Telematics for Flexible and Distance Learning
(DELTA)

Final Report

An EU Research and Technological Development Programme
(1991 – 1995)
under the STIG Programme
(Systèmes Télématiques d'Intérêt Général)

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I   Foreword

As Europe enters the emerging global information society, new opportunities for transforming lifelong learning and continuing training are beginning to emerge. The convergence of information and communication technologies is enabling the creation of new multimedia telematic applications and services. The European Union has been committed to stimulating these developments since the early 1980s. This preparatory work for the advent of the information society dates from the launch of major research and development programmes on information technologies such as the ESPRIT Programme launched in 1984 and the RACE Programme on advanced communications in 1985. In 1986 the European Commission started the first systematic work on technologies for education and training in the pilot projects which led to the Exploratory Action on DELTA (Developing European Learning through Technology Advance).

These experiences have been carried forward under the area of "Telematics for Flexible and Distance Learning" within the Third Framework Programme which was defined in 1991 with projects running from 1992 until mid 1995. This is the Final Report of this Programme, which is still commonly known as the DELTA Programme. It was partially funded by the European Commission under the STIG Programme (Systèmes Télématiques d'Intérêt Général) within the Directorate-General for Telecommunications, Information Markets and Exploitation of Research (DG XIII).

The purpose of this report is to present the key scientific results achieved by the 30 projects plus the concerted actions and studies, within the Telematics for Flexible and Distance Learning Programme, so that they may be widely disseminated to decision makers, politicians, company managers, public servants, service providers and learning technology consumers. In particular, it is anticipated that this report will be a valuable reference document for all organisations who are involved in the "Education and Training" sector of the new Telematics Applications Programme under the Fourth Framework Programme. It also aims to put the Telematics for Flexible and Distance Learning Programme within the context of present day thinking about developments towards the Information Society and in particular future developments towards learning in an Information Society.

Where possible, the report has been written in a non-technical language, so as to be easily readable by a wide audience. Persons interested in more detailed information about each project should refer to the Annex, which provides a summary of each project and contact points. In addition, there are also a number of other publications including a catalogue of all publications and a "CD-ROM" available from ECOTEC (address overleaf).

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A few words from the Editor

This report has been written on behalf of the European Commission based on information which was made available by the projects and the European Commission up until April 1995. The conclusions have been derived from information provided by the projects and the Education and Training Sector of DG XIII. However, this report does not represent a formal review or evaluation of the Programme.

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II   Executive Summary

This report describes the key results achieved by the 30 projects and the other concerted actions and studies within the Telematics for Flexible and Distance Learning Programme (DELTA). It also aims to put this Programme within the context of future developments towards learning within the European Information Society.

Coming from 12 Member States and 5 EFTA countries, more than 200 organisations participated in this European Commission Programme, of which more than one-third were SMEs – small or medium size private enterprises. Each project consisted of several partners, associate partners, sponsoring partners and sub-contractors, spread over a number of different European countries. The Commission contributed 62 million ecu towards the cost of the projects.

62 million ecu programme involving 200 organisations

The Programme has acted as a catalyst for European co-operation amongst pioneers from many different types of organisations and disciplines. This report describes the key results which have been presented under three main challenges:

■ Improving access to learning facilities

■ Meeting the increasing demand for cost-effective learning solutions

■ Improving quality, defining standards, understanding and stimulating the market.

The Programme has laid the foundations for improving access to learning facilities. It has enabled the creation of a number of networks for specific learner groups. For example, a European-wide network has been established linking 15 existing Training Technology Support Units to increase the access to learning resources for small and medium enterprises. Based on the concept of a virtual European Open University Network, a European-wide integrated telematic network has been established, which by 1996 will be used by over 6000 fee-paying students working from home or from their local EuroStudyCentre. An experimental multimedia teleschool was established involving the delivery through telematic systems of 15 distance learning courses. This involved more than 1400 learners from 60 European companies and institutions within 12 countries. Aspects of this pilot are now being commercially exploited.

Improving access to learning facilities

Positive learning outcomes were observed in these pilot applications, particularly where distance teaching and learning were combined with periodic face-to-face interactions in the form of seminars and residential meetings. As yet, this has tended to support existing social, institutional and pedagogical arrangements, but it does provide the basis for the development of new paradigms for learning.

Successful pilots and prototypes

Prototypes have been developed involving systems integration of commercially available hardware, software and communications systems. These could develop as value added products and stimulate the emergence of an important niche market for customised learning systems, tailored to the needs of a particular training activity.

A number of software tools have been developed which will enable more cost-effective methods to be utilised for the design and production of multimedia learning resources. A cost-effective process has been developed which will allow providers to re-use course learning modules, and a system has been developed to enable tutors to "pick and mix" their own courses and to publish the necessary materials on-demand.

Meeting the increasing demand for cost-effective learning solutions

A number of studies looked at the cost-effectiveness of telematics-based flexible and distance learning. This has created a body of knowledge but has highlighted the complexities of looking at cost-effectiveness in real user environments. There is a need to collect more concrete evidence of cost-effectiveness of advanced technology based training solutions.

Improving quality, defining standards, understanding and stimulating the market

The Programme has provided a focal point for starting to raise awareness of the potential of new technologies in education and training, and has acted as a catalyst for European co-operation amongst pioneers from many different types of organisations and disciplines. Projects have highlighted the complexity of issues which need to be addressed when introducing new technologies into what is still a very traditional environment of education and training. Embedding an innovation into an organisation requires the active involvement of a number of key players – senior management, the computer department, personnel department, training materials developers and training providers. It has also highlighted the cultural, linguistic, pedagogical and organisational issues which have to be addressed in the emerging but diverse European market for technology-based education and training.

A framework for common standards has been established for hardware, software and communications used in learning technologies. This will reduce the possibility of fragmenting the market due to lack of interoperability.

A market observatory study concluded that a European-wide flexible and distance learning market has only recently started to emerge, although the markets in some individual European countries were more developed than others. A survey based on the opinions of European experts predicted that the market is likely to become fully developed within ten years. During this period there is likely to be an increased demand for lifelong learning, a growing acceptance by traditional education and training providers to adopt telematic systems, and increased competition due to deregulation of telecoms which will stimulate new pricing structures and telematic infrastructure development.

Emphasis has been placed on trying to achieve a Europe-wide education and learning system, but it is evident that this "Europeanisation" has not been successful yet. Markets are still predominantly local, regional or national – hence the market for European products and services will still need to be nurtured at a European level.

Whilst experts in a given field are able to come together to co-produce learning materials at the European level, the delivery and support for learners will continue in the main to be provided at a more local level. As education and training provision becomes more "Europeanised", providers will increasingly use technologies to achieve widespread delivery.

Many projects have highlighted the need for proper training in the use of the telematic systems for tutors, students, and other users. This factor was largely underestimated. This training also needs to recognise cultural differences and to adapt the training to local cultures.

Fourth Framework – future focus on large-scale user trials

There is still widespread ignorance of the implications of using telematics in education and training, and scepticism about the benefits. Further demonstrations and validations are needed with a broader user base in order to establish durable education and training service networks. There is a need for broader dissemination activities to encourage the education and training market to really "take off". The Fourth Framework Programme will focus on users in large scale demonstrators and less on research and development of new technologies.

II   Kurze Zusammenfassung

Dieser Bericht beschreibt die wichtigsten Ergebnisse, die in 30 Projekten, gemeinsamen Aktionen und Untersuchungen innerhalb des Telematics for Flexible and Distance Learning Programme – DELTA- (Telematik Programm für flexibles Lernen und Fernunterricht) erzielt wurden. Darüber hinaus wird der Zusammenhang zwischen dem Lernen und der zukünftigen Entwicklung in die Europäische Informationsgesellschaft hergestellt.

Unter den mehr als 200 Organisationen aus 12 Mitgliedsstaaten und 5 EFTA Ländern, die an diesem Programm der europäischen Kommission teilnahmen, waren kleine und mittlere Betriebe zu über 30% vertreten. Jedes Projekt umfaßte Partner, assoziierte Partner, Sponsoren und Subunternehmer in mehreren europäischen Ländern. Die Europäische Kommission stellte für dieses Programm 62 Mil. Ecu zur Verfügung.

62 Millionen ECU Fördermittel bei 200 beteiligten Organisationen

Dieses Programm fungierte als Katalysator für die europäische Kooperation der Pioniere auf dem Gebiet des flexiblen Lernens und des Fernunterrichts. Teilnehmer aus unterschiedlichen Organisationen und Fachdisziplinen waren daran beteiligt. Dieser Bericht beschreibt wir die wichtigsten Ergebnisse unter folgenden Heraus Forderungen:

- ◼ einen besseren Zugang zu Lehrmitteln zu ermöglichen,

- ◼ dem wachsenden Bedarf an kosteneffektiven Unterrichtslösungen zu entsprechen,

- ◼ Qualität zu verbessern, Standards zu definieren, den Markt zu verstehen und zu stimulieren.

