World Academy of Science, Engineering and Technology
International Journal of Humanities and Social Sciences
Vol:5, No:11, 2011

Knowledge Management Applied to Forensic Sciences

Norma Rodrigues Gomes

***Abstract*—**This paper presents initiatives of Knowledge Management (KM) applied to Forensic Sciences field, especially developed at the Forensic Science Institute of the Brazilian Federal Police. Successful projects, related to knowledge sharing, drugs analysis and environmental crimes, are reported in the KM perspective. The described results are related to: a) the importance of having an information repository, like a digital library, in such a multidisciplinary organization; b) the fight against drug dealing and environmental crimes, enabling the possibility to map the evolution of crimes, drug trafficking flows, and the advance of deforestation in Amazon rain forest. Perspectives of new KM projects under development and studies are also presented, tracing an evolution line of the KM view at the Forensic Science Institute.

***Keywords*—**Business Intelligence, Digital Library, Forensic Science, Knowledge Management

Open Science Index, Humanities and Social Sciences Vol:5, No:11, 2011 publications.waset.org/2406/pdf

I. Introduction

THE Forensic Science Institute (FSI) of the Brazilian Federal Police is the organization responsible for performing forensic exams in a set of knowledge areas like Chemistry (drugs analysis), Civil Engineering (construction evaluation), Environmental Engineering (environmental crimes), Economics (financial crimes), Computer Science (computer crimes), etc. One of the main functions of FSI is to produce scientific evidence to support judicial proceedings.

FSI has faced Knowledge Management (KM) as a strategy to gain and to develop learning, collaboration and innovation. Despite the non-existence of a formal KM department inside the structure of the FSI, there is an informal group working with KM, whose role has been to identify opportunities for implementing KM practices, seeking to overcome the challenges, which are in great part related to organizational culture.

Since KM represents a very broad concept, there is a variety of ways to address and to establish KM programs, methods or techniques. One interesting definition of KM, which has been used to guide FSI´s approaches in this area, it is presented by Madanmohan Rao in [1], page 3: "KM can be defined as a systematic discipline and set of approaches to enable information and knowledge to grow, flow, and create value in an organization. This involves people, information, workflows, enabling tools, best practices, alliances, and communities of practice". This poster presents a macro view of FSI´s organizational structure, followed by some successful initiatives related to knowledge sharing, drugs analysis and environmental crimes, all in the KM perspective. In conclusion, there will be indicated perspectives of new KM projects, some of them in progress, to be implemented inside the forensic science scope.

Norma Rodrigues Gomes is with the Brazilian Federal Police, SPO lote 07 Ed. INC, CEP 70.610-902, Brasília-DF, Brazil (phone: +55-61-2024-9341; fax: +55-61-2024-9367; e-mail: norma.nrg@dpf.gov.br).

II. FSI´s Organizational Structure

The FSI´s organizational structure is illustrated in Fig. 1, which presents the org chart of FSI with a view of all forensic areas linked to the Division of Forensic Exams, and also the areas linked to the Division responsible for Quality and KM.

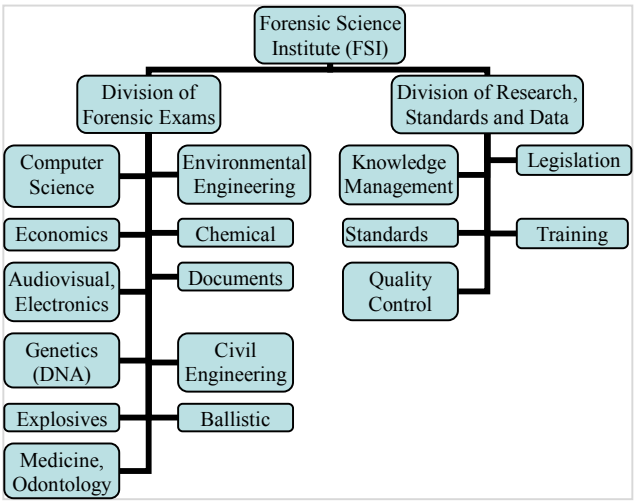


Fig. 1 Organization structure of Forensic Science Institute

As can be seen, FSI is a multidisciplinary organization that leads with a great variety of branches inside the forensic sciences field. For this reason, the organization uses and produces a large amount of data, that needs to be available and accessible in an appropriate way to the whole institute. This comprehends a wide universe of subjects that involves diverse themes ranging from computer crimes to DNA tests, for example, or from environmental crimes to drugs analysis. There is a national institute located in the country´s capital and also forensic units distributed all over the country, one in each Brazilian State. Working with KM in such a vast environment brings a lot of opportunities to improve the flow, production and use of knowledge in order to combat and elucidate a broad range of crimes. One basic need for this kind of organization is having a virtual environment where each forensic area has its own space to store and retrieve knowledge in an organized and agile way using web technology.

