

KM and KA in International Cooperation

Lesson from the K-Link project in Central Asia

Gianluca Colombo¹, Alessio Vertemati¹, Emanuele Panzeri¹, Eva Grolíková² and Philipp Reichmut¹

¹*Siris Academic S.L., Av. Francesc Cambó 17, 9th floor B, 08003 Barcelona, Spain*

²*Palacký University Olomouc, Křížkovského 8 771 47 Olomouc, Czech Republic*

Keywords: Knowledge Management, Central Asia, International Cooperation, Organizational Development, Search Engine, Knowledge Artifact.

Abstract: The K-Link initiative concerns a Knowledge Management (KM) solution for Central Asian institutions committed to Sustainable Land Management (SLM) and Natural Resource Management (NRM) projects implementation in the framework of international development cooperation. It supplies a technical solution based on the use of a distributed network in which all data and information remain stored on each institution's server and can be accessed from each institution's website without the need to create a central hub. One of the main issue regarding the sharing of documents in the Central Asian context actually regards motivations for sharing. In fact the trigger for information sharing in Sustainable Land Management in Central Asia is given by the management of information. This principle verified and tested with the participant institutions led to the resolution to design and implement a specific Document Management System (K-DMS) in order to allow end users to get to know the sharing features of K-Link as special cases of more general information management ones. The K-DMS represents computer-based environment for the production and sharing of knowledge artifacts.

1 INTRODUCTION

The K-Link initiative concerns a Knowledge Management (KM) solution for Central Asian institutions committed to Sustainable Land Management (SLM) and Natural Resource Management (NRM) projects implementation in the framework of international development. It has been financed by GIZ GmbH and implemented by SIRIS Academic S.L; it started on December 2013 and ended up with a running pilot on June 2015. Before going through the K-Link project in details and showing how it is promoting knowledge artifacts production, a survey on both general and specific background conditions which motivate KM initiative in Central Asia in the framework of international cooperation need to be taken into account.

All five Central Asian states along with Azerbaijan were one of the poorest in the former Soviet Union. And when they became unexpectedly independent in 1991, they faced three large negative shocks: the end of central planning, the dissolution of the Soviet Union system, and hyperinflation. At first the shock in all Central Asian countries caused the fall of output, and increased their poverty and inequality but

each country faced it differently. The newly independent states emerged from the USSR with similar economic systems and some similarity in economic structure (Brill Olcott, 1998). However, by the twenty-first century their economies differentiated but not their political systems, for all of them had established super-presidential systems with concentrated power and weak legislatures (Pomfret, 2006). The level of economic growth in Central Asian countries also proportionally reflects the number of Internet users (IWS, 2014). The Global Information Technology Report (Dutta, Geiger and Lanvin, 2015) ranks Tajikistan 62nd, Kazakhstan 69th and Kyrgyzstan 111th out of 143 countries in terms the capacity for innovation (to what extent do companies/organizations have the capacity to innovate). And the same report ranks them 90th, 74th and 119th respectively in terms of impact of ICTs on new services and products (to what extent does ICT enable new business models). Unfortunately data for Uzbekistan and Turkmenistan were not included in the report. Based on this information it could be stated that (1) although the Internet penetration rate is not in all states as high as it could be, it is growing steadily, (2) in all states there is better capacity for innovation as well as for impact

of ICTs on new services and products than in one fourth of other countries in the world. Hence this situation can be used as a basis for usage of new technologies (ICTs etc.) for capacity building in Central Asia. According to Rondelli (2014) all actors (i.e. researchers, NGOs and institutions) in Central Asia have difficulties accessing knowledge, for even after years of study part of the existing data still escapes their attention. And (reflected) knowledge (e.g. best practices) itself contains the ability to change the learning (to develop capacities) of individuals, groups or society as a whole. Therefore a Knowledge Management approach to academic-practitioner and practitioner collaboration is one of the most effective ways in order to bridge the research-practice and practice-practice gap that is hindering the development of efficient problem-solving strategies.

These are the general motivations in which a KM initiative in Central Asian is necessarily framed. Regarding the specific motivations, this led the K-Link project implementation, some additional remarks on KM needs in Sustainable Land Management (SLM) need to also be considered.