Besserer Zugang zu Lernmitteln

Mit Hilfe des Programms wurde der Grundstein für einen besseren Zugang zu Lernmitteln gelegt, denn es ermöglichte die Einrichtung diverser Netzwerke für bestimmte Gruppen von Lernenden. So wurde unter anderem ein europaweites Netzwerk installiert, das 15 bereits bestehende Ausbildungszentren miteinander verbindet und so kleinen und mittleren Unternehmen einen besseren Zugang zu Fernkursen ermöglicht. Auf der Grundlage des Konzepts für das Netzwerk einer virtuellen, europäischen, offenen Universität wurde ein europaweites, integriertes telematisches Netzwerk eingerichtet, das schon 1996 von mehr als 6000 zahlenden Studenten genutzt werden wird, die entweder zu Hause oder in ihrem örtlichen EuroStudienCenter arbeiten. Eine experimentelle Multimedia Teleschule wurde eingerichtet, in deren Rahmen 15 Fernlehrgänge durch telematische Systeme bereitgestellt wurden. Dort lernen in 60 europäischen Unternehmen und Institutionen bereits 1400 Lernende aus 12 Ländern mit Hilfe dieser Systeme. Viele Teile dieses Pilotprojektes werden derzeit kommerziell genutzt.

Erfolgreiche Pilotprojekte und Prototypen

Ein Ergebnis dieses Probelaufs waren positive Lernerfolge insbesondere da, wo Fernunterricht und persönliche Präsenz in Form von Seminaren und Arbeitsgruppen vor Ort miteinander kombiniert wurden. Zwar verstärkt diese Methode noch die vorhandene soziale, institutionelle und pädagogische Organisation von Lernen, sie schafft aber gleichzeitig die Grundlagen für die Entwicklung neuer Paradigmen für Lernorganisation.

Die Prototypen wurden zur Anwendung mit gängiger Hardware, Software und Kommunikationssystemen entwickelt. So können aus ihnen Produkte werden, die entscheidend zum Entstehen einer wichtigen Marktnische beitragen: maßgeschneiderte Lernsysteme, die auf die Bedürfnisse konkreter Ausbildungsaktivitäten zugeschnitten sind.

Auf die wachsende Nachfrage nach kosteneffektiveren Unterrichtslösungen reagieren

Es wurden einige Software Tools entwickelt, die die Erstellung und die Produktion multimedialer Unterrichtsmaterialien kostengünstiger gestalten. Zudem wurde ein sehr wirtschaftliches Verfahren entwickelt, mit dessen Hilfe Kursmodule wiederholt verwendet werden können. Für die Lehrenden gibt es darüber hinaus ein System, das

es Ihnen ermöglicht, ihre Kurse aus dem vorhandenen Material selbst zusammenzustellen und benötigtes Lehrmaterial je nach Bedarf herzustellen.

Es gab einige Untersuchungen bezüglich der Kosteneffektivität im Bereich flexibles Lernen und Fernunterricht. Dies führte zu umfangreichen Erkenntnissen auf diesem Gebiet, aber auch zu der Einsicht, wie komplex die Aufgabenstellung der Messung der Kosteneffektivität in einer konkreten Anwendersphäre ist. Daher besteht ein großer Bedarf die Kosteneffektivität von technologiegestützten Ferunterrichts nachzuweisen.

Qualität verbessern, Standards definieren, den Markt verstehen und stimulieren

Dank dieses Programms ist es gelungen, die Möglichkeiten neuer Technologien in Bildung und Ausbildung stärker ins Bewußtsein zu bringen und die europäische Kooperation von Pionieren auf diesem Gebiet in den verschiedensten Organisationen und Disziplinen zu unterstützen. Die Projekte haben aufgezeigt, wie komplex die Themen sind, die es anzusprechen gilt, wenn man neue Technologien in den nach wie vor sehr traditionellen Bereich von Bildung und Ausbildung einführen will. Solch eine Innovation in einer Organisation zu verankern, erfordert das Zusammenspiel aller: der Geschäftsleitung, der DV Abteilung, der Personalabteilung, derjenigen die das Lehrmaterial entwickeln und den Lehrenden, die es zur Anwendung bringen. Aufgezeigt wurden außerdem die kulturellen, linguistischen, pädagogischen und organisatorischen Themen, die es im aufstrebenden aber sehr vielfältigen europäischen Markt für technologiegestützte Bildung und Ausbildung anzusprechen gilt.

Für Hardware, Sofware und Telematik in der Unterrichtstechnologie wurde ein System allgemeiner Standards erstellt. Dadurch verringert sich die Gefahr von einer Marktfragmentierung durch mangelnde Interoperabilität.

Eine Marktstudie belegte, daß sich der europaweite Markt für flexibles Lernen und Fernunterricht erst in jüngster Zeit stärker entwickelt, wobei einige europäische Länder in diesem Bereich weiter fortgeschritten sind als andere. Laut einer Untersuchung, die sich auf europäische Experten beruft, wird sich dieser Markt innerhalb der kommenden Dekade voll entfalten. In diesem Zeitraum wird die Nachfrage nach lebenslangem Lernen ständig ansteigen; diejenigen, die traditionell in Bildung und Ausbildung tätig sind, werden immer eher bereit sein, telematische Systeme in ihrer Arbeit zu verwenden; der Wettbewerb wird durch die Deregulierung der Telekom Märkte immer schärfer werden und somit zu neuen Preisstrukturen und der Entwicklung telematischer Infrastrukturen führen.

Die Bedeutung eines europaweiten Bildungs- und Lernsystems wurde besonders betont, es ist allerdings offensichtlich, daß die "Europäisierung" in diesem Bereich nicht sehr erfolgreich war. Die Märkte sind nach wie vor überwiegend lokal, regional oder national strukturiert – daher sollte man dem Markt für europäische Produkte und Dienstleistungen auf europäischer Ebene besondere Aufmerksamkeit schenken.

Während die Experten auf europäischer Ebene zusammenkommen und das Lehrmaterial gemeinsam erstellen können, erfolgt die Weitergabe an die Lernenden weiterhin hauptsächlich auf lokaler Ebene. Mit zunehmender Europäisierung von Bildung und Ausbildung werden auch die Kursanbieter sich immer mehr der Telematik bedienen, um eine optimale Verbreitung zu erzielen.

Viertes Forschungsrahmenprogramm – die Zukunft liegt in großangelegten Anwenderversuchen

Viele Projekte haben betont, wie wichtig eine gute Schulung in der Anwendung telematischer Systeme für Lernende und alle anderen Anwender ist. Dieser Faktor war stark unterschätzt worden. Eine solche Schulung muß kulturelle Unterschiede berücksichtigen und die Lehrmaterialien den örtlichen Gegebenheiten anpassen.

Nach wie vor wissen die wenigsten um die Bedeutung der Telematik für Bildung und Ausbildung, und viele sind skeptisch, was die erhofften positiven Auswirkungen betrifft. Es bedarf weiterer praktischer Beispiele und Nachweise auf einer breiteren Anwenderbasis, um dauerhafte Dienstleistungsnetzwerke für Bildung und Ausbildung zu etablieren. Es gibt einen großen Bedarf, die Telematik im Lern- und

II   Synthèse

Ce rapport présente les principaux résultats des 30 projets, "actions concertées" et études menés dans le cadre du Programme "Télématique pour l'éducation flexible et à distance" (DELTA). Il vise aussi à analyser le Programme dans le contexte des développements futurs de l'enseignement au sein de la société européenne de l'information.

Plus de 200 organisations, dont plus du tiers est constitué de P.M.E. (Petites et Moyennes Entreprises), et provenant des 12 Etats membres et de 5 pays de l' AELE, ont participé à ce Programme de la Commission Européenne. Chaque projet comprenait plusieurs partenaires, ainsi que des partenaires associés, des partenaires-sponsors et des sous-contractants, en provenance de divers pays européens. La Commission participa au Programme à concurrence de 62 millions d'écus.

un programme de 62 millions d'écus impliquant 200 organisations

Le Programme joua un réel rôle de catalyseur pour la coopération européenne agrégant des acteurs très diversifiés en terme de type d'organisation ou de disciplines.

Ce rapport décrit les principaux résultats que l' on peut regrouper autour de trois défis majeurs:

■   l' amélioration de l'accès aux ressources d'enseignement

■   la rencontre de la demande croissante de solutions d'enseignement rentables

■   l' amélioration de la qualité, la définition de standards, la compréhension et la stimulation du marché.

