ANNALS of the ORADEA UNIVERSITY.
Fascicle of Management and Technological Engineering, Volume VI (XVI), 2007

PROPOSAL FOR AN E-LEARNING SYSTEM EVALUATION METHODOLOGY BASED ON THE INPRO RESEARCH VIRTUAL NETWORK CASE STUDY

Anca Draghici[1], Radu Constantin Parpala[2], George Dragoi[2], Costel Emil Cotet[2]
[1]Politehnica University of Timisoara, Integrated Engineering Center, adraghici@eng.upt.ro
[2]Politehnica University of Bucharest, UPB-PREMINV Research Center,
{pmc, gdragoi, costel}@mix.mmi.pub.ro

Key words: e-Learning system, Internet, IBM Collaborative Learning, AeL Enterprise

Abstract: The concepts of a virtual research network and virtual teams, enabled by a new generation of Internet/Intranet/Extranet-based services are discussed here, as means to stay competitive and to thrive in a turbulent research globalize market. The paper focuses on a preliminary analysis needed in building an e-Learning system for such a virtual research network. We consider that the collaborative environment of the INPRO Romanian Network will very well illustrate some methodological aspects concerning selecting and adapting an e-Learning system taking into account the advantages and disadvantages implied by each solution. IBM Collaborative Learning software and the AeL Enterprise software made by SIVECO Romania are the software e-Learning applications used for this e-Learning system analysis case study.

The most important and critical issue in building an e-Learning system is how to evaluate and determine whom we should partner for our e-Learning solution. Hopefully, *the definitions, discussions, analysis and arguments* within this paper will assist us to build an e-Learning system in a virtual research network, as INPRO, and so we can best accomplish our targeted training needs as declared and described by the industrial partners.

1. THE NETWORK SUPPORT FOR AN E-LEARNING SYSTEM

A hierarchical e-Learning network design model breaks the complex problem of network design into smaller, more manageable problems. Each level, or tier, in the hierarchy addresses a different set of problems so that network hardware and software can be optimized to perform specific roles. Devices at the lowest tier of the hierarchy are designed to accept traffic into a network and then pass traffic up to the higher layers [4]. The core of the network has one aim: to provide an optimized and reliable transport structure by forwarding traffic at very high speeds. In other words, the core layer should switch packets as fast as possible. Devices at this layer should not be burdened with access-list checking, data encryption, address translation, or any other process that stands in the way of switching packets at top speed [9, 4].

The distribution layer sits between the access and core layers and helps differentiate the core from the rest of the network. The purpose of this layer is to provide boundary definition by using access lists and other filters to limit what gets into the core. Therefore, this layer defines policy for the network. A policy is an approach to handling certain kinds of traffic, including routing updates, route summaries, Virtual Local Area Network (VLAN) traffic, and address aggregation. You can use policies to secure networks. The access layer feeds traffic into the network and performs network entry control. End users access the e-Learning network via the access layer. As a network's "front door," the access layer employs access lists designed to prevent unauthorized users from gaining entry. The access layer can also give remote sites access to the network via a wide-area technology, such as Frame Relay, ISDN, or leased lines. A reliable and available e-Learning network provides users with 24-hours-a-day access [5, 7].

In a highly reliable and available e-Learning network, fault tolerance and redundancy make outages and failures invisible to the end user. The high-end devices and telecommunication links that ensure this kind of performance come with a steep price tag. Network designers constantly have to balance the needs of users with the resources at hand. Multicast traffic can also consume a large amount of bandwidth. Multicast traffic is propagated to a specific group of users. Depending on the number of users in a multicast group or the type of application data contained in the multicast packet, this type of broadcast can consume most, if not all, of the network resources. As networks grow, so does the amount of broadcast traffic on the network. Excessive broadcasts reduce the bandwidth available to the end users and force end-user nodes to waste CPU cycles on unnecessary processes. In a worst-case scenario, broadcast storms can effectively shut down the network by monopolizing the available bandwidth [6].

Two methods can address the broadcast issue for large switched LAN sites.

The first option is to use routers to create many subnets and logically segment the traffic. This scenario can create a bottleneck in the network.

