

Personal Information Environments pose challenges for Digital Libraries in a 2.0 Web

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Abstract

The current social-technical system named “Digital Library” 2.0 can be viewed as a “social machine” made up of tools and organizational rules and praxis, dedicated to opening up the information management and access to a Web-wide scale. However for the very nature of the 2.0 applications centred on a “read-write” approach and on the social paradigms, the consequence of “2.0 digital libraries” brings also frustration in the information management due to the overload of resources and connections which are thus far made easily available via multiple channels and modes. In this paper we provide our view on the emerging nature of a Personal Information Environment (PIE) system at the beginning of the third decade of the Web. Such analysis should pave the way for a clearer conceptual design of libraries’ innovative services to better meet users’ needs. We conclude the paper highlighting two key functions for next generation of digital libraries: 1) developing expertise for monitoring, adopting and developing new social machines coming from the frontiers of web development 2) supporting library users in developing higher order skills in their personal information and knowledge management approaches. While in this paper we focus more specifically on the issue 1), we do defend the idea that the issue 2) can be participated by libraries in close synergy with educational institutions with great advantages for the library users.

1. Introduction

The social-technical Web wave tagged “Web 2.0” is characterized by the easiness of a read-write approach and the consequent increase in users’ participation in content generation. As a consequence new socially-created information sites widespread: from social networks, to blogosphere conversations, forum, etc. clearly showing that social information and social knowledge highlight characteristics profoundly different from those we were used to. We are seeing a shift in focus: where the primary purpose of the early Web was sharing files and applications, there is now a growing awareness that the real value of the network lies in the emergent collective intelligence and in the ways it helps us create, identify, and sustain relationships availing of a multitude of tools and services (Di Maio, 2008) (Horizon, 2008).

Within this framework, looking for information poses several challenges because it entangles interacting with fragmented data, heterogeneous documents and interconnected people through a non-unified set of tools and without codified approaches to guarantee satisfactory results. Such an issue is related at the state of the art, to concept of “Personal Information Management” (Jones, 2007) (Jones & Teevan, 2007).

Web-based information management often causes overload, because users are overwhelmed with news, resources and relations whose management has clearly become a daunting task (Horizon, 2009). While the user is often overwhelmed with non-requested information, finding relevant information with proven reliability and trustfulness is a very hard task. Indeed, contents are often archived in different formats and made accessible by

the Internet protocols only in a very limited way, as it is pointed out in studies related to the deep Web (also referred to as hidden or invisible Web) (Bergman, 2001) (Wright, 2009).

If the above issues in information search are not new to scientists in the domain (Singhal, 2001), for a certain period Google's approach to this issue seemed to provide a long-lasting solution because of its ability to account for the users' behaviour (linking activities) in its Page Rank algorithm (Langville & Meyer, 2006) thus providing a good-enough accuracy in the search results. Today the supremacy of such approach is questioned, because of the changes occurring in content types and creation ways brought by Web 2.0. This is witnessed by the newly available solutions in the domain of information search: *Google's Rich Snippet*, *Google Search Options* and *Google Squared*. These important new features are symptoms of the need to adapting the searching strategies to the changes in the Web scenario (MacManus, 2009a). This trend is also confirmed by the growing importance of the computational knowledge solution led by Wolfram Alpha (<http://www.wolframalpha.com/>) engine and the other alternative search engines rising the scene over time (Knight, 2007).

While showing differences in the search approaches adopted, the majority of the above product and search features highlights that, behind the information growth, searching strategies try to introduce new search criteria over which conduct a more effective search (Search 3.0, 2008). Between such criteria we recognize two mainstream ideas whose combination is likely to drive the innovation process for by digital libraries:

- 1) Information management powered by structured data, paving the way to the semantic search
- 2) Information management powered by socially generated/shared/indexed content, i.e. collective intelligence.