Le Programme a créé les conditions d'un meilleur accès aux ressources d'enseignement. Il a favorisé la création d'un certain nombre de réseaux dédiés à des groupes spécifiques d'apprenants. Par exemple, un réseau européen reliant 15 centres de ressources en technologie de la formation (Training Technology Support Units) a été créé afin d'accroître l'accès aux ressources de formation pour les P.M.E. Fondé sur le concept d'une Université Européenne Ouverte en réseau, un réseau télématique intégré a été lancé pour être utilisé dès 1996 par plus de 6000 étudiants payants. Ces étudiants seront reliés au réseau à dimension européenne à partir de leur domicile ou d'euro-centres locaux dédiés à la formation (les "EuroStudyCenters"). Une école multimédia a aussi été expérimentée. Elle a diffusé 15 cours d'enseignement à distance à l'aide de systèmes télématiques et a impliqué plus de 1400 apprenants de 60 entreprises et institutions européennes situées dans 12 pays. Des éléments de cette expérimentation sont maintenant exploités commercialement.

améliorer l'accès aux ressources d'enseignement

Ces applications pilotes ont produit des résultats positifs, particulièrement dans les situations où l'enseignement et la formation à distance étaient combinés avec des rencontres périodiques menées sous forme de séminaires ou de réunions. Ainsi ces résultats tendent à renforcer le rôle des dispositifs sociaux, institutionnels et pédagogiques existants tout en proposant les fondements de nouveaux paradigmes d'apprentissage.

succès d'actions pilotes et de prototypes

 Des prototypes intégrant des produits matériels et logiciels ainsi que des systèmes de communication déjà commercialisés ont été développés. Ces prototypes pourront devenir des produits à valeur ajoutée et par conséquent stimuler l'émergence d'un important marché-niche de systèmes d'apprentissage sur mesure, systèmes de formation taillés selon les besoins de chacun.

Un certain nombre de didacticiels qui permettront le développement de méthodes plus rentables pour la conception et la production de ressources d'apprentissage multimédia ont également été développés. Le Programme a aussi engendré un système rentable de réutilisation des modules de cours et un système d'assemblage ("pick and mix") de documents pour préparer et publier des cours personnalisés et à la demande.

à la rencontre d'une demande croissante pour des solutions rentables

Un certain nombre d'études se sont penchées sur la rentabilité de l'enseignement flexible et à distance utilisant la télématique. Un fond de connaissances en la matière a ainsi été créé, qui souligne d'ailleurs la complexité d'analyser la rentabilité dans un environnement d'usagers réels. Il est nécessaire de poursuivre la collecte d'informations plus concrètes sur la rentabilité des solutions d'apprentissage utilisant les technologies avancées.

améliorer la qualité, définir des standards, comprendre et stimuler le marché

Le Programme fut un lieu de sensibilisation aux potentialités des nouvelles technologies dans l'éducation et la formation et un catalyseur de la coopération européenne entre les pionniers types d'organisations et de disciplines très diversifiés. Des projets ont souligné la complexité des questions qu'il est nécessaire de poser et de résoudre lorsque sont introduites des technologies nouvelles dans un environnement qui demeure encore très traditionnel. Insérer une innovation dans une organisation requiert l'implication active d'un nombre certain d'acteurs clés tels que ceux des diverses directions de l'organisation, de l'informatique, des ressources humaines ainsi que les développeurs de produits d'apprentissage et les fournisseurs de formation. Le Programme a aussi souligné les divers aspects culturels, linguistiques, pédagogiques et organisationnels qu doivent être pris en compte dans ce marché européen naissant de l'éducation et de la formation utilisant les nouvelles technologies.

Un cadre pour des standards communs a aussi été établi pour le matériel, le logiciel et les télécommunications utilisés pour l'enseignement. Il réduira la fragmentation du marché occasionnée par le manque d'inter-opérabilité.

Une étude d'observation du marché a conclu que le marché européen de l'éducation flexible et à distance a seulement émergé récemment bien que les marchés soient plus développés dans certains pays européens que dans d'autres. Une étude fondée sur les opinions d'experts européens conclut que le marché se sera probablement complètement développé dans une dizaine d'années. Durant cette période l'on devrait assister à un accroissement de la demande pour la formation continue, une acceptation croissante des systèmes télématiques par les acteurs traditionnels de l'éducation et de la formation et une compétition accrue due à la dérégulation des télécommunications qui va modifier la structure des coûts de communication et stimuler le développement des infrastructures télématiques.

Le Programme a insisté sur l'européanisation des systèmes éducatifs et de formation, mais cette volonté n'a pas encore rencontré tout le succès escompté. Les marchés demeurent avant tout locaux, régionaux ou nationaux et le marché de produits et services européens nécessitera encore d'être soutenu au niveau européen.

Bien que les experts dans des domaines donnés soient capables de s'unir pour co-produire des produits européens de formation, la diffusion des produits et le soutien des apprenants continueront à être principalement de nature locale. Comme l'éducation et la formation sont de plus en plus "européanisées", les fournisseurs vont utiliser de plus en plus les technologies pour une diffusion élargie.

Beaucoup de projets ont souligné la nécessité de proposer aux formateurs, étudiants et autres utilisateurs une formation à l'utilisation des systèmes télématiques de qualité. Cette question avait été largement sous-estimée.Une telle formation devra aussi prendre en compte les différences culturelles et devra s'adapter aux pratiques locales.

Quatrième Programme – insister sur les expérimentations impliquant de nombreux usagers

Il demeure encore beaucoup d'ignorance sur les implications de l'usage de la télématique sur l'éducation et la formation et beaucoup de scepticisme quant aux bénéfices à attendre. Des démonstrations et des systèmes de validation plus poussés sont nécessaires. Ils doivent se fonder sur des groupes d'usagers plus larges afin de créer des réseaux durables de services en éducation et formation. Il est nécessaire de renforcer et élargir la dissémination des résultats pour aider le marché de l'éducation et de la formation à croître. Le Quatrième Programme Cadre mettra plus l'accent sur les démonstrations à grande échelle et impliquant de nombreux usagers et insistera

II Sommario Esectivo

Questo sommario descrive i risultati chiave ottenuti dai 30 progetti e le altre azioni e studi concertati nell'ambito del Programma Telematica per l'apprendimento a distanza (DELTA). Il rapporto ha anche l'obiettivo di indirizzare questo programma relativamente agli sviluppi futuri relativi all'insegnamento previsti dalla Societa dell'Informazione.

Più di 200 organizzazioni, provenienti da 12 stati membri e 5 paesi EFTA, hanno partecipato a questo programma della Commissione Europea. Per circa un terzo di esse, si trattava di piccole o medie imprese. Ogni progetto comprendeva diversi partners in alcuni paesi europei. La Commissione ha contribuito per 62 milioni di ECU al costo del programma.

Un programma di 62 milioni di ECU comprendente 200 organizzazioni

Il programma ha agito come catalizzatore per promuovere la cooperazione Europea tra organizzazioni provenienti da diversi settori e discipline. Questo sommario descrive i risultati chiave presentati sotto forma di tre obiettivi principali:

- Migliorare l'accesso all'insegnamento

- Rispondere alla crescente domanda di diminuire i costi per l'insegnamento

- Migliorare la qualità, stabilire i livelli, comprendere e stimolare il mercato

Il programma ha posto le fondamenta per il miglioramento dell'accesso all'insegnamento, e ha reso possibile la creazione di alcune reti per gruppi specifici di allievi. Per esempio è stata creata una rete Europea che unisce i 15 Gruppi di Supporto per la Formazione Tecnologica esistenti, col fine di aumentare l'accesso delle piccole e medie imprese alle risorse per l'apprendimento. Si è inoltre provveduto a sviluppare una rete telematica integrata diffusa su tutta l'Europa, basata sul concetto di una rete virtuale di Università a Distanza Europee. Entro il 1996 tale rete sarà usata da oltre 6000 studenti paganti, che vi accedono da casa o dal loro Eurocentro locale. Una scuola a distanza multimediale sperimentale è stata inoltre organizzata per l'erogazione, attraverso sistemi telematici di 15 corsi di apprendimento a distanza. Questo ha coinvolto piu di 1400 allievi da 60 organizzazioni in 12 nazioni diversi. Alcuni aspetti di questo corso vengono ora sfruttati commercialmente.

Migliorare l'accesso all'insegnamento

In questi corsi sono stati riscontrati positivi risultati per quanto riguarda l'apprendimento, particolarmente dove l'insegnamento a distanza e l'apprendimento erano combinati con periodici incontri con tutor locali. Tutto ciò fornisce la base per lo sviluppo di nuovi modelli esemplari di apprendimento.

Corsi e prototipi

Alcuni prototipi sono stati sviluppati, relativamente a sistemi per l'integrazione di software e hardware commercialmente disponibili e sistemi di comunicazione. Questi potrebbero svilupparsi sotto forma di prodotti a valore aggiunto, sviluppati per stimolare l'esigenza di apprendimento e per i bisogni di una particolare attività di formazione.