A second option would be to implement virtual local area networks (VLAN's) within the switched network. A VLAN is a group of end devices that populate multiple physical LAN segments and switch ports; they communicate as if they were on a single LAN segment. One of the primary benefits of VLAN's is that LAN switches (by creating VLAN's) can be used to effectively contain broadcast traffic and manage traffic flows. The Virtual Local Area Network (VLAN) is the best support for the virtual design offices or the virtual teams [5]. The interconnection of VLAN's is realized on the level two (ELAN – Emulation Local Area Network), and on the level three (MultiProtocol Over AT –MPOA). MPOA Client (MPC) and MPOA Server (MPS) are obtained the configuration by LECS (LAN Emulation Configuration Server). The virtual networks MPOA is named IASG (Internet Address Summarization Groups) [5, 6].

In this case an e-Learning team is formed with members located at different geographic locations [4]. A virtual local area network will be created for the e-Learning project of the INPRO virtual research structure (as described in figure 5). In addition to the INPRO's full-time members, the team will also include contributing members who are recruited for specific components of the project. As such, a core group is responsible for leading the project and a sub-group is involved in specific components of the training project while the full time INPRO members form the central core of the team, experts in the different training modules of the project will coordinate the corresponding modules.

2. COLLABORATIVE LEARNING SOFTWARE – SHORT OVERVIEW

Synchronous and *asynchronous* communication via the Internet provides modern training and learning with two very powerful domains [8, 10].

- The *synchronous* domain is the more traditional instructional approach to online training and has the instructor (or mentor) and learner available at the *same time*. Usually they are in the *same place* but with the Internet, it is possible for them to be in *different places* at the same time. Synchronous training via the Internet is very helpful for the learners that are willing to adjust his or her learning style away from the traditional classroom or lab.
- Being *asynchronous* means that the instructor (or in most cases, computer-based courseware) and the learner are only available at *different times*, a windfall for self-directed learner who likes to learn at their own pace and their own time. An e-Learning solution should place equal emphasis on both of these important learning domains.

2.1. IBM Workplace Collaborative Learning

In organizations today, efficiently managing intellectual and human capital is a significant challenge. To deliver the best performance, workers need to know and understand the latest business processes, products and policies. Sometimes a worker needs to learn something new while already doing a task. This need to blend learning and work activities is contributing to a transition from traditional learning programs to learning integrated with portal solutions, which delivers just-in-time access to learning tools to employees in the context of the business applications they use daily. This new model allows learning and business activities to blend, which supports ongoing professional development and effectiveness.

Built and managed on a componentized service-oriented architecture (SOA) using open standards, IBM®. Workplace Collaborative Learning™ 2.6 software makes it flexible and easy to deploy any mix of learning capabilities within a composite Workplace environment, giving people the tools they need for their roles. IBM Workplace Collaborative Learning software can help drive organizational productivity by allowing your company to manage its entire training program worldwide from a single platform. Workplace Collaborative learning software is an essential enterprise-wide application that delivers and tracks all kinds of training [11].

IBM® Workplace Collaborative Learning™ is an enhanced IBM® Workplace™ product and part of the integrated collaborative environment delivered by IBM® Workplace™ Collaboration Services. Using the tools in the IBM Authoring Tool (figure 1), trainers can easily create new courses packages.

