

Distance Training and Co-operative Work through Internet Video- Conferencing

G. Bazzana, E. Fagnoni, G. Rumi

*ONION Communications-Technologies-Consulting
Italy*

J. Boegh

*DELTA Danish Electronics, Light & Acoustics
Denmark*

E. Van Veenendaal

*KEMA International B.V
Eindhoven University of Technology
The Netherlands*

S. Geyres

*SMC International-Division PSTI Evaluation
France*

Abstract

Software Process Improvement (SPI) concepts and benefits are still poorly known and understood by most software executives in Europe. In particular, SMEs need special attention. The EPIC Project has been launched by SMEs and with the goal to reach SMEs. EPIC aims at proposing an innovative dissemination approach that is expected to eliminate problems such as: isolation of the companies within their specific application domains, very different development practices and business needs, locality of the market, limited attendance to international conferences or events and narrow-

scoped local meetings.

The basic idea of EPIC to reach SMEs is to organise a set of local workshops, focused on precise SPI topics and with an international dimension. The international dimension is important to allow wide exchanges of experience, in order to avoid meetings that would carry a too much narrow view. The usage of video-conferencing technologies is one of the communication services most envisaged by both large organisations and SMEs. Unfortunately so far such services are not enough widespread due to the high costs of professional solutions and to the low quality of service of naïve Internet-based solutions. While waiting for the guaranteed quality of service that ought to be offered by Internet-2, a solution has to be found which optimises the cost-quality ratio. This paper describes the set-up and usage of video-conference solutions used by a group of European companies to perform multimedia based geographically distributed and simultaneous workshops about software process improvement.

More details can be found on the WWW at the URL: <http://www.onion.it/epic>

Introduction

SPI is a concept that is still not well known and understood by many small or medium enterprises (SMEs). The EPIC Project [1] (European Commission Number: 23659) aims at disseminating pragmatic experiences about software process improvement, with a special focus on SMEs, and by means of multimedia advanced communication technology. The Project is targeted at middle management and SMEs. It has planned – and started – to organise ten cluster meetings, half of which dedicated to specific application domains and the other half dedicated to specific topics. Given this target approach, the idea of using video-conference technology has of course been considered by the project team. Video-conference brings all communication potential that is needed to turn traditional local meetings into really attractive pan-European exchange events. The usage of video-conference is envisaged by both large organisations (which see it as a way to minimise travel efforts and expenses) and by SMEs (which would like to take benefit of this to push their business opportunities abroad).

Today, widespread adoption of video-conferences facilities is hindered by the following factors:

- High costs of professional services, often based on leased communication lines and proprietary solutions; this constitute a barrier for SMEs and very often is a limit also for large enterprises: they are all refrained from making huge investments on a solution that could become obsolete very soon and which only allows them to do video-conferencing among a limited number of sites sharing the same technology

*They need to use an open solution suitable for communication
with whoever in the world;*

- Low-quality of service of Internet-based solutions, due to the limited bandwidth available at European level; in fact the average bandwidth which most users can experience when connected to a professional Internet Access Provided is such that in principle it could be possible to use some video-conference packages that thanks to high compression algorithms and intelligent image pattern recognition claim to be usable with less than 3 k-bit/sec bandwidth. In practice there is no guarantee of the quality of service, which is almost always of such poor quality that it forbids

its usage for professional purposes.

They need a stable and sufficient bandwidth for smooth exchanges.

The emerging Internet-2 protocols, together with the progressive strengthening of communication lines, are expected to introduce guaranteed bandwidth, which could possibly result in a solution to the problem. But such protocols will be available to the end-users only in several years and thus there is the need in the meanwhile to define solutions which optimise the cost- quality of service ratio.

This paper describes the usage of video-conference facilities for distance training and co-operative work across several European companies, in the context of a co-operative Dissemination Action performed under the auspices of the ESSI initiative of the European Commission.

The focus of the paper will be on the following aspects:

- Goals of the EPIC Project, focused on Process Improvement topics;
- Business needs and goals of the project;
- Technological solutions adopted;
- Application of such technology for the organisation of multimedia geographically distributed and simultaneous workshops
- Potential for replication and deployment.

The EPIC Project

EPIC in a nutshell

The EPIC Project (EC Number 23659) is intended to be very practical, focusing on business goals and needs derived from experiences in the field. It falls within the ESSI Programme (European Systems and Software Initiative), which hosts various projects of very different natures but with an key focus on Process Improvement experiments and dissemination.

