

A Network of Excellence as a Virtual Organization : the Nanobeams case.

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Abstract : The concept of Virtual Organization is widely discussed in the literature. The SICOV project aims to develop a generic web-based platform to support the Virtual Organization creation and work. This paper intends to present the SICOV position in the VO concept field and the main characteristics of the platform. Some results on an ongoing case study in the nanotechnology field will also be discussed.

Keywords : Collaborative Platform, Nanobeams, Network of Excellence, SICOV, Virtual Organization, Workplace.

1. Introduction

Advances in communications and computer networks represent enabling factors for emerging organization forms such as virtual organization but many unresolved issues and challenges still remain in the development of supporting platforms. Many research projects are focused on developing tools to meet the need of a particular industry, others focus on a specific life cycle step or a specific process. The SICOV project aims to provide a generic web-based platform to support the communication, cooperation and coordination needs of a virtual organization whose goals include innovation management as well as research and development activities.

In the first part, this paper elaborates a working definition of a virtual organization including its properties based on the current literature. The next part presents the SICOV vision (definition, life cycle) and the web-based collaboration platform that has been developed (architecture, main modules). The last parts are devoted to an ongoing case study in the physics domain.

2. Virtual organization and relative concepts

2.1. Virtual organization

For some years now, the concept of virtual enterprise has been largely discussed in the literature. Most authors ([AKH04], [BA05], [CA99], [CL98], [Go99], [HB00], [Ki05], [KS99], [Le96], [MM02], [Tr97]) agree in the following definition that can be summarized as : ‘A virtual enterprise is a network of independent companies that use information technologies to share complementary competencies in order to fulfil a specific market requirement’.

Some authors use the concept of ‘virtual organization’ [Tr97], [WGR98], [JJS98]. A virtual organization may be defined as a network of independent parties (persons and/or organizations) that use information technologies to share complementary competencies in order to attain a common objective.

The concept of virtual enterprise differs from the virtual organization only on 2 points. In a virtual organization :

- the partners are not required to be commercial companies;
- the common objective can be driven by another element than the market.

In this paper, only the “virtual organization” term is used, while most of the discussion also applies to the virtual enterprises.

A set of 3 basic properties is often mentioned in the literature :

- a virtual organization is a network of independent organizations grouped under a unique identity. A virtual organization is visible as a single organization but is composed of different ones [WGR98];
- each partner of the virtual organization focuses on its core competences where a proven level of excellence can be reached. Sharing these complementary pieces of expertise leads to create a “best-of-everything organization” [BW98];
- a virtual organization uses the information technologies in an intensive manner. It is considered as a prerequisite for achieving an adequate level of efficiency [JJS98]. The information technologies are used to distribute and process information in real time, which permits to take decisions rapidly and to coordinate operations [HB00].

In addition to those basic features, other properties of the virtual organizations are discussed. The scientific community has not yet reached a common position concerning those attributes :

- Duration : the short duration of the collaboration is often mentioned as a feature of a virtual organization (e.g. [Go99], [Le96], [KS99]). Many authors explain that a

virtual organization appears in response to a specific (market) opportunity and that it disappears when this opportunity fades. Other ones claim, however, that a virtual organization may have an undetermined duration due to a persistent (market) demand [JJS98], or that a virtual organization may be set up as a long-term alliance [CA99];

- Hierarchy : the hierarchy among the partners is a second feature that is still under discussion. Some authors argue that all participants of a virtual organization have a similar hierarchical status [BW98], [RGK02]. Other ones explain that, in certain sectors, a 'star' topology is encountered, where one company imposes its own standards to the others [CA99]. In the same way, some authors claim that a central executive entity may be present [HB00].

2.2. Relative Collaborative Network concept

Virtual organizations are one specific type of collaborative network. Collaborative networks are characterized by the following properties [CA04], [PL05] :

- network of autonomous organizations, people, resources, or mixed;
- geographically distributed;
- common or compatible goals to be achieved by collaboration;
- interactions supported by information technologies.

A large variety of collaborative networks concept close to Virtual Organization has emerged during the last years. The figure below presents some of them :

