A Knowledge Management Environment for Knowledge Working Communities Fostering Local Development

Alberto Faro[1], Daniela Giordano[1], and Salvatore Zinna[2]

[1] Dipartimento di Ingegneria Informatica e Telecomunicazioni,
Universita' di Catania, viale A.Doria 6, 95125, Catania, Italy
[2] Direzione XXIV – Politiche Comunitarie, Relazioni Internazionali
e Programmazione dello Sviluppo Locale,
Comune di Catania, via S.Euplio 13, 95100 Catania, Italy

Abstract. The paper presents a case study dealing with an e-government system specifically designed and implemented for supporting knowledge working metropolitan communities and their internetworking to favour local development, where "local" doesn't have a bureaucratic meaning (city or county) rather it is centred on the notion of basic economic-productive community upon which the virtual community of the net-economy rests. The system provides knowledge-based services such as information on plans, programs and projects dealing with local development and supports several simultaneously working groups. Each group may access a common board, whereas authorized users may access an advertising service for communication and workflow synchronization, an advanced information retrieval service on relevant web documents and best practices, joint authoring of documents, peer reviewing and access to expert assistance. The first experiences indicate that the interface simplicity has been a key factor for the successful acceptance of the system.

1 Introduction

Although the role of knowledge management for supporting organizations has been widely recognized for many years [1], and recently, its importance for e-government has been pointed out (e.g., [2]), the effort in developing e-government systems in Italy has been mostly devoted to address citizens' papers requests. This has biased the public sector towards implementing front-office systems, with little knowledge inside, mainly to distribute certificates, forgetting that the effectiveness of the e-government systems highly depends on having an efficient back-office infrastructure provided with suitable knowledge management tools. In the shift from a "stand alone" administration to public administration networking at a metropolitan or regional scale, issues such as groupware support for knowledge working communities [3] and data standardization (ontology) for information systems integration [4] are crucial, yet this subject is widely underestimated. Moreover, although modernizing the public bureaucracy cer-

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tainly impacts on improving the quality of life, an e-government policy to foster local development is important too, especially for those communities that need assistance in finding funds and developing proposals for innovating traditional sectors and activating new business. In this field, workers do not need automated tools to collaborate in a generic way, rather they need a CSCW environment in which the e-tools are integrated with respect to the specific working context and objectives.

Aim of the paper is to present a case study dealing with a web-based e-government system specifically designed and implemented for supporting knowledge working metropolitan communities and their internetworking to favour local development. The web system provides knowledge-based services such as information on plans, programs and projects dealing with local development, an advertising service for communication and workflow synchronization, an advanced information retrieval service on relevant web documents and best practices; it also allows joint authoring of documents, peer reviewing and access to expert assistance. It has a simple web user interface to facilitate interaction and supports several simultaneously working groups. Each group may have access to a common board, whereas authorized users may access all the remaining services per group, i.e., they can access and work only on the data belonging to a specific group. The paper is organized as follows: sect.2 explains why the territorial dimension of local development extends outside the conventional boundaries of the cities and industrial districts and points out the organizational change needed by this extended physical dimension pertaining to local development. This involves cooperation of many subjects on a multi-department and multi-disciplinary basis to develop the integrated and complex projects pertaining to the "space of places" where both the local and global flows of the net economy must intersect. Sect.3 outlines the functions and architecture of the web system that has been implemented to support this organizational change of the public sector in the Catania metropolitan area.

2 The Territorial Dimension of Local Development: The Space of Places and the Space of Flows

Currently, the Public Administration (PA) supports economic local development mostly by activating calls within National or European Development and Funding Programs and distributing the relevant information to the enterprises by means of Official Gazettes and sites that diffuse the calls and announcements. This approach to local development has the effect to enhance the transnational flows (of information and resources) and contributes to a global economy at a large scale. This coherently leads to a net-economy that increasingly develops in the "space of flows" [5]. As a consequence of the process of globalization and virtualization of the economy, the "space of places", i.e., where activities are located, looses importance to the space of flows. Metaphorically, places become shrinking points whose specificity simply derives from being the source or the destination of some large scale flow. Still organizations and enterprises keep functioning in a dual mode: a) the virtual mode, which is carried out through information exchanges with partners and clients via Internet (these