Especially as Kyrgyzstan is one of Asia's most sparsely wooded countries, with a forest cover of only 4-5%. Despite that fact, the world's largest connected natural fruit and walnut forests are to be found in the south of Kyrgyzstan (Jalalabad and Osh Region). They are considered the origin of many domesticated fruit and nut varieties; the *in-situ* conservation of these wild varieties is of global importance. Those forests are located at an altitude of 1,100 – 1,800 m.a.s.l. and are inseparably connected to the adjacent biodiversity rich highland pastures (1,800 – 3,400 m.a.s.l.), in terms of their ecology and usage. At the same time, the forests form a significant basis for rural livelihoods and have important regulating functions for the downstream regions, e.g. for the water regime. The soils are important carbon sinks, thanks to their thick humus layers.

Degradation processes, induced by unsustainable resource use (firewood extraction, one-dimensional concentration of the management on nut harvesting, wood pasture), result already in a significant reduction of the water retention capacity of the forests. The forest stand has changed in its structure and has been reduced in its diversity. The harvests have decreased considerably harming the natural resilience of the forests. The negative impacts on the forests as well as the surrounding ecosystems are additionally exacerbated by the already perceived adverse impacts of climate change. The pressure on the forest resources increases steadily due to high levels of population growth. Uncontrolled settlement development leads

to a fragmentation of the forests (Borchardt et al., 2011; Swetnam et al., 1999).

Acknowledging the unique nature of the forests, a high variety of research on biodiversity and the breeding of new varieties of nuts and fruits was conducted already in Soviet times. After the independence of Kyrgyzstan namely Kyrgyz, German and Swiss **research institutes** did intensive research on the region, covering ecologic as well as socio-economic and management aspects.

Simultaneously, a multitude of steps to align the Kyrgyz forest sector towards multi-functional forestry and to include the local population in the management were undertaken within the scope of the Swiss KIRFOR Programme from 1995 to 2009. The walnut forests in the south of Kyrgyzstan were a pilot area for the implementation of participatory forest management approaches. This project has undoubtedly accomplished, however, fundamental reasons for the degradation of the forests prevail and new have occurred respectively. A very important reason for the degradation of the walnut forests is the unsolved issue of overgrazing of near to forest pastures and the unfinished reform of the pasture sector in Kyrgyzstan. **NGOs, State Agencies and Academics** with the support of the **GIZ** Regional Programme on Sustainable Use of Natural Resources in Central Asia are currently testing appropriate approaches for a better management of pastures in South Kyrgyzstan.

The paper is organized as follows. In section 2 Knowledge Management issues are framed with respect to the central Asian international cooperation needs. In section 3 the K-Link project is presented and discussed. In section 4 the K-Link is discussed taking into account the Knowledge Artifact design principles. In section 5 Conclusions and future directions are presented.

2 KM NEEDS FOR CENTRAL ASIAN SLM

Knowledge management platforms in its many forms can be used both to improve the way organizations communicate and to disseminate knowledge internally as well as externally. Generally, it could be said that even after many years of KM use most of the organizations are not yet taking maximum advantage of what new knowledge management systems and technologies have to offer (UNICEF, 2008). To do so the organizations should focus on sustainability, it means to decide on which areas their organizations need to

focus on, and how much effort, time and financial resources they are willing to invest.

The field of international cooperation in Central Asia is not so different from other regions it is just specific. Its specific functioning and all involved actors are described in detail below.

International Implementing Agencies. like GIZ is - are normally requested by donors - in the case of GIZ the German Federal Ministry of Economic Cooperation and Development [BMZ] - to elaborate project proposals on biodiversity preservation and poverty alleviation in Central Asia. Over the last decade large amount of projects have been focused on the walnut forests of Southern Kyrgyzstan.

In order to fulfil the request of Donors, implanting Agencies usually send a mission to the rural areas (e.g., walnut areas).

For their respective preparation as well as for compiling the project proposal according to the donors format and standards the implanting agency mission normally uses manifold different documents (Donors policy papers, implanting agencies country strategy, scientific papers on the project area, documentation and best practices of other projects in the region, etc.) The **NGOs** involved into the project proposal and future implementation are already approached during the project finding mission by the implementing agencies in order to develop a proposal for a training concept for local land users to enhance the pasture management in and around the area of interest (e.g., the walnut forests).