Un grande numero di strumenti software sono stati sviluppati, al fine di rendere possibili ulteriori metodi, relativi alla convenienza economica per la progettazione e la produzione di risorse di apprendimento multimediale. E' stato sviluppato un processo per rendere i costi efficaci e che permetterà ai fornitori di riusare i moduli dei corsi d'apprendimento.

Andare incontro alla crescente domanda di convenienza economica per l'insegnamento e le relative soluzioni

Alcuni studi hanno analizzato la convenienza economica dei costi relativi all'insegnamento flessibile e a distanza. Ciò ha creato un insieme di conoscenze, ma ha messo in rilievo le complessita dell'analisi della convenienza economica per gli utenti reali. C'e bisogno di raccogliere maggiore evidenza della convenienza economica della formazione basata sull'utilizzo delle tecnologie.

Migliorare la qualità, stabilire i livelli, capire e stimolare il mercato

Il Programma ha fornito un punto focale nello stimolare la consapevolezza della potenzialità di nuove tecnologie nell'istruzione e nella formazione e ha agito da catalizzatore per una cooperazione Europea tra partecipanti provenienti da diverse organizzazione e discipline. I progetti hanno messo in rilievo la complessità degli argomenti che hanno bisogno di essere affrontati quando si introducono le nuove tecnologie in un ambiente tradizionale di educazione e formazione. Introdurre una innovazione dentro una organizzazione richiede un coinvolgimento attivo da parte di figure chiave – i manager più esperti, il centro informatico, l'ufficio personale, i progettisti dei materiali necessari alla formazione e i fornitori della formazione. Il Programma ha anche messo in rilievo gli aspetti culturali, linguistici, pedagogici e organizzativi che debbono essere indirizzati nell'emergente, ma ancora con grandi differenze a livello dei singoli stati membri, mercato europeo dell'istruzione ed educazione basato sulla tecnologia.

Un quadro standard è stato stabilito per hardware, software e comunicazioni usati nelle tecnologie per l'apprendimento. Questo ridurrà la possibilità di frammentazione del mercato dovuto alla mancanza di cooperazione.

Uno studio di mercato ha concluso che un mercato per l'apprendimento a distanza in Europa è appena agli inizi, nonostante che i mercati in alcuni paesi Europei siano piu sviluppati di altri. Una ricerca basata sulle opinioni di esperti Europei ha previsto che il mercato probabilmente sarà pienamente sviluppato entro 10 anni. Durante questo periodo probabilmente ci sarà una domanda crescente per l'apprendimento per l'intera durata della vita, un crescente consenso da parte dei fornitori di formazione nell'adottare sistemi telematici e un incremento della competizione dovuto alla deregolamentazione dei servizi di Telecomunicazione, che stimolerà l'abbassamento dei prezzi e lo sviluppo di strutture telematiche. L'enfasi del Programma è stata posta nel cercare di ottenere un sistema di apprendimento e di istruzione valido in tutta l'Europa, ma è evidente che questa Europeizzazione non è stata ancora un pieno successo. I mercati sono ancora principalmente locali, regionali o nazionali: da ciò deriva che il mercato per i prodotti e i servizi trans-europei deve ancora essere sostenuto a un livello Europeo.

Ormai gli esperti in un dato campo hanno facilità ad unirsi per co-produrre materiali di apprendimento ad un livello Europeo, mentre l'erogazione e il supporto per gli allievi continuerà principalmente ad essere fornito a livello locale. Mentre l'istruzione e la formazione diventano maggiormente Europei, i fornitori useranno tecnologie meglio erogare i corsi. Molti progetti hanno messo in rilievo il bisogno di una reale formazione all'uso dei sistemi telematici per insegnanti, studenti e altri utenti. Questa formazione ha anche bisogno di riconoscere differenze culturali e adattare la formazione a culture locali.

Quarto Programma Quadro – futuro interesse per gli utenti

C'è ancora una diffusa ignoranza sull'uso della telematica nell'educazione e nella formazione e scetticismo relativamente ai benefici. Ulteriori dimostrazioni e convalide sono richiesti, con una utenza più ampia, al fine di stabilire una rete stabile di servizi per l'educazione e la formazione. C'è bisogno di una maggiore attività di diffusione per incoraggiare il mercato dell'educazione e della formazione e avere un vero e proprio trampolino di lancio. Il quarto Programma Quadro sarà maggiormente centrato sugli utenti e meno sulla ricerca di nuove tecnologie.

II   Resumen Ejecutivo

El presente informe describe los principales resultados alcanzados por los 30 proyectos, y estudios y Acciones Concertadas llevados a cabo dentro del Programa de Telemática para la Formación Flexible y a Distancia (DELTA). Asimismo, tiene como objetivo situar dicho Programa en el contexto de los desarrollos futuros en materia de Formación encaminados a la consecución de la Sociedad Europea de la Información.

En este Programa de la Comisión Europea han participado más de 200 organizaciones, pertenecientes a 12 Estados Miembros y 5 países de la AELC (Asociación Europea de Libre Cambio), de las cuales un tercio han sido Pequeñas y Medianas Empresas (PYMES). Los proyectos han estado compuestos por socios, socios asociados, socios patrocinadores y subcontratados de distintos países europeos. La Comisión ha financiado 62 millones de ECU sobre el coste total de ejecución de los proyectos.

Programa de 62 millones de ECU, con participación de 200 organizaciones

El Programa DELTA sin duda ha actuado como catalizador de la cooperación a nivel europeo entre investigadores pioneros provenientes de diferentes disciplinas y organizaciones. El presente informe describe los resultados que esta colaboración ha generado en torno a tres retos fundamentales, que constituyen los ejes del Programa:

- Cómo mejorar el acceso a la Formación
- Cómo afrontar la creciente demanda de soluciones rentables de Formación
- Cómo mejorar la calidad, definir estándares, e interpretar y estimular el mercado.

El Programa ha sentado las bases para mejorar el acceso a la formación a través de la creación de redes para grupos específicos de alumnos, tales como por ejemplo una red Pan-Europea de 15 Unidades de Apoyo a la Formación con Tecnologías destinada a mejorar el acceso a recursos formativos de las PYMES. En otro de los casos, a partir del concepto de lo que podría ser una Universidad Abierta Europea virtual, se ha puesto en marcha una red telemática integrada a nivel europeo, que en 1996 contará con más de 6000 alumnos matriculados que trabajarán desde sus hogares o centros locales (EuroStudyCentres). Asimismo, se ha creado una "teleacademia multimedia", a través de la cual se han distribuido y llevado a cabo 15 cursos por vía telemática, en los cuales han participado más de 1400 alumnos de 60 empresas e instituciones en 12 países diferentes. Algunos de estos servicios están comenzando a comercializarse en la actualidad.

Mejorar el Acceso a la Formación

Todas estas experiencias piloto han arrojado resultados muy positivos, sobre todo en los casos en que se ha complementado la distancia con acciones presenciales, tales como seminarios o talleres residenciales. Estas combinaciones de diferentes modalidades de formación indudablemente van a generar nuevos paradigmas de aprendizaje, aunque por el momento se hayan utilizado como una simple forma de mantenimiento de estructuras sociales, institucionales y pedagógicas ya existentes.

El desarrollo de experiencias y prototipos ha arrojado resultados positivos

Se han desarrollado asimismo prototipos en los que se ha probado la integración de hardware, software y sistemas de comunicación disponibles comercialmente, que pueden evolucionar hasta convertirse en productos de valor añadido y así estimular la generación de un importante nicho de mercado de sistemas "a medida", adaptados a las necesidades de actividades de formación particulares.

Se han desarrollado un conjunto de herramientas de software que permitirán el diseño y producción de recursos multimedia utilizando metodologías más rentables. En concreto, se ha desarrollado un procedimiento optimizado que permitirá la reutilización de módulos formativos, así como un sistema que permite a los tutores generar sus propios cursos y publicar los materiales a medida de los requisitos de cada situación.

Afrontar la creciente demanda de soluciones rentables de Formación

Diferentes estudios han analizado la rentabilidad y relación coste-beneficio de los sistemas de formación con soporte telemático. Con ello se ha generado un cuerpo de

conocimientos sobre el tema, al tiempo que se ha puesto de manifiesto la enorme complejidad de investigar este tipo de variables en entornos de usuarios reales. En este sentido, se necesita un mayor número de evidencias de rentabilidad y relaciones coste-beneficio positivas en soluciones de formación apoyadas en tecnologías avanzadas.