1.1 Social Information, that is Web 2.0

The current phase of the Web has radically changed the approach to "information", which is recognized as being one of the most vague and difficult to define terms in our vocabulary. In Florindi's words, "Information is notoriously a polymorphic phenomenon and a polysemantic concept so, as an explicandum, it can be associated with several explanations, depending on the level of abstraction adopted and the cluster of requirements and desiderata orientating a theory" (Floridi, 2005) (Knox, 2007). In the context of digital libraries, studies in the domain of information theory is always more often focusing on the information creation and usage processes (Goguen, 1997) (Hjørland, 2007). While the notion of information to which we were attached in the first decade of digital libraries (Baeza-Yates & Ribeiro-Neto, 1999) was largely referred to a decontextualized, generalized and universal information, we now acknowledge the existence and the relevance of a social information emerging from the network and deriving its meaning in specific contexts and upon specific solicitations and impulses. If the "old" information has to be codified, the "new" one is derived from the tacit knowledge, that is from the application to specific situation of cognitive abilities and intuitions developed through the experiences and availing of the personal knowledge history. While codified knowledge aims to be exhaustive – isolating a give phenomena and describing it in a systematic way – social knowledge is vague and "it is only elaborated to the degree that it is useful to do so" (Goguen, 1997). Codified knowledge has the ambition of being definitive, social knowledge has the peculiarity of being always under construction, open to integrations and modifications. Being a foundation of the social-economical system,

objective information is stored in machines as “data”, it is replicated and diffused through replication. Social information is created through communication, in conversations (Sifry , 2005) and stored in networks (Siemens, 2008). Given such premises, there is now a quite wide awareness that information search and retrieval itself can significantly benefit from online social processes (Brynn & Chi, 2008).

Nonetheless, social search, though being widely accounted for in mediated references library services, it is hardly accounted in online library catalogues. Indeed, to the state of our knowledge, there are to date few experiences trying to integrating library catalogues and social network tools such as social tagging, social review and ranking. Such experiences, such as PennTag (http://tags.library.upenn.edu/help/what_is_penntags), seem to highlight that the only coupling of the traditional digital library service to Web 2.0 services has not really entered the digital libraries practices because it has not yet proven its relevance and usefulness. Recent literature (Peterson, 2008) advocates that such services fail to spread in Information Library Services because their effectiveness is triggered beyond a critical mass participation. In order for the collective intelligence generated by the library users to be effective, it is required a considerable amount of material which should go well beyond the single library system dimension.

A different and promising approach seeming to pave the way for richer and more effective information search processes is the one which opens digital libraries to the Web 3.0 services, that is those services leveraging on structured and semantic data. To clarify this concept it is worth doing a slight digression, focusing on the paradigm shift Web 2.0 versus Web 3.0.

1.2 Structured Interlinked Data, that is Web 3.0

Web 2.0 has been defined in different and even controversial ways. For the purpose of this work we describe it as a period in time in which Web technologies allowed the widespread of “read/write” and “social” services, that is services in which anyone can be a publisher, with a strong focus on social aspects, i.e. relations between users enabled by links to the contents, experienced through social networks. From an information search perspective, Web 2.0 central years (2005-2008) have been dominated by Google, with very few alternative search engines, while from an information organization perspective, Web 2.0 was characterised by the diffusion of content aggregation and syndication techniques, coupled with social tagging approaches. Mashups applications also spread during the 2.0 wave. In early 2008 something began to clearly change and a shift in focus *from unstructured information to structured information* started to be always more evident. In the early months of 2007, Alex Iskold (Iskold, 2007) forecasted that “unstructured information will give way to structured information - paving the road to more intelligent computing” and to a more intelligent Web, a Web in which data is “getting smarter” (Spivack, 2008). A new term land-marking this shift then entered the scene, the term *Web 3.0*. Though such a term is not widely accepted on a Web-wide scale because of its vagueness (“The Web 3.0 term misleads organizations by implying that a new version of the web is upon us.” Bradley, 2009), Greg Boutin (May 2009) caught the very essence of the idea and attached to this term a meaningful definition: “The Web of Openness. A Web that breaks the old siloes, links everyone everything everywhere, and makes the whole thing potentially smarter.” (Boutin, 2008). According to this perspective, Richard MacManus in his sharp ReadWriteWeb column provided an even clearer view on what’s different. The core idea is that there is a difference in the products we are seeing in 2009 compared to the ones we saw at the height of ‘Web 2.0’ (2005-08): more products are based on open, structured

data (e.g. *Wolfram Alpha*), a stronger emphasis is put on real-time services (e.g. *Twitter*, *OneRiot*) and better filters enter the scene (e.g. *FriendFeed* and *Facebook*), while on the information search standpoint, Google evolves (*Search Options* and *Rich Snippets*, *Search Wiki*, *Google Squared*). If Web 2.0 was about user generated content and social applications such as YouTube and Wikipedia, then Web 3.0 is about *open and more structured data* - which essentially makes the Web more 'intelligent'.

