Personal Knowledge Management with the Social Semantic Desktop

Niki PAPAILIOU[1], Costas CHRISTIDIS[1], Dimitris APOSTOLOU[2], Gregoris MENTZAS[1], Rosa GUDJONSDOTTIR[3]
[1]*National Technical University of Athens, Iroon Polytechniou 9 Zografou Athens, 157 80 Greece, Email: {nikipa, gmentzas}@mail.ntua.gr*
[2]*University of Piraeus, Karaoli & Dimitriou St. 80 Piraeus Greece 185 34 Email: dapost@unipi.gr*
[2]*KTH – Royal Institute of Technology, Lindstedtsvägen 6, SE-100 44 Stockholm, Sweden Email: rosag@kth.se*

Abstract: A large number of tools has recently emerged supporting personal knowledge management. Semantic technologies play an important role in the development of such tools because they allow for advanced organisation, annotation, navigation and search capabilities. In this paper we present SPONGE (Semantic Personal Ontology-based Gadget), a software tool that supports the management of all relevant information in the personal workspace of knowledge workers via cross-media and cross-application linking and browsing of information items based on standard semantic web data structures, together with un-intrusive metadata generation support. In SPONGE, we aim to provide a light-weight gadget for easy organisation and access to desktop information plus seamless access to Internet information by means of linking to popular Web search engines or other remote resources.

Keywords: knowledge management

1. Introduction

The discipline of knowledge management addresses four levels of knowledge management: individual, team, organizational and inter-organizational [12]. However, the main focus of research as well as of commercial projects up to now has been the organizational level, which has been analysed from several points of view, mainly the strategic, process, technology and organisational ones [5], [14]. More recently, various attempts have been made to delve into the team and personal levels.

At the personal level, the phrase “personal information management” was first used in the 1980s [9] in the midst of popular excitement over the potential of the personal computer to greatly enhance the human ability to process and manage information. Today, personal information management is meant to support activities such as acquisition, organization, maintenance and retrieval of information captured, used and applied by individuals [18].

A large number of tools has recently emerged supporting personal (e.g. [17], [15], [4]) knowledge management. A knowledge worker is typically using a variety of such tools, often switching between different tools when moving from one assignment to another. This has created the need for novel means to enable users to seamlessly manage more than one personal information management activities. Semantic technologies play an important role in the development of such tools [3], [10].

In this paper we present SPONGE (Semantic Personal Ontology-based Gadget), a software tool that aims to support personal information management. In particular, SPONGE supports users finding, retrieving and annotating desktop resources. The paper is

organised as follows: At first we discuss related work and our research motivation. We then present the SPONGE architecture -- SPONGE uses and extends a number of Social Semantic Desktop components developed within the Nepomuk project (see http://nepomuk.semanticdesktop.org). Afterwards, we illustrate the use of SPONGE within a typical scenario of a consulting company. The last section presents our conclusions and areas of further work.

2. Related Work and Research Motivation

In recent years the number of ways to keep and manage personal information has increased considerably, in line with the overall increase in the number of devices, technologies, and applications on which knowledge workers rely. The attendant fragmentation of personal information increases the probability of keeping something in the wrong place or form and forgetting that something was ever seen, heard, or read in the first place [11]. Knowledge workers keep information in many different formats, applications, devices and systems. They sometimes keep the same piece of information in several formats to be sure they can get back to it again later and to remind themselves to do so.

Definitions of personal information and knowledge management revolve around a set of core issues: managing and supporting personal knowledge and information so that it is accessible, meaningful and valuable to the individual; maintaining networks, contacts and communities; and exploiting personal capital.

To support individuals better manage their personal knowledge, a wide variety of tools have emerged. Examples of such tools are GNOME-PIM, Gnowsis, Haystack, IRIS Semantic Desktop, KDE, MyLifeBits, etc. Metadata and the application of ontologies in KM tools are important topics affecting the development of personal knowledge management tools. Metadata are used to characterise information; as such they provide means to organize information and make it possible for machines to automatically process and interpret information. Moreover, semantic architectures and the application of ontologies in information systems in the area of KM facilitate the integration of heterogeneous information items within the corporate memory [2], [13]. Nevertheless, ontology-based applications are often associated with high set-up and maintenance costs and with complicated user interfaces that are not suitable for regular users.

