Virtual Campus for Collaborative Design Education

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Abstract

The rise of the Internet and the rapid development of long distance communication technologies have made easy for people all over the world to work together. Global information and communication technology platform allowed more people to collaborate, share knowledge and work flexible, efficient and with low costs. Based on the benefits and challenges of virtual teams, the paper debates some practical aspects in the case of the National Research Network for Integrated Product and Processes Engineering. Also, there are presented arguments, the proposed architecture and functionalities for building a virtual campus for collaborative design education.

Keywords:
Virtual campus, e-learning system, training

1 INTRODUCTION

The nature of work has begun to shift from a production-based to service related business rising a new generation of knowledge worker no longer bound to a physical work location. Taken together, these factors suggest that firms are faced with increasing challenges to coordinate tasks across time zones, physical boundaries, cultures, and organizational contexts. The increasing globalization of trade and corporate activity increases the pressure to innovate and provide quality services to worldwide markets. Over time, this has led organizations to choose the most qualified people, a ‘dream-team’, regardless of their physical location [1]. These remotely connected teams are known as global virtual teams.

Global virtual teams are different from intra-national virtual teams in that they are not only separated by time and space, but differ in national, cultural, and linguistic attributes [2]. Global virtual teams can be formed quickly and are agile by their nature. They can help organizations decrease their response time to changes in today’s hyper-competitive markets by taking advantage of round the clock work by team members dispersed around the world.

A global virtual team possesses some similarities to a traditional team whom is collocated. The same fundamental ideas that are necessary for the success of a traditional team still apply to global virtual team. The approach however, requires modification focusing extra effort to exploit the benefits that global virtual teams bring while minimizing the disadvantages that exist from communication difficulties and lack of physical contact [3].

This paper investigates the benefits, challenges, and best practices of managing national virtual teams by given the example of the Integrated Product and Processes Engineering (INPRO) National Research Network and by underline the link with a global virtual team - the Virtual Research Lab for a Knowledge Community in Production (VRL-KCiP) Network of Excellence (NoE). The paper focuses on a preliminary analysis needed in building an e-learning system for a virtual research network. The INPRO network’s collaborative environment will very well illustrate some methodological aspects concerning the e-learning system design. The purpose is to show a feasible solution for building INPRO network’s sustainability through the virtual campus.

Finally, some conclusions are formulated regarding the increasing of global virtual teams and the importance of virtual relation development between INPRO network and VRL-KCiP NoE [4], [5].

2 BENEFITS OF VIRTUAL TEAMS

A relevant approach considers that virtual teams promise the flexibility, responsiveness, lower costs, and improved resource utilization necessary to meet ever-changing task requirements in highly turbulent and dynamic global business environments [6]. The links between these benefits’ teams are shown in Figure 1.

![Figure 1: The Links between Benefits in Virtual Teams.](image-url)
The use of virtual teams provides an opportunity to coordinate complex business tasks across organizations. This allows companies to have a better communication and coordination even though vast distances separate the different team members, making it easier to expand nationally or internationally and removing other location and distance-based restrictions [7], [8].

3 DESCRIPTION OF THE INPRO NATIONAL RESEARCH NETWORK

The Integrated Product and Processes Engineering (INPRO) National Research Network is a national virtual network that joint 139 members (88 PhD, 48 PhD students, 9 researchers and 4 master students), from 9 research centers, localized in the Universities of Timisoara, Bucharest (two laboratories), Iasi, Brasov, Bacau, Suceava, Sibiu and Oradea and a national research institute. The partners’ teams have decided to share their competencies and knowledge in the field of integrated product and process engineering. The network’s establishment is based on the idea of linking the national scientific research to the European research by using the participation of the Politehnica University of Timisoara, the leader of the research project, in the VRL-KCIP NoE. The research network’s Directory Board (Figure 2) consists of the project director and the scientific responsible persons from each partner and assures the research network’s management. Directory Board is in charge with: the network strategy the establishment, decision-making process, organizing, planning, coordination, monitoring and evaluating the activities.

The ambitious objectives of the national research network, the large number of participants and the implementation of the joint research activities itself require a strong and coherent excellence-oriented management system to be able to carry out such an initiative. The network aim is to implement a management system that stimulates sustainable integration of research activities at the national level.

To achieve this objective, the Directory Board provides management support for the whole network coordination and the transfer skilled management expertise to the members of the network, where appropriate. This will enable the network to operate on a long-term basis as an integrated and self-sufficient high-level virtual organization, even after the end of the financial support provided by the Excellence Research Program, in 2008.