The target audience is meant to be middle/high management and in particular Project Leaders, Department Leaders and R&D Managent, practitioners and SPI coordinators. Special care will be devoted during the workshops to SMEs and non-IT companies (where most of the European software is developed and maintained). In particular, the workshops are meant to be attended by people whose intention is:

- to discuss their process improvement experience with experts to make sure that the chosen way is the right one;
- to improve timeliness of their projects and the quality of the software products;
- to exchange know-how with ESSI supported process improvement experiments to get new ideas about how to make it better and what to avoid;
- to participate in an up-to-date workshop environment.

European coverage

The EPIC Consortium includes seven partners: Onion – Italy (Prime); Delta - Denmark, ISCN - Ireland, KEMA – The Netherlands, LGAI - Spain, SMC International - France, University of Paderborn – Germany. In addition to the countries of the partners, also Austria and Greece will be involved in the workshops, thanks to agreements with local companies. Henceforth the global European coverage of the EPIC Project is very significant, as shown by the following picture.

Focus of the workshops

As already described, EPIC aims at circulating pragmatic experiences about Software Process Improvement through targeted events run throughout Europe and conducted with the support of the most advanced communication technologies. The targeted events are subdivided into two sets:

- Cluster meetings focusing on the presentation of pragmatic experiences for specific application domains. Such events have been targeted both to IT and non-IT companies, without constraints on the company size. Considering the break-down of IT companies in Europe, the following five application domains will be disseminated:
 - Embedded software (telecommunications, avionics, devices, etc.);
 - Commercial software (banking, insurance, finance, etc.);
 - Industry (e.g.: manufacturing, engineering, process control, energy, etc.);
 - Public administration;
 - Software houses.

The application domains have been selected in accordance with the high interest shown by software Process Improvement Experiments (PIEs) for such sectors [2].

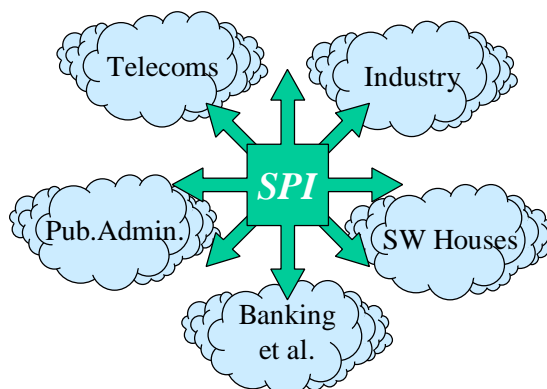


Fig.1 – Application domains covered by EPIC

- Cluster meetings on topics strictly related with Process Improvement. Such events will be targeted mainly to IT SMEs and will be oriented toward the impact of Process Improvement on specific issues having a direct influence on meeting business goals. Considering the most frequently asked questions about Process Improvement and the skills of EPIC Partners, the following five topics have been selected for dissemination:
 - Process Improvement (PI) and Software Product quality and testing;
 - PI and ISO 9000;
 - PI Measures and Return On Investment;

- PI and security/ formal certification;
- PI and new technologies.

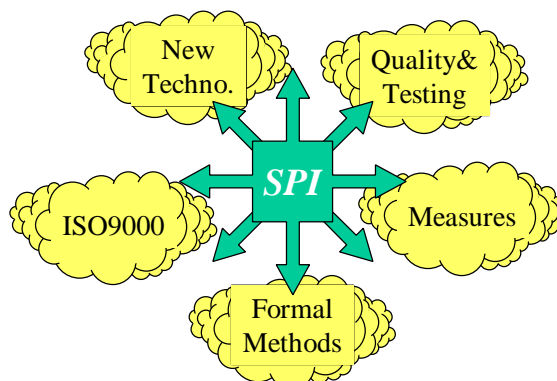


Fig.2 – Technical aspects covered by EPIC

The following table shows the planned dates and venues for the workshops.

Country	Application area / date									
	Industry	Public Admin.	Banking/ Insurance /Finance	Embedded Systems	Formal methods/ Security/ Safety	PI and Sw Quality and Testing	PI measures and ROI	SW Houses	PI and new technologies	PI and ISO 9000
	Oct-97	Nov-97	Dec-97	Feb-98	Mar-98	Apr-98	May-98	Jun-98	Sep-98	Oct-98
Austria			✓					✓		✓
Denmark	✓			✓	✓	✓	✓			
France		✓		✓	✓	✓			✓	
Germany	✓					✓		✓	✓	✓
Greece					✓			✓		
Holland	✓	✓	✓			✓	✓			
Ireland					✓	✓				
Italy	✓		✓	✓			✓		✓	✓
Spain	✓	✓	✓				✓			✓