immaterial exchanges are followed by material exchanges through traditional infrastructures), and b) the physical mode, which relies on the services offered by the local PA and by the companies that manage the territorial technological networks. In this new scenario the PA cannot limit its action to provision of innovative services to make bureaucracy lean and efficient, as are those traditionally associated to e-Government. It must go beyond and adopt methods, organizational and administrative procedures to enact all the initiatives relevant to these financial and work policies capable of providing the local system with infrastructures and networks (both physical and virtual) to support economic development, thus giving to the space of places the importance it deserves. The relationship between the space of places and the space of flows is exemplified in fig.1, where two productive communities, in the agricultural and tourist fields, are distributed on the territory. Both these communities, made up of private and public companies, cannot work or produce independently of their local context which is responsible of many competitive factors such as safety, energy and transportation, advanced telecommunication services and access to public co-financing. Thus, while enterprise compete within their productive and commercial networks (the space of flows), the PA must contribute to economic development by supporting endogenous growth (the space of places), by means of co-financing new investments in public utilities and full utilization of the territorial goods: if economy takes place in the space of flows, life is still carried out in places. Hence the notion of territorial areas as the space of places whose value must be improved.

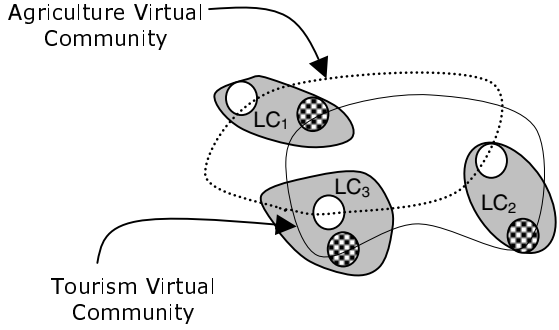

Fig. 1. Net society: a system of productive communities consisting of organizations (represented by nodes) that collaborate via Internet and receive basic services from the Local Communities (LC) to which they belong.

In the past, the Public Administration has pursued actions at the city level or at the industrial area level. Today these actions seem to be too specific and limited to be regarded as sustaining a suitable space of places. There is a "dimension", or a level of scale in which the local productive context has its own organic characterization notwithstanding its economic-productive diversification. This level is the intermediate area between the city and the county, typically the metropolitan area. It is at this level that the PA should be able to address effectively and coherently the territorial development needs. Thus novel e-government actions and the related knowledge management system should be designed to support local economic development, where "lo-

cal" doesn't have a bureaucratic meaning (city or county) rather it is centred on the notion of basic economic-productive community upon which the virtual community of the net-economy rests (for example, networks of tour operators or networks of import-export agencies). To understand why local development must be addressed starting from the above basic community, it is useful to think of the problems of people transportation, goods distribution, school and training, office supply and office automation, spending free time, enjoying environmental and historical heritage, or local crafts and low-tech and high-tech industrial areas. In all of the above cases the level at which the economic activity is carried out is neither the city nor the county: it rather has a local trait made up of the available resources and professionalism, besides the specific territorial vocation. In our case, the ideal dimension at which the e-government system should operate to pursue integrated development has been identified as consisting of the city of Catania plus nine surroundings municipalities plus the industrial area. In the above context the local government (PA) can take on the responsibility of complementing the process of globalization (i.e., large flows, small places) by creating a more comprehensive space of places where local flows can flourish (i.e., smaller flows, larger places), and actors who would be leaved out of transnational flows are supported in their activity. These "larger" spaces of places become on their turn more useful and attractive also for large scale activities. If the PA is involved in the process of creating a more comprehensive space of places, its projects must undergo a significant transformation: from sector interventions they become integrated and complex (multidisciplinary) interventions. The above strategic choice calls for an overall reorganization of the local government to introduce another organizational level centred on projects to be carried out in places.

