

Web Service Support for Collaboration between Demographers

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Abstract. The paper promotes the use of novel Web services in the daily work and research of social scientists and other professionals. The case presented in the paper pertains to demographers and their research, but the technology used is generic and can be easily instantiated for use by other social science researchers. Specifically, the case covers facilitating collaboration between a university research group in the field of demography and professionals in the field of demographic statistics. The technology used is a set of new Web services developed as parts of an EU research project. The paper explains the case itself and the motivation for using the services, describes the services themselves, and discusses the experience acquired and the benefits and lessons learned by using the services so far.

keywords: Demography, Web services, collaboration, research, content & knowledge provision.

1. Introduction

The term "Web service" is somewhat ambiguous; different people often mean different things when they say "Web service" [10]. In this paper, the term "Web service" is understood as an autonomous, self-contained, and self-describing software component accessible through a Web server that provides functionality through a standardized set of interfaces. Web services can be combined in and used by other applications, can communicate using open protocols, and can be orchestrated to implement a more complex functionality.

To many common end users, Web services are things like instant messaging services (e.g., Yahoo! Messenger, Windows Live Messenger, Skype, and AIM) and social networking and microblogging services (such as Facebook and Twitter). Very often, people also use various booking services (such as accommodation booking at Booking.com), payment services (e.g., PayPal), and buying/selling and auction services (such as eBay).

What kinds of Web services are of interest to researchers? To what extent researchers have adopted and do use Web services in their daily work?

To help answer these questions, the Research Information Network from UK has recently conducted a comprehensive study [6]. Although focusing on Web 2.0 services in the first place, the study has also indicated typical uses of other Web services by researchers of different profiles and backgrounds. The results have shown that the majority of researchers predominantly use digital library services and services related to submission and publishing of their research in scholarly journals. Many of them also use well-known generic tools and services such as Google Scholar (73%) and Wikipedia (69%). On the other hand, while most researchers have a positive attitude towards Web 2.0 services (blogging, social networking, social bookmarking and tagging, wikis, RSS feeds and the like), only a few have made them a routine part of their working life. These few researchers typically use SlideShare (<http://www.slideshare.net/>) as a presentation sharing service, social bookmarking and tagging services such as Delicious (<http://delicious.com/>), and discipline-specific services such as <http://arts-humanities.net>, a 'hub' for teaching and research in the digital humanities. Very few use blogging to publish work in progress or to comment other researchers' work, although their number is slowly increasing. Not surprisingly, the majority of those researchers who have adopted Web services as tools for their daily use come from computer science, math, and engineering; very few come from social sciences. The study concludes with the recommendation to raise awareness (among the researchers) of tools and Web services, and the uses to which they can be put, as well as to provide guidance and training.

However, a notable exception in the study is related to collaborative research: the use of services is positively influenced by researchers' involvement in collaborative research activities. Here collaborative research can be work as part of a local team, work with collaborators in different institutions, participation in an informal, local research network, and participation in wider, discipline-based research networks.

This last fact has been one of the starting points for the work presented in this paper. Another one was the recent development of useful Web services that support collaborative learning, work, and research; the services have been developed within an EU-funded, 3-year research project called IntelLEO (<http://www.intelleo.eu>). A suitable case of collaboration between researchers and other professionals working in the field of demography has triggered the work.

2. Problem statement

The objective of the research presented here is to promote the use of novel Web services in the daily work and research of social scientists and other professionals. The paper describes a case related to the field of demography, but the approach can be easily extended to other social sciences as well. Moreover, extension to fields outside of social sciences is quite feasible as well.

Specifically, the paper focuses on the following questions:

- What specific kinds of Web services can be of interest to demographers, given the intrinsically collaborative nature of their daily work and research?
- What exactly are the benefits demographers get from using such Web services?
- What does it take to start using specific Web services in collaborative work and research in demography, and how to start?

The obvious underlying assumption here is collaborative work. However, the approach to collaboration covered in this research is not restricted to collaboration between individuals; the most suitable cases are actually those of collaboration between different teams and/or organizations.

3. Motivation

Much of the work done by demographers is intrinsically collaborative. This collaboration often includes researchers and professionals from more than one institution. For example, researchers from universities typically rely on various databases and statistics related to the population in a certain region, or in a country, or in a city; in many cases, these include various census data and data about events related to vital statistics, such as births, marriages, deaths, and so on. Such databases are usually maintained by institutions like national and local bureaus of statistics, as well as by various governmental and provincial offices. Hence university research groups often collaborate with professionals from such institutions. Another typical example is a whole category of interdisciplinary projects, usually initiated by certain ministries and other governmental institutions, where demographers from universities and demographic research centers are asked to participate to spatial planning, social care, educational policy development, and similar population-related programmes.