Table 1 – Dates and venues of the planned workshops

Organisational mechanisms

In order to reach and attract the target audience, taking into account their requirements and habits, it is proposed to run the events with usage of Multimedia technologies, in adherence to the following scheme:

- a set of cluster meetings (one set for each selected topic) is organised at the site of selected EPIC partners;
- such meetings are run at the same time by all involved partners (e.g.: on November 4 1997, all cluster meetings on Public Administration will be run);
- at each site the cluster meetings are attended by around ten-fifteen companies, including companies that have run a Process Improvement Experiment and companies that want to know about;
- the material to be presented is put on WWW accessible by all sites some days in advance so that attendees can start looking at it;

- Internet based audio/video-conference facilities are set-up among the various sites;
- Internet based facilities are used to run the “Multimedia-based geographically-distributed dissemination events”.

From an organisational point of view, each event will be managed by a subset of EPIC partners, selected on the basis of target audience, dissemination topics and partners’ know-how.

Dissemination material

The material to be disseminated is composed of two main parts:

- WWW multimedia material;
- Accompanying supports to the multimedia material.

Concerning WWW multimedia material, an appropriate guide-line has been defined in order to produce consistent material, covering aspects such as:

- structure of the WWW sites (that will have to be easy to browse also for people not attending the events);
- usage of features enabling the co-operative browsing of sites (e.g.: the co-ordinator of the event activates a hyper-textual link and immediately all other sites participating in the event have their site aligned to display the new location);
- careful usage of HTML features in order to ensure portability across the various browsers (e.g.: various versions of Netscape’s Mozilla and Microsoft Explorer);
- moderate usage of advanced interactive features (e.g.: Frames, Java, VRML) in order to have a balance between usability and performance and accurate usage of audio/ pictures in order not to have too heavy pages to download
- set-up of interactive distance learning techniques (e.g.: questionnaires interspersed with navigation; adaptation of navigation to user’s skill and goals, etc.);
- set-up of automatic default navigation path (to be used in a “slide show” approach, whenever needed);
- thorough testing of the prepared material [3].

The choice of the authoring tool (the tool suitable to create the multimedia packages) relied on the assumption that no know-how on HTML had to be required by content-provider of the training material for workshops. Thus the following features had to be satisfied:

- user friendliness, to reduce the overhead and allow a good productivity;
- good integration and compatibility with MS-Office, to allow an exchange of information between word processor, spreadsheet and authoring programs;
- possibility to build a template, to speed-up the development phase and ensure a good coherence in look and feel across the multimedia packages;
- good conversion in HTML, that must be fast and easy, must keep correspondence with the original document, must guarantee a good quality of the results and must not generate “large” HTML pages.

At the end of a comparative analysis between several tools, Power Point’97 was selected since it matches the listed requirements and is very presentation oriented, supporting also a portable format (presentations can also distributed for off-line analysis). Unfortunately HTML conversion leads to loss of many fancy features of such package, particularly the dynamic ones: sound effects (that can be replaced by adding a background music in each slide, preferably in midi format), slide transition

effects, objects animations (that can be replaced by animated GIF) and links (that have to be re-built e.g. by using a client side map).

Measurement of success

The measurement of success for the EPIC Project will be measured through the following quantitative and qualitative parameters:

- Direct participation of European companies to events: the Project will be considered successful if the events will be attended in average by 10-12 attendees per site. Such figure will be computed as an average over all meetings at all sites;
- Number of PIEs presented: the dissemination events will be based as reference material on the results of the ESSI Process Improvement Experiments. The Project will be considered successful if it will package and present the detailed results of no less than 40 Process Improvement Projects, including no less than 20 ESSI PIEs.
- Availability of dissemination/ training material for the software engineering community at large: the material will be composed of WWW pages and associated textual description as well as consolidated conclusions from meeting minutes. The Project will be considered successful if it will deliver more than 300 WWW pages in a format suitable to be browsed/ understood by the software engineering community.
- Access to WWW Project information: the Project has set-up a WWW site for presenting the events and offering detailed information/guidance. At least 50.000 hits are foreseen on the EPIC WWW during project lifetime (from Jan 1997 to Dec 1998)
- Customers' Satisfaction Index (CSI): the Project will set-up a mechanism for evaluating the success of events, covering aspects like: interest of subjects, usefulness of the events, effectiveness of the mechanisms used, quality of the domestic arrangements, etc

Technical goals

The technical goals of the experience can be summarised as follows:

“To set-up audio-video conference facilities featuring optimal cost-quality of service ratio allowing their usage for distance training and co-operative work”

The following sub-goals can be derived:

- connection of distributed sites with audio/video hyper-media technology;
- hardware/ software procurement costs for setting-up the infrastructure at each site less with a negligible cost;
- usage of scalable solutions;
- adoption of de-facto standards, not based on proprietary solutions;
- mirroring of the scenarios in various parallel sites.