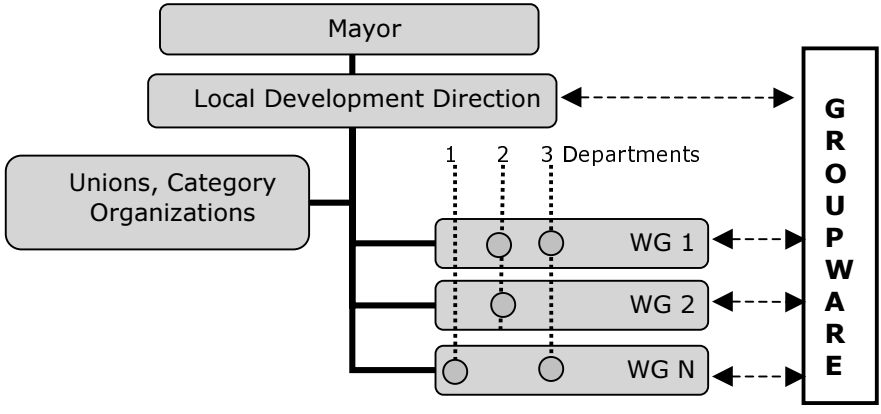

Fig. 2. Organizational change in the Public Administration: from department-centric to project-centric organization for local development. Resources from Departments (DP) participate to Working Groups (WG) if the intersection between DP and WG is labelled by a grey node.

This kind of reorganization is illustrated in fig.2 by using the organization chart adopted by the Catania Municipality to promote local development. It consists of a local development direction under the authority of the Mayor. This direction coordi-

nates a set of working groups dedicated to develop projects and to monitor their implementation. Coordination is achieved also upon consultation of the Union and Category associations. Due to the complexity of the projects to undertake all the above actors and groups may utilize a groupware system whose features are illustrated in the next section.

3 A Knowledge Based System for Local Development: A Case Study

In the scenario of sustaining local development as outlined above, web based information systems must be conceived not only as a means to provide general information and certificates to the public but also as an environment that allows the users (i.e., citizens, enterprises and personnel of the public sector) to do the following: a) reuse meaningful experience that the system makes available under the form of expert assistance and best practices to solve specific problems; b) easily retrieve suitable information on how to fund their projects; c) develop their proposals by joint authoring and peer reviewing of documents; and d) coordinate the implementation of complex projects according to the workflow methodology.

To proceed in this direction the public sector needs to undergo a transformation from a bureaucracy organized in divisions that provide services at the city scale (e.g., development of sector projects, issuing certificates and so on) into an active system organized in groups dedicated to support the projects at the metropolitan scale from ideation to implementation, and with greater responsibilities, i.e., by assuming the role of project leader or partner depending on the nature of the projects. However, this integration of functions and competencies cannot be reached without specific automated tools that allow the personnel to contribute to departmental, interdepartmental and intercity groups despite the distance between the departments and the culture of cooperative work that is just beginning. By the joint use of web and groupware technologies it has been possible to implement a web based e-government system for supporting this process of organizational change, the knowledge working metropolitan communities and their internetworking, thus favouring local development. This system (www.cataniapolitichecomunitarie.it) has been implemented in PHP and is accessible to three categories of users (i.e., citizens, social and industrial organizations and public administration personnel). It provides the following four types of services:

1. Information services dedicated to local development and consisting of an area in the Web site that makes all the current and future projects visible to all the users. Information on significant events that explain the projects (i.e., what is their aim, who may participate and how to present a proposal) is also available.
2. Advertising services consisting of an advertising board, an event management facility based on a calendar and a messaging system supporting wireless communication; these are available for organizations and public administration personnel.
3. Information retrieval services allowing personalized and feedback based searching (e.g., project fund, technical recommendations, quality standards, personnel re-

cruiting etc.) assisted by intelligent agents; these are available to authorized organizations and public administration personnel.

4. Groupware system allowing: a) joint authoring of documents, b) access to expert assistance for developing projects via mailing and conferencing systems, c) online consulting of a best practice environment provided with a Case Based Reasoning (CBR) mechanism [6]. This is available to organizations and public administration personnel provided with full access authorization.

Service N.1 is a portal entirely dedicated to the projects for local development and differs from the traditional portals of the public sector usually dedicated to presenting divisions, functions and related services. It aims at providing all the interested parties with a shared representation of the territory and its projects organized along the temporal dimension (current and future) and by scope. As is shown in fig.3, the first section deals with the funds available for local development, the second one with the socio-economical aspects (i.e., who are the people resident in the area, what they are doing, what these people and organizations expect from the public administration in terms of structures and services), the other section deals with the master plan of the metropolitan area, i.e., the future projects related to the thematic fields (life quality, tourism, and so on) chosen by the Municipalities to steer development. The next two sections deal with the programs already activated to support both multi-sector and sector activities. The last section deals with international programs.