Mejora de la calidad, definición de estándares, e interpretación y estimulación del mercado

El Programa ha proporcionado un punto de partida para la toma de conciencia del potencial que las nuevas tecnologías ofrecen en el campo de la educación y la formación, y ha actuado como catalizador de la cooperación europea entre investigadores provenientes de distintos campos y organizaciones. Los projectos han resaltado la complejidad de analizar todas las variables implicadas en el proceso de introducción de tecnologías en lo que todavía son entornos de aprendizaje tradicionales. Dicho proceso implica necesariamente la participación activa de un buen número de actores clave: gestores estratégicos, centros de cálculo, departamentos de personal, productores y distribuidores de materiales, etc. A lo largo del Programa se han visto resaltados también los aspectos culturales, lingüísticos, pedagógicos y organizativos que deben tenerse en cuenta en el naciente, pero al mismo tiempo diversificado, mercado de las tecnologías aplicadas a la formación.

Se ha establecido un marco de referencia de estándares de hardware, software y comunicaciones utilizados en el campo educativo, lo cual reduce las posibilidades de fragmentación del mercado que podría causar la falta de interoperatividad.

Un estudio de observación realizado asimismo dentro del Programa concluyó que el mercado trans-europeo de formación flexible y a distancia está tan sólo despuntando en estos momentos, aunque existen diferencias de desarrollo entre los distintos países. Una encuesta basada en la opinión de expertos europeos ha arrojado la predicción de que el mercado podría estar consolidado en los próximos diez años. Durante todo este período se espera que se produzca una demanda creciente de formación continua y educación permanente, una progresiva adopción de las tecnologías por parte de los proveedores de educación y formación, y un aumento en la competitividad debida a la desregulación de las telecomunicaciones que estimulará nuevas políticas de precios y nuevos desarrollos de infraestructura telemática.

A pesar del gran énfasis puesto en la consecución de un sistema de educación y formación transeuropeo, resulta evidente que esta "Europeización" no se ha conseguido por el momento. Los mercados son fundamentalmente locales, regionales o nacionales; por ello el mercado europeo de productos y servicios ha de generarse y alimentarse precisamente a nivel transnacional.

Aunque los expertos de un mismo campo en diferentes países pueden ya trabajar juntos y co-producir materiales a nivel europeo, la distribución de dichos materiales y el apoyo a los alumnos continuará siendo predominantemente de tipo local. A medida que se vaya produciendo este proceso de europeización de la formación, sin embargo, los distribuidores incorporarán progresivamente tecnologías para obtener una cobertura más amplia.

Muchos proyectos han señalado la necesidad de proporcionar una formación adecuada en el uso de los sistemas telemáticos a alumnos, tutores y otros usuarios, aspecto éste que ha sido muy subestimado. Esta formación debe considerar las diferencias culturales y por tanto adaptarse a las culturas locales.

El Cuarto Programa Marco – Enfoque futuro hacia pruebas con usuarios a gran escala

Existe todavía un gran nivel de desconocimiento sobre las implicaciones del uso de la Telemática en educación y Formación, y no menos escepticismo sobre sus beneficios. Se requieren, por tanto, demostraciones y validaciones de aplicaciones más extensas y con mayores números de usuarios para consolidar redes de servicios en este campo. Por otra parte, se precisan más acciones de difusión que estimulen el despegue final del mercado. En este sentido, el Cuarto Programa Marco hará un menor hincapié en investigación y desarrollo en nuevas tecnologías, a favor de un enfoque en los usuarios que se reflejará sobre todo en demostradores a gran escala.

1 Learning in the Information Society

Information and communication technologies are bringing about a new industrial revolution based on information. These technologies and the advances of digital electronics are now allowing the creation of new multimedia telematic services and applications which combine sound, image and text and for which all means of communication – telephone, facsimile, television and computers – are used in a complementary way. The development of these new means of communication represents an element of increased competitiveness for enterprises and opens up new perspectives in terms of work organisation, job creation and learning opportunities. The diffusion of these new technologies at all levels of economic and social life is thus gradually transforming our society into an "information society".

The European Union has been committed to this path since the beginning of the 1980s. The preparatory work for the advent of the information society dates from the launch of major research and development programmes on information technologies such as the ESPRIT Programme (launched in 1984), the RACE Programme on advanced communications (1985) and the first three programmes on telematic applications (launched in 1986): AIM (health care), DRIVE (road transport) and DELTA (distance learning). All these programmes have been extended in the Fourth Framework Research & Development Programme. The policies implemented since 1987 in the fields of telecommunications and, more recently, the audio-visual sector, are also involved in this dynamic development.

EU commitment to the Information Society

In 1993 the Commission's White Paper on "Growth, competitiveness and employment: the challenges and ways for entering into the 21st century",[1] emphasised the significance of this evolution towards the information society for the future of Europe. It stressed the importance and urgency of developing a Pan-European information infrastructure to help revive European economic growth and competitiveness and to create new markets and jobs.

"Growth, competitiveness and employment"

The White Paper considered that education and training have a key role to play in stimulating growth and restoring competitiveness. But, in a society based far more on the production, transfer and sharing of knowledge than on trade in goods, access to theoretical and practical knowledge must necessarily play a major role. As 80% of the European labour force of the year 2000 are already now in the labour market, all measures must be based on developing systematic lifelong learning and continuing training. This will involve more flexible and more open systems of training, including the use of new decentralised multi-media training tools.

Following the White Paper, a high-level group of experts were asked to present a report on the information society and to suggest concrete measures for its implementation. The report "Europe and the global information society: Recommendations to the European Council"[2] which was presented to the

"Europe and the global information society"

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[1] "Growth, competitiveness and employment: the challenges and ways for entering into the 21st century" – White Paper, European Commission, 1994

[2] "Europe and the global information society: Recommendations to the European Council" – The Bangemann Report, 1994

European Council at Corfu in June 1994, emphasised the urgency of Community action to ensure that European enterprises remain competitive internationally. The report highlighted the need to speed up the process of telecom liberalisation while, at the same time, maintaining a universal service for all. It also specified that financing information infrastructure is mainly the responsibility of the private sector. However, it was seen as the task of the European Union and its Member States to create a coherent statutory framework to avoid the circulation of information being impeded by different national regulations.

In order to create a virtuous circle of supply and demand, the report considered that a significant number of market testing applications based on information networks and services should be launched across Europe to create a critical mass. Ten initiatives aimed at demonstrating the feasibility and usefulness of new telematic applications were proposed – teleworking, distance learning, networks between universities and research centres, telematic services for SMEs, road traffic management, air traffic control, health networks, computerisation of invitations to tender, trans-European networks of government authorities and urban information superhighways.

Distance Learning – Life long learning for a changing society

What should be done?

Promote distance learning centres providing courseware, training and tuition services tailored for SMEs, large companies and public administrations. Extend advanced distance learning techniques into schools and colleges.

Who will do it?

Given the required network tariffs at competitive prices, industry will set up new service provider companies to supply distance learning services for vocational training. European Commission should support quality standards for programmes and courses and help create a favourable environment. Private sector providers and public authorities will enter the distance education market, offering networked and CD-I and CD-ROM interactive disk based programming and content at affordable prices.

Who gains?

Industry (specially SMEs) and public administrations, by cost reductions and optimisation of the use of scarce training and education resources. Employees needing to upgrade their skills by taking advantage of lifelong learning programmes. People tied to the home and in remote locations. Students accessing higher quality teaching.

Issues to watch?

Need to engage in a major effort to train the trainers and expand computer literacy among the teaching profession.

What target?

Pilot projects in at least 5 countries by 1995. Distance learning in use by 10% of SMEs and public administrations by 1996. Awareness campaigns among the professional associations and education authorities.

Taken from "Europe and the global information society"

As well as distance learning, there are four other application areas which could be of relevance to enhancing learning through telematic systems. The promotion of "Teleworking" in homes and satellite offices and "City Information Highways" providing large numbers of households with networked access to multimedia services increase the opportunities for the same systems being used for flexible and distance learning. Equally, the promotion of the widest possible use of telematic services for SMEs also increases their potential use for flexible and distance training through

"learning on demand" and "just in time learning". In addition, the Report also recommends that 30% of European universities and research centres should be linked through advanced communications networks by 1997.

The IRDAC Report "The Challenge to European Education: Unlocking Europe's Human Potential",[3] published in 1994, considered that "for Europe's economy to remain competitive and maintain the prosperity of its citizens, the only valid response is innovation and quality. Education and training systems have a central responsibility in this matter and must react flexibly and appropriately to the changing economic environment." It also recognised the need for preparing people and society for a lifetime of learning and to make sure that industry and education deliver fast and flexible responses to new demands. IRDAC welcomed the actions under way in various European Programmes but observed that important obstacles still need to be removed, in particular the complete lack of standardisation, the high unit cost of multimedia training products, the inadequate teaching and learning experience regarding their effective use and the insufficient user-friendliness and attractiveness of such packages and systems.

In 1990 IRDAC[4] had recommended that a large structural effort in distance and flexible learning was required in Europe and that new technology should be used in the production and delivery of training materials to allow for individualised learning and to increase the efficiency of the training process. The 1994 report considers that:

> "new technological developments have raised immense expectations in the training area. Numerous initiatives have been taken to train people through non-traditional means, now commonly referred to as multimedia. But take-up has so far been limited, partly due to the lack of maturity of the technology until now. Expectations of substantially increased learning speed, as initially hoped for, were often not met and costs have often been under-estimated.