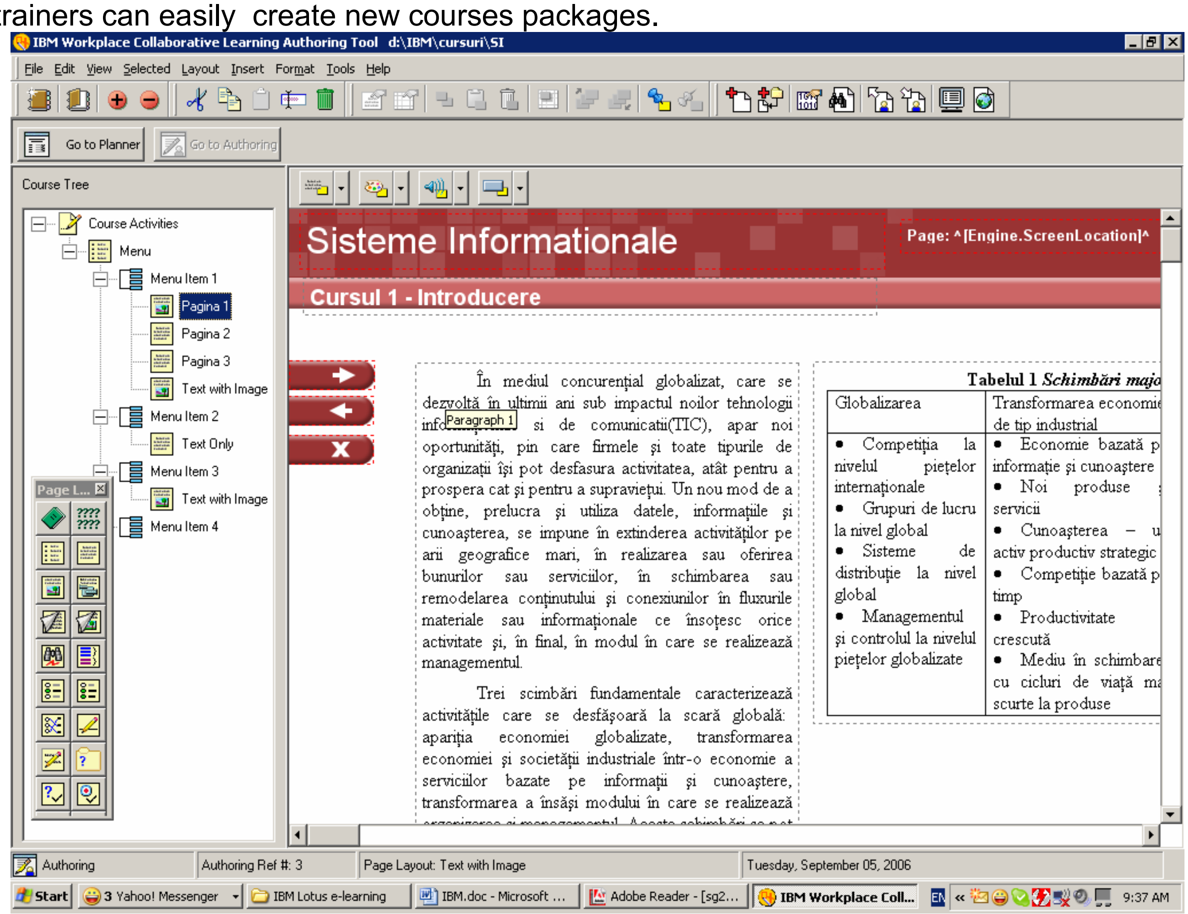

Fig. 1. IBM Authoring tool

It provides learning services that help organizations manage their training programs more efficiently and integrates learning resources on the desktop. Integration with other Workplace Collaboration Services capabilities delivers blended learning experiences and provides students with enhanced tools such as course discussion areas, document sharing, web conferencing, and chat rooms. For fully integrated, ready-to-use communication and collaboration services the system provide integrated messaging, presence awareness, instant messaging, team spaces, Web conferencing, learning, and document and Web content management.

The benefits/advantages of the IBM Workplace Collaboration Services are [11]:

- Provides students with enhanced collaborative tools such as course discussion areas, document sharing, web conferencing, and chat rooms.
- Helps organizations more efficiently meet ongoing training requirements and measure the results and effectiveness of students' learning activities.
- Integrates with other Workplace Collaboration Service capabilities to deliver collaborative tools such as team spaces, e-mail and calendaring.
- Uses customer-supplied job profile information to deliver roles-based learning resources right to the desktop.
- Automatically assigns learning activities as part of a personalized employee development plan so users can work towards closing their skills gaps.
- Empowers users to self-manage their learning programs and access on-line learning in a "just-in-time" manner.
- Protects your investments by supporting standards-based courseware.
- Tracks and reports on student learning activities to help manage regulatory compliance training requirements.
- Delivers a variety of learning experiences to groups of students, wherever they are located.
- Enables learning resources to be accessible at all times within the context of workers' day-to-day activities.
- Authoring tool creates customized courseware to deliver training on new products, business processes, regulations, etc.

2.2. AeL Enterprise - SIVECO Romania

AeL Enterprise, a software platform developed by SIVECO Romania (figure 2), is an innovative e-Learning solution that was first implemented and tested for telecom companies. Within the AeL Enterprise advantages can be mentioned the employees unitary training and testing, the efficiency offered to the management of human resources allocated to the training process, the supervise of trainers and employees performances, flexibility, reduces the training costs, reduces the unproductive period, interactivity and a great control on the amount of information received by the employee within the training stage. The AeL e-Learning platform offers support for teaching and learning, for tests and evaluations, for managing the educational content, for monitoring the educational system and creating the curricula. AeL can be used for the learning process assisted by the teacher/trainer or for individual education. AeL is implemented at undergraduate and graduate levels of the educational system, as well as in corporations, for internal employee training. It is designed takes into account the flexibility criteria: it can be used in several languages, different regions, learning levels and types of organizations [12].