Fig. 3. Sections of the web site for local development

Passing from the emerging needs of the metropolitan area to the programs of the master plan to address such needs, and from these programs to the detailed integrated and sector projects and to the management of their implementation requires organizing the public sector as a network of working groups instead of more or less independent departments. This does not entail that classical public organization should be abandoned, rather at least another organizational dimension dedicated to designing the future projects and optimizing the current ones has to be added to the traditional dimensions (i.e., department, functions and services). The main difficulty is the interdisciplinary nature of the project groups and the distance between participants which involves a high cost of meetings and of collecting the documents and, more generally, the resources needed for supporting project and planning. Thus **Service N.2** addresses the need of supporting communication and synchronization among people involved in the groups. This has been obtained by the sections named “Board” “Calendar” and “E-Mail” of a groupware system accessible, as a reserved area, from the web site. In

these sections, people belonging to a given group may find the main facilities for communication and synchronization of their activity flows. These facilities are:

– an advertising system shared by all the groups, consisting of an advertising board to inform the entire design community about general events, conferences, deliverables, and deadlines, each coded by a different colour. The insertion of a message in the board is very simple to allow any user to insert personally her/his communication. As is shown in fig.4, this may be obtained by simply writing the message (few text lines) in the text box and then by pressing "Aggiungi" (i.e., Add). The message will immediately appear as a row in the message list ; this row will point out also the message author and her/his e-mail. Interested people can send an e-mail to the author's message to know details about the event. Currently, messages in the board may be extracted by date. Other retrieval methods (by author or by text) are planned in the next version.

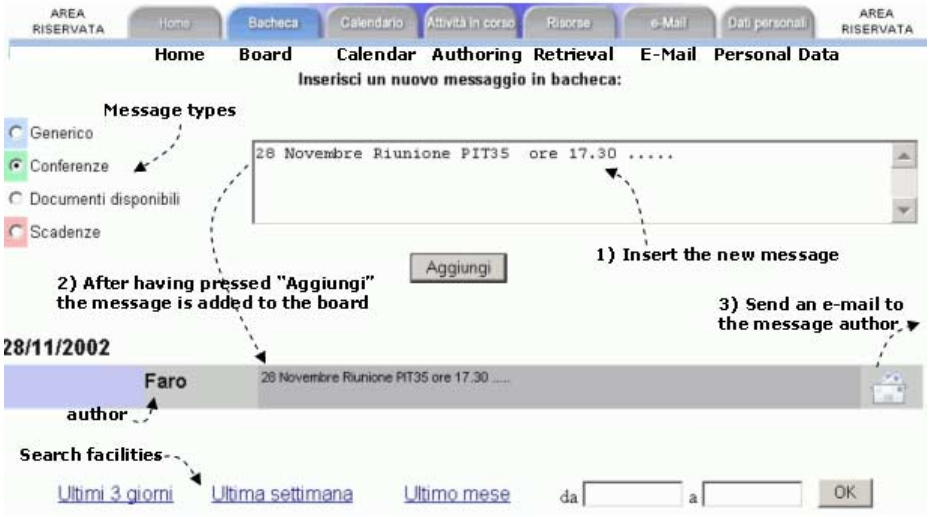

Fig. 4. Advertising board

– an event management facility allowing each group to visualize only their own calendar (fig.5). This system is conceived to synchronize project activities and it is especially needed when a group is organized in cooperating subgroups. In these cases it is suggested to organize each subgroup as a separate group, whereas coordination is achieved by another group whose members are the leaders of the subgroup and the leader of the overall group. The calendar is accessible to all the members of the group to read and post general events. Only the group leader can insert deadlines for delivering documents, de-allocating resources and allocating the ones received from the higher level leader. Any event posted in the calendar consists of a title and of a downloadable file that could be the agenda or the draft of the meeting, a document to be revised or voted by the members to become a group deliverable, conference programs, notification of allocation or deallocation of resources and so

on. Posting an event and inserting the related document is very easy: first the user has to press "Inserisci un nuovo evento" (i.e., Add a new event), then she/he fills the form and chooses the document to be associated to the event by the classical browse window. The calendar dates in bold refer to days containing meaningful events. After pressing the event title, the user may download the related document. Only the author of the insertion or the group leader may delete the event inserted in the calendar. SMS services may be requested depending on the importance of the event. The system is also provided with an e-mail service to support communication between the group members; it may be augmented by videoconferencing for increasing communication efficacy.