The selected NGOs have a long standing experience in developing trainings in the field of pasture management and sustainable land management in general. In order to develop an approach NGOs usually retrieve and study different kinds of documents.

Academics. e.g., University of Central Asia, which is well connected to the international Agroforestry Center (ICRAF) - are also involved into the process. Many valuable data and publications originating from Soviet times are actually stored in the institutions library. Many Universities in Central Asian have indeed established a wide national and international research cooperation network.

Based on that wealth of knowledge and contacts, researchers of the university in cooperation with research fellows from the EU Universities normally prepare a research project on monitoring the dynamics of biodiversity and condition of the target rural areas. An analytical study and baseline of the currently existing conditions is thus compared with historic

data and later with monitoring data at the mid and end of the planned donors financed development project. Normally also **private companies** take part into the process. The companies are looking for two things: firstly for new markets and export schemes (tax and tariff arrangements; standards; laws; experiences of nut producers in other countries). Secondly they are also committed to find out innovative schemes to connect them with huge importing companies on the international markets.

The **State Agencies** have of course a huge interest in an improvement of the current situation in SLM (e.g., walnut areas). This is due to the importance of the forests and water resources for the global efforts to preserve biodiversity. Accordingly to it, the State Agency highly welcomes the initiative of Donors to launch projects in that area. However, State Agencies, which are the political implementation partner of the planned projects, are aware of many other projects, which have been implemented or are under implementation there. In order not to double and to coordinate the new project with the others, the State Agencies are trying to compile an overview of past and present development projects for any specific area of interest (K-Link, 2015).

3 THE K-LINK PROJECT

According the above reported surrounding conditions and stakeholder needs, in the context of the K-Link (2015) initiative by Knowledge Management is meant the adoption of technologies to the support of reliable resources detection, organization and sharing among stakeholders working in SLM and NRM in the specific area on international cooperation in post-soviet countries. By “reliable resources” is here meant documentation regarding statistics, best practices, valuable past experiences of projects implementation (both positive and negative), scientific reports and deliverables. All these information sources mainly regards projects proposal building, implementation, monitoring and results that normally are spread into unstructured documents owned by single institutions, i.e. State Agencies, NGOs, Implementing Agencies and Academics all over Central Asia. The main requirement K-Link was expected to cover was, in other words, the stakeholders’ need to speed up the process of information access (Baeza-Yates and Ribeiro-Neto, 1999) and to reduce the information entropy provided by popular Web search engines. According to the requirements analysis carried out with the client and the stakeholders, three main constraints should have been also be taken into account:

- to enable sharing while respecting ownership of data and information,
- to support information management without imposing a single model for organizing the resources (documents and data) and
- without forcing end users to share.

The K-Link supplies a technical solution to this problem, based on the use of a distributed network in which all data and information remain stored on each institution's server and can be accessed from each institution's website without the need to create a central hub. Plugged into pre-existing content management platforms that run at the end-users institutions side, K-Link extends those systems with information retrieval, management and sharing features. On the one hand by applying state of the art content-based search engine to the parsing of local documents repositories, the K-Link offers a palette of services aimed at supporting users in information discovering and accessing. On the other hand the peer-to-peer software architecture enables end-users to share information with the networked institutions (or members of the institutions) without forcing them to use a central hub while respecting the freedom to decide what to share, with whom and when. Six institutions have been involved into the K-Link Pilot, namely one academic placed in Bishkek-Kyrgyzstan – the University of Central Asia (UCA), two NGOs one from Kyrgyzstan and the other one from Kazakhstan – Camp Alatoo and Ecomusem, the State Agency of Kyrgyzstan on Forestry Management, an Implementing Agency ICARDA and one private company from Kazakhstan that is CAREC.

3.1 The Peer-to-Peer Architecture

The K-Link architecture has been engineered to be modular and extendible to better fit the changing requirements and the different environments where the system would be integrated, while enforcing its distributed aspects.

The K-Link system is composed by two main components, namely the Core and the Adapters components: the K-Link Core (or in short KCore) component represents the heart of the distributed network and it is in charge of the document analysis and the text search features. The Adapters components are specific pieces of software that allow third-party Content Management Systems to be integrated with the K-Link system.

