp. 15 – 26.

[13] Gardoni M., Jaime A., Frank C., "Harnessing Communication in Research Projects", Proceedings of the Cybernetics and Information Technologies, Systems and Applications, CITSA 2004, Orlando, USA, July 21-25, Information Technologies and Computing (Proceedings on electronic format).

[14] Hutchins, E., "Cognition in the Wild", The MIT Press, Massachusetts Institute of Technology. (Third Printing), Cambridge, Massachusetts (USA), 1995.

[15] Jaime A., Gardoni M., Mosca J., Vinck, D., "Quality Management, Framework of Knowledge Capitalization at Research Organizations", IAMOT 2004 - International Association for Management of Technology. Washington, D.C. (USA), April 3 - 7, 2004 (http://arago.cprost.sfu.ca/~smith/conference/viewpaper.php?id=709&cf=4, accessed on March, 11th, 2005).

[16] Johannsen, C. G. "Total Quality Management in a Knowledge Management Perspective", Journal of Documentation, Vol. 56, No. 1, January 2000, p. 42 – 54.

[17] Linderman, K., Shroeder, R. G., Zaheer, S., Liedtke, C., Choo, A. S. "Integrating quality management practices with knowledge creation processes", Journal of Operations Management, Vol. 22, 2004, pp. 589–607.

[18] López-Ortega E., Alcántara T., Briceño S. "Technology Intelligence System Implementation: The Mexican Institute of Engineering Experience", Proceedings of the IAMOT 2004 Conference, IAMOT, Washington, D. C. (USA), 3-7, April, 2004, (http://arago.cprost.sfu.ca/~smith/conference/viewpaper.php?id=1150&cf=4, accessed on March, 11th, 2005).

[19] Marshall, C. C., Bernheim Brush, A. J., "Exploring the Relationship between Personal and Public Annotations", ACM/IEEE-CS Joint Conference on Digital Libraries, Proceedings of the 2004 joint ACM/IEEE conference on Digital libraries - SESSION: Supporting personalization, Tucson, AZ, USA, 2004, pp. 349 – 357.

[20] Meho, L. I., Tibbo, H. R., "Modeling the information-seeking behavior of social scientists: Ellis's study revisited", Journal of the American Society for Information Science and Technology, Volume 54, Issue 6, 2003, pp. 570-587.

[21] McAdam, R. "Knowledge creation and idea generation: a critical quality perspective", Technovation, Vol. 24, 2004, pp. 697–705.

[22] Michaux V., Rowe F., "Grille d'Analyse des Situations de Coordination Médiatisée par un Système d'Information Informatisé", Proceedings of the CITE'2003 Conference, UTT, Troyes, 3 – 4 December, 2003, pp. 163-187

[23] Molina, L.M., Lloréns Montes, F.J., Fuentes Fuentes, M. del M., "TQM and ISO 9000 Effects on Knowkledge Transferability and Knowledge Transfers", Total Quality Management, Vol. 15, No. 7, September 2004, pp. 1001-1015.

[24] Motta, E., Buckingham Shum, S., and Domingue, J. (2000) Ontology-driven document enrichment: principles, tools and applications, Int. J. Human-Computer Studies, Vol. 52, pp. 1071 -1109.

[25] O'Hara K., Smith F., Newman W., Sellen A., "Student readers' use of library documents: implications for library technologies", Conference Proceedings on Human Factors in Computing Systems CHI'98, ACM Press, New York, 1998, pp.233-240.

[26] Oliveira J., Moreira de Souza J., Strauch J.C.M., Marques C., "Epistheme: A Scientific Knowledge Management Environment in the SpeCs Collaborative Framework", Computers in Industry, Vol. 52, Issue 1, September 2003, pp. 81-93.

[27] Peterson Bishop, A., "Document structure and digital libraries: how researchers mobilize information in journal articles", Information Processing and Management, Vol. 35, 1999, pp. 255 – 279.

[28] Pfeifer, T., Freudenberg, R., Hanel, G. "Using knowledge management to improve quality", Proceedings of 2nd IFIP Working Conference on Infrastructures for Virtual Enterprises, Kluwer Academic Publishers, Norwell, MA, USA., 4-6 Dec., 2000 Florianopolis, Brazil, pp. 495-504.