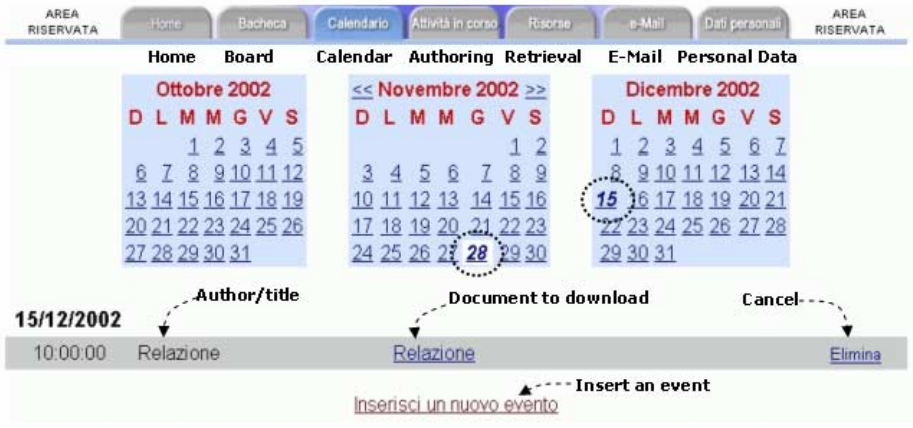

Fig. 5. Advertising and synchronizing activity flows by calendar events

The groupware can support several simultaneously working groups. Each group may have access to either its private communication area (i.e., service N.2) and to the communication area common to all the groups (i.e., service N.1) without closing the working session. This is obtained by controlling the access to the communication records contained in a single data base (in our case IBM DB2) by a double key: one identifies the section currently accessed and the other identifies the group to which the user belongs to. From the implementation point of view, this architecture based on a single database allows us to use the same indexing scheme for information and case retrieval for all the working groups, thus greatly simplifying implementation and updating of the services N.3 and N.4 which are illustrated in detail in the following.

Service N.3 deals with information retrieval and is based on the IBM Web-crawler agent [7] programmed to visit daily interesting remote sites and take away the more recent documents. These documents are stored in the local server so that the IBM Text Miner may start the indexing procedure that makes it easy for the user to retrieve documents according to a lexical search string. This string is based on the scheme $(Term_1 + \ldots + Term_n)^*$, where $Term_i$ is a general word, the string $(Term_1 + \ldots + Term_n)$ causes the engine to retrieve the documents containing $Term_i$ and … and $Term_n$ in sequence, and the asterisk in the scheme means that the user may insert an arbitrary

number of strings. As an example, the search string: "2002 tourism local + development" asks the engine to retrieve all the documents that contain the words tourism, 2002 and the two words "local development" in sequence. The engine considers two words having the same root as the same word, thus all the documents containing tourism and touristic are retrieved in response to the search string "tourism". In addition, to avoid remembering a lexical string that the user wishes to repeat in the future, the user is allowed to give a name to any search string.

