SOMEONE
A cooperative system for personalized information exchange

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Abstract: This paper presents a user-centric, social-media service: SoMeONe. Its goal is to build an information exchange network using Web informational networks. Itshould allow the construction of personal knowledge bases whose quality is improved by collaboration. It tries to increase the user's commitment by helping him to establish and to maintain interesting interactions with enriching people. Although many users are individualist, the rules we define for this media should encourage a cooperative behaviour. The functionalities it offers are between a bookmark management system and mailing lists. With SoMeONe users exchange information with semantic addressing: they only need to annotate information for being diffused to appropriate users. Each user interacts only through a manually controlled contact network composed of known and trusted users. However, to keep his contact network open, SoMeOne helps each user to send information to new appropriate users. In return, the user expects these users to send him new information as well. In companies, where the Intranet is composed of huge amounts of heterogeneous and diverse information, such collective behaviour should increase the personal efficiency of each collaborator. Thus, SoMeONe provides some solutions to some knowledge management problems particularly for companies aware of the value of their social capital.

1 MOTIVATION

Today, the World Wide Web is getting essential, but the problem is that it is just becoming so overwhelmed that, instead of satisfying the user, it frustrates him and can be a source of time waste. Of course, many services are developed to help the user to navigate in this magma of information. The most famous are search engines[1] and portals[2] including information directories. Others, more sophisticated, like recommendation systems (Delgado et al, 2001), (Popescul et al, 2001) are under development. However, all these tools are generally thought for creating centralized intelligent systems. Our

[1] cf. http://www.searchenginewatch.com/

[2] See for example: http://www.wanadoo.fr , http://www.voila.fr ,or http://www.yahoo.fr

approach is different. We use the distributed intelligence of the users that handle the information. We help users to exploit their relationship exchange networks to find and filter information between each other. By doing this, we develop a kind of new network where information navigates from users to users instead of having users navigate through information; we call this network the "human web". As with push technologies, information goes directly to the user. Nevertheless, instead of having channels controlled by information providers, we manage networks of human channels. With our system, a user from trustworthy relationships becomes a Third Party Confidence. We think that the selection made by these human channels can be much more personalized and adapted to users needs by using human faculties far beyond nowadays automatic indexing technologies. For example, how to identify, automatically, a document containing false information? How can software recognize that a level of document description is appropriate to a user's background knowledge, or to measure the clarity of the discourse, or the pedagogical qualities of the presentation? How can software model user's sensibilities in order to detect funny stories, beautiful pictures, dramatic movies that he/she will be sensible to and will certainly appreciate? The challenge is now to cope with the quantity of available information. But first, the goal is not to replace traditional search engines but it is to complement them for example with new ranking mechanisms. Second we hope to scale with the number of the users that will participate and will post new information in the network.

Many systems have been developed to take advantage of collaborative relationships. Newsgroups and mailing lists are the most famous ones. By using them, we are acquiring a new, social, cyber-behaviour that asks us to adopt new habits in working and even in thinking schemas. We call "social media" such systems where information comes from a network of users. These media support virtual communities, and deal more or less with social aspects of information exchange. Like many others, we call "virtual community", a group of people sharing common interests, ideas, opinions, and feelings over collaborative networks. Then a social media contributes to the creation and evolution of these communities and consequently helps people to establish relationships.

We present SoMeONe (**So**cial **Me**dia using **O**pinions through a trust **Ne**twork) a user-centric, social-media service that helps people to build efficient networks of relationships to exchange information. It is user-centric because users are the source of qualified information and are assuming the main processes. The system only helps users. The quality of the exchanged information comes from our assumption that each user wants to send valuable information in order to confirm and maintain mutually enriching relationships. It is social because we take into account the social aspect of the analysis of relationship networks in order to regulate the media.

Compared to available social media, SoMeONe is first dedicated to information about information (meta-information). It can thus be seen as a media for the semantic web (Berners Lee 2001). Second, its operational rules are defined in order to stimulate cooperative behaviours. The following sections will develop these points.