Our motivation in this paper is to develop a usable ontology-based personal knowledge management tool that helps typical knowledge workers to overcome some of the above mentioned problems. We focus on a recent research direction related to the emergence of the Social Semantic Desktop [7], [16]. The Social Semantic Desktop aims to support the management of all relevant information in the personal workspace of knowledge workers via cross-media and cross-application linking and browsing of information items based on standard semantic web data structures, together with un-intrusive metadata generation support. In SPONGE we aim to provide a light-weight gadget for easy organisation and access to desktop information plus seamless access to Internet information by means of linking to popular Web search engines or other remote resources.

3. Research Methodology

3.1. – The Application Area and Research Approach

Our work focuses on professional business services (PBS) firms, i.e. firms that provide business services which are based on the application of highly specialized knowledge and expertise such as legal or consulting services [6]. Being knowledge intensive organizations, PBS firms employ professionals that can be characterized as typical examples of knowledge workers. Examples of such firms are law, investment banking, advertising, market research.

An example professional business services firm is TMI (see http://www.tmiworld.com/), an international management consultancy. TMI is operating through a network of local partners in 40 countries. It offers solutions through training, consulting, and tools, for individuals, teams and organizations, aiming to transform organisational culture.

In order to understand user needs and requirements, we conducted user research at TMI using ethnographic methods such as contextual observations and interviews. From our study we extracted requirements about typical processes and we created personas [1], [8] as a means to encapsulate user needs. Although personas are fictitious, they are based on the knowledge of real users and therefore identify users' behaviour patterns, motivation, expectations, goals, skills, attitudes and environment. Using these typical processes and personas we developed a number of use cases representing the knowledge creation and sharing work processes within TMI. One of these use cases and persona will later be used to illustrate the developed system functionality. Moreover, based on the elicited requirements we developed a computer-based high-fidelity mock-up, i.e. a partially functioning software prototype that provided typical PKM functionalities and that had a User Interface which was similar to the ones of pertinent tools, such as Gnowsis and Haystack (Figure 1).

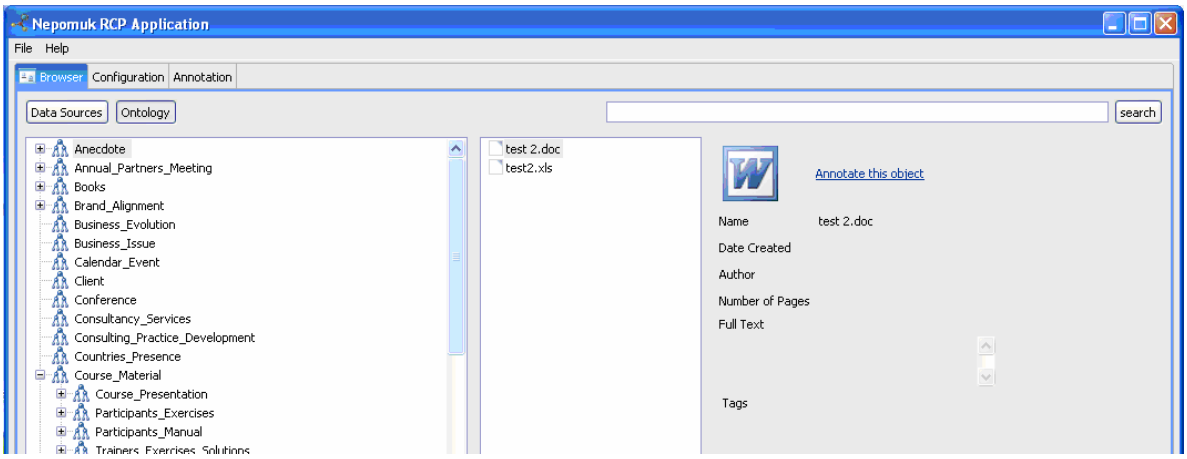

Figure 1: Mock-up used in user research

The high-fidelity mock-up was evaluated by TMI employees in three different office locations; Athens (Greece), Redditch (UK) and Haslev (Denmark). We chose to perform the user research in the informants' work context since it gives an in-depth understanding of their work situation and how the envisaged software fits into their daily work. The evaluation session consisted of a pre-interview, a task phase following pre-defined scripts and a post-interview. The sessions had one moderator and one or more persons observing. The evaluations were videotaped for further analysis. We evaluated the prototype with eleven participants, six men and five women. The medium age of the participants was 42 and it varied from 21 to 64 years old. The informants were both senior and administrative personnel. We had informants working as purchase ledgers, project managers and project support. We also had participants working as trainers, consultants, IT directors, partners and program developers.