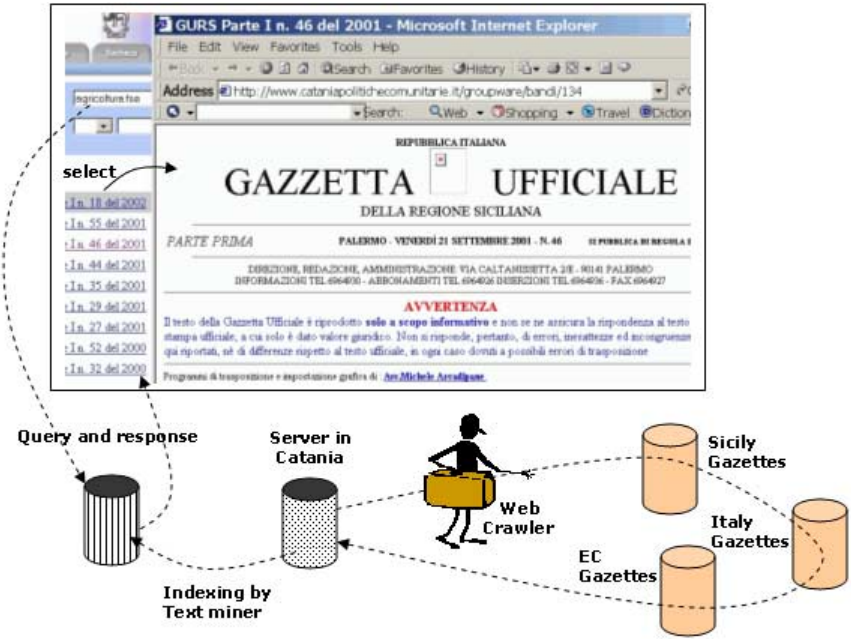

Fig. 6. Information retrieval of web documents by mobile agents and text miner

Fig.6 above shows how, after the system has retrieved the Sicily Official Gazettes dealing with "agriculture and FSE" (i.e., European Social Funds), the user may open the document by simply clicking on the selected Gazette number. Let us note that the artificial agent stores the Gazettes on the local server for indexing reasons, however, after having indexed the documents, the system may delete them and maintain only their URLs. A relevance-feedback mechanism that allows the users to increase the search precision is planned for the next version of the system. This method has been tested off-line. It needs a client-side software to be installed on the end systems and a server-side software to be installed on the computer where the web site is running. Based on an indication of to what extent the found document fits the user request (e.g., high, medium, low), the system is able to refine the original search string. This technique may be used to classify the documents not only according to personalized strings but also to traditional taxonomies. As an example, if a group wishes to classify the documents according to the scheme: POP, POM and POR (these are typical EC programs), then the group has to create three classes and subsequently evaluate the docu-

ments by providing feedback until the classification contains few errors. Let us note that the search engine learns by user feedback why a document containing both POR and POM has to be considered belonging to both classes or to only one of these classes. This information is exploited by the search engine to refine the initial search string by autonomously adding other keywords that suitably correspond to the user needs. This is done by taking into account the other words of the document, usually the most frequent and the more rare ones, with respect to the evaluation of the users.

The above scheme is also adopted to retrieve best practices and other documents relevant for the problem at hand (e.g., meeting notes, project deliverables, etc.). This is obtained by storing these documents into the directory managed by the Text Miner which is in charge of indexing and retrieving them according to the search string issued by the users. To increase precision, any document may be described by a template subdivided in sections according to the Case Based Reasoning (CBR) paradigm [6]. For example, the best practices may be suitably subdivided into sections such as: Title, Problem, Solution, Where the solution has been implemented and Who was involved; similarly, the meeting notes may be subdivided in sections such as: agenda, participants, and so on. As a consequence, the search method allows also the user to express queries as follows: [$(Term_1 + \ldots + Term_n)$ in $Sect_k$] *. In this way, all the documents that are extracted share the search string in the same sections, thus greatly increasing precision [8]. To increase documents'recall it may be useful to link the documents by a similarity index defined as follows: $S_{ik} = (\Sigma S_{iks})/N$, where N is the number of the sections of the template describing the documents, and S_{iks} is the similarity between document i and k with respect to section s defined on the basis of the frequently and rare words they share [9]. The square matrix S_{ik} is then passed to a Kohonen-like neural network to classify the document in M classes [10]. The input neurons are equal to the number of documents, whereas the output neurons are equal to the class number M which is not known a-priori. The network starts from a tentative M and increases it until adding a new class does changes a little the previous classification. In response to a query the system retrieves the documents satisfying the search string and the ones contained in the classes to which these initially retrieved documents belong.