Virtual Professional Community (VPC)	
<p>“Virtual Community” <i>Social systems of networks of individuals who use computer technologies to mediate their relationships.</i></p>	<p>The project VE-Forum :</p> <p>Community that regroups consultants, practitioners, researchers and technologists focused on the challenges and opportunities associated with networked organisations and virtual enterprises. [Ve06]</p>
<p style="text-align: center;">+</p> <p>“Professional Community” <i>Environments for professionals to share the body of knowledge of their professions.</i></p>	
<p>When a professional community adopt computer network and globally most of the virtual communities tools and practices, it becomes a Professional Virtual Community (PVC). [KS02]</p>	
Virtual organization Breeding Environment (VBE)	
<p>“Virtual organization Breeding Environment” <i>An association of organizations and their related supporting institutions, adhering to a base long term cooperation agreement, and adoption of common operating principles and infrastructures, with the main goal of increasing both their chances and their preparedness towards collaboration in potential Virtual Organizations. [CA03]</i></p>	<p>Virtuelle Fabrik :</p> <p>Network in Switzerland and Southern Germany. [Vi06b]</p>
<p>In order to support rapid formation of collaborative networks such as a virtual organisation it is necessary that potential partners are ready and prepared to participate in such collaboration. This requires common interoperable infrastructure, common operating rules, and common cooperation agreement among others. Therefore, the concept of breeding environment has emerged as the necessary context for the effective creation of dynamic virtual organizations. [AC05]</p>	
Virtual Laboratory (VL)	
<p><i>A heterogeneous, distributed problem solving environment that enables a group of researchers located in different geographical places to work together, sharing resources (equipments, tools, experimental data, etc.).</i></p>	<p>The project VLAM-G : <i>(Grid-based Virtual Laboratory Amsterdam)</i></p> <p>Provides a science portal for distributed analysis in applied scientific research. It offers scientists the possibility to carry out their experiments in a familiar environment, where content and data are clearly separated. [VI06]</p>
<p><i>Has to be supported by remote operation (to have access and manipulate tools and equipment located at a remote workshop), information management (to store information and data generated by the experiments realized); simulation (to visualize and reproduce the actions on the remote workshop) and collaborative tools (to share and coordinate the experiments among different partners around the world). [KA1102]</i></p>	
<p>A more recent term – “E-science” – is likely to replace the term virtual laboratory.</p>	

Figure 2.1 Relative Collaborative Networks Concepts

3. The SICOV Approach

3.1. The SICOV Vision

In the SICOV approach, a virtual organization can be seen as a more or less temporary network of legally independent enterprises and/or organizations and/or persons that come together to share their core competencies and resources in order to carry out a project which exceeds the individual capacities and competencies of each one. Considering the absence of heavy organizational structures, setting up and operating a virtual organization requires the intensive use of information technologies to communicate, to cooperate and to coordinate the work among the different partners.

Many research projects study the virtual organization concept. Some of them are focused on a particular industry. For instance, DIVERCITY [Di06] and E-COGNOS [Ec06] relate to the construction sector, VirtoWeb [Vi06a] to the biotechnology sector. Other projects are more focused on a particular phase of the life cycle of a virtual organization (for instance, the GLOBEMAN21 [Gl06] project is focused on the product life cycle management with an emphasis on the operation phase), or on a specific process (for instance, TrustCoM [Tr06] studies the contract management process and RAVEN [Ra06] the knowledge management process).

The SICOV project focuses on the management of innovation as well as research and development tasks. It aims thus to provide a platform that meets the communication, cooperation and coordination needs of a virtual organization whose main purpose is innovation management independently of its activity domain (construction, mechanical, etc.) or its purpose (e.g. supply chain management, production management, sales management). Therefore, it is designed to offer some features that are specifically adapted to the innovative and research and development activities.

3.2. SICOV Life Cycle

The literature ([CA99], [Le96], [WGR98], [Br99], [Ra04]) proposes several life cycle models. From a theoretical viewpoint, the SICOV platform has adopted a six stages model (see Fig. 3.1), which is specifically customized for the innovation activities.

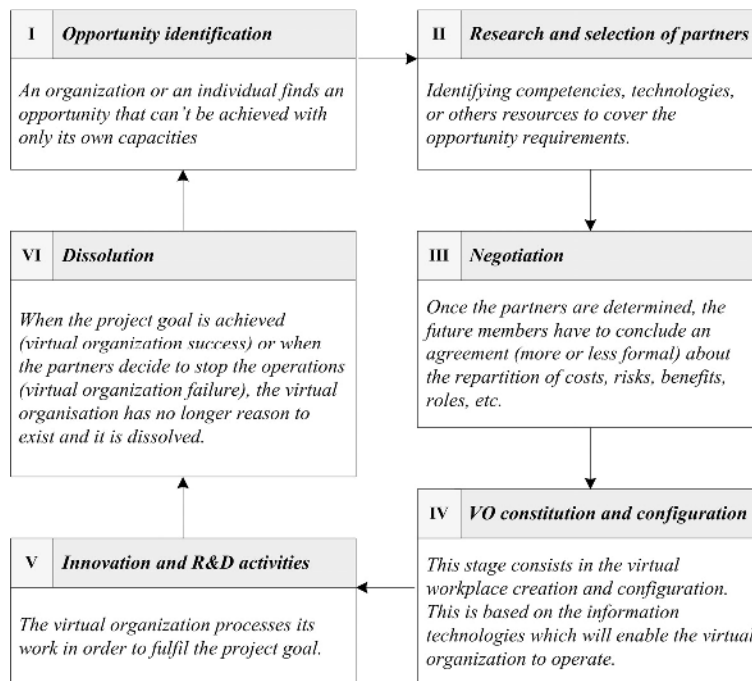


Fig. 3.1. Virtual organization life cycle

Considering the purpose of the SICOV platform, the complex issue of legal contract elaboration appeared less critical than in other circumstances (e.g. supply chain management). The negotiation phase is thus not supported by the platform.