2 TRADITIONAL MEDIA FOR INFORMATION EXCHANGE

Although the Internet was presented as an exchange and share support and although it has allowed the development of systems such as :

newsgroups,

mailing lists,

knowledge sharing systems (Bouthor, Dedieu, 1999) (Glance 1999), or

peer2peer systems (Adar and Huberman, 2000), (Adamic et Adar, 2000),

these collaborative systems still raise certain problems.

With newsgroups (1), the users receive a great amount of information because of the number of participants. The quantity of information could hide the interesting one. The number of participants makes it difficult to remember interesting people and to locate experts. The access to the published messages is public. As a result, the user who sends a message does not see the people who can read it. There is no control in the visibility of their publications. This is the typical source of spamming. This tendency seriously threatens the use of these community services.

Controlled sharing systems (2), like mailing lists, partially solve the problems listed above. Mailing lists allow the definition of the receiver of a sent message. However, they still contain inconveniences. A user receiving messages cannot filter them in another way than using the emitter's address (because he/she does not see the mailing list's name to use it as a filtering criterion). All the messages from this user are then filtered, whatever the subject. This can be a shame. When a list is personal, only the mailing list creator can send messages to this list. When a mailing list is public, everybody can send a message to this list, but if a message interests two groups of people

corresponding to two different mailing lists, if one user belongs to both, he/she will receive this message twice. Notice that, whatever the privacy of lists, when we manually manage distribution lists, we only insert the people we know. It is true that users can sometimes ask to be registered. Nevertheless, how could a user know about an existing distribution list? Moreover, how can he/she know if the contents could interest him/her if he/she has no access to these contents already?

Knowledge sharing systems (3) store information to be shared among users. Information is usually classified in a collective taxonomy. Users can't access to information according to his own criterions. Users do not control information visibility. Without such control, some users are afraid and intimidated to participate.

Finally, new exchange systems are based on "peer to peer" (4) technologies. Their main problems are: the uncontrolled information search, the impersonality of the exchanges (although sometimes anonymity is appreciated) and, for most of them, the need for a specific client software installation.

Some systems try to handle some of those problems using collaborative techniques (Glance et al., 1999) (Good et al., 1999). However, this filtering process is limited by users' motivations to supply comments about the messages. Even if at the beginning the user is motivated to supply this information, the perceptible return on the quality of the obtained filtering is often long and can be disheartening.

Cockpit tries to take into account some subjective features in annotating information (Gräther and Prinz, 2001). However, Cockpit distinguishes between community and personal vocabulary, forcing users to add more information.

We also observe that whatever the exchange system, problems also arise from the user's behaviour (Adar and Huberman, 2000). One of the most observed behaviours is that more users are consuming rather than producing information. One consequence is that the quality and robustness of the system are dependent on these producers. Moreover, these users are powerful and can use this power in inadequate ways –like rumour diffusion, advertising, etc.

3 SOMEONE'S BASIC FUNCTIONALITIES

We try to deal with these problems in our system. SoMeONe's conception is influenced by ideas from mailing lists and personal bookmark managers (Andrews, 2000), (Kanawati et Malek, 2000), (Trevor, 2001).

An online service. A difference between a traditional bookmark manager and SoMeONe, is that SoMeONe stores and manages all this information in an online server. There are two advantages of this network exchange solution. First, this very useful information can be accessed by the user from any terminal using a plain HTML browser. The increasing mobility of workers and the availability of multiple connected mobile devices is becoming crucial. Second, this information can be accessed and shared by several users.

Meta-information management. Each user can manage his/her own taxonomy to classify documents. Generally, 'shared workspace' systems require the definition of a common shared taxonomy (Gräther et al, 2001). We call each taxonomy element a topic. Each topic can be a specialization of a more general topic. Document references can be associated with several topics and can thus be found through each of those topics. Many bookmark managers do not allow this multiple access. Users can also associate textual description to references added to topics. This set of information is called "meta-information" (information about information). In the following, we call it "document reviews" or for short "reviews". It can be associated to any kind of documents available using http protocol (Berners-Lee and al., 1996). They can be mono or multimedia documents coming from the WWW or an enterprise Intranet, or an email in a web mail server, or any kind of personal file accessible by an http server. Their URL identifies them.

Communication functionality. Unlike general mailing systems, SoMeONe is dedicated to send information on information.