By the above tools the members of the group may communicate, synchronize their activities with the ones of the other groups, obtain assistance, via e-mail or videoconferencing, from a pool of consultants made available upon agreement with selected consulting companies, exchange best practices and documents relevant for their problems, but they still need to jointly author their projects. For this reason we have developed another section of the groupware dedicated to this task, i.e., **Service N.4**. Any member may insert a document into the system to be corrected by the other members until the final version is agreed by all. This is obtained by a simple and efficient semaphore mechanism that guarantees information consistency. Any document may be deleted only by its author or by the group responsible. After completing a document, the responsible of the working group may publish it in the board (see service N.2), or ask the system to send it with digital signature to a given destination address. In addition the system allows the responsible to store the documents into two directories, i.e., the directory managed by the Text Miner and the one belonging to the "Joint Author-

ing" section of another group. In the former case the document may be retrieved according to a search string issued by any partecipant of the group, in the latter case the document may be consulted by any partecipant of other groups. In particular the system allows the documents of each group to be exported to the higher level group, thus making possible to sustain the work of groups subdivided into subgroups.

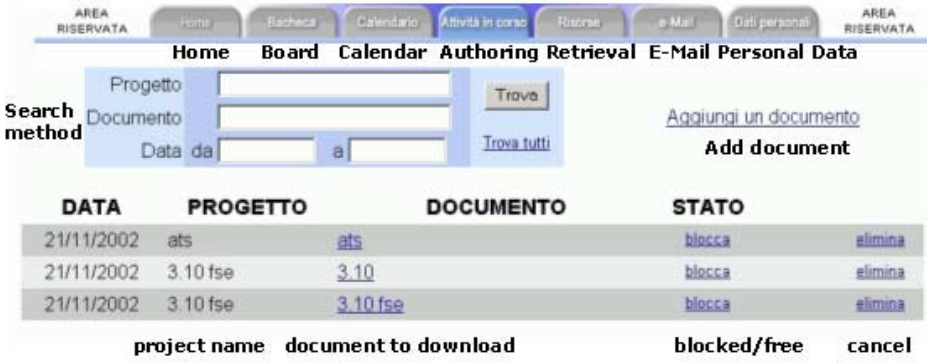

Fig. 7. Joint authoring of documents

4 Concluding Remarks

The major contribution of the paper is that of having pointed out the importance of the "space of places" and related local flows for supporting a net-economy traditionally believed to be mostly linked to global flows. This entails an organizational change of the Public Administration towards a project centric organization consisting of working groups supported by knowledge based web systems. Consideration of cultural and psychological aspects suggests that the transition from a departmental based organization to a net-organization for local development has to be performed step by step. For this reason, all the services described have been implemented, but some of them (i.e., the relevance feedback and the neural net based classification of documents) will be deployed only in a new version of the platform, thus proceeding incrementally. Another claim of the paper is that an information portal and related multi-channel access is not enough for the net-economy. Rather, advanced groupware systems augmented with intelligent agents and mobile facilities seem more suitable for it, especially if they are provided with a simple user interface that speeds up diffusion of the culture of cooperative work.

So far the system has been used for managing the web-site, for carrying out projects and developing project proposals at both local and international level. In particular, information to be published in the site is sent for immediate publication by the authorized components of the group to the web site manager by using the service implemented for the joint authoring of documents. This guarantees information freshness. Another relevant application of the environment has been the development of

two joint projects among the Municipality, the University and external companies dealing with local development: one project regarded the elaboration of questionnaires on work conditions, another project dealt with the definition of an architecture for location information services at metropolitan scale (e.g., information on traffic conditions, parking, etc.). The system has been also successfully used for the preparation of proposals carried out by many actors such as the one dealing with the activation of e-learning facilities for enhancing the skills of the personnel working in the public sector. An application of the presented system for developing a joint proposal at European level is currently going on. All these experiences clearly indicate that the interface simplicity is a key factor for a successful acceptance of the system.

Standardization of the proposed environment by means of ontological definitions and related F-Logic based queries has been also developed in Protegè [11], and it is ready to be implemented in further versions. This will be activated when the advantages of the semantic search will be obtained without expensive computational resources. In fact, current experiments on the ontological implementation of the groupware show that the indexing scheme may be extended over all the documents in the local web without transporting them on a single server if fast computing systems are available, due to the high processing time needed by the ontological searches. Thus a deeper evaluation of usability and performance for this new environment has to be done before extending the current system. This might imply a re-definition of the ontological schema and the related queries.

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