In all such cases, a common problem faced by both the researchers and the other professionals participating to the collaborative activities is that not all data, statistics, documents, facts, and knowledge are readily available. In spite of the fact that censuses and vital statistics provide a number of useful data to the researchers, there are always new demographic insights, new social processes and circumstances, and new externalities that the researchers are aware of, but are not tracked and updated regularly in the existing databases. It also happens that data useful to researchers are difficult to obtain due to the other institutions' organizational restrictions and policies. Likewise, federal, state, and provincial governments sometimes contract demographers and other researchers to conduct studies and surveys that diverge from established research methodologies. These often assume studying international statistics, documents and regulations, as well as additional data collection and processing to fit the contractual requirements.

Table 1 shows examples that illustrate this common problem and the points made here.

Table 1. Topics and phenomena of interest to demographers, but not well covered in information sources related to census data and vital statistics (The topics/phenomena indicated in the table illustrate the case of Serbia, but are also observed in many other countries as well)

Topic / Phenomenon	Explanation	Missing data / Further work needed	Target information of interest
Cohabitations	Unmarried couples living together	Number of cohabitations, their durations, resulting fertility, number of cohabitations ending in marriages	More complete picture about the size of married population, celibate, and attitudes towards traditional life; more accurate classification of population according to their marital status
Population ageing	The number of elderly citizens vs. the number of young ones	Social status of elderly citizens, their habitation types, health conditions, sources of income, level of poverty	Estimates of population ageing trends, related actions of local governments, regional and international contexts of ageing
Brain drain	Emigration of highly educated labor force	Demographic data before and after emigration, such as marital status and fertility, professional activities, type of college degree, level of further education	Migration trends to help the government create appropriate population policies
Social mobility	Horizontal and vertical mobility and "generation shift"	Mobility related to ethnical recognition (especially for minorities) and types of habitats	Quantitative insights into how social, political, financial, and other crises affect social mobility
Population activity	Citizens' primary and secondary (additional) activities	Additional activities of a part of the population struck by poverty and turbulent political events	More complete insight in the share of additional activities in the total population activities

It is often advocated by both parties that a major step towards alleviating this problem would be to develop and maintain a repository of various documents, research material, online tools and resources, and other information that all interested individuals and organizations could use in their daily work and activities. Uploading and annotating new relevant resources in this repository, as well as removing or repurposing existing ones, can help discover new trends and interests of researchers and institutions, indicate

specific services of interest to organizations and individuals that should be developed to support and facilitate their activities, and point out emerging topics and profiles of professionals required to cover them in future projects.

Such a repository should be supported by appropriate, intuitive, and easy-to-use Web services to allow for easy access to the resources stored therein. In addition, using these Web services should enable interested individuals and organizations not only to collaborate over specific resources in their projects, but also to contribute to the repository with newly created and/or discovered resources. And that is where the IntelLEO Web services come into the play.

4. IntelLEO services

IntelLEO project aims at developing Web services to support collaboration between two or more organizations. An important underlying assumption here is *temporal integration* of the organizations – they are supposed to work collaboratively, over a certain period of time, and enjoy the benefits of collaborative learning and knowledge building (LKB) activities. This temporal integration can be organized around a collaborative project, or can stem from other activities of mutual interest for the organizations involved (e.g., organizing a seminar, or establishing a research communication over a certain topic).

In addition, such collaboration can origin from objectives and interests of the organizations as business entities, but is most fruitful when simultaneously accommodates personal objectives and interests of the individuals (i.e., employees) involved. For example, an employee of one organization may need to extend her knowledge of a certain topic or certain practices in order to get her work done. What IntelLEO services enable her to do is to find appropriate online resources most efficiently, discover people from the organizations involved who are most competent on the topic, create an online working group with them, share her knowledge and experience with the other members of the group, learn from the experience of the other group members, and the like, and yet stay within the business policies and interests of her organization and contribute to fulfilling them.