SIVECO Romania specialists are constantly assisted, in developing the AeL system, by experienced teachers and the professionalism of the technical team in the software field [12].

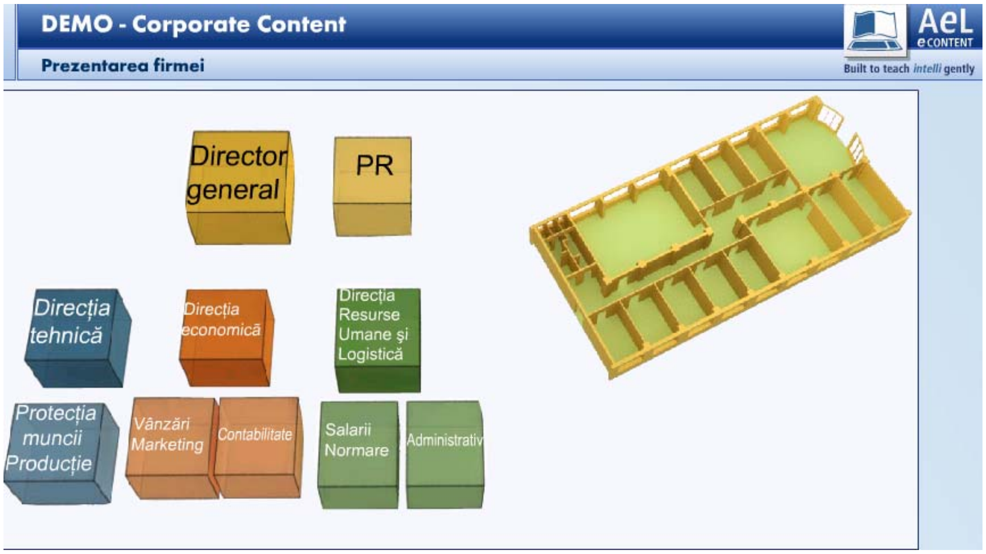

Fig. 2. An example of an interactive course module using the AeL Enterprise platform [12]

AeL system aims to:
- Support the teaching/learning process by modern information tools, providing the teachers a complimentary tool;
- Facilitate the learning process;
- Stimulate the creativity and competence, as well as team work;
- Use the simulation software as substitute teaching materials and tools, which are too expensive or difficult to be provided.

General features:
- User friendly and adaptable interface, differentiated depending on the type of user, the access rights being configured;
- The roles, groups, users and associated access rights are easy to manage;
- Compatible with the standards: MathML, SCORM and IMS;
- Easy to install and manage (4780 platforms installed in Romanian schools);
- Multi-lingual and regional support: AeL can be easily configured for use in any new language

AeL is a complete e-Learning solution, offering facilities for managing and presenting different types of educational material, such as multimedia interactive materials, interactive guides, exercises, simulations, educational games and many others. The system has an electronic information database, with functions for managing and administering educational content, which can be adapted, configured and indexed. AeL is an optimum solution for synchronized learning, the teacher being completely in control of the lesson (it is the teacher who creates, coordinates and monitors the educational environment) as well as for non-synchronized learning (the pupil/student has his own study pace, collaboration projects, being suitable for distance learning).

AeL aims to offer a strong support [12] to the responsible factors in deciding upon, controlling, planning, assisting and making forecasts about the educational process. AeL is a modern software platform based on the latest IT technologies. For portability and maintenance reasons, AeL was created as a multi-layer system - using a web client connected at a Java-based application server. We use Enterprise Java Beans, Jdbc, Java servlets, JSP, Java applets and XML. The need for inter-operable content has also been taken into account; XML is basically used, but the support for standard format for interoperability content packaging, such as SCORM and IMS, has also been implemented.