The management system is split into four levels:

1. Directory Board sustains the strategic management and its role is to formulate the political and strategic orientation of the network and to monitor their implementation of the process. The related strategic management activities aims at defining, applying and following up the management of excellence, how the INPRO network’s mission and vision are defined and developed by the leaders. The defined activities are:

   • The design, development and implementation of the network’s management methods and tools. From the beginning of the national research network development there was proved that the most efficient management tool was the manager table board. It reflects the tasks and work packages allocation between the partners. In addition to this tool, there were established: the financial table board (financial resources allocation, acquisition plan), Gantt graph for the time joint research activities scheduling; the plan for reports (responsibility, structure and template) and the financial plan and research activities rapport (research contributions and costs justification from all the partners);

   • Management training days developed through the workshops that are regularly organized in the network.

   The duties transfer from the top management (Directory Board) to each partner team are linked and sustained by the development of the information and communication (internal and external) system of the network. The main tools that define this system are:

   • E-mail – this is the most common way of information, documents and duties transfer. All the network members are used with the system and easy adapt their work style to the network requirements regarding the use of this tool;

   • Skype conferences – during the first year of the virtual network development, all the members of the Directory Board have install the software and the web camera for facilitate video and audio communication and even, virtual conferences. This tool has been proved very useful for the operative management of the network;

   • The INPRO network web site (www.eng.upt.ro/inpro) has been built in 2006 and it has been up-date continuously. The interest information on the web page are: details regarding the project; the partners involvement in the research activities; the industrial partners section (was developed after the results of a research for identifying the industrial needs); the general activities of the network; announcements about conferences and workshops organized in the network or with the network’s support; events that are on the Orientation Board Meetings; important links; the access to the INPRO network’s Intranet (this area is restricted to the members only) and the contact with the network’s director.

   Recently there were developed the following tools for management and collaborative research (communication infrastructure development):

   • ‘Politehnica’ University of Timisoara - coordinator

   • ‘Politehnica’ University of Bucharest CNCSPT – partner 1

   • ‘Politehnica’ University of Bucharest PREMINV – partner 2

   • Technical University of Iasi – partner 3

   • University of Sibiu – partner 4

   • University of Oradea – partner 5

   • University of Bacau – partner 6

   • University of Suceava – partner 7

   • National R&D Institute for Welding and Material Testing Timisoara – partner 8

   • University of Brasov – partner 9

   Figure 2: The INPRO Network’s Directory Board.
Activity leaders are responsible for the implementation and follow-up of management procedures that will allow the interchangeability of the application for the product realization.

2. The Integrative Management is defined in accordance to the principles developed in the ISO 9001 and ISO 9004 standards. Integrative management includes different management actions called ‘processes’ which allow the describing, organizing and completing of the joint program of activities implementation to obtain a sustainable integration and to reach excellence. These processes are correlated with the VRL-KCIP NoE strategy and can define and organize the lasting fulfillment of INPRO network objectives. For the implementing of the integrative management process and the coordination of the specific processes there are named leaders from the partners that are personalities with experience in project management.

3. Management of Activities includes the establishment, implementation and follow-up of management procedures for each activity and phase organization. These procedures define the decision-making method in each activity as well as the relations with the other management levels. The detailed activities are:

- Coordination management: content, costs, resources, communication, risks and purchases management. Activity leaders are responsible for research reports that describe the different stages of the research network development. The Directory Board sustains the progress of the joint research program and prevent deviations;
- Management consulting and training.

4. The Financial Management is the responsibility of the Directory Board members and the financial responsible person from each partner team. The project director is in charge with the financial reports realization and with the correlation analyzing between the costs and the research activities results in each year.

4 REACHING SUSTAINABILITY – CREATING A VIRTUAL CAMPUS

Beside the aspect of ‘capacity building’ effects of the network the question of sustainability has to be considered to reach an enduring partnership among all participants. To do so the broad expertise, the technical infrastructure and the distributed locations of the partners can be used to reach a high number of people all over the country. The network itself can develop course and training modules on different levels of education and offer its services to interested target groups. The videoconference facilities have to be used as a very powerful tool for collaborative learning especially when the training programs are dedicated to design education. The demand for education is permanently rising and not limited to a certain age, degree or job position. Even among retired people, there is a demand for continuous education to extend their personal knowledge and skills. The detected target groups for educational services are shown in Error! Reference source not found.

In general, one can identify four major groups for scientific education [8], [9], [10]. The ‘qualifying education’ is meant as an education for students who are enrolled at a university or any other educational institution to get a scientific degree. This also includes people who already have a degree and study on to reach a higher or an additional degree.

Figure 3: The VC system architecture in INPRO network.