3.2. – Findings

All informants, when they had understood how the mock-up worked, really liked that they were able to search for relevant material from their desktops. They appreciated the fact that they were able to search and collect relevant material, independent of original application and format. User feedback confirmed that the mock-up offered desirable functionalities for

supporting management of all relevant information in the personal workspace of knowledge workers. Nevertheless, informants generally felt that the prototype was cumbersome to use because they had to click many times to get to a finished task. Another problem with the prototype was the terminology (both of system labels and ontology terms) because it was not adapted to the target audience. Informants did not understand terms such as 'tag cloud', 'resources', 'wiki', etc. Iinformants did also have trouble using the search field of the prototype as it was not easily distinguishable from less important features. Moreover, informants did not understand how to refine the search results as e.g., they did not understand the choice provided to refine search results by selecting classes from the ontology. They also felt that the refine choices were too many.

When informants searched for TMI employees in the mock-up they seemed to be confused as to why they had to search for people in a different way than when they searched for documents. Searching for people should become consistent with searching for documents. There were also issues related to the graphic form and layout of the mock-up as they found the interface to be too grey and with no clear identity. The graphic form is considered vital to the success of the system because the experience during the usage of the system is almost as important as the usability. TMI employees spend a lot of working hours on making their client presentations and other material look attractive and the systems they use should therefore be the same. Informants also commented that there were fields that were empty and not used to execute their scripts. Fields should appear only when needed, i.e. the system should adapt to what the user was doing with the system.

In summary, informants raised many issues related to the usability and simplicity of software tool that was intended to be used by regular users, in a daily basis, and in an effort to improve work productivity in knowledge-intensive tasks. Based on the evaluation results, a radically re-designed software tool was developed, having simplicity and usability as a main priority while maintaining the essential functionalities and benefits of ontology-based information management.

4. System Description

4.1 – Overview

SPONGE is a personal information management system that provides advanced search, browse and annotation capabilities based on semantic technologies. SPONGE allows users to search for information resources using free-natural text querying. Resources containing content or metadata that match exactly the query keywords as well as content or metadata that are semantically similar are retrieved. Users are able to search resources either from one specific area/category, such as documents, projects, departments, experts, etc., or from all areas/categories.

Moreover, SPONGE provides users with the ability to browse resources based on semantics. Users are able to navigate through available resources by exploiting relationships between different resources. Different types of resources are shown with different icons. For a selected resource, the system displays resource-specific information, such as metadata, tags, place in the ontology and resource content preview. For example, if a person included in the persons' list of the system is selected, the system provides information, such as his/her profile, his/her documents or other items shared in the system and contact data (email, telephone, address).

Users are able to annotate manually the selected resource. They can add new tags and related items from the ontology while the system automatically restricts the possible options. Metadata are modelled in an ontology that represents the user's conceptualization of his/her domain. This allows a more fine-grained desktop resource classification than the

one provided by some operating systems that only allow one file to exist in exactly one folder.

4.2 – Technical architecture

SPONGE is a desktop client application that extends the core Social Semantic Desktop services. The Social Semantic Desktop is a software framework comprising a set of interoperable components including:

- The User Context Service component which aims to support the observation of and reasoning about a user's current work context.
- The Task Management component which aims to provide functionalities such as personal task modelling, scheduling, trigger and control, task delegation, task model reuse and retrieval.
- The Personal Information Management Ontology (PIMO) & Metadata Alignment component which aims to host personal ontologies and implement metadata alignment methods.
- The RDF-Store component which is used to store all crawled content and associated metadata in RDF.
- The Distributed Index component which allows users to search across the public spaces of other users' desktops and download the requested document.
- The Local Index component which allows full-text and semantics-based search in the personal desktop.
- The Data Wrapper component which extracts and queries full-text content and metadata from various information systems (file systems, web sites, mail boxes, etc.) and file formats (documents, images, etc.).

The aforementioned components are integrated on a service-oriented architecture and standard communication technologies (Figure 2). The architecture includes a Service Registry which allows registering, un-registering and discovery of available services. Moreover, the architecture is based on ontologies to support the use of semantic web technologies.