3. SOLUTION FOR BUILDING AN E-LEARNING SYSTEM IN THE INPRO VIRTUAL RESEARCH NETWORK

3.1. Brief Overview of the Context Establishment of INPRO

The **INPRO** – **Romanian Research Network for Integrated Product and Process Engineering** was developed in the context of the **CEEX** national program in 2006. The project joint 121 members (73 PhD, 37 PhD. students, 9 researchers and 2 master students) from 9 research centers, localized in the Universities of Timişoara, Bucureşti, Iaşi, Braşov, Bacău, Suceava, Sibiu and Oradea and a research national institute. They have decided to share their competencies and knowledge in the field of integrated engineering [3].

The project proposal is based on the idea of linking the Romanian scientific research to the European research using the bridge created by the participation of **Politehnica University of Timisoara** (the leader of the proposed project), by the **Integrated Engineering Research Centre** in the **Network of Excellence** (NoE) **Virtual Research Lab for a Knowledge Community in Production** (VRL-KCiP, [14]), financed by the **6th Framework Program** (FP6) of the European Commission. In NoE VRL-KCiP, the partners have the mission to create and develop **national research networks**, to sustain their integration process in the European network, for the development of the **European Research Area**. This objective was attended by setting up the national research network in the field of Integrated Engineering (INPRO). Also, it derive from the need of reducing research fragmentation in the field, for building of a common material and human base that assure the possibility for complex researches in modeling and simulation of product and manufacturing, and processes associated with their life cycle. It will be create a dynamic structure and a collaborative platform in integrated design that will allows its members to participate in collective design projects with industrial applications. The share information process needs the information change into knowledge. Their variety is from the determination of the product specification to the life cycle end, including the processes and the manufacturing systems design. The integration process inside the network will be the base for the communication system development between the partners and for the knowledge community establishment. The proposed project answer the requests of the FP7 European Commission program for building a **Europe based on the knowledge society principles** [1, 2, 3].

3.2. The Context of e-Learning System Development

The motivation of building an e-Learning system in the INPRO research network is linked with: (1) the vocational training need of the network's members in the context of the long life learning concept (learners are: master students, young researcher, PhD. students etc.) and (2) the specific demands from many industrial partners in the context of the dynamic evolution of the software dedicated for industrial problems solving or applications (a marketing research was developed in the end of 2007) [1, 2].

In the present, the modalities of knowledge transfer (as a base for the e-Learning system) inside and outside the INPRO research network are linked with the development of the information and communication (internal and external) system of the network:

- 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 INPRO requirements;

- Skype – 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;
- The INPRO web site (figure 3, [13]) have been developed in 2006 and it have been improved continuously. The interest information on the web are: details regarding the INPRO project; the partners involved in the virtual research network; the industrial partners section (will be developed after the results of a research for identifying the industrial market's 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 the Orientation Board Meetings; important links; the access to the INPRO network's Intranet (this area is restricted to the INPRO members only) and the contact person details (the network's director).

Fig. 3. INPRO Network's Web Page [13]

In the next period of the intra-national virtual network, there will be developed the Virtual conference (VC) system – a Polycom VC system (the same type like it is install in the VRL-KCiP NoE and at Timisoara, www.polycom.com) will be installed in each research pole of the network (figure 4). Polycom offers network infrastructure products that support a scheduled or on demand conferencing environment. From small to large networks, organizations can design a solution from the portfolio of Polycom products that fit its multipoint conferencing and video network management needs and requirements. The VC system will support the collaboration between the INPRO partners in the following domains: virtual training and learning; knowledge sharing in virtual workshops or virtual conferencing; management virtual sections of the Directory Board; tasks or work packages virtual workshops; PhD. rapports or thesis presentation; collaboration in any future project between partners etc. These are the basic resources of the INPRO research network for building the e-Learning system.

3.3. The Content of the e-Learning System

The main demands that where taken into consideration in choosing the right e-Learning solution were: hardware requirements for both application server and the workstations, course documents management system, course packet development, software maintenance, IT knowledge level needed. Considering this we believe that the best solution was to use AeL e-Learning platform. The software is able to ensure unitary training, a better monitoring of the learning process and of the results obtained by the students and by the instructors, the evaluation of the didactical methods, good course and resource planning, time saving and learning process optimization.