Indeed, we think that this specific kind of content needs a specific media to be distributed. The reasons are the following. First, several pieces of meta-information can be about the same document and specific treatments can then be applied in order to aggregate and filter them. For example when a review is seen or deleted by the user, any new review about the same document will be hidden; and all reviews about the same document are displayed grouped together showing the multiple topics the user can access that have been associated to the document. Second, the documents described by that meta-information may require availability of time, bandwidth, or display size to read it. This specific media is consulted when these appropriate resources are available.

Third, exchanged multimedia documents are increasing in size, in contrast, mobile devices are becoming smaller. By developing media that distribute documents by sending meta-information and URLs, we want to encourage users to store documents on http servers and send URLs instead of

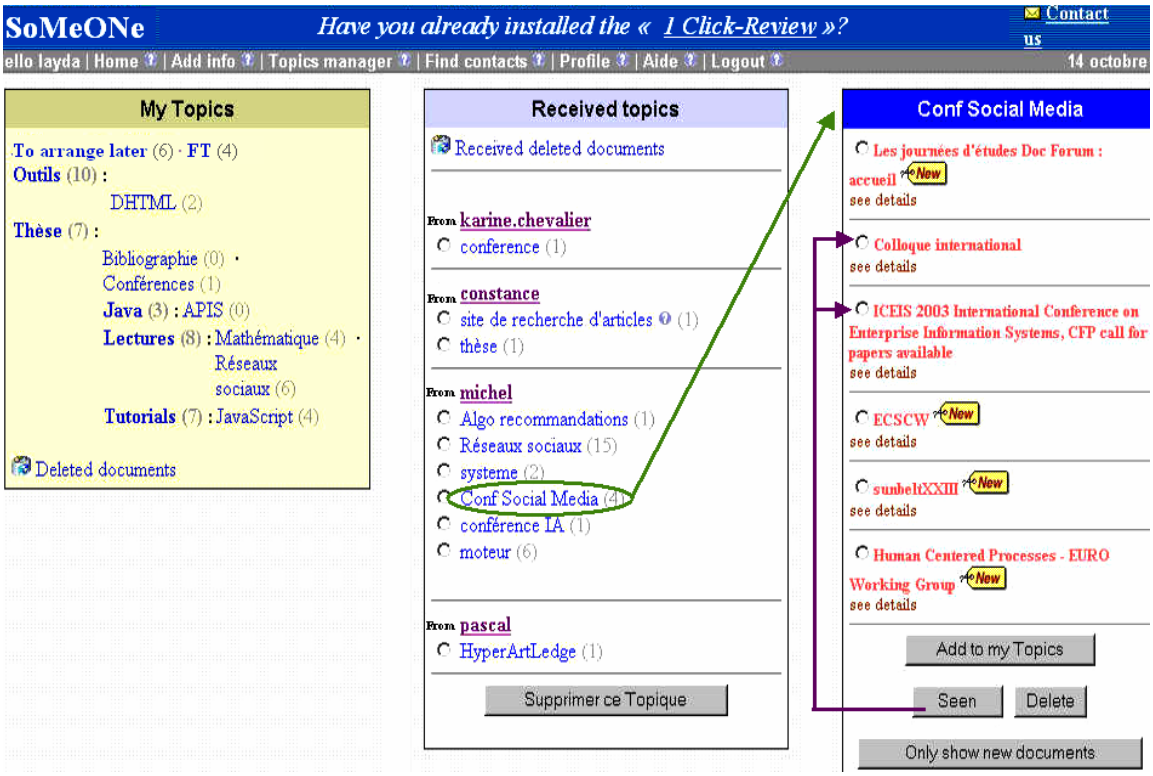

Figure 1: SoMeONe's home page.

sending huge attached files by email and copying them in each recipient's mailbox. Therefore, the disk space of mailboxes could be more efficiently used and the time to download communication messages significantly reduced. Users download voluminous contents only if they need it and when they have the appropriate connection. We are aware that users have to manage and control the accessibility of online documents on the http servers to the appropriate users, but easy solutions can be developed (see for example shared document functionalities associated with group or mailing list services on main Internet portals).