The KCore can be identified as a node in the distributed K-Link network and represents the entry point for the document textual analysis and the full-text search features; most of such functionalities are

exposed via dedicated Application Programming Interface (API) by using the RESTful paradigm. A KCore is responsible of the following aspects:

- Multi-format document indexing;
- Text and Geographical analysis and extraction;
- Document metadata extraction;
- Full-Text search (with document filtering and grouping capabilities);
- Secure API invocation with authentication and role-based permissions;
- Distributed network management, orchestration, scalability and information sharing;
- K-Link network status and components health-check;

Furthermore, the KCore has been designed to be able to support both the local institution “private” and the distributed (or “public”) document search. Particular attention has been used to secure a complete separation of the two ‘private’ and ‘public’ collections: the two set of document are, in the KCore, represented by two different search engines where the functionalities related to the ‘private’ documents collection is not accessible from the distributed network, this to avoid any private document data leaking.

The K-Link Adapters are specific pieces of software that allows a Content Management Systems (CMS), or other pre-existing document management software owned by the participant institutions, to access and interact with the K-Link services, by using the exposed KCore's APIs. An adapter is specific to a particular CMS: the K-Link project provides the adapters for the most common Open Source CMSes (Drupal, Wordpress, ModX). Additional adapters can be subsequently implemented by following the freely available KCore APIs specification, and the source code of the currently available adapters.

3.2 From Information Retrieval to Management

One of the main issues regarding the sharing of documents in the Central Asian context actually regards the following motivations: why should someone invest time for uploading and documents into an information sharing system? What is the benefit of sharing? After one year spent in discussing and negotiating with Central Asian stakeholders on these topics, we realized that the trigger for information sharing in Sustainable Land Management in Central Asia (SLM) is given by the management of information.

In other words, the sharing of information is a consequence of the management of information, not vice versa. This turns the question of information

sharing into a problem of the organizational development of the participating organizations, their internal information workflows and knowledge management processes. It is a consequence of the fact that the information to be shared is *about* something that is relevant to the organization's own practices, mission and purpose, and that this purpose for most organizations includes generating, processing and distributing knowledge as part of their mission.

Depending on the nature and degree of professionalism of the organization, the link between its mission and its intrinsic motivation to engage in information sharing as part of its internal information management strategies can take different forms. It is important to see this as a question of organizational development, as K-Link was commissioned by a development organization (GIZ) that engages in supporting the development of third-world countries. In this setting, the organizational development and overall professionalism of NGOs as well as Government institutions tend to be suboptimal, and there exist little if any professional knowledge management approaches.

Introducing K-Link and providing capacity building for it therefore has direct impacts on the knowledge management approaches in these organizations. Most of the participating organizations are supposed to engage in knowledge processes as part of their mission; e.g. NGOs should engage in research, participate in professional discourse with their peers and/or inform the public, and government institutions should be transparent and accountable and provide clear policy information pertinent to its thematic sector.

The experience with introducing K-Link has shown that the introduction of KM instruments even in developing country settings has significant impacts on how organizations approach questions of KM as part of their general management and operating strategy. Through embedding the management and sharing of information into the everyday workflows of the organization, the organization can do a significant step in professionalizing its own practices. In the context of K-Link this systemic change is now observable in several of the participating organizations.

The principle of sharing as a consequence of information management – verified and tested with both the client and the participant institutions – led to the resolution to design and implement a specific Document Management System (K-DMS) so to allow end users to get to know the sharing features of K-Link as special cases of more general information management ones (Kwasnik, 1991)..

The analysis of the basic features of the DMS (and their requirement analysis) has been conducted by taking into account a set of use cases discussed with the NGOs (which represent the key providers of competences for any project implementation in SLM domain) and then extended to all the other stakeholders.

The requirements analysis lead to the identification of two main requirements:

- Req1: The need of exploring the available documentation on current projects so to gather the information needed for writing the NGO history and reporting the on-going projects:
- Req2: Documents are potentially uploaded and edited by multiple persons or working groups and a version tracking is somehow required to handle the process of document creation.

An important remark on the nature of the working groups is reported here (quotes from the technical documentation produced during the requirements analysis and knowledge acquisition campaign carried out with stakeholders.): *“In case the project is trans-disciplinary (contribution from two or more working groups in a more or less balanced ratio – usually there is one working group in the lead), or in case the project manager is not a coordinator of a working group, the project file is stored on the server on the working group level”*. This circumstance brought to an additional requirement:

- Req3: Some documents and/or entire projects need a way to be shared between working groups or need to be categorized in multiple working groups.