Open Science Index, Humanities and Social Sciences Vol:5, No:11, 2011 publications.waset.org/2406/pdf

In order to reach this type of necessity, FSI has developed a project of a digital library, which is described in the next section. The project has focused on equitable access and learning achievement for all members of the organization, aiming at the establishment of a culture of information and knowledge society.

III. BDCrim – Digital Library

BDCrim (Biblioteca Digital de Criminalística (in Portuguese) or Criminalistic Digital Library (in English)) is a project started in 2006 and launched in 2007, which is the milestone for KM at FSI. It was created to promote a multidisciplinary environment for the purpose of storing and retrieving relevant information from various forensic areas in various digital formats.

The contents are mostly technical and scientific in nature, such as scientific papers, details of relevant cases, patterns, resources for examinations, procedures manuals, among others. Besides the variety of technical and scientific information, it is essential that the relevant legislation in every area of forensics is constantly updated, without compromising the historical record given the frequent need to replenish preterit situations [2].

The Digital Library is organized into communities, which correspond to forensic areas. Each community has its content structured into collections that match the type of document that is stored (presentations, papers, cases, etc.). BDCrim was customized over a free software platform, called DSpace (www.dspace.org). Fig. 2 shows a view of BDCrim's structure.



Fig. 2 View of BDCrim's structure

Every digital document filed in BDCrim is indexed and can be classified according to its subject by using a controlled vocabulary created for each community. This *controlled vocabulary is a hierarchical representation of terms and concepts from a specific forensic area*, allowing a process of **information retrieval** more efficient.

One example of BDCrim's content is what is called digital patterns of security documents, like for example passports (it is a digital document that identifies the security elements of a passport). As an instance of BDCrim's use case, similarity was found between two cases of forgery of Malaysia's passport occurred in different states in Brazil, using the content inserted in BDCrim. Fig. 3 shows part of BDCrim's content used in these cases, highlighting the differences between the authentic passport (left) and the forged passport (right) of Malaysia.

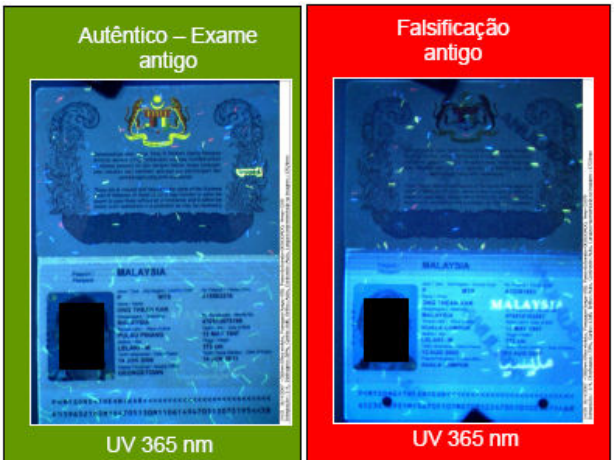


Fig. 3 Counterfeiting of Malaysia's passport (left: authentic passport, right: forged passport)

Currently, BDCrim has around 7,500 items distributed in its communities, and approximately 800 registered users. One of the big challenges to maintain the BDCrim alive and updated remains in motivating people to deposit new contents, emphasizing the ongoing effort to establish a culture for using this *sharing knowledge tool*.

IV. KM in Specific Forensic Areas

Given the FSI´s multidisciplinary environment, comprehending the wide range of knowledge areas as described before, there is a large variety of opportunities to implement KM practices. This section presents two KM projects developed for two specific forensic areas: chemical and environmental engineering. To each project is presented a brief resume, followed by their main results, perspectives and challenges.

A. PeQui

PeQui (Perfil Químico (in Portuguese), or Chemical Profile (in English)) is a project started in 2006 and launched in 2009, that allows the chemical profile tracing of drugs (cocaine and ecstasy) apprehended across the country and the identification of characteristics such as: origin of the drug, products used for its manufacture, traffic transport conditions and purity of each sample. *Combined* with the investigation results, these data are *transformed in knowledge* establishing connections between criminal groups and suppliers, tracing traffic routes and identifying products that must be a control priority in each of the country's regions [3].