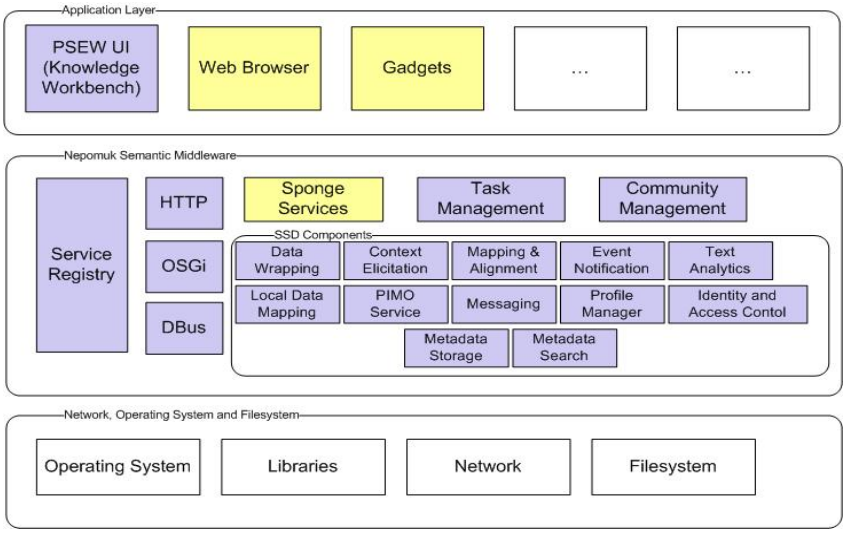

Figure 2: System architecture

PSEW (P2P Semantic Eclipse Workbench) is an effort to integrate the universe of SSD components in a single application with a single user interface. It is built on top of the Eclipse RCP 3.3 and consists of several independent views and editors that allow the user to manage the personal information and its semantic relationships. In this, the usage of Eclipse plug-ins is promoted, thus following the underlying OSGi architecture. The resulting

software is an Eclipse Rich Client Platform Application which provides access to available functionalities. In this way PSEW provides a central place to browse, query, view, and edit resources and their metadata.

SPONGE, the focus of this paper, is designed as a combination of a small gadget (a window taking up limited user space) and the user's preferred web browser. The gadget is preferred for user actions where a small part of screen area is required, such as entering a few words, while the web browser is used for presenting more information, for instance the results of a semantic search. The gadget is implemented using Microsoft Visual Studio.NET in an effort to create a simple to install and use application while also keeping a consistent look and feel throughout the user's windows desktop. It can be implemented in other platforms with minimal effort, since the services are provided in a language independent interface. The web pages use open source DOJO JavaScript framework for the presentation of the results and AJAX for asynchronous transfer of data. This interface is integrated using Jetty web server in the PSEW environment, providing functionality to desktop applications through simple xml-rpc.

5. Walkthrough

In order to understand how SPONGE can facilitate a TMI employee to perform his/her daily work we discuss a typical scenario in which the persona of Alistair impersonates a Sales Manager. In a typical situation, Alistair has to prepare a sales meeting for an automotive client. He has to design a solution and write a proposal for the client taking into consideration the clients requirements.

At first, Alistair has to find out TMI experts being able to help him for the sales meeting preparation. Further, Alistair has to find out all proposals and standard products developed by TMI, in order to review the relevant to the case existing TMI offerings. In order to search about TMI experts and relevant existing TMI offerings Alistair enters queries in the SPONGE query interface in free text (free text search). Area A of Figure 3 shows the SPONGE query interface.