- Virtual conference (VC) system - the same type as it is installed in the VRL-KCIP NoE and at Timisoara (Figure 3).
- Common research platform – there were elaborated new working methods based on the information and communication technologies tools and existing web site. There was developed a new method for research process optimization that will allowed the interoperability of the application for the product realization.

Figure 4: Target groups of scientific continuous education.
The group of 'Post graduates and Scientist' requires activities to reach a higher level of personal knowledge and skills in specific and selected fields. This additional knowledge are necessary to master daily job requirements. This is, very often the case of the employees of different departments of the same company.

The education is offered on a continuous or continual basis. The third group includes students of any age and any social level. These courses are open to everybody. Such courses offer a platform to learn and discuss about the latest research results and allow people to join lectures, which are not related to their core subjects. The objective of such courses is to extend one's individual general knowledge base and create expert forums.

The fourth group consists mainly of retired persons who are still interested in learning and extending their personal knowledge and skills. The main objective of this group is not to hunt for certificates, but to keep contact with current questions and results of research. These types of students are, frequently integrated into the schedule of undergraduate courses. As can be seen in Figure 4, the different target groups for scientific education call for a holistic approach to master the entire range of students.

On the other hand, the management of education cycles requires individual programs to meet the various demands of all groups. Delivering adequate education modules to such different target groups calls for adequate organizational structures and resources of the educational institution.

The key conditions for a network with virtual structures are courses that are offered in modules. A modular structure provides flexibility and faster reaction to turbulent market conditions. The modules can be delivered "on demand", in different languages and from the partner of the network that is most competent.

A broker who keeps contact with network partners and configures the course portfolio (Figure 5) manages the network activities. He determines the form of education course and the necessary support activities (materials, communication channels, etc.) delivered and provided on the web platform [9], [10].

The construction of such a web-based model ensures the system's flexibility, because new courses can be established on demand and, if necessary, at short notice. The broker establishes (based on the specific field of demand) a course offer to meet this demand. He chooses the adequate form of teaching (seminar, workshop ...) and decides about the channel of knowledge transfer (internet, face-to-face meetings...). In a third and fourth step, the location and the course tutors are established. The course tutors determine the contents of the courses and are responsible for the delivery of adequate materials. Therefore, the approach to generate a course is a mixture of a bottom-up and a top-down strategy.

This open broker organization supports the demand for fast reaction to market requirements and allows integrating many partners and experts. Especially for international research cooperation or education networks the systems offers a high degree of flexibility [11]. In this modular organization, each partner teaches courses in their specific fields of core competence. The system provides a high level of independence concerning location and content of courses. The synchronization of different courses and coordination are subject to the broker.

The existing technical infrastructure also enables INPRO network to offer telebased courses via videoconference, so that the courses can be offered at many physical locations at the same time (any time - any place). It is also an option to charge fee from some selected courses or trainings participants that will help to make the system independent from public funding. The INPRO virtual campus will therefore ensure the permanent spreading of current research results and will open a gate to offer further educational or training services to different target groups. The efforts will also foster the deep integration of the national network in the society and it will open further links between researchers.

Figure 5: The concept of a virtual campus.
5 THE E-LEARNING SYSTEM ARCHITECTURE

Based on the previous ideas for building a virtual campus for collaborative design education, the partners involved in the INPRO network have developed a new project with SIVECO Romania Company (national market leader for e-training systems/platforms) [12].

The software solution chosen was AeL Enterprise e-learning platform. It is able to ensure unitary training, a better learning process of monitoring, didactical methods evaluation, good courses and resource planning, time saving and learning process optimization. The concept of content reusability is implemented by using standard formats such as XML, MathML, SCORM. The AeL platform is dedicated learning management software, which covers the three main learning possibilities: asynchronous, synchronous in class and synchronous at distance. The training programs for the INPRO network’s members and for the industrial collaborators, can be easily satisfied by the chosen solution. It will be integrated with the collaborative training solution through videoconferences. The main features (functionalities) of the AeL Enterprise e-learning platform that will be developed are:

- **Asynchronous study** - allows the students to complete their high-priority tasks without having to leave their office in order to attend training sessions. The students can learn whenever they want, within the time specified by the training instructor.

- **The virtual class** - The trainees can be in the same room or miles away and the training session takes place in a similar manner. The trainer can see, hear, and communicate with the trainer via instant messages. All the participants in the training process can be located anywhere. The trainer sends the materials and monitors the training session - both these activities are performed online. Class materials and test can be viewed by all trainers or just by those selected by the instructor. The videoconference system will give an other dimension to this functionality.