Furthermore, *“[...] What is really relevant here is that the technical proposal is normally realized as a refinement of the preliminary baseline that is on its turn arranged by taking into account previous base lines documentation and technical proposal regarding similar projects. [...]”*. This process points out that:

- Req4: the management must be able to access an organized set of material and to search into them to better find the documents they need.

Many NGOs in Kyrgyzstan and Kazakhstan use a central server that can be accessed through the institution internal network to store documents. On the server they have started to organize the reports on the mitigation of conflicts among farmers. The next passage is extracted from the use case document: [...] *“They are now trying to migrate the reports into the server, but reports are in Kyrgyz and at normally only a subset of reports are translated into Russian and/or English. Once the translation has been done, they are*

uploaded into the server. Mediators decide what report is to be translated according to its relevancy. But moderators often do not have access to the server because most are from outside (e.g. university). In addition these reports are stored on the personal laptop“.

Thus, the project implementation normally involves external experts as key-contributors of the reports, which don't have the access to server.

- Req5: The main service here is to provide a controlled access to the documents repository and management, hopefully limited to specific shared folders, so to allow mediators and moderators to access the documents and the report writers to upload documents and share or notify its availability to the other persons involved.

According to the above mentioned analysis the following main services have been decided for the K-Link DMS:

1. **Controlled Document Upload and Viewing:** the document upload, editing and management experience must be controlled by a form of authentication.
2. **Collections of Documents:** the way to overcome the limitation of folders based approach for organizing the documents. Collections can be labelled (eventually importing a taxonomy) so to enrich the documents descriptors and enhance the documents retrieval. By using the label concept it is possible to categorize documents in

multiple collections. Two main types of collection have been designed:

- a. Personal collections: used by the user to fasten the access of the documents;
 - b. Institutional collections: used to represents the current working groups' organization.
3. **Groups:** Users can be grouped into sets so to facilitate the share of documents to the stakeholders.
 4. **Share Documents and Collections:** the mechanism through which users are enabled to share one single document (or a collection of documents) with other users of the DMS. Document owners can further define which documents can be accessed by other DMS users participating into specific projects.
 5. Document sharing is intrinsically performed inside the involved institutions by using email attachments, with this feature we would like to reduce the need of the email communication and the confusion created by the multiple versions of that email communications.
 6. Document **Version Tracking:** enables to upload new versions of the same document.
 7. Document **Naming Policy** check: the feature covers the need of forcing all the produced documents (or files) to respect the naming convention established by the institution.
 8. Bulk **Import** of documents: allows users to massively upload and index existing documents from the local institution document storage, such as their hard-drives, into the DMS.

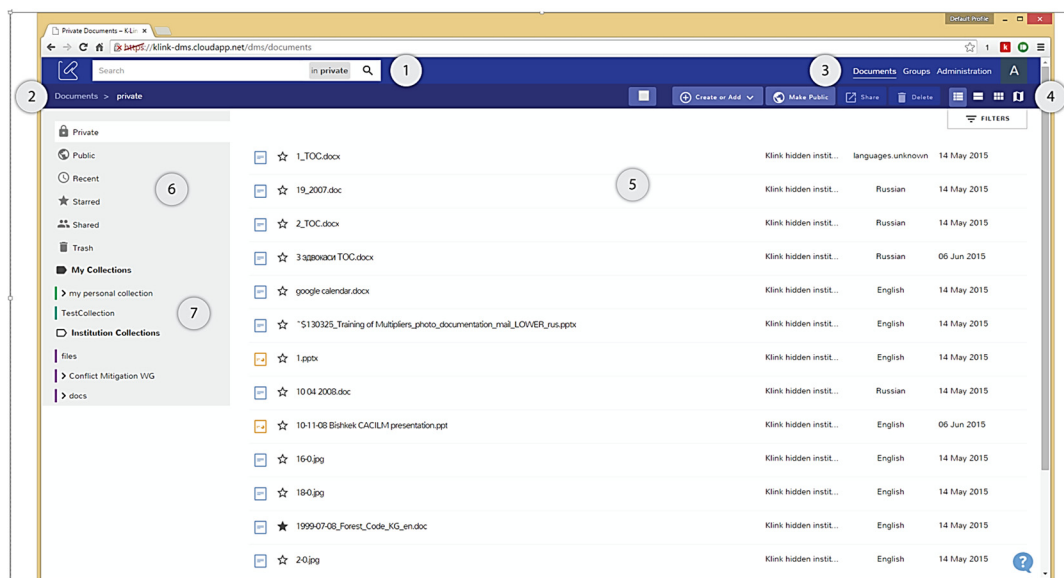


Figure 1: Hierarchy of the main page of the K-Link DMS.