> However, multimedia has a strong potential for increasing the attractiveness of training, raising learner motivation, and even increasing the 'entertainment value' of training and so maintaining the trainee's attention. But, in reality, these possibilities appear still somewhat underdeveloped."

Despite some of these critical comments on distance learning and multimedia, IRDAC believes that there is a lot of potential for further growth provided that flexible learning approaches become even more responsive and tailored to customer needs. Developments in this area should be demand-driven and not supplier-led, which it considered had been the cause of failures in the past. Regrettably, most European education institutions have so far largely abstained from these developments. Partly this attitude relates to unsuccessful experiences; more often it has to do with ignorance about the many new learning opportunities available, which are increasingly cost-efficient and effective. Development of flexible learning also requires skills and infrastructure which traditional universities do not possess.

[3] "The Challenge to European Education: Unlocking Europe's Human Potential" IRDAC Report 1994

[4] Opinion on Skills Shortages in Europe, IRDAC, 1990

"The Challenge to European Education: Unlocking Europe's Human Potential"

"Multimedia has a strong potential for increasing the attractiveness of training"

What is "needed is an open attitude to the context, models and types of education and training which will be best adapted to the increased and changing learning demands of the future. Moreover, for Europe to gain a prominent place on the fast growing flexible education and training market, – where the direct competition, e.g. from the USA, is increasing every day – European higher education institutions must be more receptive to and involved in flexible learning methods and technologies, investigate its effectiveness and cost-efficiency, and provide this promising market with graduates that have the combined educational and technological competence."

Extract from the section of the IRDAC Report "The Challenge to European Education: Unlocking Europe's Human Potential"

In February 1995 the G7 members along with the European Commission decided to take the opportunity offered by the Ministerial Conference on the Information Society being held in Brussels to identify a number of selected projects where international co-operation could be an asset. Eleven joint pilot projects were launched aimed at promoting awareness and demonstrating the potential of new applications for human progress. One of these activities involved cross-cultural education and training.

As one of the concluding remarks of the G7 Ministerial Conference, the Chair stated that:

> "the knowledge-based economy demands greater openness and creativity in schools and universities, and the acquisition of new skills and adaptability through life-long training. An open approach to education that combines local and national cultures and promotes mutual understanding between our citizens is required. Access must therefore be tackled at its roots by providing citizens with the tools to learn in an information society. Advanced multimedia information services can meet such requirements whilst complementing and enriching the traditional education and training systems."

Against this background of emerging policy developments and recommendations, the Telematics for Flexible and Distance Learning Programme has been actively conducting research and development and pilot experiments. Involving co-operation between many European organisations, a body of knowledge and expertise for the utilisation of telematics for flexible and distance learning has been accumulated in this rapidly developing field. Future developments which emerge from the latest policies should take note of lessons learnt and should build upon the experiences gained within this Programme. This report aims to disseminate widely that knowledge and know-how.

"The provision of high quality education and training for all citizens is the key to economic and cultural development. The Information Society will bring about a revolution in the way we live, work and learn. In education and training this revolution will necessitate greater openness and creativity in schools, new approaches and methodologies in universities and new ways of providing training and skills updating in the workplace. In addition the Information Society will bring about new challenges, as the world becomes the global village and traditional boundaries disappear, there will be an even greater need for understanding and co-operation."

Introductory statement referring to the G7 Pilot project "Cross-Cultural Education and Training in the Global Information Society"

2   Telematics for Flexible and Distance Learning

In 1986 the European Commission started the first systematic work on technologies for education and training in the pilot projects which in time led to a decision in the European Council on an Exploratory Action on DELTA (Developing European Learning through Technology Advance). At this time the work was focussed on the development of applications specific to teaching and learning, in other words a technology-led Programme. The objective was to identify the most promising technologies for production, distribution, and reception.

In the life span of the Programme, however, it became clear that specific purpose-built workstations and/or software suites were not going to be taken up by the education and training market. The most successful applications identified were multi-purpose hardware and software systems. The technology to provide solutions for education and training market was already there: what was needed to boost the market and to make R&D effective was, on the one hand, definition of standards – to minimise the risk involved in developing courseware and services – and on the other, that more emphasis should be given to pilot experiments – in order to give more insight into cost-effective ways to deliver training using the new media.

These experiences have been carried forward under the Telematics for Flexible and Distance Learning Programme, within the third Framework Programme, which was defined in 1991. Project work started in 1992 and is due to be completed by mid 1995. The unifying concept in this phase of the Framework Programme has been the European Infrastructure for Flexible and Distance Learning. The projects have converged towards this goal in two ways. They have aimed at creating effective distribution systems for increasing access to distance learning by using the advances in telecommunication networks. Or, they have aimed to develop cost effective tool kits and applications to create interactive learning environments like the use of simulation. The concept behind both ways is that the learner should be inspired to learn, be brought back in control of the learning situation and have access to education and training resources when and where required in the most appropriate form for the learning purpose. This is the final report of this Programme which aims to draw together its key results and overall conclusions.

The European Commission's Third Framework Programme of Research and Development had three areas covering information technology and telematic technologies:-

> ESPRIT – aiming to generate new advanced "basic technologies"

> RACE – experimenting with integrated broadband communications, technologies and systems.

> STIG – focussing on application orientated telematic systems and services of general interest

The original aim was that the results of ESPRIT and RACE would be tested by users in specific sectors by programmes under STIG (Systèmes Télématiques d'Intérêt Général). This consisted of five sectors:

> AIM – focussing on Medical Informatics

> DRIVE – the development and application of telematic systems in the transport sector

> ENS – systems and technologies for the enhancement of public administration

> ORA – telematic support for rural areas.

> Telematics for Flexible and Distance Learning

The Telematics for Flexible and Distance Learning Programme had three main objectives:

- to develop enabling technologies which might further enhance the strategic contribution of learning technologies to the performance of companies, organisations and work forces in the European Community

- to validate these technologies through pilot experiments in a range of markets

- to assist the transfer of the successful learning technology research and development to the marketplace, through investigations and forecasts of the market itself, the production of reliable and practical methods of evaluating the impact and benefits of learning technologies, and the promotion of the programmes results to relevant target audiences.

In line with its main objectives, the Programme had three main strands of activity:

- Implementation Strategies and Scenarios – these projects researched the implementation, marketing and evaluation of learning technologies

- Technologies and Systems Development – these projects concentrated on the development of technologies and systems necessary to support open, distance and flexible teaching and learning situations

- Pilot Testing and Experimentation – these were pilot projects testing learning technologies with users in a variety of markets.

The diagram below shows the Telematics for Flexible and Distance Learning Programme in the context of past and future R&D activities.
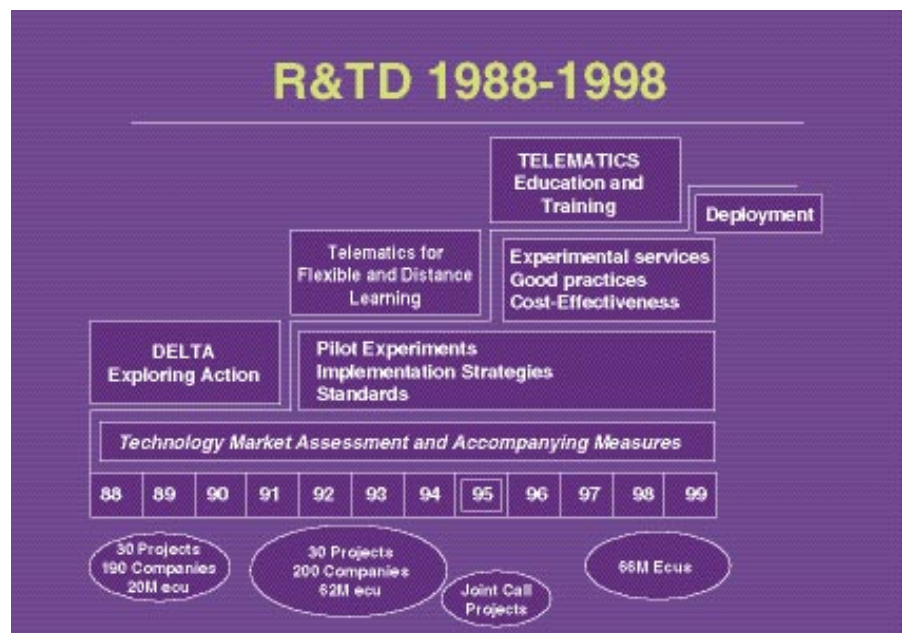
The following diagram aims to show the interrelationship between the projects from a technology perspective following the main strands of activity. Those projects involved in horizontal actions developed implementation strategies and scenarios. However, it has been decided in this report to present the key results according to the three main challenges which need to