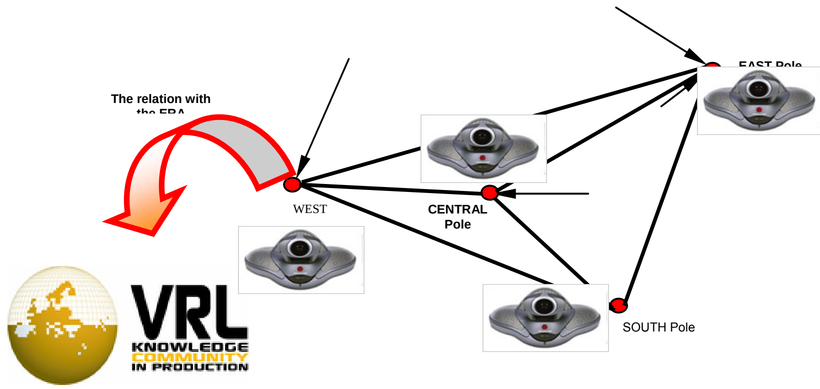

Fig. 4. VC system architecture in INPRO virtual research network

The concept of content reusability is implemented by using standard formats such as XML, MathML, SCORM.

The AEL platform is the sole Learning Management Software which covers the three main learning types: [12]

- Asynchronous (the instructor prepare the manual and each student traverses it in his own rhythm);
- Synchronous in class (the instructor and the students are physically in the same room and communicate directly);
- Synchronous at distance (the instructor and the students can communicate only through the system).

Both of the INPRO research network requirements, training of the network's members and training of the industrial partners can be easily satisfied by the chosen solution.

The server needed for the e-Learning system will be localized at one of the INPRO partners, UPB-PREMINV [3]. This server will be accessible to the others member of the INPRO research network via internet connections. The description of the server configuration is shown in table 2. It must allow a good internet connection in order to be able to accept a great number of simultaneous clients. The requirements of the client software are not very high, so that it can run on almost all computers that have internet explorer and an internet connection. Also the installation of client software can be done easily even without high IT knowledge.

Table 1. UPB-PREMINV Server configuration

Server type	IBM x3400, Xeon Dual Core 5050, 3.0Ghz/667Mhz, 2x2MB L2, PC2-5300, ServerRaid 8k-l SAS Controller
Processor	2xDual-Core Intel Xeon Processor 3.0Ghz/667/2x2M L2
Memory	4x512 MB
	4x1024 MB
HDD	4x 146.8 GB Hot Swap 15k RPM Ultra 320 SAS
Optical	IBM Multi-Burner Plus
Power	Redundant Power and Cooling Option

As we present in figure 5, an e-Learning architecture consists of two classes that are being held simultaneous (Virtual classroom 1 and Virtual classroom 2). The first course is located at UPB-PREMINV, one of the INPRO network partners. The second course is delocalized (Synchronous at distance), the trainer is located at the coordinator of the

INPRO research network UPT – CCII but at this course are attending learners from all partners. Others are attending in the same time to some asynchronous courses (AL).