9. **Starred:** The feature which allows to mark (and subsequently filter) documents through a favourite set.
10. **Make Document Public:** allows end-user to public a document into the K-Link Network.

Furthermore, different types of users have been defined to better manage the differences in roles and permissions on which set of actions they can (or cannot) perform on the documents and collections. This feature has been widely discussed with both the client (GIZ GmbH) and the stakeholders. Actually the different permissions over the documents (ability to upload, share and organize) reflect the typical organizational structure of the NGOs, implementing agencies and research institutes we interviewed in Central Asia.

As we work in Central Asia the Multilanguage topic is important. The interface is automatically localized based on the user's language, both configured or requested by the browser. The documents could contain any language supported by the search engine component. User generated content is actually considered in the original language only.

A usability study is planned and will be initially conducted over 10 users. Moreover, we will add an A/B testing mechanism to the DMS implementation.

4 K-LINK AS KNOWLEDGE ARTIFACTS PROMOTER

Initially, the K-DMS was conceived to provide institutions with an easy way to upload documents and consequently to feed the K-Link network and trigger its adoption. Later on, it evolved beyond the needs of documents uploading in the direction of an information management and project management system. Even more, after the first release while tuning the K-DMS features, it emerged from stakeholders the need to be supported in the decision making process for documents structure organization and conceptualizations. Thus, the K-DMS started to be re-designed to cope with the need of mediating the process of information conceptualization within SLM communities of practice.

The established hierarchy of the elements in the page is showed in Figure 1.

The first header row (1 in Figure 1) is reserved to show the search form and to show the global navigation (3), which includes the user profile link. Some users might not see other pages in the global navigation other than the current page; this is caused by the fact that the global navigation is subject to the user

permissions. The second header row is half divided into the navigation breadcrumbs (2) and the page related actions (4). The page content is divided into 80% for the main page area (5) and 20% for the documents navigation sidebar. The first part of the documents navigation sidebar (6 in Figure 1) is reserved to show macro documents organization like the shared, the starred and switch between K-Link publicly available documents and institutional documents. The second part of the document navigation sidebar (7) shows the documents Collections.

Collections have been introduced instead of folders to organize documents. Collections can be personal or institutional. Personal collections are visible only to the user that has created it, while the institutional collections are visible to all the users of the institution that can manage documents. To better distinguish between personal and institutional collection a colour-coded band has been introduced in addition to the full and empty tag icon, respectively for personal and institutional collections.

To interact with the collections a contextual menu was introduced. The concept of Collection is wider than the folder concept.

A Collection is a logical group of documents that might not be directly mapped to a single folder on the file system. A document can be pertaining to more than one Collection at the same time, while this is not possible when using folders without duplicating the document. To organize the documents in collections the user interaction is based on the drag and drop of the document, or the selected documents, to a collection.

Recalling Knowledge Artifact as discussed in (Cabitza et al., 2013) the definition adheres to the K-DMS through which different representations of same sets of information may be allowed and orchestrated (Kreiner, 2002).

The principle of representational locality (Cabitza et al., 2013; Váncza and Márkus, 1993) responds to the need of not imposing an exogenous language or notation to a community of users. The introduction of collections exactly responds to this requirement inasmuch as users were already adopting folders to organize and share documents.

The principle of representational openness, that means that "a computer-based system should allow for the introduction of new symbols and signs to cover the need to represent either portions or aspects of the reality of interest that were previously, possibly rightly, disregarded.". The supplying of labels and symbols (e.g. stars) whose semantic is completely user dependent has been done exactly to respect the representational openness.

Finally, the principle of autonomy in managing levels of underspecification has been realized by the distinction of collections into personal and institutional, by which different degree of specification and granularity may be freely choose by different users collaborative working on the organization of the same set of documentation.