be overcome in order to develop the market for flexible and distance learning.
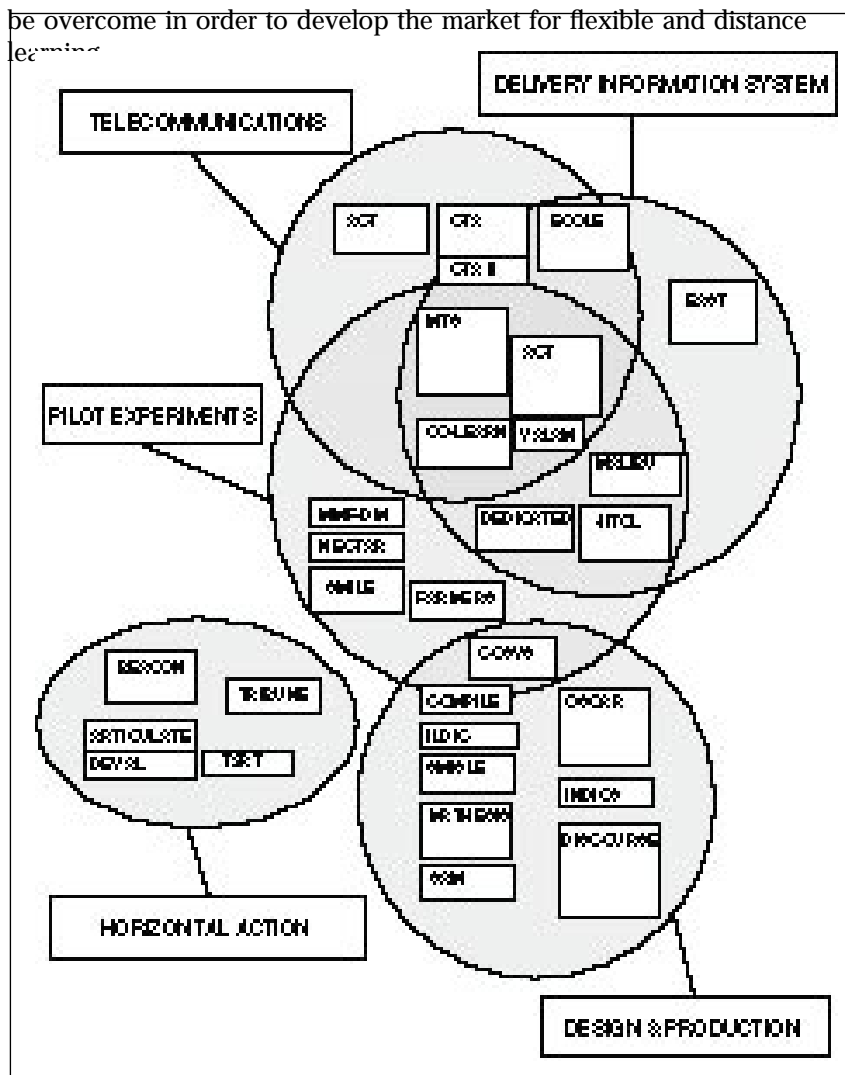
By 1994 there were a total of 30 research projects working together in the DELTA Programme, with the European Commission contributing 62 million ecu. Coming from 12 Member States and 5 EFTA countries, over 200 organisations participated in these projects, including over one third involving SMEs – Small or Medium Size private enterprises. Each project consisted of several partners, associate partners, sponsoring partners and sub-contractors, spread over a number of different European countries.

"Active Learning" (Photo courtesy of Adrian Rawlings)

3 Key Results – Towards Utilising Telematics-Based Learning

A large body of knowledge and know-how has been accumulated by the organisations involved in the Telematics for Flexible and Distance Learning Programme. This can be found in many different formats. New prototype systems have been designed and produced by integrating existing hardware and software as well as by developing new software tools. Stable and new technologies have been tested out in pilot projects involving a variety of learning experiences in different contexts. These have focussed on seeking cost-effective solutions and increasing the accessibility of learning facilities for all. Learning technology standards have been defined. Evaluation activities have aimed to improve the processes which lead towards the development of new learning technologies. Studies have been conducted aimed at understanding the market for new learning technologies. Dissemination activities have been conducted to raise awareness and to spread knowledge and know-how.

Therefore, the key results have been presented under the three main challenges:

Main challenges

- Meeting the increasing demand for cost-effective learning solutions

- Improving access to learning facilities

- Improving quality, defining standards, understanding and stimulating the market.

This chapter attempts to pull out the main issues, without going into too much technical detail, on what are a range of often complex integrated issues which have had to be addressed. More detailed information can be found in the many reports which have been produced by each project. These are obtainable through the Catalogue or directly from the project co-ordinator. Contact points are found in the Annex.

3.1 Meeting increasing demand for cost-effective learning solutions

Developments in multimedia are offering new opportunities to stimulate and accelerate learning in a wide variety of contexts. However, developing multimedia learning resources is a very time consuming and expensive process. This is one reason for the restricted use of multimedia in existing learning environments. The challenge is to find more cost-effective ways of producing multimedia learning materials. Some of the projects focussed on this challenge, in two ways:

- developing new and more effective ways to design and produce learning resources

- developing new approaches for the re-use, adaptation and updating of learning materials.

Developing new and more effective ways to design and produce learning resources

Projects have approached this challenge in a number of different ways. The ILDIC project gained a better understanding of the processes of design and production of multimedia learning resources, thus helping to improve the

design of learning materials and therefore saving time and money. The COMPILE project developed a method of producing high quality multimedia materials which did not require the day to day input of a multimedia expert during the production process. The SMISLE project found a solution to enable the authors of learning products which use simulations to more easily "build-in" additional support to the product – usually this would have required the expertise of a computer programmer. The MATHESIS project was able to develop a courseware authoring system which could be used in a more flexible way than has normally been possible.

ILDIC – Learning Design Model

Focussing on the processes that people go through when designing multimedia materials, the principal aim of the ILDIC project was to help designers to improve the design of learning materials. Eight roles were identified: content expert, pedagogical expert, multimedia designer, graphic designer, programmer, media specialist (AV), script writer and project manager. The project analysed each of these roles in order to determine their contribution to the development of multimedia materials that have to be undertaken, and identified the risks involved if these roles were not represented, over-represented or under-represented.

It concluded that all these roles need to be present in a multimedia development process. Although they could be present in one person it was highly questionable whether one individual could undertake to keep them all in balance. Therefore a small team of persons was considered to be preferable and likely to be most effective. A practical set of guidelines for developing learning material was produced for interactive multimedia development teams. These are backed up by standards which state the contribution of learning design to the development process and describe the learning design process in terms of outcomes achieved by the multi-disciplinary development team. This process includes a template for evaluating the design quality of multimedia applications, from the perspective of learning

This Learning Design Model, which has been made available on a CD-ROM, considers a cluster of factors that particularly affect the quality of a product. These factors are described in the model as a set of ten perspectives. The term "perspective" emphasises the idea that design teams need to look at what they are doing from different angles:

environment	feedback
learning theory	user interface/control
instructional position	aesthetics/media mix
machine character	content
use	technology

The ILDIC prototypes were subjected to field testing with users to determine the validity of the underlying learning design model. The standards for learning design have been evaluated by the project team and have been subjected to further validation by interactive designers in other development teams including in the COMPILE project.

The COMPILE project tackled an important issue in the production of multimedia learning materials based on CD-ROM and CD-I technologies. With the focus on language learning, it found a way of making it possible for the "content experts" to produce materials without having to have the direct involvement of all the other multimedia expertise in the day to day production work – thus achieving a situation similar to authoring a traditional book. This makes the production of multimedia-based learning materials less expensive, but retains high quality standards.

The project conducted an investigation into learning and linguistic theories and analysed a number of existing multimedia and computer assisted language learning products in order to see what successful strategies had been implemented by other teachers, designers and programmers. In addition, the three educational partners provided input, concerning classroom teaching strategies, problems and areas of particular interest.

The result has been an authoring tool, based on database technology, consisting of a library of templates; a template editor that will allow the design team to develop new templates based on the set of objects supported; a flow editor that will allow the design team to link templates in a specific application; and a number of content editors that will handle the entering, editing and linking of data to specific events. In order to provide greater flexibility for the design team, "lower-level" objects – the building blocks of templates – have been created. The main achievement has been developing the complex data model needed to support this highly specialised and yet flexible authoring system and process.