Fig. 4 Picture of the chemical forensic lab at FSI

Fig. 4 shows the laboratory where the drugs analysis is performed, using specific equipments (gas chromatograph with mass spectrometry technique).

As an example of results, in 2009, it was possible to conclude that cocaine seizures made in three different regions of the country (200 kg in the northeast, 50 kg in the north and 1 kg in the west-center) had the same origin.

The implementation of a database system for importation and processing of analytical results is in progress [4]. In this sense, it is important to use a graphic visualization *KM tool* in order to be able to establish all the possible connections among the samples, providing an entire view of a situation under analysis. Fig. 5 shows an example of this kind of graphic view.

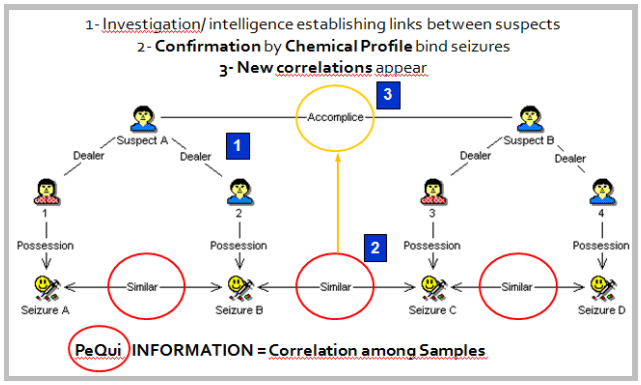


Fig. 5 Correlation among drugs samples using PeQui (Source: Chemical Forensic Laboratory at FSI)

Among the challenges faced by this project, the head of the chemical forensics lab at the Brazilian Federal Police, Adriano Maldaner, quotes that "The greatest difficulty is to integrate the chemical labs, having all talking the same language" [5]. At this point, the construction of a *taxonomy* to be used in all the chemical labs would be very appropriate, as a *KM tool* to be implemented.

B. Inteligeo

INTELIGEO (Inteligência Geográfica (in Portuguese), or Geographic Intelligence (in English)) is a project started in 2008 and launched in 2010. It is a system developed to centralize, validate and make available geospatial data to be used in forensic, logistics, planning and control of police work.

Using the data available in the environment of INTELIGEO the users will be able to: find addresses, make planning of a police operation, look geospatial places that have been a crime scene and interact with different data formats, especially vector data (roads, rivers, environmental protection areas, mining licenses, territorial limits, etc.) and raster data (Satellite imagery, multi-spectral optical imagery, radar imagery, etc) from several sources. Fig. 6 shows the INTELIGEO functional Layout [6].

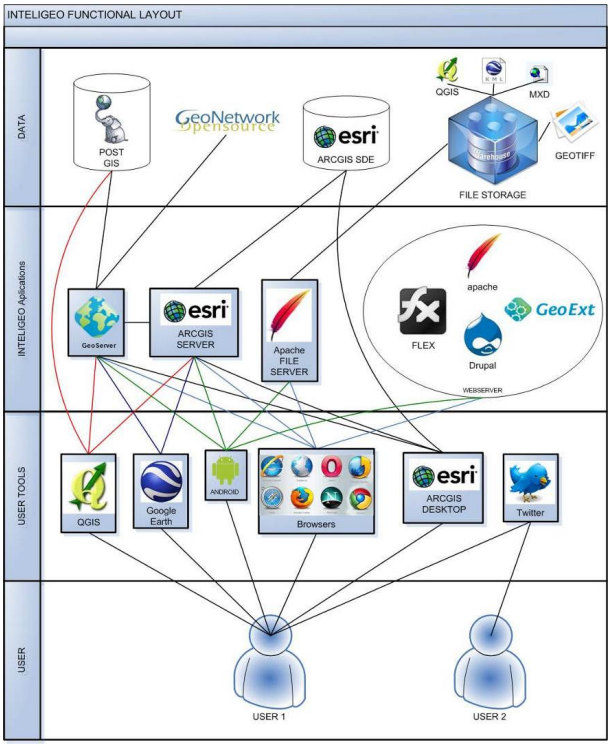


Fig. 6 Inteligeo functional Layout, which aggregates the best softwares from free and proprietary solutions [6]

The INTELIGEO´s staff has also considerate the risks and challenges involving the success of the project, like, for example: lost of the knowledge acquired in the project by the assignment of INTELIGEO team personnel to others jobs, which is an organizational risk [6]. In this sense, an initiative to elicit tacit knowledge from main experts involved in this project would be very interesting. One approach could be the deployment of processes or tools such as communities of practice (CoPs), best-practice repositories, or after-action reviews. These processes are easily adaptable for retention and transfer [7].