Some authors call the step V the “operation phase” [Br99]. In the SICOV context however, no real operations are undertaken. The activities supported by the platform concern the R&D and the innovation process.

3.3. The SICOV Platform Architecture

3.3.1 The SICOV platform objectives

The SICOV project aims to facilitate the virtual organization’s activities along each stage of its life cycle (excepted for the negotiation phase, which is not supported) and more specifically on the innovation and R&D activities phase. Therefore, it is required to design an environment which will provide a way :

- to heighten the organization’s awareness of the virtual organization concept (with a special focus on the small- and medium-sized enterprises of Luxembourg);
- to offer organizations a way to exchange new ideas, to propose or meet an opportunity, and in the best case, to organize a marketing intelligence in order to better capture the market variation and thus be more reactive;
- to assist the efficiency and the agility of the virtual organization by supporting three essential vectors : communication, cooperation and coordination among each partner of the virtual organization and that, in compliance with security and rapidity requirements;
- to ensure a clean dissolution of the virtual organization notably by maintaining a backup and a way to access data of virtual organizations which are no longer active.

3.3.2 A workplace based architecture

In order to support these objectives and to respect the virtual organization life cycle as described above, the platform has been divided into 3 workplace types :

- The network public place can be accessed by anyone and provides an entry point for the platform members to the private workplaces. This place also provides tools to register the network and public information;
- The inter-organizations workplace is accessible to each network member. This is the place where each organization member can discuss new ideas, search or offer opportunities for creating or taking part in a virtual organization;

- The virtual organization workplace is private and can be accessed only by the members of the consortium. These workplaces are the core of the SICOV project and they include the most advanced features (e.g. shared calendar, shared task list, secured file sharing, document management, group workplace, specific tools, etc.);

- The Private Workgroup is a particular place where a subset of network members can work together. Private workgroups can be created in the inter-organizations workplace or in the virtual organization workplace.

Each network operates on its own instantiation of the platform.

The SICOV architecture is synthesized in the Fig. 3.2, which shows the organization of the different areas.

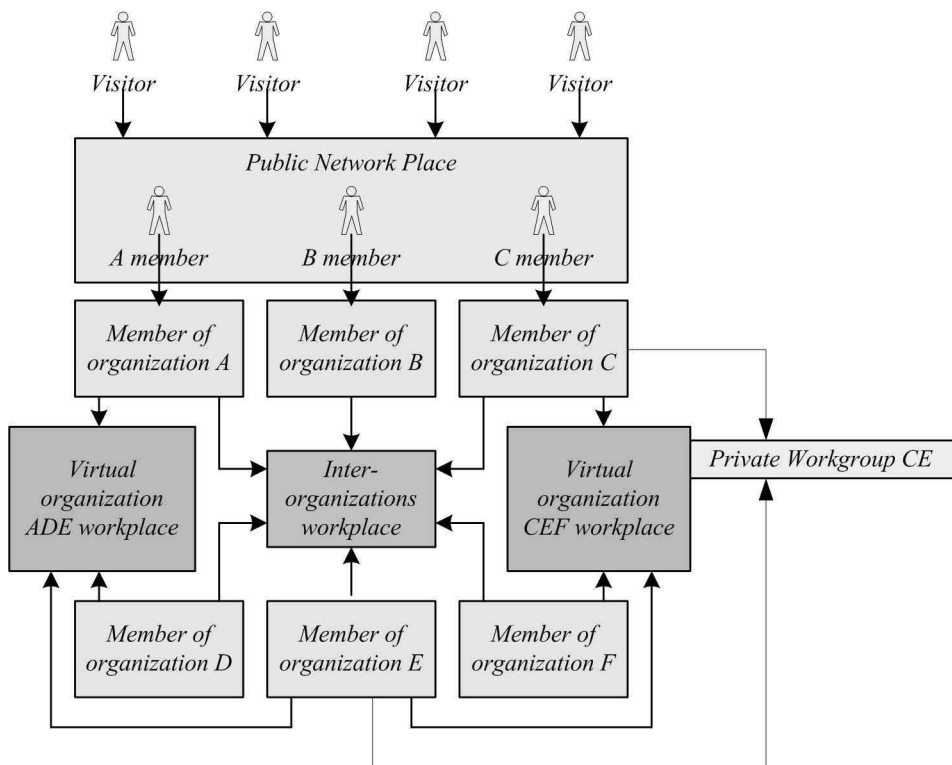


Figure 3.2 The SICOV Architecture

3.4. The SICOV main modules

This part of the paper describes the most important features of each workplace of the SICOV platform. It is important to note that the platform is always evolving following the VO needs and that the list of tools described below is not exhaustive.