According to these technical goals the EPIC project has set up its infrastructure The choice was made on the usage of this approach and of innovative multimedia technologies for the management of multi-site synchronous cluster meetings dedicated to software process improvement subjects.

The goal of the experiment was to organise workshops that would be more attractive to software companies than more traditional events usually are. As a matter of fact, software development industry in Europe is characterised by a large number of small software producing units, focusing on different application domains and thus with different needs. This results in problems to reach effective technology transfer of pragmatic experiences about best practices. The analysis conducted before the start-up of the Project showed that two barriers exist for an effective technology transfer and dissemination of Process Improvement Success Stories:

- clustering of the companies in specific application domains with utterly different development practices and business needs (it is very seldom the case that a detailed practice that gave good results in a telecommunication company is successful, or even applicable, in e.g. a banking environment);
- locality of the market and limited attendance to international events (looking at the attendee list of international events on software engineering, the number of SMEs and non-IT companies is quite small, in particular foreign companies).

To overcome these problems, an alternative approach could be to organise cluster meetings close to the sites of attendees. This, though being suitable and often successful, suffers of the narrow view that there is a risk to get without confrontation with a higher number of experiences. Since it is generally accepted that technology transfer of success stories is of great importance, the proposed action aims at removing such barriers while taking into account the requirements of the intended audience and proposing an innovative dissemination approach. This in turn should eliminate the problems of narrow-scoped local meetings.

The requirements to be addressed in order to get more involvement can thus be summarised as follows:

- to introduce new forms of dissemination besides the common tutorial approach applied mainly in conferences, where we too often see an information flow going only from experts to experts;
- to minimise the need for absence from the company headquarters;
- to provide information tailored to the specific company needs;
- to provide pragmatic results applicable to specific application domains;
- to allow room for discussion, exchange of views and comparisons.

This is thought to be accomplished by the organisation of the multimedia based geographically distributed and synchronous workshops, a sample scenario of which is briefly described in the following.

Each local workshop is planned for about an attendance of 15 people. A local moderator prepares all equipment and material on site and co-ordinates the local discussion as well as the discussion between the local site and the remote sites via the video/audio hyper-media connection. In a cluster, 3 to 4 local workshops are connected together using real-time audio/video equipment allowing to switch communications between the workshops. Based on the selected technology, each workshop consist of a balanced mixture of local and connected presentations and discussions concerning the above mentioned application domains and topics.

As a consequence, the benefits for the target audience can be summarised as follows:

- exposure to success stories matured in their specific application domain;
- possibility to benchmark various approaches and related outcomes;

- access to up-to-date assets in a very cost effective way;
- possibility to discuss specific issues without barriers; in fact the organisation of parallel events in various sites will allow to accommodate the dissemination approach and presentation style to the specifics of the location (cultural issues, language, etc.)
- possibility to have access to the dissemination material via WWW before and after the events, in order to prepare the participation and, afterwards, “to sell” the outcomes to the internal decision makers.

The adopted solution

System Architecture

The envisaged technology infrastructure must be able to reach two main goals:

- allow each company to participate to workshops from their own site;
- guarantee a good quality of service during each workshop.

In order to satisfy the first objective, the solution is to use Internet and de-facto standard tools to publish data. As far as objective two is concerned, due to the impossibility to guarantee a high quality of service using Internet, all involved companies have to set-up a private network, that is an Intranet, based on ISDN, by which the network availability and throughput can be ensured. To complete the infrastructure, the Internet world and the “Intranet private network” must be connected. Using such a scheme important benefits can be reached:

- independence of the connection from potential troublesome Internet servers;
- availability of high bandwidth to exchange multi media material (audio and video).