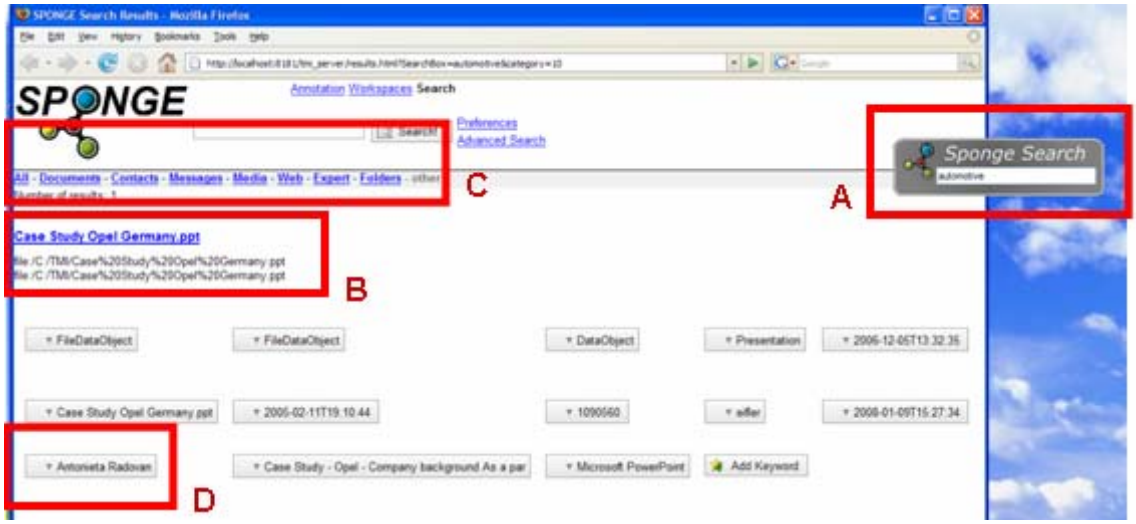

Figure 3: SPONGE Graphical User Interface for search

Results are retrieved in a web page (Area B of Figure 3). Among the retrieved results, Alistair identifies some that seem to be relevant. Alistair is not interested in a particular type of content, so he keeps the 'All' selection on (Area C of Figure 3). In order to clarify if a specific retrieved resource is useful for his work, Alistair selects it. The system provides information about the selected resource (metadata), such as author (Area D of Figure 3).

Metadata have been extracted when the resources were crawled. Metadata are modelled in an ontology that represents the user's conceptualization of his domain. Nevertheless, Alistair may want to alter some metadata or to provide additional ones. Figure 4 realizes the annotation interface.

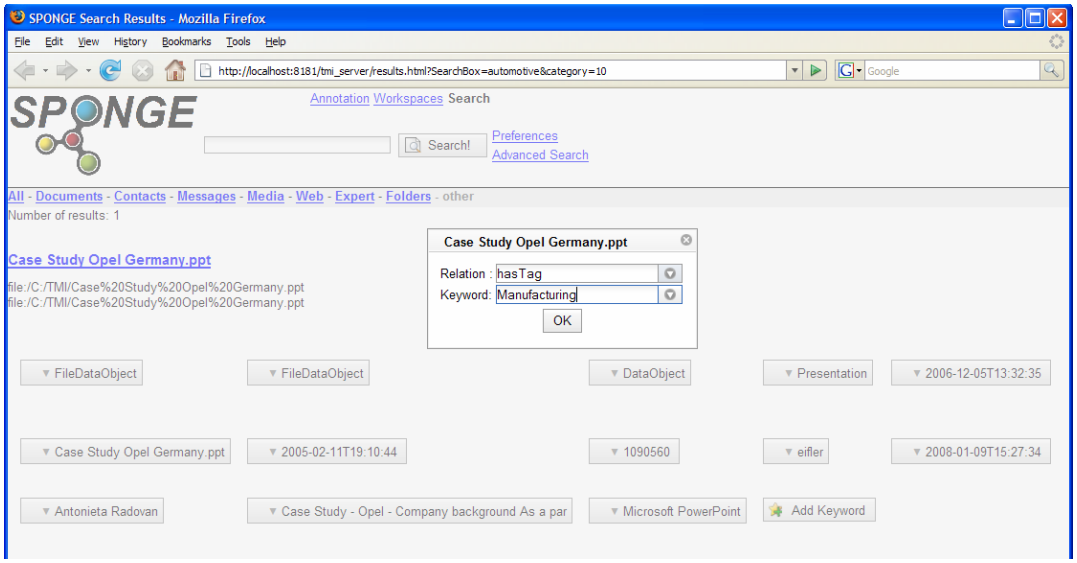

Figure 4: SPONGE Graphical User Interface for annotate

After finding relevant desktop resources, Alistair decides to look for relevant experts. He therefore selects the 'Expert' link in Area C of Figure 3. In addition, he searches for information about the client industrial sector on the Web. Based on the selected information, Alistair is now able to proceed in designing the solution and writing the proposal for his client.