3.4.1 The public network workplace

The purpose of the public network workplace is to heighten the visitor's awareness of the network and its activities. This area is clearly content oriented, but some tools are also provided to facilitate the initial contact process and the informal information exchange needed at this stage. Finally, some electronic forms are provided to ease the registration process.

3.4.2 The inter-organization workplace

The goal of the inter-organizations workplace is to enable the communication between the network members and to support virtual organizations in their first life cycle steps (step I and II). Several forums will be available to allow members to discuss new ideas or market trends or to diffuse opportunities. This tool will be notably used to support the opportunity identification phase (step I). The next step, the research and selection of partners, is mainly supported by the platform address book. This tool stores some data about each organization and each user registered on the platform. It is not limited to the contact information but it also includes some basic information about the specific know how, the core competencies and the technologies of each organization as well as the professional profile of each individual member. This tool facilitates the search for a partner. Finally, an "instant messaging" function will be added to allow the platform members to communicate with each other in real time. Other tools are also available such as : news, mailing-list, brainstorming, etc.

3.4.3 The virtual organization workplace

The virtual organization workplace offers the same functionalities as the inter-organization workplace and proposes complementary collaborative tools to support the communication and cooperation among the users of a given organization.

The figure 3.3 presents the VO workplace features following the 3C-model (Communication – Coordination - Cooperation) presented in [Fu05] which has been adapted to show the synchronous/asynchronous aspect of the tools.

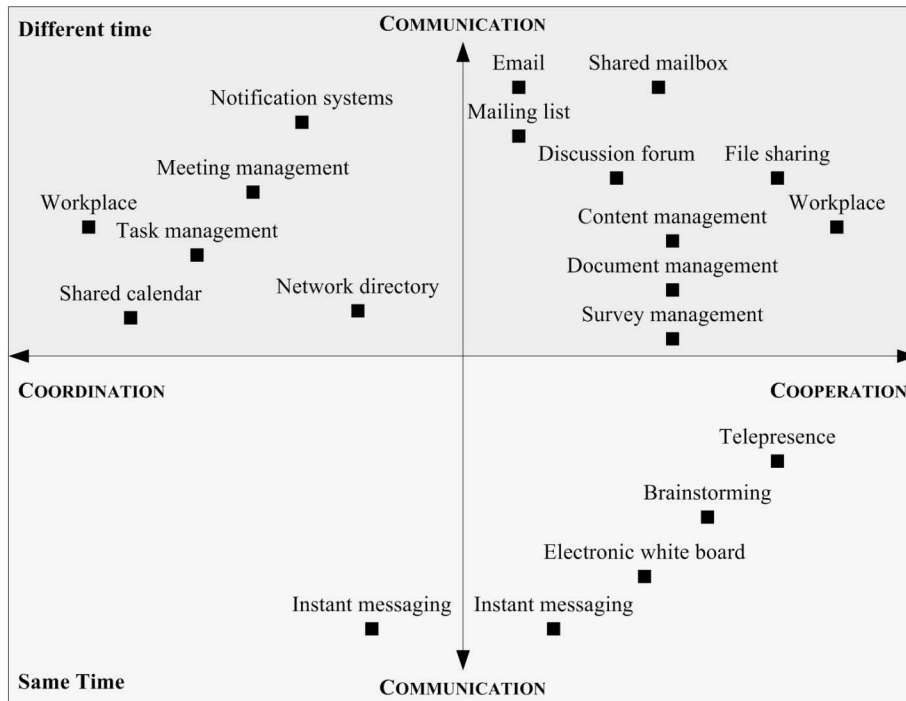


Figure 3.3: Classification of VO Tools

The synchronous tools available in the VO Workplace are described below :

- Instant messaging to exchange messages in real-time between two or more platform members.
- Electronic white board is a shared electronic workspace. Each participant can add text, make drawings or paste pictures on the whiteboard. Other participants can immediately see the result on their workstation. Each participant can make a local printout or save the contents of the whiteboard for later reference.
- Brainstorming to invoke ideas and solve dilemmas. In practice, all the members are invited to debate few days before the session. The participants know the problematic before the meeting to have time to prepare their ideas. When the session starts, each member introduces his or her ideas anonymously. Anyone can see in real time all the propositions which are submitted to foster the birth of new ones. Once finished, the chair categorizes all the answers and invites the participant to rank them. Next, a report is generated automatically and sent to all participants.