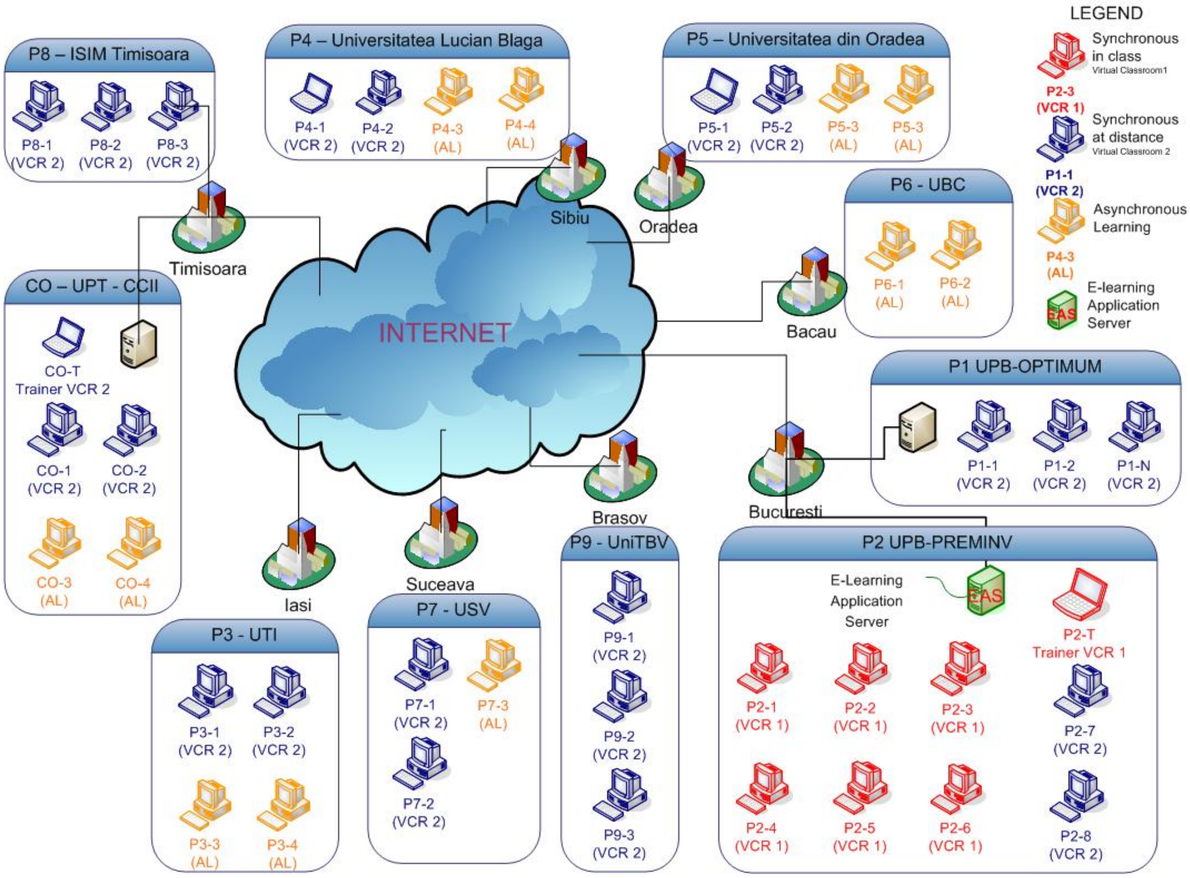

Fig. 5. INPRO e-Learning system solution

4. CONCLUSIONS

As a result of a new training development paradigm, there is a greater need for software tools to effectively support the formal representation, collect and exchange of information during the training development stage [5]. In this paper, we discussed different related issues and proposed a conceptual methodology for supporting an interdisciplinary research team e-Learning solution considering all phases of a comparative analysis (briefly presented in figure 6). We consider this approach as a vision for the future of virtual research networks training development. We know that developments in all of the sub-areas are necessary to achieve this vision. We do not expect full implementation in short term.

With this paper we want to stimulate discussions and further collaborative research and development activities, and to encourage colleagues both from academic institutes and from the industries to stepwise, incremental, but continuously develop and deploy emerging e-Learning technologies and concepts adapted to the actual needs.

The concept of INPRO research platform, enabled by a new generation of Internet/Intranet/Extranet-based services is discussed here, as a means to stay competitive and to thrive in a turbulent training market. The new Internet technologies, the latest evolutionary step in distributed computing, has been proposed as the platform for realizing the INPRO e-Learning infrastructure. This platform for research, training, consulting in the new digital economy will be developed by the INPRO partners according with the expressed industrial needs.