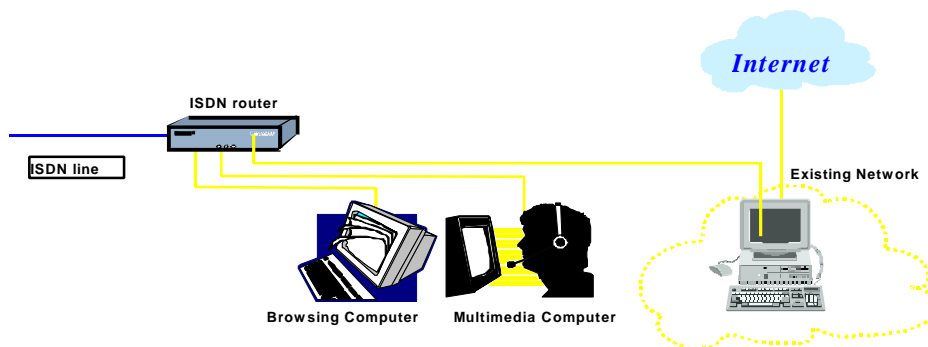


Fig.3 – An overview of the infrastructure needed at each company premises

Henceforth the network infrastructure solution is based on a private TCP/IP network using ISDN connection from each company to a central site (located at Onion's). In fact, all central servers reside at Onion which is permanently connected to the Internet. Due to the fact that ISDN usage is expensive (companies need to do an International call in order to be connected to the central site) the private network will be used just during network set-up and testing (approximately ten hours) and during each workshops and in particular during interactive sessions (five hours for each workshop in average).

Technological infrastructure

The following picture gives a more detailed overview of the defined technological infrastructure.

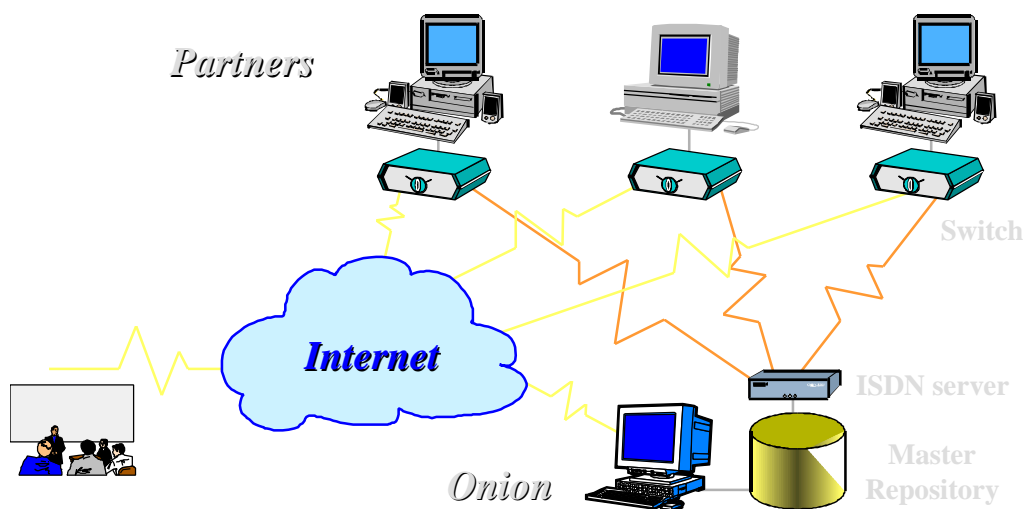


Fig. 4 - Technological infrastructure

The figure shows both the partner site and the Central site (that is ONION) and the connections between them. At each workshop, all involved partners shall set-up a direct ISDN connection to the central site (making international phone calls) and at the same time use basic Internet for applications which are not bandwidth intensive (browsing, synchronous navigation, etc.).

The complexity of the technical infrastructure is “hidden”, due the fact that most services are directly provided by a Central Site.

In particular, the Central Site provides:

- audio/video “reflector” configuration and management that permit a co-operative videoconference, in contrast with the traditional one-to-one videoconference;
- synchronous browsing feature, that allows all Partners to be constantly synchronised on the same browser page;
- routing, that permit to each partner connected through the ISDN line to be connected to the Internet;
- accounting and security services.

The ISDN solution, combined with a direct access to Internet based on common lines, has been chosen because only such a solution can guarantee the needed bandwidth which allow to have a clear image and a noiseless voice transmission during multi-point video-conferencing (thus involving broadcasting aspects). The following figure shows the details about the technological infrastructure foreseen for the Central site, which acts as technology manager.