6. Conclusions and Summary Recommendations

The rapid prototyping approach coupled with early user research revealed user needs and issues in an early development phase. Our research revealed a number of important usability issues in ontology-based PKM systems, such as the appropriateness of the terminology used, the degree of integration with desktop activities and the clarity of choices and features offered to the users that exploit the underlying semantic information. To address these issues, a radically re-designed software tool was developed, having simplicity and usability as a main priority while maintaining the essential functionalities and benefits of ontology-based information management. Further evaluation will follow to assess the impact of the improvements on the productivity of the users' daily PKM activities.

Our future plans include extending SPONGE with the ability to access remote desktops in a peer-to-peer topology and with collaborative features which will in turn give users the possibility to create workspaces supporting the accomplishment of their tasks. The idea behind workspaces is to provide a placeholder for storing, organising and sharing resources needed for the accomplishment of personal and collaborative tasks and to organise work-related tasks. This way, users will use SPONGE not only for easy organisation and access to desktop and Internet information but also for seamless access to semantically organised group resources. The planed extensions aim to facilitate wider and easier involvement of knowledge workers in project teams, easier reach to colleagues and experts for advice and information, and persistency of shared knowledge.

Acknowledgement

Research reported in this paper has been partially financed by the European Commission in the Information Society Technologies (IST) project Nepomuk.

References

[1] Calabria T. (2004) “An introduction to personas and how to create them”, Retrieved February 2, 2006 from Step Two Designs PTY LTD Web site: http://www.steptwo.com.au/papers/kmc_personas/index.html
[2] Caldwell F. (2006). Managing Philosophies and Risks when Knowledge and information Management Converge. Retrieved March 14, 2006 from Gartner Web site: www.gartner.com
[3] Caldwell F., Linden A. (2004). “PKN and Social Networks Change Knowledge Management”, Retrieved March 10, 2006 from Gartner Web site: www.gartner.com
[4] Cheyer, A., J. Park, R. Giuli (2006) IRIS: Integrate. Relate. Infer. Share, Proceedings of the ISWC 2005 Workshop on The Semantic Desktop - Next Generation Information Management & Collaboration Infrastructure. Galway, Ireland, November 6, 2005
[5] Davenport and Prusak (1998). Working Knowledge, Harvard Business School Press.
[6] Dawson, R. (2000). Developing Knowledge-Based Client Relationships, The Future of Professional Services, Butterworth-Heinemann.
[7] Decker S., Frank M. (2004). “The Social Semantic Desktop”, Technical Report, September 10, 2006
[8] Goodwin K. (2007). “Perfecting your personas”, Retrieved April 16, 2007 from cooper Web site: http://www.cooper.com/insights/journal_of_design/articles/perfecting_your_ personas_1.html
[9] Lansdale, M. (1988). “The psychology of personal information management”, Applied Ergonomics, 19, 1, 55–66.
[10] Linden A. (2005). “Semantic Web Drives Data Management, Automation and Knowledge Discovery”, Retrieved March 14, 2006 from: www.gartner.com
[11] C. C. Marshall and W. Jones (2006). Keeping Encountered Information, Communications of the ACM, January 2006, 66-67.
[12] Mentzas, G., Apostolou, D, Abecker, A., Young, R, (2002). Knowledge Asset Management, Springer 2002
[13] Mika P. (2006). Social Networks and the Semantic Web: The Next Challenge. In Staab S. (2006). Social Networks Applied. IEEE Intelligent Systems, January/February 2006, 80-93.
[14] Nonaka and Takeuchi (1995). The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation, Oxford Univ. Press.
[15] Quan, D., D. Huynh, and D. Karger (2003) Haystack: A Platform for Authoring End User Semantic Web Applications, International Semantic Web Conference, 2003 – Springer.
[16] Sauermann L., Bernardi A., Dengel A. (2005). “Overview and Outlook on the Semantic Desktop”, Procedings of the 1st Workshop on the Semantic Desktop at the ISWC 2005 Conference.
[17] Sauermann, L. S Schwarz (2004) Introducing the Gnowsis Semantic Desktop, Proceedings of the International Semantic Web Conference, 2004, Springer.
[18] Teevan J., Jones W., Bederson B. B. (2006). “Personal Information Management”, Communications of the ACM, January 2006, 40-43.