Concluding this brief review of the Web evolution between Web 2.0 and Web 3.0 what is clear is that the time for open structured data has come, thus paving the way for the next generation of context-dependent, real-time and personalized applications. We are beginning to see it in the current Linked Data sets being released (s. <http://wiki.dbpedia.org/Interlinking>), and in the support that big companies, like Google and Yahoo, are showing for structured data (MacManus, 2009c). Even if the two approaches above can seem contradictory – or at least they can be perceived as being so in some context, such as the one of library information systems, there is now a growing evidence that this is not the case (Hendler & Golbeck, 2008)(Ankolekar et al., 2008). Indeed, it is actually true that a Web of Data, or a Web 3.0, is not yet a reality, because data are still mainly stored in information silos, managed through tools and logics which are proprietary and non standard, while a real Web of Data perspective would require the possibility to interlink open structured data according to an agreed standard. On the other side, Web 2.0 is grounded in the capability to create and publish information and knowledge through a grassroots participation and creation of shared knowledge, thus becoming an extraordinary powerful tool to maintain a dynamically update the knowledge produced. In order for the Web to become a framework for the development of knowledge, beyond the aspect of information search, it is therefore important to bridge the two worlds Web 2.0 and Web 3.0 according to a social-technical perspective, thus availing of “2.0” essence (collective intelligence) supporting the growth of the 3.0 Web of Data and, eventually, of the Semantic Web.

According to such premises, the view on the social information theory calls for a rethinking of the evolution strategies for the Digital Libraries (DL), starting from a reconsideration of the roles together with all the elements of the logical and functional architecture. At this design level, the distinction between external or internal information sources is less relevant, while the main objective of the Digital Library shifts from the aggregation of data, eventually through low level descriptions, to their functional organization in a higher level “knowledge organization”.

In this paper we will focus on two directions which we consider relevant in the definition of the Digital Libraries’ practices in the third decade of the Web:

1. Digital Libraries can configure them in order to make wider and systematic use of combined 2.0 and 3.0 approaches and make it available to its users; this implies developing a sound expertise in monitoring and integrating new solutions and praxis owing to the Web evolutions frontiers.
2. Digital Libraries can support their users in developing new skills to become more effective “personal information managers”.

2. A conceptual view of the Personal Information Environment: new challenges for the Digital Libraries

The evolution of DL should be inspired by a closer analysis of the possible configuration of a users' – or researcher's - personal information space – hereafter named PIE (Personal Information Environment).

Figure 1 schematizes how a PIE evolved over time, according to the three decades of the Web evolution. For each of the three Web stages (here labelled 1.0, 2.0 and 3.0) the PIE is made up by five main "slices" decorated by different set of tools which supported/support to various degree the primary function to which they are attributed (Peña-López, 2008): gathering of digital resources, personal production with public aim, self-archiving and self-publishing facilities, networking and collaboration.

The "gateway" to the PIE is a personalized home page accessible through a Web browser and made available by webtop applications¹.

What is common to the different Web eras is that a Web user can enrich his PIE to a various degrees, depending on his digital literacy, abilities and interests. In the present time, in which we cross the edge of the second decade and we enter into the third one, the richness and the variety of tools which can compose the related PIE has become overwhelming for the most expert and shrewd user.

Within this scenario, DLs clearly need to refocus their core expertise and practices to meet the users' needs in the effective management of a Personal Information Environment. In the following paragraphs we discuss in deeper details some of the key technology trends and products in the Web evolution which are susceptible to remarkably affect the DL services.