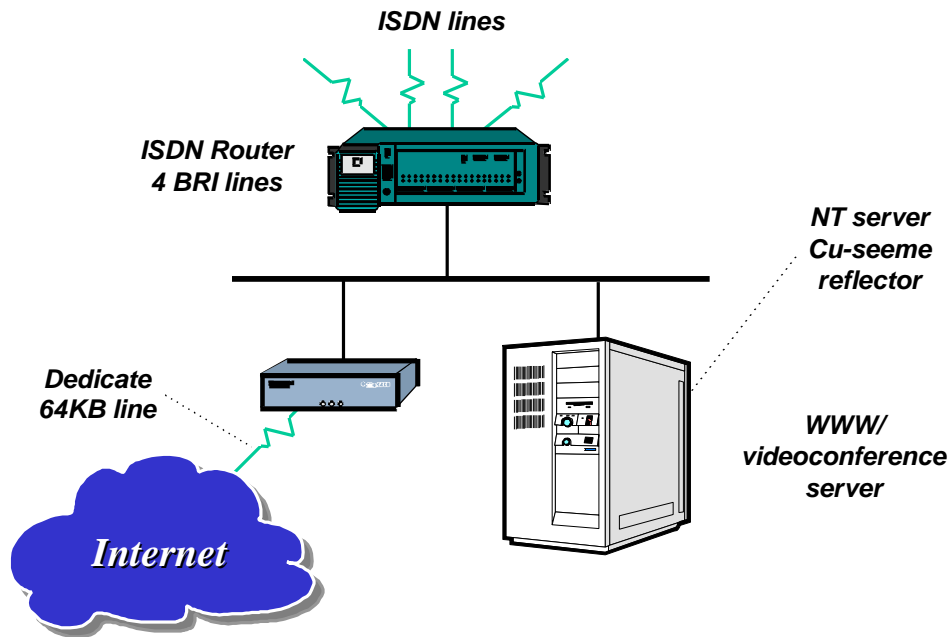


Fig. 5 - Technological infrastructure at Central site

The following picture shows the detailed structure of the technological infrastructure needed at each site willing to have an active role in the workshops.

The technological infrastructure requires the usage of Enhanced CU-Seeme for the video/audio conference and MS-Explorer for the browsing aspects. For sites willing only to act as listeners, the technical infrastructure can be simplified, since there is no need for the Cam-Corder. Other partners will of course need the Cam-Corder for the interactive discussion sessions.

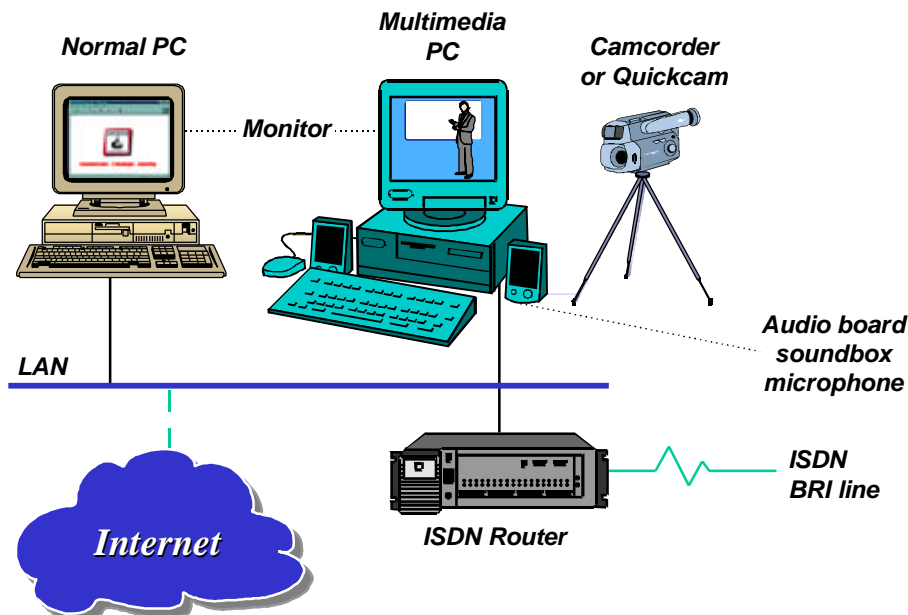


Fig. 6 - Technological infrastructure at each partner site

In order to better understand the correct usage of the EPIC technology infrastructure, the following picture shows the interactions between partners with respect the whole set of activities in which they can be involved during workshops. The figure also shows

the position of the participants from outside the consortium.