- **The virtual library’s role** is to store and to organize significant amounts of information and educational materials. The feature allows the information to be organized within the database in agreement with a hierarchy defined by the system administrator. AeL has an organization system of the resources (educational materials, tests, opinion surveys etc.) arranged hierarchically. Practically, any educational material that can be displayed on the customer’s computers can be introduced in the knowledge base. Thus, on a single mouse click we can add, in the course support, any Office document, movies, HTML or Flash animation. Depending on the access rights, users may have the option to change the structure of the information by adding, modifying, or erasing directories, courses, tests or problems files.

- **Training records** offers the possibility to monitor and administrate the information relating to courses, instructors, students, organizational structure, statistics, thus facilitating an optimum allocation of the organization’s internal resources over the entire process of continuous training. The training records refer to:
  - **Courses** - This function allows the display of all courses for which the user is allowed to access (internal courses, auxiliary or external courses; course modules). It is planned to develop a ‘career path’ module that will facilitate the management and the monitoring of professional development within the beneficiary organization;
  - **Planner** - Enables the management of synchronous courses to help the course schedule as well as the virtual/physical classrooms in which the courses are held. The available functions are adding, changes or erase a course program. It is also possible to send e-mail notifications regarding course-related activities to all users;
  - **Students and instructors** - Offers complete information about students and trainers registered in the system; database that stores information about trainers and students; Details on the activity of the students and trainers;
  - **Defining the organization** - This feature offers the possibility to define and visualize information about the structure of the beneficiary organization (structure details, job titles, subjects (area of study) and classrooms.

- **Reports** - This functionality is created for the reports and statistics management regarding the development of the training process within the beneficiary organization.

- **Administration** - This section enables the administration of the users and of their actions within the system. Access allowed only to the system administrators.

- **Discussion Forum** - is a way of communicating between the trainers or dedicated groups.

The new Internet technologies, the latest evolutionary step in distributed computing, has been proposed as the platform for realizing the INPRO e-Learning system as the core for building the virtual campus. The network partners in accord with the expressed industrial needs will develop this platform for collaborative design education in the new digital economy, too.

6 SUMMARY

The increasing use of virtual teams demands special attention to differences in culture, communication barriers, and inherent trust existing among the team members. While these teams are not fundamentally different from traditional teams, additional focus and effort in some key areas is necessary to ensure team success. These include knowing the cultural differences that exist in the team and taking steps to educate the other team members and understanding how they should approach different research situations.

Only by understanding the challenges and differences between virtual teams and traditional teams, management and team members can better prepare themselves and take advantage of their strengths to promote success.

During the paper content, were depicted the specific tools of managing INPRO national research network and the development of the informational and communicational (internal and external) system. Based on the financial support of the Excellence Research Program the partners/researchers have built the collaborative environment of work that allowed the national network to develop knowledge links with the global virtual team VRL-KCIP NoE, for the declared goal of connecting the Romanian Research Area with the European Research Area. This was possible because of the participation of the ‘Politehnica’ University of Timisoara in the VRL-KCIP NoE since 2004. Two forces have determined the INPRO research network developed:

1. The research team of ‘Politehnica’ University of Timisoara, as member of the VRL-KCIP NoE, has the
duty to develop a national network connected with the global one. This created a real competitive advantage for the Timisoara team;

2. The opportunity offered by the national Excellence Research Program has determined the research team of Timisoara to develop a complex project with a real connection with the European Research Area.

The created knowledge bridge is based on the following similarities:

- The INPRO network’s joint program of activities is almost similar with the VRL:KCiP NoE, with the declared purpose of aligning the national research specific to the European tendencies in the field of manufacturing;
- The collaborative work environment will assure the compatibility of work and training with the global virtual team (VC system is the same type; the common research platform is build with the same software facilities);
- The VRL:KCiP NoE organizational culture based on knowledge sharing is also, developed in the INPRO network, by adopting the European spirit in research.

Finally, the paper presents the motivation and the initial solution for developing an e-learning system as a core of the INPRO virtual campus for collaborative design education. Based on the AEL Enterprise platform there are detailed the functionalities of the modern learning and modern system dedicated to support personnel training for direct Computer Assisted Learning (CAL) as well as for the remote/nonassisted training way (Computer Based Training).

Furthermore, the virtual campus for collaborative design education will ensure unitary training, a better monitoring of the learning process and of the results obtained by the students and by the trainers, the didactical methods evaluation, connections with areas of study related to the training subject, the careful planning resources (trainers, classrooms). All is achieved while saving time and optimizing the learning processes.

The virtual campus for collaborative design education will be developed through a new national project with SIVECO Romania Company, in the context of the Innovation Program.

7 REFERENCES