Finally, meta-information is a key issue for the famous Semantic Web and needs appropriate services to stimulate their production and use (Berners Lee 2001) .

Distribution list functionality. In SoMeONe as with mailing lists or personal email clients, users can manage distribution lists to send information.

To help the user, SoMeONe's interface shows the list to which he/she already sent or from which he/she received information. By doing this, SoMeONe reduces the possibility of spamming users who are not already known.

A user can also add new contacts corresponding to real people he/she already knows by asking them their SoMeONe identifier using traditional media (email, phone, meeting, etc.). He/she can also add a new contact by only specifying an email address he knows. If this address corresponds to a subscribed user then SoMeONe will add the user identifier in the distribution list. If it is not the case, it will create automatically a new user subscription with a password and a user identifier computed from the email address. The new user identifier will then be added to the distribution list. SoMeONe proposes to the user to send an email to this newly created user displaying a mailto: hyperlink. When the user clicks on this link, his email client pops up with an automatically generated email. This mail tells the new user that some information is available for him by using SoMeONe. He has to follow an included URL, and use his/her generated password and identifier. He/she is also informed about the user who has made this information available (the sender of the e-mail) and the involved topic name. The new user will be able to change his identifier and password at anytime, and merge, if necessary, his multiple identities in SoMeONe(if he/she is already subscribed). This crafty feature lets the SoMeONe service to bootstrap and grow rapidly. Later, we will see how SoMeONe can help users to discover new interesting contacts.

To manage distribution lists, a user associates a list of users to each topic of his/her personal taxonomy. Instead of having to manage as many distribution list as domains about which a user wants

to exchange information, a SoMeONe user can reuse and specialize his/her distribution lists. A topic being a specialization of a more general topic can by default inherit the distribution list of its ancestor. A user can specialize this default list by adding or removing contacts. He can also declare that the topic is "secret". Any review with such a topic is only accessible from its author.

Then, to distribute a review on a document, a user only needs to add topics to the review for describing the document instead of having to precise physical mailing addresses. We distinguish this distribution process as "semantic addressing". According to the topics put together in a review, the distribution list will not be the same (for example if one topic is declared "secret" then the distribution list will be empty). Therefore, this semantic addressing process is also contextual.

Information access: These lists are used to compute information displayed to a user when he logs on to SoMeONe's home page (see screenshot on figure 1). This personal homepage is like the user's email clients. It shows the user's personal topics (left column of the screenshot) , and all the information a user has "virtually" received since all the information is in the server and no information is sent to any device or duplicated to any personal file folders (middle column of the screenshot). A user must belong to one of the distribution lists to be able to access a review of one of the topics. None of these topics should be declared "secret".

This new information is grouped by contact's identifiers and by topics. The displayed topics are those to which the user belongs to the distribution list. To limit spamming and information overload, the user can filter a topic of a specific user. This fine grain filtering allows a user to receive information from another user regarded as competent in these topics. To access the topic's contents -which are reviews that include this topic-, a user has to click on the topic name. A review is displayed if it is accessible (for example there is no "secret" topic) and if the user hasn't created any review on the same document. A user can declare any review as being seen or deleted (see buttons on right column of the screenshot). These two actions create specific reviews on the document associated to the user that will filter the review for the new displays. This precious personal information will also be used in the future to compute a personal profile of user interests. Documents being identified by their URL, we are aware that two documents having the same content but different URLs won't be filtered. We expect to download reviewed documents and to compute a signature of them in order to identify that two URLs relate to the same document.

Thus, if a user "receives" several times the same document using reviews, he will consult its reviews only once.

Information propagation: For each displayed review, a user can create his own review on the same document with his own topic ("add to my topics" button of the screenshot). By doing so, the user will be able to retrieve this review using his own taxonomy criterion but he will also propagate the diffusion of the document to all his contacts in the distribution list of the topics in the new review.

When a user will access to the new review he will see his own review and all other review he can access on the same document. Only the topics of the reviews that contain the user in their distribution list are displayed.