Specifically, IntelLEO services include:

- Human Resource Discovery – searching for human expertise in the organizations involved, to support LKB for individuals and groups, according to predefined objectives; checking for experts' availability;
- Working Group Composition – Proposing a suitable working group based on identified available expertise, individual competences and experience, and organizational objectives;
- Collaboration Tracing – Tracing of LKB collaboration contexts, events and activities, interaction (type, frequency etc.), feedback provided, team results, and resource usage;

- Content/Knowledge Provision – Context-dependent and proactive discovery/delivery of LKB resources within the organizations involved, including discovery/delivery of information and knowledge on individuals and working groups;
- LKB planning – Selection of the most appropriate sequence of LKB activities and criteria to provide resources in a specific context (e.g., for a specific individual and/or group)
- Organization policy – Identification of rules and/or objectives relevant for a specific content/context and filtering (from a set of provided resources) those that fit with the identified organizational rules, objectives, and strategies.

In order to use IntelLEO services efficiently, collaborating organizations are supposed to maintain a common repository of resources of interest, with specific and controlled access rights of the repository users. IntelLEO project provides technical and administrative guidelines on how to set up such a repository.

5. Application case

Through private connections, IntelLEO dissemination activities, and another research project, a group of demographers from the Institute of Demography (ID) at the Faculty of Geography of the University of Belgrade has got introduced to the IntelLEO Web services. Although the IntelLEO project is not completed yet, and its services are still getting improved, ID wanted to experiment with the current versions of the services and find out if they can help them address some of the issues described in the section on motivation. One way or another, ID found all IntelLEO services to be of interest to them, but was mostly interested in the Content/Knowledge Provision service (CKP).

Together with researchers involved in both IntelLEO and the other research project mentioned above, ID has set up a case, a repository, and a testbed for working with CKP. They have also come up with several typical scenarios for use of CKP by demographers. The scenarios considered here are related to the issue of population ageing.

Population ageing is the increase in the number and proportion of older people in society [9]. It has three possible causes: migration, longer life expectancy (decreased death rate), and decreased birth rate. Being a global phenomenon, population ageing has a significant impact on society.

5.1. Practical problems that hinder research on population ageing

Data on elderly population of interest to demographers are only partially available straightforwardly from census sources. Other data require additional census data processing and cross-referencing (e.g., do elderly people live

alone, do they live in multi-generation families, are they married, what are their education levels and nationalities, and so on).

Still other relevant demographic data on elderly people are not available from census data and in many countries are not even tracked systematically (e.g., what are their health conditions, their typical diseases, who helps them, do they have children who visit them and take care of them, what are the activities they can conduct on their own, what is their degree of invalidity, how they spend their time, what are their incomes, and the like).

Some institutions may even keep track on some of these data (e.g., healthcare institutions and NGOs), but when it comes to using the data in demographic research it takes considerable time and effort to get the right information and to get through various administrative and data access procedures. Worse still, when professionals from national and local bureaus of statistics, public health, and other institutions call for meetings with demographers in order to get suggestions and advice on how to extend and modify relevant forms for the next census, it usually turns out to be too costly to do it or that the time remaining is too short.

5.2. Application scenarios

As scenario 1, assume that Joan, a professional from the National Bureau of Statistics (NBS), is working on a publication that would cross-reference selected data from the latest census to focus on (and cover in more detail) elderly population only. She is interested to learn what specific data should be cross-referenced, what composite indicators should be calculated, and how to present them in the publication to be of most use to the readers. Using IntelLEO services and especially CKP, Joan can be in a regular (online) touch with demographers from ID and have access (through CKP) to the repository of relevant resources exemplifying the issues of interest to population ageing studies. Moreover, she can upload (to the repository) resources available at NBS, at another institution, at an NGO, or elsewhere, and ask researchers to check them out and comment them in order to help the new publication include more relevant data and exclude irrelevant ones.

Scenario 2 is another hypothetical scenario that ID has come up with. It might involve Helen, a young PhD student and researcher from ID who currently works on her thesis related to population ageing in a selected region of the country. She collaborates with the regional government institutions and NBS alike, and has already contributed a number of useful documents to the common repository. She is always eager to learn what data relevant for her research can be obtained from these institutions, and at what cost. She is also interested in finding out how easy it is for these institutions to start tracking specific data they did not track in the past, and is ready to illustrate how it is done in other regions, or in other countries. She can do it by using CKP to upload specific resources to the repository and by asking people from the other institutions to use CKP to take a look at them.

Two issues are important here, in both scenarios. First, all resources uploaded to the repository using CKP can be appropriately annotated to facilitate subsequent search and use. Part of the annotation happens automatically and the end users do not have to take care about it. The other part is done by end users in the form of tagging. Annotations help users to get to the relevant material easily and to recognize other users interested in the same resources and topics.