Some asynchronous VO tools are described below :

- A network directory which offers the same functionalities described before (see 3.4.2) and enables to store the contact persons external to the platform.

- Notification systems enable the platform members to be informed when new information is available on the platform. Members can choose the items to track.
- Meeting management is an advanced tool to organize the meeting (for instance to mark or not the presence of the attendees), to diffuse meeting report and to keep an history of all the events.
- Task management allows repartition, assignment and monitoring of the VO project work. These tasks will also be displayed in the shared calendar.
- Shared calendar is dedicated to store and share the events (meetings, appointments, etc.) and to keep track at the availability of each member.
- Shared mailbox makes possible to store the emails relative to the entire virtual organization. Each member of the virtual organization can add an e-mail into this mailbox, thus the message will be shared to all virtual organization members without making multiple copies of it.
- Mailing list is a list of e-mail addresses identified by a single name. When an e-mail message is sent to the mailing list, it is automatically forwarded to all the addresses in the list. The list can be moderated.
- A secured file sharing system helps the members to share any kind of electronic files.
- Document management allows the virtual organization members to share and categorize their internal documents. This advanced tool supports the document life cycle (creation, approbation, revision) by implementing a basic workflow.
- Survey management is a tool to create, diffuse and manage questionnaires.

Workplace module is described in more details in 3.4.4 an example is available in 5.5 Telepresence tool is presented in 5.4.

3.4.4 The private workgroup area

Private workgroups are special areas that allows a subset of network or virtual organization members to work on a particular task or sub-project in a restricted area. These workgroups provide functionalities such as : shared calendar, library, discussion forums. Moreover, it's possible to store and manage structured or non-structured information by creating very quickly and without any computing knowledge customized forms.

3.4.5 Life cycle steps degree of support in workplace types

The several workspaces support the life cycle steps of a virtual organization. The specific needs of any stage are taken into account to include the corresponding tools in the platform while it must be reminded that the most important tools concern the steps IV and V. The Fig. 3.4 shows how each life cycle step is supported in each workplace type and the importance of SICOV tools and implication in each stage.

	<i>Public Network Place</i>	<i>Inter-organisations workplace</i>	<i>Virtual organisation workplace</i>	<i>Private Workgroup</i>
<i>Opportunity identification</i>	■	■	■	
<i>Research and selection of partners</i>	■	■	■	
<i>Negotiation</i>	NOT SUPPORTED			
<i>VO constitution and configuration</i>			■ ■ ■	■ ■
<i>Innovation and R&D activities</i>			■ ■ ■	■ ■ ■
<i>Dissolution</i>			■	

Legend :

■ ■ ■ *Important tools* ■ ■ *Less important tools* ■ *Limited tools*

Fig. 3.4. Life cycle steps degree of support in workplace types

The features of the SICOV platform may also be regrouped according to the steps of the virtual organization life cycle in which they are mostly used (see Fig. 3.5).

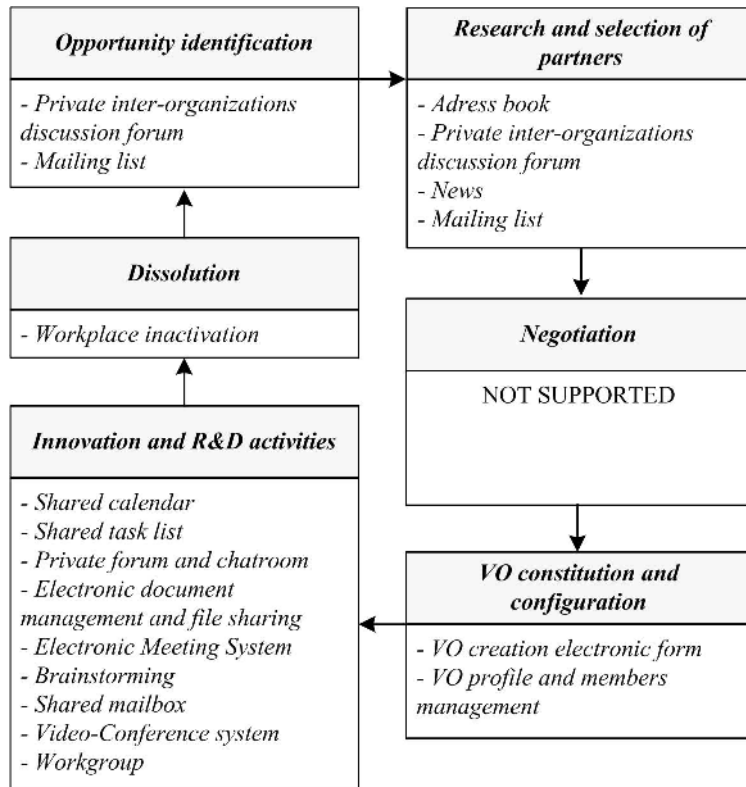


Fig 3.5. SICOV tools classified by virtual organization life cycle steps

3.5. The SICOV Platform status

The SICOV Platform can be deployed freely for each person and/or organization who plan to deal a project which respects the VO criteria described in 3.1 and the aim of the platform.