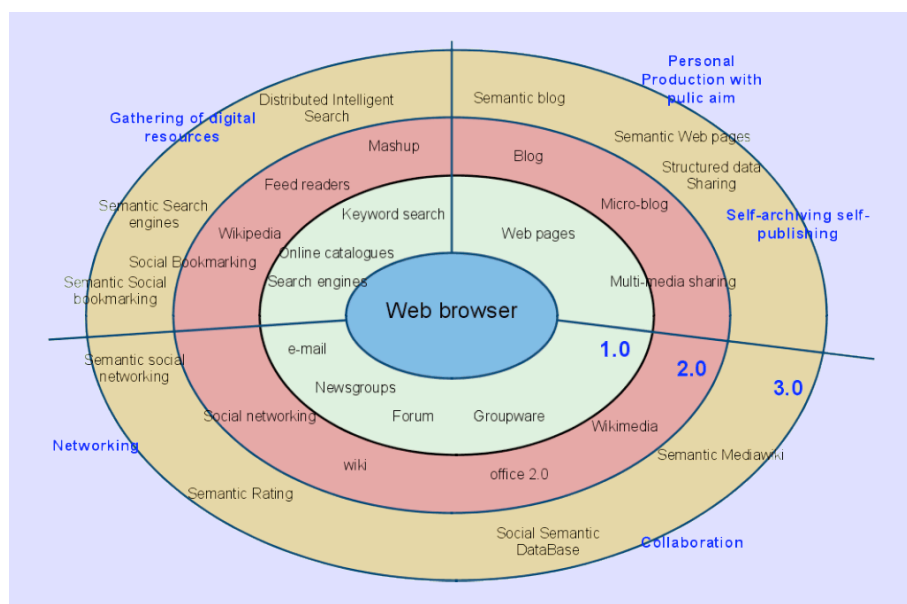


Figure 1: a view of the evolution of the PIE – Personal Information Environment in traversing the three decades of the Web evolution

¹ Of course the Web browser itself is susceptible of evolution, therefore a true representation of the PIE evolution over time should account for a third dimension which is not depicted here, for the sake of simplicity

3. Personal Information Environment tools in 2009

In Web 2.0 we assisted to the rise of the “collective intelligence systems” (Di Maio, 2008) in which contents are widely generated by the users and provide evidence of an extremely rich “emergent intelligence” on a wide scale. Availability of structured and semantic data – that is the opening to Web 3.0 solutions, added to this scenario the possibility to build countless relations with other systems and information sources. Gathering digital information sources, one of the primary functions of the digital libraries, has thus acquired new facets, which are witnessed by several trends, products and tools.

The first trend which is worth citing is the one driven by the information search leader: Google. In November 2009 Google opened its *SearchWiki* service: the ability to add, annotate, and remove search results (Sullivan, 2008). In May 2009 (MacManus, 2009d), Google announced three significant features to its search product which are now already available to every Google user: *Search Options*, *Rich Snippets* and *Google Squared*. The first two features have notably extended Google's core search product aiming at integrating search results from across Google's properties into the main search (images, maps, books, news, and video and blog). Such evolutions is witnessing the fact that Google is about to significantly enter the domain of structured data in order to value its potential in the information retrieval domain (Mika, 2008). Going further, *Google Squared*, which went live only in these days (June 2009), proposes itself as a search engine that creates structured data from big piles of information and lets users compare various things by their attributes. There have been suggestions that Google Squared will crush *Wolfram Alpha*, a powerful computational knowledge search engine of very recent creation even if, at the moment of this writing, it doesn't look very well performing (Schonfeld, 2009) (Kirkpatrick, 2009). Even more recently (June 2009) Google acknowledge the integration of links to Wikipedia articles about current events clustered in the lists of sources on Google News.

With those sets of changes, Google search added more types of content (including multimedia like video and maps) and some read/write functionality (which Google termed a “wiki”) and centred its evolution around three core themes distinguishing the transition between Web 2.0 and Web 3.0: real-time information, adding more meaning to the data (also known as Semantic Search), and filtering results.

Along the same direction, Yahoo! search engine proposed its initiative leveraging on structured data, named *Search Monkey*, a product still in its development phase. SearchMonkey allows sharing structured data with Yahoo! Search, displaying a standard enhanced result (available for certain content types) and providing a SearchMonkey developer tool to extract data and build apps to display custom enhanced results.

In the domain of knowledge-oriented search engines, it is worth mentioning the information management products focusing on faceted search, such as *Mspace*. This class of products allows organizing search through large data sets availing of exploration by domains, that is successive information filtering to refine the search domain until the most accurate information view is provided.

Besides *Wolfram Alpha* and *Google Squared* initiatives, aiming at providing computation on information for the extraction of new meaning, several other tools exist which it is worth citing: *Thumbtack*, *DataPress* (supporting journalistic excellence in online content) and *ContextMiner* (for the management large structured data sets). *ContextMiner* allows collecting, analyzing and presenting contextual information along with the data. It is based on an idea that while describing or archiving an object, contextual information helps to make sense of that object or to preserve it better. *ContextMiner* provides tools to collect data, metadata, and contextual information off the Web by automated crawls. At present, *ContextMiner* supports automated crawls from blogs, YouTube, and Twitter but additional sources are planned to be added to the system in order to enrich its potential. *Context Miner*, though being a prototype and not a real product, highlights the trend of exploiting structured data to analyse large collection of data for specific, meaning-extraction purposes.