Second, remember that all IntelLEO services, including CKP, facilitate online *collaboration* between different individuals, groups, and organizations. As the next subsection illustrates, it is likely that in the above two scenarios Joan and Helen will "run onto each other" through the repository resources and CKP. Joan can always see in CKP that a document in the repository relevant for her publication is annotated by Helen (and possibly some other users interested in the same document and/or topics). The opposite is also true. Thus Joan may want to use other IntelLEO services to initiate more intensive collaboration with Helen.

5.3. Using CKP

To use CKP and other IntelLEO services, one needs an account. Collaborating organizations may want to restrict access to their shared repository, but getting an account is free. Installing IntelLEO services and a shared repository of resources on a server and running them from it is a straightforward task for a server administrator.

On the client side, all one needs to do is install a Web browser add-on for interacting with IntelLEO services; it is done in a couple of mouse clicks. The add-on is represented in the browser as a toolbar (called the IntelLEO toolbar) with three buttons – *IntelLEO*, *Upload*, and *Resources*, Fig.1. (The toolbar can be easily hidden/shown at any time, using the browser's Tools/Options menu.)



Fig.1. IntelLEO services toolbar

Now assume that Joan (or Helen) from the scenario(s) described above wants to bookmark a resource in (and possibly upload it physically to) the common repository. The resource can be an online one (a Web site, a Web tool, an online document, and the like), or it can be a local document stored on her computer. She opens/accesses the resource in her browser and clicks the *IntelLEO* button in the IntelLEO toolbar. A popup window like the one shown in Fig. 2. opens.

In the upper part of the popup window, a few standard terms from Dublin Core Terms vocabulary (<http://dublincore.org/documents/dcmi-terms/>) instantiate the usual metadata for the resource. If any of them is not retrieved automatically from the resource, it can be filled manually if the user wants to do it. The *Tags* field is not mandatory, but it is highly recommended that the user tags each resource appropriately, for it may benefit all other users of the repository. *Visibility* is related to the access restrictions that can be set for the resource being bookmarked in the repository. The possible values that can be set include *public*, *organization*, *group*, and *private*.