The core modules are not dedicated to one particular field of activity so that the platform is adaptable to all economic sectors or scientific communities.

The platform is in constant evolution. New modules are added regularly according to the specific needs of the different actors. Existing tools are also improved in accordance to the feedback of the users. Nevertheless, a stable version of each module is already available.

Core modules such as forum, meeting management, document management or workplace have been elaborated and tested in collaboration with several partners. Specific or new modules are developed and tested in strong cooperation with the user having requested the tool.

4. Nanobeams a network of excellence as a virtual organization

4.1. The concept of Network of Excellence

Networks of Excellence (NoE) are one of the instruments of the Sixth European Framework Programme (FP6), which covers Community activities in the field of Research, Technological Development and Demonstration (RTD).

Networks of Excellence are designed to strengthen scientific and technological excellence on a particular research topic by integrating at European level the critical mass of resources and expertise needed to provide European leadership and to be a world force in that topic. NoE also have to spread excellence beyond the boundaries of its partnership [Eu02].

The project must regroup a minimum of 3 partners from three different countries and during typically up to 5 years, with a maximum of 7 years.

4.2. The Nanobeams Case

The Network of Excellence Nanobeams concentrates on analytical techniques using focused ion and electron beams in order to develop analytical techniques and instruments matching the requirements of nanomaterials. This Network regroups the manufacturers of scientific instruments as well as the leading research laboratories in the field. 12 laboratories and manufacturers from five different European countries are involved in the Network.

The main activities of the different partners in the Nanobeams Network are the instrumental development, the coordination of fundamental research, the application to nanomaterials, the coordination of manufacturers, the organization of an annual European workshop and training sessions on the different instruments.

One of the strong points of the Nanobeams Network is the creation of a PhD school based in Luxembourg which aims at forming PhDs specialised in the field of nanoanalysis.

Nanobeams involves 80 researchers as well as 40 PhD students for a period of 4 years.

4.3. Nanobeams as a SICOV Virtual Organization

The Nanobeams NoE has all characteristics of the SICOV virtual organization concept (see 3.1). It's a network, which involves manufacturers, leading research laboratories and students for a period of 4 years. The partners are geographically dispersed in Europe (Belgium, France, Germany, United Kingdom for instance). The goal of the network is to develop analytical techniques and instruments matching the requirements for the development of nanomaterials and to create a PhD school. This goal exceeds the individual capacities and competencies of each partner so the objectives can't be achieved without the competencies and resources of all the partner

Moreover, due to the geographically dispersion, the use of ICT is fundamental on the success of the network. The next part of the paper presents the use of the SICOV platform applied on the Nanobeams virtual organization.

4.4. Nanobeams requirements

At the beginning of the Nanobeams project, there were no specific requirements relative to the activity domain of Physics. The major need of the network was the availability of traditional cooperation and communication tools such as information management between the geographically dispersed partners (Event organisation and management, document sharing, and so on) or communication management (Discussion forum, mailing-list, ...).

When the network has function in earnest, the partners have discovered that traditional cooperation tools are not sufficient to enhance and cover their collaboration activity because they are too human and document based. The cooperation must involve the analysis machines which are the base of their work so the module Telepresence presented in 5.4. has been developed.

5. Nanobeams case study

5.1. The SICOV platform instantiation for Nanobeams

The Nanobeams platform aims to support the work among the participants by managing events (meeting, workshop, etc) organized by each partners, storing and sharing documents (deliverables, meeting presentation, reports), enhancing communication (news, forums, mailing list, etc.), spreading results and facilitating analysis (Test samples, telepresence). The activities of the Nanobeams PhD School are also managed using the platform. This part presents only a subset of tools chosen in the Nanobeams network.

In this context, 3 users roles has been defined :

- Visitor : the visitors can see only public information;

- Student : the student can access the Nanobeams Inter-Organizations Workplace;
- Member : the members (from manufacturers or research laboratories) can access each platform workplace.

The SICOV platform instantiation for Nanobeams is divided in the 3 workplaces described below :

- The Nanobeams Public workplace;
- The Nanobeams Inter-Organizations workplace;
- The Nanobeams Virtual Organization workplace.