4 SOMEONE SOFTWARE ARCHITECTURE

SoMeONe has been developed as a web application using Jalios content Management Suite[3]. Jalios provides a collaborative infrastructure that allows user groups to produce and publish information. Jalios architecture includes a light object-oriented database model entirely managed in memory, an external or internal web server (Apache, IIS), a performing jsp servlet engine (Resin), and a user directory (LDAP compatible) (see figure 2). This architecture is compliant to standards and multiple tools can be integrated. Scalability is handled by distributing servers with synchronised databases. Jalios has been implemented in Java.

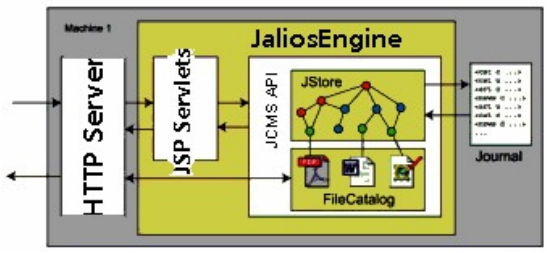

Figure 2: Jalios' architecture.

The whole administration is managed with a web interface. Default HTML templates are automatically generated for each managed information type and can be customized with classical graphical editors.

[3]http://www.jalios.com

5 ENCOURAGING COOPERATION

There is cooperation with SoMeONe when a user adds other users in the distribution list of one of his topics. Combining personal information management and information sharing functionalities in the same service reduces the extra cost of cooperation. Creating a document review has the same "cognitive cost" if the review is shared or not. The extra costs are in distribution list management. The reuse and specialization of distribution lists reduce the difficulty. Small lists are also easier to manage than long ones. Instead of having to manage long lists of users, these users can be distributed in small lists associated to different specific topics. Then adding several topics to the review can compose a long distribution list. To encourage cooperation, SoMeONe also needs to protect users who cooperate. We have already seen some features that reduce the possibility for spamming. A user sees another user's identifier only if the latter voluntarily sends him some information. This supposes that the user knows and trusts him. We will also see later that we plan to develop a recommendation system to motivate the sharing of information between two unknown users if they have valuable assets for each other. This feature has to be guaranteed by SoMeONe.

However, for the time being, cooperating only with known users is too restrictive. Users need to establish new relationships with others. To initiate those dynamics, motivated users can declare some of their topics as public. This means that any user can see the topic's name and add it's identifier to the distribution list. If this user is interested in the content, we can hope in return that he/she will add the owner of the public topic to one of his/her topic's distribution lists. Therefore, users are motivated to provide interesting contents in their public topics if they also want to receive good information. However, to receive new information users can also only wait for the availability of an interesting public topic without distributing back any information. We can expect that these users might wait for a long time. Moreover, in an information society, information is sometimes so crucial that users cannot afford waiting. Reluctant people might also be stimulated by their environment if for example, they see their nearest colleagues adopting a cooperative behaviour. So, they are better informed and have greater efficiency. Another stimulating factor is that a user can also decide, at any time, to stop having some of his topics being public. Then he can remove from the distribution lists those who did not provide him with interesting information. SoMeONe offers facilities and encourages users to do this in order to improve global cooperation. For example, a user can display all the users that provide him with the most interesting reviews. By "interesting reviews" we mean those which have an associated review created or seen —and not deleted— by the user.

6 SOMEONE IN ENTERPRISE

The main application of SoMeONe is definitely in the enterprise. Intranet companies are getting bigger and bigger as companies grow. In addition, the biggest the company is, the more we find a large diversity of jobs, workers, and cultures. All this diversity hides differences in needs, backgrounds, and sensibilities. To face this diversity, only providing an access to information with some global indexing facilities is not always sufficient. To be efficient, collaborators need to access information relevant to their business and adapted to their personal capabilities and sensibilities. As an example, any industrial researcher knows that he/she will not present his work with the same slides to a scientific community or to marketers from a business unit. We believe that this level of adaptation can only come from people networks. These networks are open, flexible and dynamic. They cannot only rely on the enterprise organisation. Collaborators are increasingly working in teams belonging to multiple entities, inside or outside the company. Suppliers, technicians, engineers, marketers, even customers are getting closer relationships in information exchange networks.