[29] Rodríguez-Ortiz, R. "A Knowledge Management and Quality Model for R&D Organizations", Lecture Notes in Computer Science, Springer-Verlag Heidelberg. ISSN: 0302-9743, Volume 2773 / 2003. In: Proceedings of the "Knowledge-Based Intelligent Information and Engineering Systems: 7th International Conference", KES 2003 Oxford, UK, September 3-5, 2003, Proceedings, Part I., pp. 1000 – 1007.

[30] Salter, A. J., Martin, B. R., "The economic benefits of publicly funded basic research: a critical review", Research Policy, Vol. 30, 2001, pp. 509 - 532.

[31] Sarini M., Blanzieri E., Giorgino P. and Moser C., "From Actions to Suggestions: Supporting the Work of Biologists through Laboratory Notebooks", Cooperative Systems Design: Scenario-Based Design of Collaborative Systems. Proceedings of the 6th International Conference on the Design of Cooperative Systems – COOP'04, Darses, F., Dieng, R., Somine, C., Zacklad, M. (Eds.), IOS Press, French Riviera, France, May 3-7, 2004, pp. 131 – 146.

[32] Sohn, W.-S., Kim, J.-K., Ko, S.-K., Lim, S.-B. and Choy, Y.-C., "Context-based free-form Annotation in XML Documents", International Journal of Human-Computer Studies. Volume 59, Issue 3, September 2003, pp. 257-285.

[33] Tenopir, C., King, D. W., Boyce, P., Mitchell, M., Grayson, M., Zhang, Y. and Ebuen, M. Patterns of Journal Use by Scientists through Three Evolutionary Phases, D-Lib Magazine, Volume 9 Number 5, 2003, ISSN 1082-9873 (http://www.dlib.org/dlib/may03/king/05king.html, accessed on March 14th, 2005).

[34] Tijssen, R. J.W., "Is the commercialisation of scientific research affecting the production of public knowledge? Global trends in the output of corporate research articles", Research Policy, Volume 33, Issue 5, July 2004, pp.709-733.

[35] Tsai, B. "Information Landscaping: information mapping, charting, querying and reporting techniques for total quality knowledge management", Information Processing and Management, Vol. 39, 2003, p. 639 – 664.

[36] Vinck, D., "Sociologie des Sciences", Armand Colin Editeur, Paris, 1995.

[37] Von Seggern, M., & Jourdain, J. M. "Technical communications in engineering and science: The practices within a government defense laboratory",Special Libraries, Vol. 87, Issue 2, 1996, pp. 98-119. In: Hertzum, M., Pejtersen, A. M., "Information Seeking Practices of Engineers: Searching for Documents as well as for People", Information Processing and Management, Vol. 36, 2000, p. 761 - 778.

[38] Vorakulpipat C., "The Design of Knowledge Sharing System in Research Organization", Proceedings of the IAMOT 2004 Conference, IAMOT, Washington, D. C. (USA), 3-7, April, 2004. (http://arago.cprost.sfu.ca/~smith/conference/viewpaper.php?id=712&cf=4, accessed on March, 11th, 2005).

[39] Wunram M., Weber F., Pawar K. S., Gupta A., "Proposition of a Human-centred Solution Framework for KM in the Concurrent Enterprise", Proceedings of the 8th International Conference on Concurrent Enterprising – Ubiquitous Engineering in the Collaborative Economy, Pawar, K., Weber, F., Thoben, K.-D. (Eds.), ICE 2002, Rome, Italy, 17th-19th June 2002, pp. 151 – 158.

[40] Yore, L. D., Hand, B. M., Prain, V. " Scientists as writers", Science Education, Volume 86, Issue 5,  September 2002, pp. 672-692.

[41] Zhao, F., Bryar, P. "Integrating Knowledge Management and Total Quality: a complimentary process", Proceedings of the 6th International Conference on ISO 9000 and TQM, Scotland, April 2001 (http://www.cmqr.rmit.edu.au/publications/fzpbicit.pdf, accessed on March 14th, 2005).

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