The figure 5.1. presents the Nanobeams architecture :

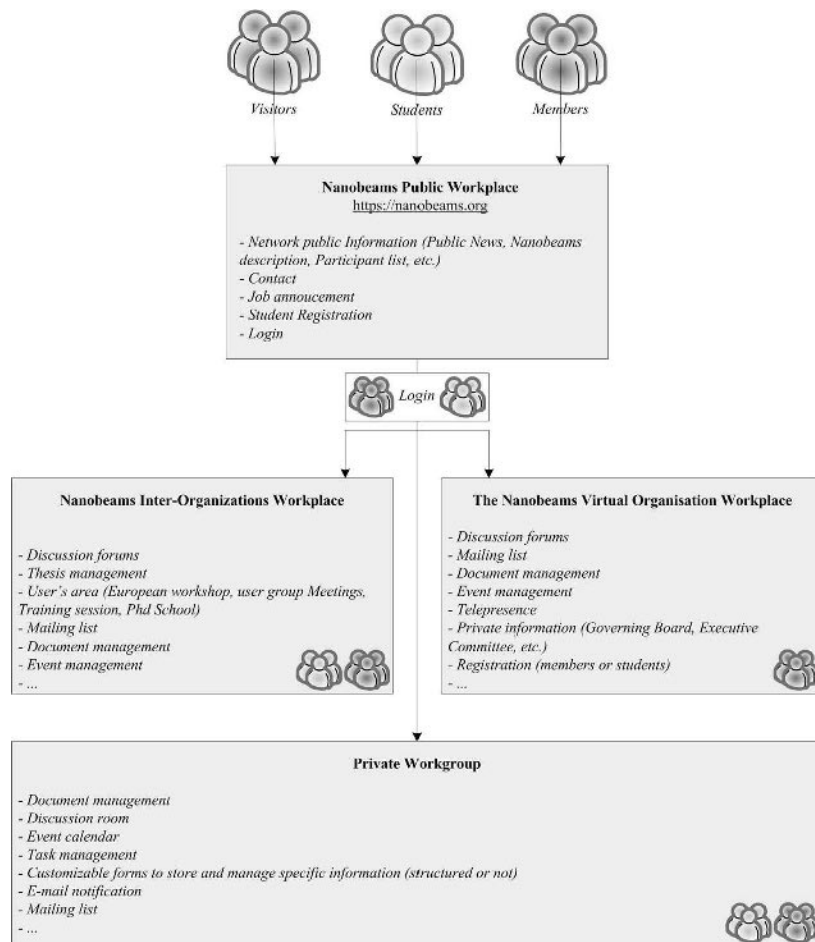


Figure 5.1 Nanobeams platform

5.2. Nanobeams Public workplace

The Nanobeams Public workplace constitutes the link between the world, the Nanobeams network and the private areas of the platform.

The first objective of this place is to provide information about the Nanobeams Network of Excellence such as the Nanobeams description, workpackages, participants and network public news. Moreover, some tools, which allow the students who are interested in the nanomaterials to join the platform, are available in this area. Nevertheless, students are free to register but a selection takes place to validate or discard the registration.

Finally, this place offers also a way to find human resources needed in the Nanobeams Network activities (job announcements).

The Nanobeams Public workplace is accessible for each visitor. Members and students can login from this entry point to the member's private workplace.

5.3. The Nanobeams Inter-Organizations workplace

The Nanobeams Inter-Organizations workplace is accessible by students and by members.

This part of the site is principally used to :

- managing events (PhD school sessions, workshops, user's group meeting, etc.). Depending of the amount of collaboration needed to set up the event, this is done by news, by mailing-list or if there is a lot of thing to coordinate by workgroup (see 5.5. for an example);

- storing and sharing documents (deliverables, meeting presentation, report);
- enhancing communication : principally by mailing list and dedicated forums;
- manage student's thesis;
- share knowledge, competencies and resources (Network directory).

5.4. Nanobeams Virtual Organization workplace

The Nanobeams Virtual Organization workplace is only accessible by the members (manufacturers of scientific instruments and leading research laboratories employees).

In addition of the functionalities described in the Inter-Organizations workplace, the Virtual Organization workplace offers very specific tools. Several others tools are available but in this paper only the complex telepresence module used by Nanobeams partners is presented.

This system aims principally to allow the video information broadcasting from the analysis machines (and especially the NanoSims) based in Luxembourg to the partners.

The main characteristics of the module are :

- Acquisition and diffusion of video flows in their original definition;
- Encryption of video flow;
- User authentication;
- Meeting room configuration (with selection of video flows, guest, etc.);
- Compatible with most of video standards (RGB / VGA / DVI / composite / Webcams, etc.) and supports high resolutions.

Figure 5.2. presents the architecture of the module Telepresence.