For companies in the business of information society, communication is a key issue. In addition, the production of these companies is often based on the production of information and knowledge. For such companies, their need is to build valuable social capital, made of the knowledge of their employees and their mutually enriching relationships (Bourdieu, 1986). Here again, SoMeONe is particularly adapted to support and develop these valuable relationships.

Another application domain in enterprise is business intelligence. SoMeONe is a solution for distributing through the company the process of detecting important information and rapidly broadcasting it to appropriate audience with a validation and commenting process all along the chain that enriches the information.

7 PERSPECTIVES

The fundamentals of SoMeONe are based on users' willingness to cooperate. Like Hazel Hall (Hall, 2001), we agree on what economists already argue: individuals evaluate alternative courses of action so that they get best value at lowest cost from any completed transaction. But in social life, people (actors) can only obtain what they need and value (resources) through dependent relationships with others (structures) (Molm, 2001). Users need others to rapidly find relevant, up to date information for not becoming an outsider in the rapidly growing information society. We think that some participants can also be aware that the viability of their community depends on their commitment to it. This is "embodied in the willingness of individuals to share information and knowledge with other members of the community" (Merali, 2000). If no contributions are made the results are drastic: the community will not continue to exist. SoMeONe will stimulate this consciousness by showing users some viability indicators of his communities. These indicators will be computed using social network analysis techniques (Wasserman et al. 1994).

Anyway, we are aware that SoMeONe has to integrate regulation mechanisms to stimulate cooperative behaviours. The first mechanism we will implement is a recommendation system in order to propose users to exchange information. Nevertheless, the recommendation process will be completely different as traditional one (Glance et al 1994). Instead of directly proposing users to *receive* more information from a new contact and thus encouraging "free riders" (unproductive users) (Adar and Huberman, 2000), we will recommend users to *send* their information to carefully chosen users. Therefore, a user must have information to share for being able to receive, and it has to be valuable if he/she wants users to send him valuable information as well; but how will those users know what kind of information this user will find valuable? Being an expert in one topic, he can be disappointed to receive information on that topic. However, he can be interested in other topics. This is why our recommendation algorithm will try to couple users that have topics to exchange. It needs to search sets of four topics. Two of those topics (*u1*, *u2*) should belong to one user *u*, and the two others (*v1*, *v2*) should belong to another user *v*. Then we choose the sets of four topics that maximize the two of the following probabilities. If user *v* receives reviews from user *u* having the topic *u1*, he should review them with his topic *v1*, and if user *u* receives reviews from user *v* having the topic *v2*, he should review them with his topic *u2*. We are still working on the way we are computing those probabilities. This recommendation factor only takes into account the individual profile of users' interests. In order to augment global social optimisation of the exchange network, we think we also need to take into account other social criteria. For example, we will use structural social network analysis techniques to compute factors like: centrality, independence and solicitation (Wasserman, 1994). These factors will be stored in a social profile of each user and will be used in the choice of the sets of topics for making recommendations.

Finally, we need to validate our hypothesis, recommendation algorithm, and their multiple scaling factors. First, we need to identify the criteria of our social media we want to optimise. Then we need to find means to measure these criteria in the logs and SoMeONe's database. One of the problems is to compute global measures of a social system from individual indicators. How to evaluate global satisfaction, global noise, or silence? Having those measures defined, we then plan to use a simulation tool to test the influence of the regulation mechanism, algorithm options and scaling factors values. (Beugnard and Fan, 2002). To define and calibrate the model of the user's behaviour we will simulate and conduct some real experiments. One experiment will take place in a enterprise using its Intranet. Another one will be integrated into a larger project named "the Cartable Electronique"® (Martel and Vignollet, 2002).

8 CONCLUSION

We propose a social media to find and filter information in web-like networks. This service solves some of the main problems of traditional social media:

- The service is available on line without any installation of dedicated software
- Users visibility is managed and controlled.
- The service develops personal relationships.
- Information is classified with users own criterions, and can be aggregated and filtered according topics, users and novelty.
- In order to receive valuable information, users are encouraged to send valuable one.
- By combining a personal management information tool and a communication tool the cost of cooperation is reduced.

SoMeONe's main contributions are:

- Using network of people as human information channels.
- Information is successively filtered user after user and enriched with personal opinions.
- The management of multiple personal taxonomies.
- Message semantic addressing by automatic calculation of distribution lists according to document labelling
- Easy management of distribution list using topics inheritance.
- Tools to detect profiteers in order to remove them from the exchange networks.