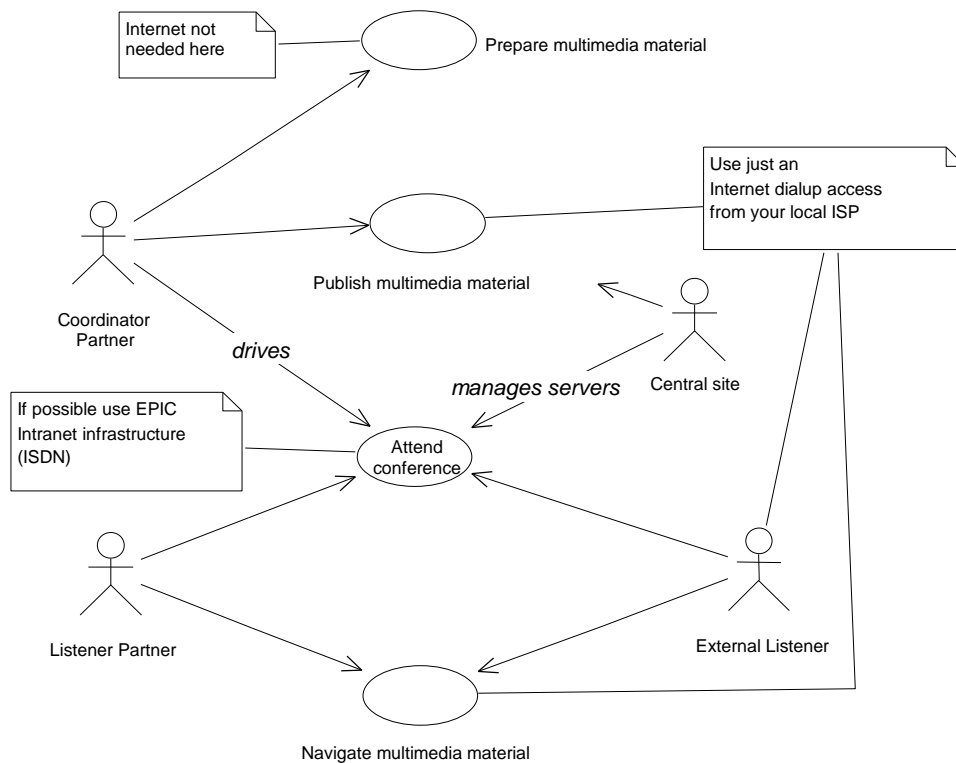


Fig. 7 – Usage of the EPIC technology infrastructure

Looking at the picture, four main use-cases can be identified:

- **preparing multi media material:** in these case neither access to the Internet nor to Intranet is needed because all authoring works can be done “off line” on a local PC. Of course Internet can constitute a valid support when exchanging data and ideas with other people during conference preparation
- **publishing multimedia material:** what is needed in this case is to transfer data from the local PC to the EPIC server. To accomplish this step it can be used a simple Internet connection to a local Internet Services Provider (minimum cost); it is also possible to connect to the EPIC Intranet achieving maximum performances but high costs.
- **attend the conference:** in this case, in order to minimize risks during conferences at partner premises, each EPIC Partner must connect to the EPIC Intranet. The connection will be active just when needed (for an estimated period of 5 hours per workshop). It is relevant to note that it is possible to participate to workshops also from Internet but, in particular for videoconference services, it is not expected to have high performances by using this kind of connection.
- **navigate all conference material:** in this case it must be possible to access multimedia material related to each workshop (both in advance and after). To do this, both Partners and people from their site do not need to access the EPIC Intranet, but can use their standard Internet access.

The most critical case is represented by the running of the workshops. The detailed view is shown in the following figure.