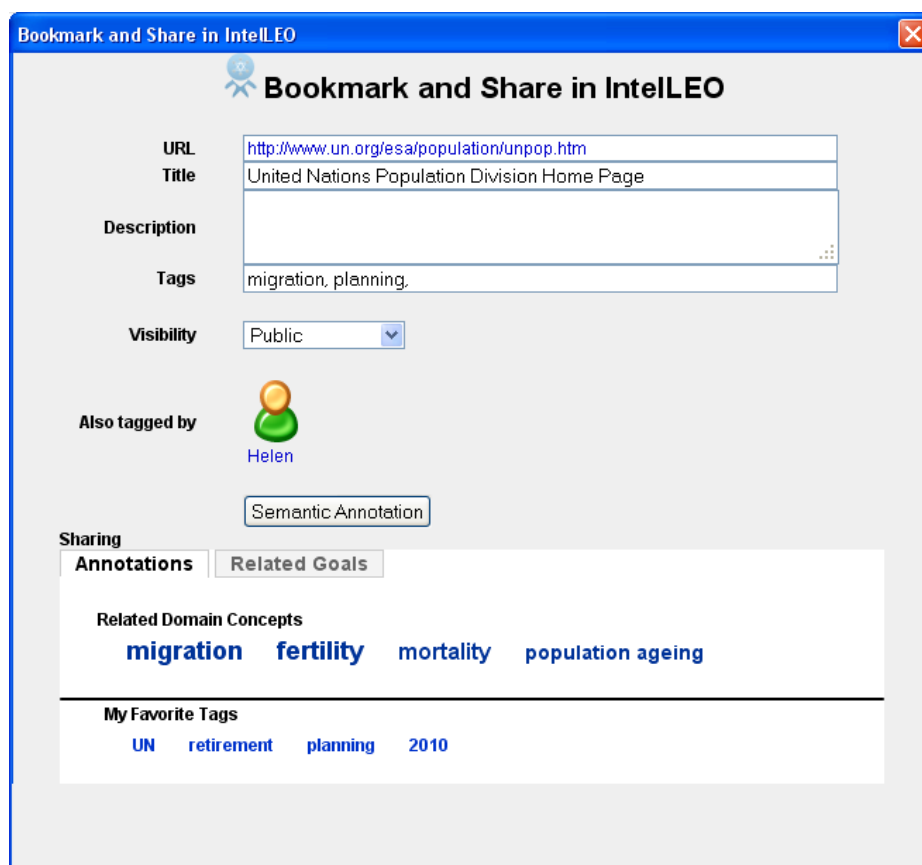


Fig. 2. CKP service: annotation and tagging

The lower part of Fig. 2. is more interesting from the end user's point of view. In collaborative work users share common resources, so *Also tagged by* indicates who else has tagged (and hence presumably is interested in) the same resource. The first time a resource is uploaded to the repository, this field is empty; when *another* user accesses the resource through CKP, this field will indicate all the other users who have tagged the resource. The user's own frequently used tags are indicated in *My Favorite Tags*, and clicking any of them adds the tag to the *Tags* field.

When the user clicks the *Semantic Annotation* button, *Related Domain Concepts* are inserted automatically by CKP, provided that CKP is pre-fed by an appropriate domain ontology. Domain ontology contains the domain vocabulary and describes domain concepts and their relationships. Experts from ID and from the IntelLEO project have developed the ontology of population ageing. It is because of that ontology, used by CKP under the surface, that *Related Domain Concepts* in Fig. 2. look as they do – CKP has automatically recognized what the resource is about. This can be a useful addition to the end-user's tags, because it allows for an automatic resource annotation with domain concepts.

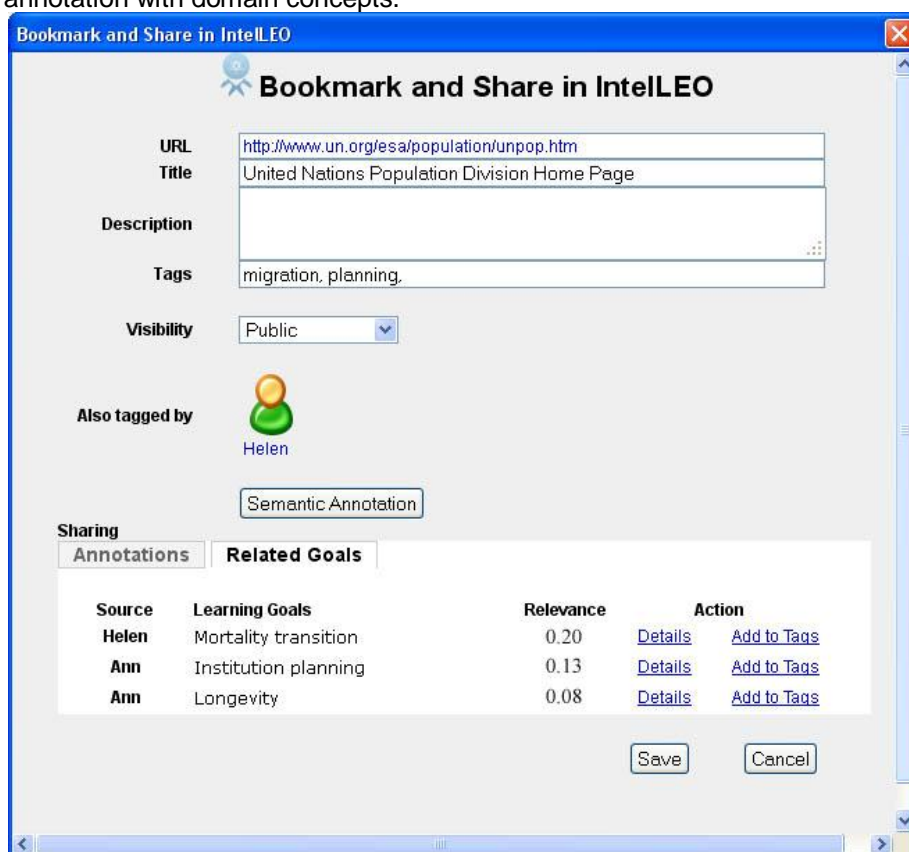


Fig. 3. CKP service: the Related Goals tab

Joan (or Helen) can also use the *Related Goals* tab in the CKP service, Figure 3. It allows her to interact with the IntelLEO LKB planning and, indirectly, with other IntelLEO services as well. Users of the IntelLEO LKB planning service can specify what they use a shared resource for. In the IntelLEO terminology, it is called a *learning goal*. For example, Helen may have used the resource described in Figure 3 to find out more (i.e., "learn about") *mortality transition* as an important issue in population ageing. Alternatively, she may have just thought that the resource is good for people from ID to be aware of it. In either case, she may have also indicated this intended use of the resource through the IntelLEO LKB planning service. In such a case, the *IntelLEO* tab will show it in the *Learning Goals* column.