This system should provide many users with a solution to take advantage of available information, mainly in companies. More generally, if some people see the power in knowledge, such system clearly set the power in personal networks.

The informational World Wide Web is an engine of the information society. The human web we have sketched in this system is it's dual space to complement it, where documents navigate from user to user instead of having users to navigate from document to document. It is also a source for the Semantic Web since it should stimulate the production of meta-information.

The main challenge is to develop a cooperative behaviour among users. To improve the efficiency of the system we have presented the future works we have planed. Experiments and simulations should confirm our expectations.

9 REFERENCES

Adamic Lada A. and Adar Eytan, 2000. Friends and neighbors on the web, Technical Report. http://www.hpl.hp.com/shl/papers/web10/

Adar Eytan and Huberman Bernardo, 2000.Free riding on Gnutella, First Monday, (October). http://www.firstmonday.dk

Berners-Lee, T., Fielding, R., and Frystyk H., 1996. Hypertext Transfer Protocol HTTP/1.0., RFC 1945 MIT/LCS, UC Irvine, May.

Berners-Lee , Hendler J and Lassila O. The Semantic Web. Scientific American, May 2001

Beugnard A and Phan D., 2002. Moduleco, a multi-agent modular framework for the simulation of network effects and population dynamics in social sciences, markets & organizations. http://www-eco.enst-bretagne.fr/~phan/moduleco/ModulecoGreyPaper.pdf

Bourdieu, P.,1986. The forms of capital. In J. Richardson (Ed.), Handbook of theory and research for the sociology of education (pp. 241-258). New York: Greenwood.

Bouthors Vincent, Dedieu Olivier, 1999. Pharos, a collaborative infrastructure for web knowledge. In proceedings of the third European Conference on Research and Advanced Technology for Digital Libaries, ECDL'99. Lecture Notes in Computer Science, 1696, pp. 215-233, Springer-Verlag Inc., (September).

Delgado Joaquin, Ishii Nohoiro,, 2001, multi-agent learning in recommender systems for information filtering on the internet, International Journal of Cooperative Information Systems, Vol. 10, Nos. 1 & 2 (2001), pp. 81 – 100.

Nathalie Glance, Damian Arregui, 1999. Manfred. Making Recommender Systems Work for Organizations Proceedings of PAAM'99, London, UK, (April 19-21).

Good Nathaniel, Shafer J. Ben, Konstan Joseph A., Borchers Al, Sawar Bradul, Herlocker Lon and Riedl John, 1999. Combining collaborative filtering with personal agents for better recommendations, AAAI/IAAI.

Gräther, W., Prinz, W., 2001.The social web cockpit: support for virtual communities. In ACM SIGGROUP Conference on Supporting Group Work, ACM Press, Boulder, Colorado, USA, 2001, pp. 252 - 259.

Kanawati Rushed and Malek Maria, 2000. Informing the design of shared bookmarks systems, In Proceedings of RIAO2000. Paris, France. Pp. 170-180.

Martel Christian, Laurence Vignollet, 2002. Educational Web Environment based on the metaphor of electronic schoolbag, ARIADNE 2002, Lyon, France.

Merali, Y., 2000. Self-organising communities. In S. Roc(Ed.), In Liberating knowledge (pp. 80-87). London: IBM/CBI.

Molm, L. D., 2001. Theories of social exchange and exchange networks. In G. Ritzer & B. Smart (Eds.), Handbook of social theory (pp. 260-272). London: Sage.

Popescul Alexandrin, Ungar Lyle H., Pennock David M., Steve Lawrence, 2001, Probabilistic models for unified collaborative and content-based recommendation in sparse-data environments, 17'th Conference on Uncertainty in Artificial Intelligence, pp. 437–444, 2001.

Trevor Robie, 2001.PageTracker: A Portable Bookmarking Tool Used for Fine-Grain Update Notification, 2001.

Wasserman Stanley and Katherine Faust, 1994. Social Network Analysis: Methods and Applications. Cambridge: Cambridge University Press.