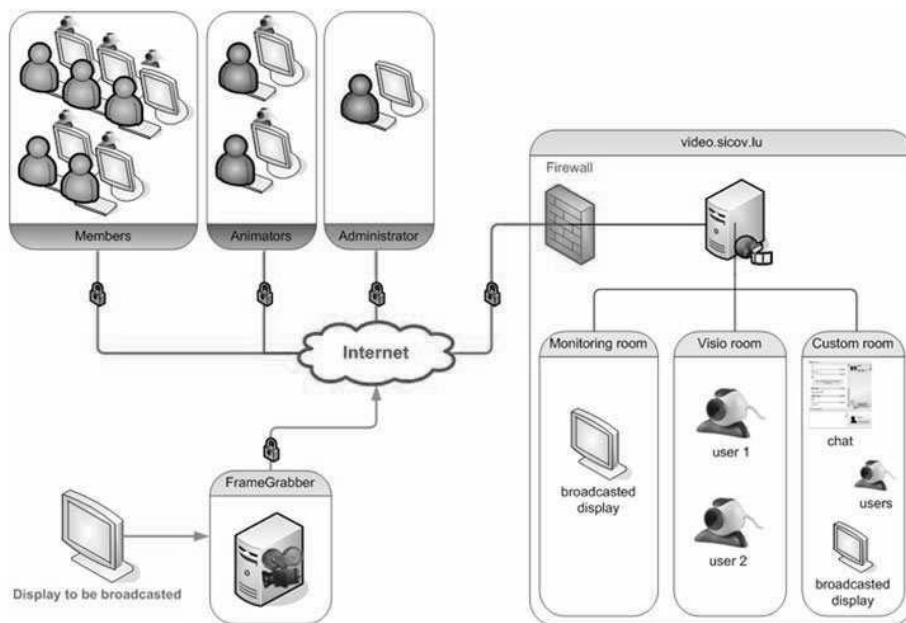


Figure 5.2 Telepresence Module Architecture

5.5. Nanobeams Private Workgroup

The Nanobeams Workpackage “European workshop, users groups, training of users” is composed of several “spreading of excellence” activities such as organization of a European workshop, training of users or the setting of user group in the field of biology or material science.

In this context, a private workgroup has been created to support the user group in the biology field. The user group biology objective is to join the efforts of the European academic labs using techniques based on finely focused ion and electron beams for their biological investigations. Activities of this group include communicating, maintaining a dedicated Internet site, and holding biannual meetings.

The private workgroup has been designed to fulfill these requirements by :

- sharing information about the activities and events of the Nanobeams user's group in biology (News, Content Management);
- storing and sharing documents related to the activities of this group (Library);
- enabling the communication among the group members (discussion forum, mailing list);
- coordinating the organization of meetings by providing registration and information tools (e-mail notification, customizable forms to register, etc.);
- the workplace acts as a dedicated Internet site and is accessible by the Internet to the private group members.

6. Conclusions

This paper proposes an overview of the SICOV platform and an example of its instantiation. The functionalities described in this article are only a subset of the platform catalog tools. Many others modules are available such as brainstorming, instant messaging, white board, and so on.

The implementation of such an infrastructure is a challenge as well as on the computing level than on social and cultural aspects. Users are not always ready to change the way they work and in the most of case don't feel at home with such systems and more generally with ICT.

The competence gained by setting up several virtual organization networks has highlighted several factors of success for the efficient use of the platform :

- An animator is required to enliven the network. His or her main function is to encourage users to use the platform. The animator's role is principally to provide the different workplaces with content, to encourage the users to take part in the activities supported by the platform (for instance, by using surveys or launching a debate on the forums) and so on;
- The use of comparatively complex tools is not well accepted even if training is provided. User's are generally busy people and do not have the time to explore or to use many functions. Simple, but versatile tools are better accepted;

- The context of the tool can also influence acceptance: In the Network of Excellence context, for instance, the platform users are scientists working in their specific field. Tools facilitating not only the administrative aspects of the NoE, but instead focusing on the scientific cooperation are more easily accepted by the participants. The positive experiences encountered while introducing the aforementioned telepresence module in the NoE context encourage us to further explore this success factor.

- Too much tools kills the tool ! The needs of each workplace must be correctly defined.

The results obtained after one year of real-world operation of the SICOV platform are encouraging. They show that collaborative tools provided by a secure platform can facilitate the operation of a virtual organizations, but they also show that acceptance of such a platform can be a considerable issue : thoughtful design and far-reaching customization possibilities are as important to the success of the SICOV platform as the dedicated work of the animators. Thanks to an additional grant from Luxembourg's Fonds National de la Recherche (National Research Fund), the platform will continue to operate until at least October 2007. The platform will evolve based on user requirements and feedback in order to interest an increasing number of virtual organizations in using the platform.

7. About the authors

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