Relevance indicates on the 0-1 scale how relevant the resource is for that purpose (i.e. for that learning goal). Clicking *Details* takes the user to the IntelLEO LKB planning service and a more in-depth description of the corresponding learning goal; however, describing all the idiosyncrasies of the IntelLEO LKB planning service is beyond the scope of this paper. Clicking *Add* is another useful CKP feature – it automatically adds the corresponding learning goal to the *Tags* field.

Clicking *Save* saves the bookmark related to the resource in the shared repository. It means that a description of the resource (essentially, most of the things shown in Fig. 2 and Fig. 3) will be uploaded to the repository, and the resource itself will be physically kept elsewhere on the Web. Clicking the *Upload* button in the IntelLEO toolbar, Fig. 1, brings up dialogs similar to those shown in Fig. 2 and Fig. 3, but the effect of clicking *Save* in these dialogs is that both the resource description and the resource itself will be physically uploaded to the repository. This is useful in cases when the user wants to store a copy of an original resource in the shared repository, or when resources originally stored on the user's local computer should be uploaded to the repository physically.

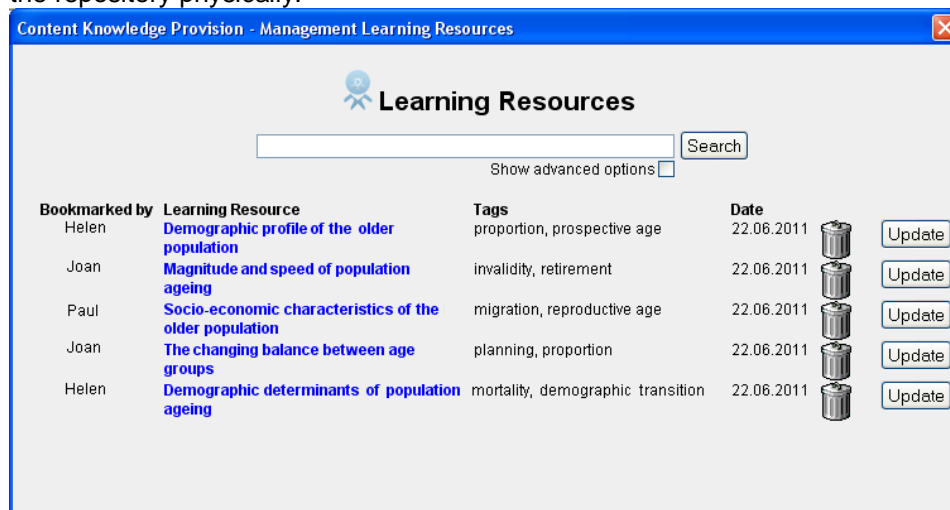


Fig. 4. CKP service: browsing the repository

If Joan wants to browse the repository, she clicks the *Resources* button on the IntelLEO toolbar. It brings up the window like the one shown in Fig. 4. If she clicks a (learning) resource there, a window like the one shown in Fig. 2 opens for that resource. She can also delete a resource by clicking its garbage bin icon, and additionally annotate and update it by clicking the corresponding *Update* button.

Finally, if Joan wants to query the repository for specific resources, she can enter the search term(s) and click the *Search* button. If she also checks the *Show advanced options* box, the search and search results can be further refined. For example, the CKP service can be instructed to query the repository looking for the resources that have the same annotations like the Joan's tags and learning goals. When the *Search* button is pressed, CKP returns a list of the ranked search results. The process of ranking the search results is based on calculating semantic similarity between the resources and Joan's tags and learning goals (as well as her competences, activities, and other details coming from her user profile and from the IntelLEO LKB planning service), depending on the refinements selected when the *Show advanced options* box is checked.



Fig. 5. CKP service: searching the repository

6. Evaluation and discussion

In order to get a feeling of how demography researchers and professionals perceive CKP and other IntelLEO services, a formative evaluation has been

conducted with 22 people (4 teachers and 10 PhD and MSc candidates associated with ID, and 8 professionals from NBS and partner institutions). The objective was to find how relevant, how useful, and how interesting would it be for such users to make CKP and other IntelLEO services part of their regular working environment. This section focuses on the evaluation of CKP only.