The perspectives of INTELIGEO usage will go beyond, enabling geospatial interactions like the possibility to make thematic maps of the evolution of crime, drug trafficking flows, the advance of deforestation in Amazon rain forest, and other crimes that have a geospatial reference. Geoinformation database will allow a statistical, multitemporal and correlational analysis, with possible connection to other criminal databases in order to crosscheck information and to

Open Science Index, Humanities and Social Sciences Vol:5, No:11, 2011 publications.waset.org/2406/pdf

effectively combat all types of crimes [6].

Therefore, on a KM perspective, INTELIGEO is a powerful tool to provide knowledge since it presents great characteristics related to *KM practices* such as Business Intelligence tools and Datawarehouse features.

V. New KM Projects

Facing KM as a continuous process, FSI has also new projects related to Business Intelligence (BI) and Text Mining, as it follows.

A BI application has being structured in order to provide strategic knowledge to support decision making. That will be a BI directed to statistical information about forensic exams production and requests under demand, involving all requests for forensic exams in the whole country. With this tool, the business managers will be able to analyze tendencies and predict the best actions to be taken to reach pre-established goals. This BI application will be implemented using an open source suite tool called Pentaho (www.pentaho.com).

Another KM project is related to the content of the scientific reports generated for all forensic exams performed in the forensic science units spread all over the country. Since these scientific reports are non-structured information, it is under studies the usage of a text mining tool to extract and discover knowledge in such a large amount of data. The idea is working with semantic content, meaning that will be necessary the development of specific ontologies to each forensic area in order to enable semantic search.

There are also other points of interest that need to be studied and analyzed like, for example, knowledge mapping issues. FSI has currently more than 1,000 Forensic Scientists working in almost 20 knowledge areas. In this scenario, a KM approach related to Expertise and Expert Locator tools would be highly recommendable.

Acknowledgment

FAPDF, for financial support.

VI. Conclusions

There are great opportunities to work with KM in the forensic sciences field. A Digital Library has shown to be essential to implement knowledge sharing at FSI. Specific forensic areas like Chemical and Environment Engineering has obtaining great results from their KM projects developed to combat drug traffic and environmental crimes, respectively. Acknowledgments to these FSI specific areas are due, since they contributed with the content of this work.

Based on the good results of the projects under development at FSI, new KM projects involving forensic sciences have been approved by the FSI managers with great perspectives of success. Therefore, all the KM initiatives described in this work have an important role in the permanent search for the establishment of a culture of information and knowledge society inside the organizations.

References

[1] Rao, M. Knowledge management tools and techniques:practioners and experts evaluate KM solutions. Elsevier Inc., USA, 2005.

[2] Gomes, N. BDCrim - Biblioteca Digital da Criminalística. Uma ferramenta para compartilhar conhecimento. Federal Expertness Magazine, Year IX – Number 26 – June, 2007 to March, 2008. http://www.apcf.org.br/AgênciaAPCF/AudioVisual/RevistaPericiaFederal.aspx

[3] UNODC. Crime Prevention and Criminal Justice: actions. UNODC – United Nations Office on Drugs and Crime, 2010. http://www.unodc.org/southerncone/en/crime/acoes.html

[4] Maldaner, A.; Botelho, E.; Zacca, J. and Vieira, M. Gerenciamento de ações voltadas para obtenção de Perfis Químicos de Drogas – Projeto PeQui da Polícia Federal. In Proceedings of the 34ª Reunião Anual da Sociedade Brasileira de Química (Florianópolis/SC, Brazil, May 23 - 26, 2011). http://sec.sbq.org.br/cdrom/34ra/editorial.htm.

[5] Torres, F. Tecnologia a serviço da investigação. Revista Inovação em Pauta, Number 5, 2009. http://www.finep.gov.br/imprensa/revista/edicao5/inovacao_em_pauta_5_pag37a42_cienciasforenses.pdf.

[6] Russo, D. and Blum, M. INTELIGEO – Geographic Intelligence - Brazil Case. In Proceedings of INTERPOL´S Pollution Crime Forensics Conference – 2011 (Lakewood, Colorado, USA, May 24 - 26, 2011).

[7] Liebowitz, J. Knowledge retention: strategies and solutions. CRC Press, Boca Raton, 2009.

Open Science Index, Humanities and Social Sciences Vol:5, No:11, 2011 publications.waset.org/2406/pdf