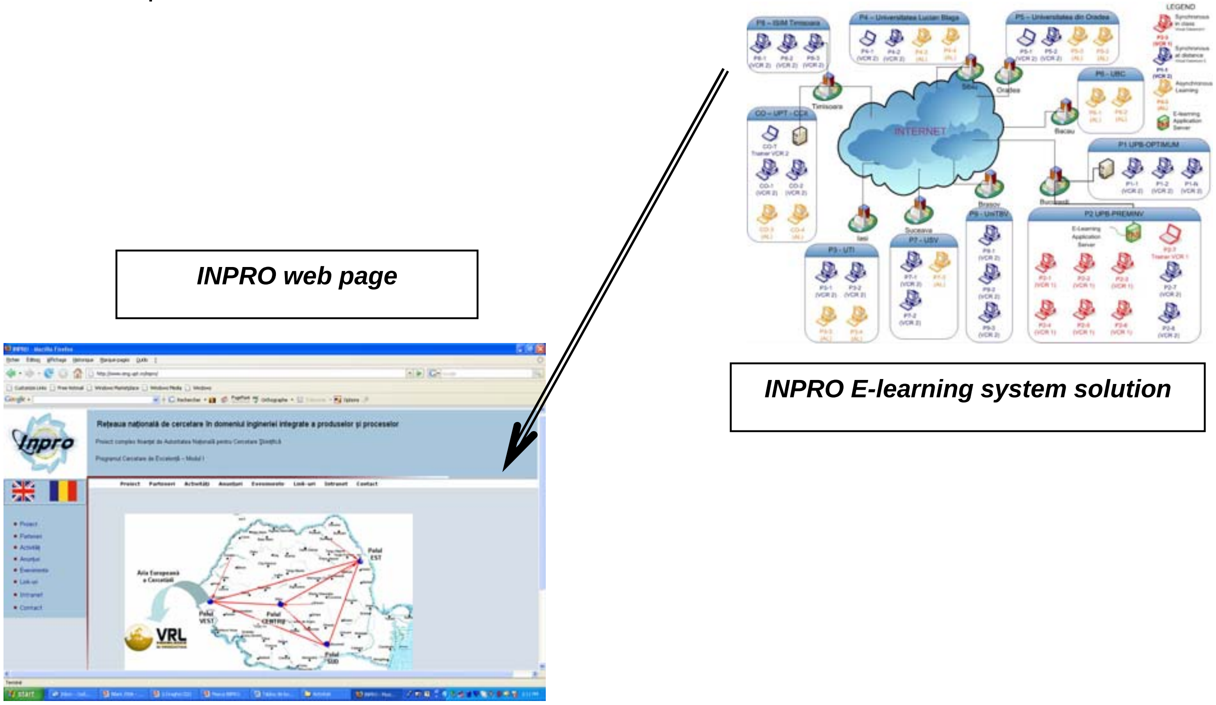

Fig. 6. The link between INPRO web page and the E-learning system solution

REFERENCES

[1] Draghici, A. and Draghici, G., (2006). New Business Requirements in the Knowledge Based Society, in Cunha, M.M. and Putnik, G.D., editors, Advanced Technology for Business Integration: Social, Managerial and Organizational Dimension, Idea Group Publishing, USA, 209-241.

[2] Draghici, A, Matta, N., Molcho, G. and Draghici G. (2007). Networks of Excellence as Virtual Communities, in Putnik, G. and Cunha, M.M., editors, Encyclopedia of Networks and Virtual Organizations, Idea Group Publishing, USA.

[3] Draghici, G. (2006). "The INPRO – Romanian Research Network for Integrated Product and Process Engineering", CEEX project, Contr. No. 243/2006

[4] Dragoi, G., (2003). Intreprinderea integrata: metode, modele, tehnici si instrumente moderne de dezvoltare si realizare a produselor, POLITEHNICA PRESS, Bucharest, Romania.

[5] Dragoi, G., Cotet, C., Rosu, L., Rosu, S., (2004). Virtual teams in collaborative systems in networks and corporations, in the Proceedings of the 7th Conference on Management of Innovative Technologies (MIT'2004), 4th - 5th October 2004, Constanta, Romania, 119-124

[6] Dragoi, G., Cotet, C., (2004). Virtual Laboratories for the Collaborative Design to Improve Product Development, in International Journal of Simulation Modelling-IISJMM, vol. 3, no. 1, 29-40.

[7] Khoshafian, S., Setrag, F. (2002). Web Services and Virtual Enterprises, Tect; Chicago, USA.

[8] Robson, R. (1999). WWW-Based Course-Support System: The First Generation, International Journal of Educational Telecommunication, Volume 5, Number 4/1999, 271.

[9] Szykman, S., Fenves, S., J., Keirouz, W., Shooter, S., B. (2001). A foundation for interoperability in next-generation product development systems in Computer-Aided Design 33; Elsevier Science, 545-559.

[10] Woodall, D., Evaluating e-Learning Solutions. Choosing the right e-Learning solution for your organization, http://www.internettime.com/itimegroup/woodall.htm#_Toc484301695

[11] IBM® Workplace Collaborative Learning, http://www-142.ibm.com/software/workplace/products/product5.nsf/wdocs/lwclhomepage

[12] AeL Enterprise, SIVECO Romania, http://www.advancedelearning.com/

[13] INPRO web page, www.eng.upt.ro/inpro

[14] VRL-KCiP official web site, www.vrl-kcip.org,