The participants were explained the functionality of CKP. The moderators have then demonstrated the use of CKP to the participants and asked them to reflect briefly on how (if) they would use it in their work. After they did, the moderators asked them to run CKP themselves, completing tasks that roughly corresponded to the scenarios described in section 4.2. In the end, the participants were asked to fill in specifically designed questionnaires.

In designing the questionnaires, three important sets of guidelines have been used. The first one was borrowed from evaluations of IntelLEO services conducted as part of the IntelLEO project, where one of the objectives has been to collect information about motivational issues related to learning in the workplace [5]. The second one is published at the *Usability and user experience surveys* Web site (http://edutechwiki.unige.ch/en/Usability_and_user_experience_surveys) and covers a number of guidelines and practical examples of organizing evaluations related to perceived usefulness and perceived ease of use of software systems and applications and their user interfaces. The third one was published by [8].

The questionnaires and the questions were related to the following criteria:

- relevance (5 questions) – issues like benefits for individuals and teams/organizations, support when looking for potential resources and partners, support for collaborative work/research, and organizational support
- organization of information (4 questions) – issues like simple and natural dialogue, sequence of screens (interactions), and logic and terminology related to task
- perceived usefulness (6 questions) – issues like accomplishing tasks more efficiently, improve job performance, increasing productivity, increasing inter-organizational collaboration, enhancing effectiveness on the job
- perceived ease of use (6 questions) – issues like learning how to use the service, straightforwardness, using it without written instructions, clear and understandable interaction with the service

The questions were designed as 5-point Likert scale ones (the possible answers being from 1 to 5, corresponding to highly unlikely to highly likely, or strongly disagree to strongly agree, or the like), but free-form qualitative judgments and comments were also encouraged.

Table 2 summarizes the evaluation results. Due to space limitations, the figures shown are rounded averages of the ones obtained from the figures obtained for specific questions related to the same criterion.

Table 2. Results of formative evaluation of CKP by a group of demographers

Criterion	Percent of Likert-scale answers (1 – lowest, 5 – highest)					Notes
	1	2	3	4	5	
Relevance	7	3	24	34	32	See discussion on free-form comments
Organization of information	21	11	26	37	5	Indicates possible need for changes in the user interface
Perceived usefulness	12	9	12	40	27	-
Perceived ease of use	0	4	12	51	33	-

Two observations follow from Table 2 immediately. First, most of the participants thought that CKP offers functionalities relevant for their work (the Relevance criterion), that it would be useful in their everyday work (Perceived usefulness), and that it is easy to use (Perceived ease of use) – over 50% of all participants answered the corresponding questions with '4' or '5' on the Likert scale. Second, a lot of reluctance is observed in answers to questions related to Organization of information. Many participants did not like some of the labels in the user interface (e.g., Related Goals in Fig. 3), and some thought that certain labels were even redundant (the Annotations section in Fig. 2). This may indicate a need for possible changes in the user interface of CKP.

In addition, the analysis of free-form comments and suggestions revealed that a considerable number of participants thought that organizational support (or restrictions) can be of high importance for adoption of Web services such as CKP. Free distribution and share of certain resources may be difficult to achieve in practice, which may hamper a wider adoption of CKP among professionals.

Some participants also did not seem to understand the use of the term 'learning' in the CKP screens. While the IntelLEO services are originally developed to support learning activities at workplaces, many participants thought that it sounded more like 'studying at school' and that using some other term(s) would make the user interface clearer. In fact, they agreed that the CKP functionality is actually more related to knowledge and resource management, although it can be understood as learning as well. Others commented that it was difficult to grasp immediately (i.e., after initial explanations and use of CKP) the actual difference between CKP and widely

used social bookmarking services like Delicious (<http://www.delicious.com/>) and Diigo (<http://www.diigo.com/>).

Still, the overall impression from the participants' free-form comments was that their perception of the IntelLEO services, especially CKP, was very positive. Some of them even put in their comments that they would like to be advised on other similar Web services. Over 80% of their comments indicated that using CKP regularly would help them, in their view, do their job more efficiently and more effectively, and would also help their institutions a better insight into the needs of their collaborating organizations. An important suggestion emerging from their comments was that promoting the use of Web services in their institutions would be very beneficial.

7. Related and future work

A recent study has indicated that researchers in the field of demography are not completely aware of the benefits they can have from using Web services and other new Web technologies and tools [1]. Moreover, creating online communities of demographers is not that widespread yet, compared to the communities in other disciplines. More effort is needed in order to raise the awareness of demographers for new Web technologies and online communities, and especially for using them in everyday work in their organizations.