The domain of tools for gathering digital resources is enriched by a set of important tools which are worth being considered for the purpose of this paper, especially in the domain of social tagging systems. Socially generated information and the exploitation of the collective intelligence play a major role in the social tagging process. The difference between a tag and a keyword is related to the statistical meaning given to the latter by traditional search engines while the sense of the former is affected by the users. On a wide scale level, recurring tags affected to a given resource represent the emergence of a shared evaluation on the resource content, regardless from the lacking precision it may bring. In order to mitigate such issue, social tagging systems can be effectively endowed with a social feedback feature. Such an approach is implemented in the prototype of an interesting product, *MrTaggy*. which is build aggregating more than 150 million of data from social bookmarking sites, thus becoming a half-way solution between a tag-based search engine and a recommendation system. *MrTaggy* is not indexing resources basing on their full-text; on the contrary it aims at exploiting the social knowledge expressed through the tagging mechanism enriched with feedback mechanisms (ordering relevant results and/or using “related tags”) (Chi, 2009). Always in this domain, the product *SparTag.us*, provides new social annotation system using a “Click2Tag” technique to provide easy keyword tagging over Web content being browsed. *SparTag.us* lets users highlight text snippets in place and automatically collects tagged or highlighted paragraphs into a personal notebook. Notebooks, tags, and highlights can be shared amongst the users’ social network.

Social tagging mechanisms have a special place between the search tools because of their potential to favour the bottom up approach to support Semantic Web applications (Spivak, 2008). Actually, the issue with such system is the one of coming to a commonly agreed meaning of terms which would pose the basis for the development of ontologies. The *Faviki* (Miličić, 2008) project, still in its beta version, is aimed to overcome such issue leveraging on the dynamic knowledge base provided by DBpedia, a community effort to extract structured information from Wikipedia and to make this information available on the Web. DBpedia provides to Faviki a large data base of sematic structured tag. In this way, Web pages saved by users are not just described by random words but connected to uniquely defined concepts defined dynamically. As it is proven by the Faviki experience, tagging emerged as a (good enough) way to integrate and organize the data. Semantic tags, as an intersection point of the two worlds, Web 2.0 and Web 3.0, have the potential to enable much faster evolution of the Web by providing a solid foundation from which the Semantic Web can grow soundly and hence provide cutting edge solutions for gathering digital resources as it is needed for today’s digital libraries. DBLP Bibliography

(<http://www4.wiwiss.fu-berlin.de/dblp/>) and Project Gutenberg (<http://www4.wiwiss.fu-berlin.de/gutendata/>) (both linked to Dbpedia), already show such potential in action.

In contrast to the keyword-based full-text search commonly found on the Web, DBpedia structured data offers the opportunity to make productive use of the relations in the data, enabling narrowing of search results in different dimensions (Dbpedia, 2007). DBpedia can also be seen as a huge ontology that assigns universal identifiers (URIs) to a large number of concepts. This knowledge base can serve as the universal controlled vocabulary needed for a number of applications. Always from DBpedia is derived the SemanticMedia Wiki project in which the encyclopaedia articles are built on predefined forms. Dbpedia also offers a starting data base for the Freebase project that aims at building a huge online semantic database which users can edit similarly to Wikipedia articles.

Pushing to the extreme the idea of semantic search, *hakia* (<http://www.hakia.com/>) proposes itself as a general purpose "semantic" search. Instead of bringing results via statistical ranking methods, *hakia*'s semantic technology is aimed at providing quality search results satisfying three criteria simultaneously: (1) providing results coming from credible Web sites recommended by librarians, (2) representing the most recent information available, and (3) remaining relevant to the query. *hakia* search results are organized in a tabbed format distinguishing results as "Web results", *hakia* "Credible Sites", "images and news". Again, *hakia* search model combines semantic search techniques with users (librarians) generated content thus bridging the Web 2.0 and Web 3.0 worlds.