5 CONCLUSION

The paper has discussed the K-Link project and its role as promoter of KAs. In the framework of International Cooperation addressed by the project, KM initiatives usually clashes against cultural and political barriers, which hinder collaborative forms of working from being implemented. According to the requirements analysis carried out with the stakeholders, the way to overcome these bottlenecks was to follow the prescription of conceiving the K-Link solution according to the general requirements for the design of a computer-based system acting as a KA. The decision to implement the approach by integrating the services provided by the application a distributed content-based search engine with information management features provided to each end-user institution proved to work well. In addition, the framework offered by the International Cooperation gives to KM initiatives focused on KA promotion a new application domain for experimenting KA as trigger of organizational development services.

In this respect the K-DMS has been mainly envisioned to create a platform powerful enough to enable new services.

Actually the design of Collections feature in the K-DMS is expected to be the starting point for supplying end users with bottom-up and collaborative conceptual modelling services based on the original folders structure enhanced with a logical layer.

The main actions planned to consolidate K-Link as knowledge artifact promoter are here:

- To test topic models techniques (TP) for identifying clusters of “conceptually connected” documents inside the search results so to detect a) the evolution and distribution of interests along the Communities of Practice that take part into the Klink network b) the detection of core indicators in the field on Sustainable Land Management for these Communities c) the arrangement of new facets to support end users in filtering the search results.
- To use the results of the previous test to support the modelling of decisional processes. In this direction the integration of tools like Moki is under study (MK);

- To extend the collaborative features with chat and annotation systems.

REFERENCES

- Baeza-Yates, R. and Ribeiro-Neto, B., 1999. *Modern Information Retrieval*. Harlow: Addison-Wesley.
- Borchardt, P., Schmidt, M. and Schickhoff, U., 2010. Vegetation Patterns in Kyrgyzstan’s Walnut-Fruit Forests. Under the Impact of Changing Forest Use in Post-Soviet Transformation. In: *Die Erde* 141 (3). 255-275.
- Brill Olcott, M., 1998. *Central Asia: Confronting Independence*. [pdf] Barker Institute: Rice University. Available at: <http://bakerinstitute.org/media/files/Research/133113ba/central-asia-confronting-independence.pdf> [Accessed 8 September 2015].
- Cabitza, F., Colombo, G., Simone, C., 2013. Leveraging underspecification in knowledge artifacts to foster collaborative activities in professional communities. In *International Journal of Human-Computer Studies*, 71(1), 24-45.
- Dutta, S., Geiger, T. and Lanvin, B., 2015. *The Global Information Technology Report 2015 ICTs for Inclusive Growth*. Geneva: World Economic Forum.
- IWS, 2014. *Internet World Stats*. [online]. Available at: <http://www.internetworldstats.com/stats.htm/>, [Accessed 7 September 2015].
- K-Link, 2015. Introduction. [online] Available at: <http://klink.asia/>, [Accessed 7 September 2015].
- Kreiner, K., 2002. Tacit knowledge management: the role of artifacts. *Journal of Knowledge Management*, 6 (2), pp.112 – 123.
- Kwasnik, B., 1991. The Importance of Factors that are not Document Attributes in the Organization of Personal Documents. *Journal of Documentation*, 47(4), pp.389–398
- Pomfret, R., 2006. *The Central Asian Economies since Independence*. Princeton, NJ. Princeton University Press.
- Swetnam, T.W., Allen, C. D. and Betancourt, J., 1999. Applied Historical Ecology: Using the past to manage for the future. In: *Ecological Applications* (4). 1189-1206.
- Rondelli, B., 2014. *Technical Offer: Regional NRM ZA – K-LINK, 11.2238.1-006.00*. Barcelona. SIRIS Academic.
- UNICEF, 2008. *Learning from KM Experiences*. [online] Available at: http://www.unicef.org/rosa/Learning_from_KM_Experiences.pdf, [Accessed 7 Sept,2015].
- Váncza, J. and Márkus, A., 1993. Features and the principle of locality in process planning. *International Journal of Computer Integrated Manufacturing*, 6 (1-2).pp.126-136
- TP, <http://www.cs.princeton.edu/~blei/topicmodeling.html>
- MK, <https://moki.fbk.eu/website/index.php>