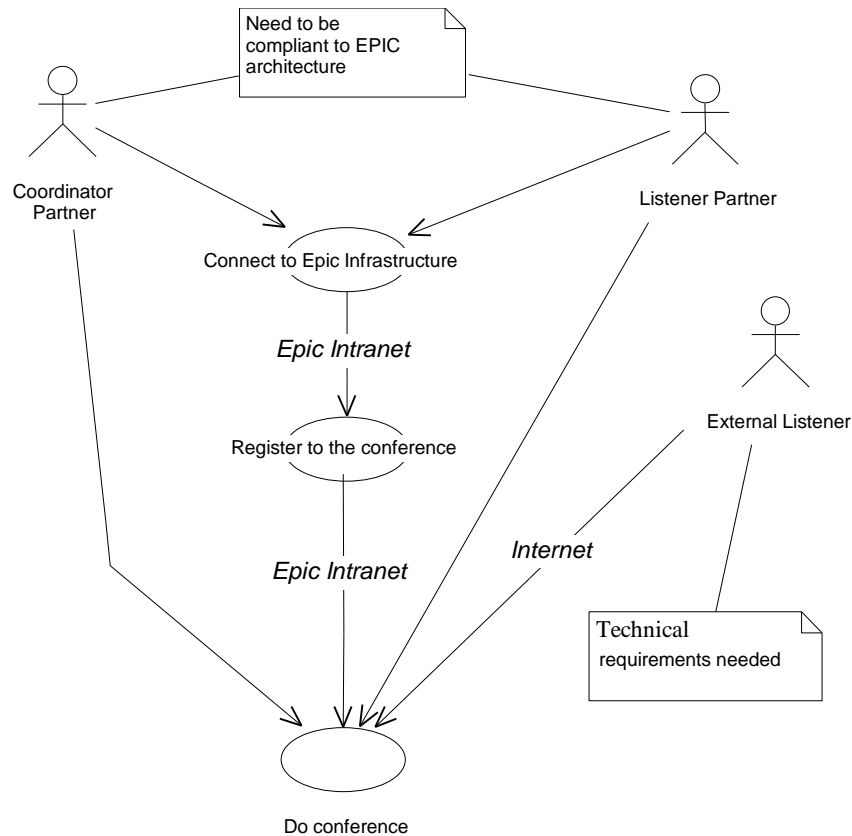


Fig. 8 – Running of workshops

According to what defined, each partner must enter the EPIC Intranet before taking part in a workshop. Note that using "Dial on Demand Routing (DDR)" features, it is possible to minimize the time of ISDN connection, keeping the line up just when needed.

Attendance to EPIC Workshops

Attendance is foreseen in one of the three following means:

- By attending the workshop at premises of one of the EPIC Partners;
- By being connected to the workshop from the company headquarters, using an infrastructure similar to the one used by EPIC Partners in the "listener" mode, thus with a guaranteed quality of service; this possibility is offered without any fee but requires to make agreements with the Project Co-ordinator in advance of the meeting, so that the communication facilities can be prepared accordingly to the needs;
- By being connected to the workshop from the company headquarters, using an Internet connection. In this case no special arrangements have to be made in advance (apart from the communication of the access rules to the URL from which the workshop starts) but of course quality of service cannot be fully guaranteed (especially for video transmission).

At the Project WWW (<http://epic.onion.it/>) such possibilities are explained in more details, together with subscription forms.

Potential for replication and deployment

First of all, we have to stress the importance of the dissemination of best practice experiences to European SMEs. This ought to contribute to a positive influence on the start-up of Process Improvement Projects and thus on the reaching of higher capabilities, resulting in increased competitiveness of the European Industry. From a technical point of view, the approach described in this paper is in no way restricted to the specific application domain chosen for the piloting. As a matter of fact, the working scheme is content-independent and thus can be adopted for distance training and co-operative work on whatever subject of interest. Moreover, the defined architecture is suitable for a number of additional use-cases, among which the following are worth mentioning:

- Outsourcing of communication services, in particular video-conference. In this case the infrastructure set-up in EPIC for audio/ video conferencing services can be offered to third parties for usage under a billing scheme; this is expected to be suitable for companies which do not need an intensive usage of video-conferencing services and thus can find very suitable the renting of “video-conferencing on demand”. From this point of view the ISDN/ Internet scheme which has been set-up in EPIC is very interesting since it does not put severe pre-conditions on the infrastructure of the companies using the service.
- Adoption of EPIC architecture for video-conferencing in the “virtual Enterprise”. In this case the infrastructure set-up in EPIC can be replicated at the headquarters of companies having an intensive need for video-conferencing services and thus willing to replicate at their own headquarters the EPIC Master architecture; this service is expected to be quite appealing considering the economic savings of the EPIC approach with respect to other video-conferencing services currently offered on the market. Notwithstanding, in order to be successful, this service will need a higher quality of service than the one currently planned in EPIC: this does not seem to be a problem since the defined architecture is modular and can take advantage from higher communication speed ensured by “bandwidth on demand”
- Provision of an efficient and flexible source of information dissemination to industry as a supplement to traditional courses and seminars; in this case it is expected that the technology could be used as part of consulting services provided. It derives that the experiences gained with the multi-media conferencing technology will be exploited for other workshops beyond the EPIC events, since the idea of EPIC to have distributed international events one can attend locally is very appealing and is in principle applicable for many other workshops
- Inclusion of video-conferencing service as part of general interest services, using the experiences made with the multi-media conferencing technology for new research in the field of multi-media and Internet systems. For instance a city-information system could combine various local information services among which a conferencing service allowing people to attend e.g. to public city hall sessions or art events etc.
- Usage of EPIC approach for reviews when software development takes place on more than one location (or even country)
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Acknowledgements

We have to thank all the people that directly contributed to the success of the EPIC Project, among which: A. Bollin, G. Deler, J. Hrastnik, A. M. Krebs, R. Kusters, P. Lucas, J. Maniera, A. Mauro, R. Messnarz, A. Ollé, N. Robusté, W. Schaefer, R. Urban, F. Visentin, R. Vodegel, P. Watzke, A. Zuendorf.

We have to thank the European Commission for the financial support given to the EPIC Project (Number 23659), run under the ESSI Initiative as part of ESPRIT Framework IV Programme. We are especially indebted to the Project Officer, Mrs. M. Rohen, for her continuing support.

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