A relevant class of tools is the one of "social semantic rating" systems among which we cite *Revyu* (Heat & Motta, 2008) a system allowing reviewing and rating things (people, books, articles, etc.). Much like DBpedia, semantic structured data generated using *Revyu* are open to linking, according to the Linked Data principles². Analogously to other systems described above, *Revyu* provides a 2.0 approach to building semantic structured data.

In the domain of collaboration powered by semantic technologies, *Twine* provides a Web-based tool to manage, organize and share information using a Semantic Web service. *Twine* allows to collect online content – videos, photos, articles, Web pages, etc. - and bring it together by topic, allowing to share it other users. Semantic technologies allow *Twine* to be powered by semantic understanding that is learning about a user interests and making personalized connections and recommendations.

The brief analysis of the tools carried out above highlights a general trend in providing effective tools for personal information management according to different users and perspectives a user might adopt and always leveraging on a combination of the best ideas from the Web 2.0 and Web 3.0. DLs are the right players to become authoritative reference in driving the development of more effective information management applications. Such application fall into the class of applications called *collective knowledge systems* (Gruber, 2007), which unlock the "collective intelligence" of the Social Web with knowledge representation and processing techniques of the Web of Data and Semantic Web. Supplementing "human-machine synergy" (ibidem), collective knowledge systems exploited in Digital Library services have the potential to avail of the key properties of user-

² a method of exposing, sharing, and connecting data via dereferenceable URIs on the Web (Bizer et al., 2008)

generated content and emergent knowledge, thus paving the way for increasing returns with scale.

4. Conclusions

In this paper we tried to provide a general view on the core evolutionary aspects highlighting the new trends in information access and management, a primary concern of Digital Libraries.

If it is there is common agreement that we live in a context in which information and knowledge are always more recognised to have a strong social component, we do not find yet sound methodological approaches and effective technological tools to make the best of the Personal Information Management experiences which DL are required to guide.

Starting with a possible schema of library users' Personal Information Environment, a PIE, we aimed at pointing out that in users' current practice the management of information characteristics (Situating, Local, Emergent, Contingent, Embodied, Vague, Open) (Goguen, 1997) is a crucial asset. To this end we made a review of the current cutting edge tools for effective information management leveraging on combined approaches deriving from Web 2.0 and Web 3.0.

According to this background we identify possible research directions in which Digital Libraries can be main players and which will stay at the core of our next future works. Such direction is centred on the idea to develop an "observatory on Digital Library evolution" a privileged viewpoint on technologies and methods for Digital Libraries in the current Web decade. Such observatory should develop core expertise in:

- 1) monitoring and evaluating tools and cutting edge technologies related to the PIE main functions (gathering digital information, collaboration, networking, personal production with public aim, self-archiving and self-publishing). Indeed, reasoning about the possible configurations and uses of a PIE in a future perspective can provide useful hints in the identification of the challenges to be undertaken by the digital libraries in their struggle to get the best from Web technologies and applications to serve their users.
- 2) promoting and incentivizing a wider adoption of semantic/social network tools, that is of collective knowledge systems, integrated into library services
- 3) evaluating the effectiveness of the adoption of such systems also availing of social network analysis tools
 - a. The analysis of network graphs can allow identifying organizational models which highlight interesting effects such as the creation of information hubs in the information network. Statistic analysis proves hence to be relevant to information discovery. Social network analysis techniques have shown, for instance that social tagging services let emerge simple models of tag uses which stabilize over time, as expression of a local negotiation, contextualized in loose representation (Goguen, 1997) of information evolving with the introduction of new tags (Golden & Huberman, 2006) (Cattuto, Loreto, Pietronero, 2007). In the context of digital libraries several analyses could be conducted in relation to this research direction: from the distribution of the library's users subscription to RSS feed, share tags, relation between objects around which social networks are built (documents, news, users, etc....).
- 4) proposing informal Personal Knowledge and Information Management skills development modules to library users. Indeed the capacity to capture and properly manage information is not only to be developed on the Digital Libraries' side; yet is

to be fostered also on users' side. DLs can act as enabler of their users Personal Knowledge Management (PKM) skills acquisition. Studies in this field provide a ground reference both to illustrate how PKM skills can be articulated into basic and higher order skills (Pettenati, Cigognini, Mangione, 2009) as well as a guide for the learning design of education activities for their acquisition (Pettenati, Cigognini, 2008). DLs – the keepers of knowledge inside institutions - are the right subjects to implement online courses addressed to their users allowing a more effective mastering of ones' Personal Information Environment.

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