A possible path to follow in this direction is to learn how professionals from industry and business areas have started to use Web services and Web 2.0 technologies at workplaces, a movement known as Enterprise 2.0 [4]. Likewise, getting familiar with some of the existing Web services for demographers may be helpful. For example, DOTS Demographics (<http://www.serviceobjects.com/products/address/demographics>) provides ZIP code-level, small-segment demographics for in-depth local-area profiles for USA. It's built with sources such as U.S. Census data, housing and urban development (HUD) data, current-year demographics and data culled from millions of consumer purchase records.

Of course, as in many other situations, motivational aspects are the key to starting and maintaining successful and collaboration and resource sharing. To this end, [5] argue that a continuous dialogue between interested parties at workplaces and organizations may contribute to creating a sense of shared ownership over resources and tools, and become a motivational driver for use of related knowledge sharing technologies.

As IntelLEO includes several other services in addition to CKP, experience is growing in terms of evaluating and using them. In a recent survey, [7] have found users to be willing to contribute to organizational learning and resource sharing provided that they receive some recognition of and feedback about their contribution. The recognition should come from their peers and organizations, and should state organizational expectations explicitly.

CKP and the other IntelLEO services are developed as Web services, and it is necessary to understand the aforementioned ambiguity of the term "Web service". It comes from the fact that developers and end users view it differently. The way the term is used in this paper so far is more suitable for end users. However, technically, a *Web service* is a software system designed to support interoperable machine-to-machine interaction over a network [2]. To enable this interaction, a Web service has an interface described in a machine-processable format and can receive and send messages typically encoded using a specific protocol based on HTTP and XML.

More recently, the emphasis in the Web service technology is moving towards *RESTful Web services*, and as a part of future development of CKP its transformation to a RESTful Web service is planned. RESTful Web services use HTTP and the principles of *Representational State Transfer*, or *REST* [3]. These mean that a client application (e.g., a Web browser) initiates requests to Web servers, the servers process the requests and return appropriate responses, and both the requests and the responses are related to the transfer of representations (states) of resources. A resource is generally anything on the Web that can be addressed (by a Uniform Resource Identifier, or URI, such as <http://example.com/resource/>). Its representation is typically a document that captures its current or intended state (e.g., an HTML page) when the client application accesses its address. The returned representation of the resource places the client application in a new state; it enables the client to, e.g., traverse a hyperlink in the returned representation to access another resource. This, in turn, will typically return the current representation of the other resource, which will place the client application into yet another state. RESTful services are simple Web services; their implementation typically involves using just basic HTTP methods, such as GET, PUT, POST, and DELETE. Thus transforming CKP into a RESTful service is expected to increase its performance and usability.

A part of transformation of CKP to a RESTful service should include modifications in its user interface (or making it configurable) to match the mindsets of its users (demographers, in this case). The same holds for the other IntelLEO services. For example, as the evaluation has shown, replacing 'learning' with 'collaboration' in the user interface would make some users feel more comfortable with CKP.

Further work is also needed to enrich CKP with more demography-related ontologies/vocabularies (or, again, to make it easily configurable for using other ontologies). As discussed in [1], good-quality domain ontologies are not easy to develop. Thus reusing existing relevant ontologies (e.g., the GeoNames ontology <http://www.geonames.org/ontology/documentation.html>) with CKP can not only increase the service's usefulness, but also save a lot of work.

8. Conclusions

Web services for demographers are not plentiful, although some do exist. Demographers are often not aware of such services, or sometimes it looks as if it would take too much effort to start using them. Still, given the fact that much of the work done by demographers requires collaboration of people from more than one institution, there is an evident need for using services that can facilitate such collaboration. These services should pertain to resource sharing, common repositories, easier navigation, and increase of on-the-job effectiveness.

The recent trend of opening government databases to research, businesses, and general public – and many of these databases are related to population of the corresponding countries – new opportunities arise for researchers and other professionals in demography to do more creative and more useful work. In such a situation, the benefits they can have from using new Web services are related to a better insight into available resources, to learning from other colleagues and professionals about new resources, and to making the things that researchers and professionals want to accomplish easier to get done. To get started with using Web services, awareness of existing services is necessary. Using them is not a technical problem, and some of them are already out there on the Web. It also helps if professionals and researchers in demography and other social sciences get aware of many Web services that facilitate collaborative work, such as IntelLEO Web services, and that can be adapted for use by social scientists.

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