COMPILE – Cheap High Quality Multimedia Language Learning Materials

> Examples of templates used in a learning experience concerning employment
>
> *Activity 1: Finding a job*
>
> Templates used: Reading job cards in a job centre (using different materials from the reading notices templates), reading newspaper advertisements, phone conversations.
>
> Treatment of the activity: Learners choose which job type they are looking for, then look through the material presented on the screen, clicking the ones appropriate to the desired job and note the phone numbers. Then they telephone a company and arrange an interview by choosing responses in the dialogue or inputting their own to be checked later by the tutor.
>
> *Activity 2: Getting to the job interview*
>
> Templates used: Listening to instructions, reading a map.
>
> Treatment of activity: Learners follow instructions given to them on how to get to the place of interview and click on a map to demonstrate their understanding.

Whilst interacting with simulations, learners can encounter difficulties which they cannot overcome on their own. A possible solution is to provide learners with additional support. However, most authors without programming experience are unable to build this into the simulation. Tackling these issues, the SMISLE project has developed a toolkit to design and implement simulations including additional instructional support.

The applications that have been created are called MISLEs (Multimedia Integrated Learning Environments). These are made up of a "runnable" model, which is an efficient representation of the domain underlying the simulation; a

SMISLE – A Toolkit for Multimedia Integrated Simulation Learning Environments

cognitive model which is the representation of the domain tailored to learning and instruction; and an instructional support model which provides the instructional measures such as progressive model implementations, assignments, explanations and hypothesis scratchpads. In addition there is a learner model, which maintains the results and characteristics of the learner; and an interface model which determines the appearance of the simulation seen by the learner.

The task of the author is then to create these models, with the exception of the runnable model which is automatically generated from the cognitive model. Creation of these models is essentially a process of the author selecting, specialising and customising generic building blocks which are provided in various building block libraries. Such a library exists for each model for which a dedicated editor is provided.

Even when using SMISLE, building a useful and correct application is a relatively complex exercise. For this reason authors are also provided with a methodology helping them to master this task. This methodology appears principally as constrained choices for the author, supplemented by visual messages guiding the author in the right direction.

The author is also provided with an advice module, providing pedagogical help in creating MISLEs. This is because a typical SMISLE author is likely to be a domain expert with perhaps little programming and/or educational experience. The advice module provides authors with hints and background information, necessary for making decisions on the choice and customisation of instructional measures.

The authoring environment has undergone an intensive evaluation by both students who created either complete or partial MISLEs under laboratory conditions, and engineers/academics who created five complete applications. These applications cover both academic, engineering and industrial domains – namely the physics domains of oscillation, transmission lines and collision; the starting up procedure of a hydrogen purification unit in the petrochemical industry; and car part stamping in the automobile industry. The five applications were used to evaluate the SMISLE approach to supported simulation-based learning.

MATHESIS – A Courseware Authoring System

Addressing the issue of portability by organising the workbench into independent components, the MATHESIS project developed a stand-alone workbench comprising three tools, available for the most part on both Macintosh and Windows. These consisted of a "Courseware Authoring System" enabling an author to create courseware consisting of didactic or simulation modules supported by a hypermedia network of information. The "Resource Manager" enables a learner to customise the learning environment and the "Session Manager" enables a learner or author to keep track of actions over time.

The prototypes were tested out on a number of users in the area of mathematics for 11-12 year old students, English as a second language and a final simulation involving counter clerks from Greek banks. Aspects of the project are also being followed up in the VALAM project. The project work has led to two commercial software products: Apple Media Tools, a development of the MATHESIS Multimedia Composer; and the Windows Help Browser, an extension of the MATHESIS Session Manager.

Developing new approaches for the re-use, adaptation and updating of learning materials

Being able to re-use, adapt and update existing materials can considerably reduce the cost of producing multimedia learning materials. This challenge was tackled in various ways by some projects. The OSCAR project developed an authoring environment which offered solutions to this issue as well as making the facilities accessible to distributed development teams. The DISCOURSE project also developed a modular authoring system which would allow the re-use of products and by-products from learning materials developed. The results of both of these projects were integrated into the INDIOS project which developed a learning resource on satellite image processing techniques.

The SAM project enabled cost savings to be made by creating learning resources which use existing commercially available packages, whereas the COSYS project developed a "Pick and Mix" system, which enabled teachers, trainers, publishers and educational providers to remotely select learning materials and customise them for their own context.

The OSCAR project recognised that design and production of quality multimedia courseware is typically a complex, expensive and group-working process, carried out by a multi-disciplinary team. Each team member plays a specific role and brings specific contributions to the whole courseware development process. But it was considered that authoring systems available today on the market neither recognised this diversity of roles nor allowed the people using them to work together effectively. In addition, they did not support the concept of "courseware life cycle", including re-use and update of existing courses. Existing authoring systems did not permit the users to obtain economies of scale in courseware production since they did not include mechanisms to facilitate sharing and re-use of "half-products" of the courseware development process.

OSCAR – Open Authoring System Architecture
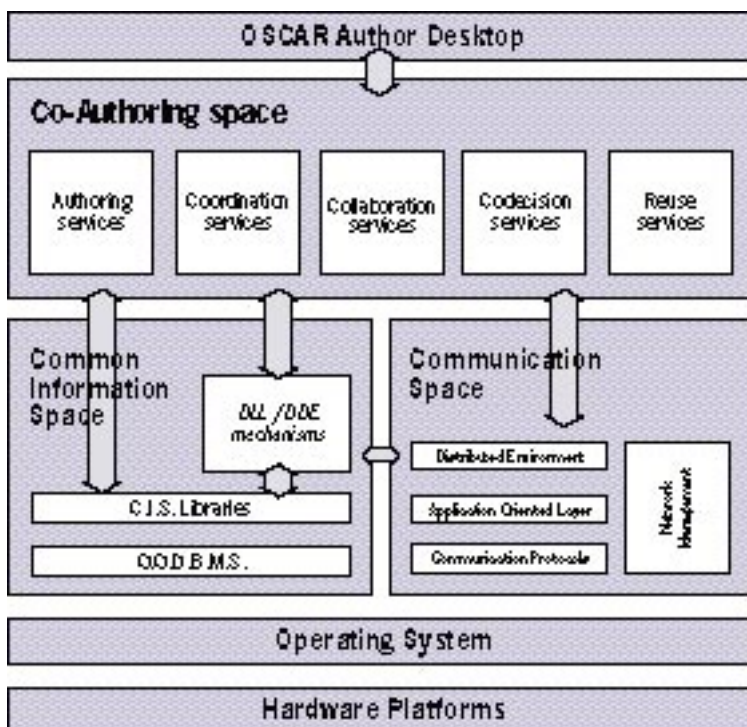
The OSCAR Architecture. From the desktop various co-authoring services are accessible. Authoring services include tools for the design and production of multimedia. Co-ordinating services support the organisation and management of courseware projects. Collaboration services allow group communication and sharing of documents, information and tools by people working together in the same activity. Co-decision services support decision making by the work group about many factors relevant to the courseware development process. The Re-use services facilitate the re-use of existing training materials, allowing retrieval and adaptation.

DISCOURSE – Modular Multimedia Authoring Environment

The authoring environment developed by the project offers solutions for these problems, supporting collaborative and distributed authoring of multimedia courseware, based on an open system architecture. It provides multimedia communication facilities, a repository of multimedia objects, and co-authoring services allowing joint courseware design and production as well as co-ordination, collaboration, co-decision and re-use. These facilities are available over local area and wide area networks.

Differing from current authoring systems, the modular system developed by the DISCOURSE project is flexible enough to allow the re-use of products or by-products. As materials are developed by authors their components are stored to enable them to be re-used at a later stage. The project has developed a multimedia authoring environment that consists of various integrated tools to support authors in both the design and production phases of courseware. This authoring toolkit should enable the design and production of economic high-quality courseware, which will adapt automatically to each learner's performance level and learning preferences. A team of authors can work together to either create, adapt or re-use existing materials. The same materials can thus be used in different contexts.

With the aid of various tools the author is able to analyse the subject to be taught according to "entities of interest", independent of any instructional strategy and thus making the components reusable. The analysis of the learning goals is devoted to the description of what is to be learnt for each given content element. This is expressed in terms of knowledge, understanding and ability. The analysis of content draws the author to elaborate on the subject, and adapt it to the particular learning experience under development and tightly integrating it with the learning goals analysis. This has been achieved by using various tools which are based on the "Generic Tutoring Environment", developed in the earlier DELTA project TOSKA.

INDIOS – Distributed and Collaborative Courseware Authoring

Integrating the results of the DISCOURSE and OSCAR projects and incorporating a specific external tool (Bilko for Windows) for the image processing, the INDIOS project developed a system which was used with courseware developed for learning about image processing techniques for satellite images. The courseware was developed on four sites and tested on students with various degrees of knowledge and differing learning styles. The application used image processing from the remote sensing Landsat satellite. The courseware developed runs on a common MS-Windows platform.

SAM – A Modelling, Authoring and Learning Framework

The SAM project has developed a modelling, authoring and learning architecture, oriented to teaching using simulations. It is based on state of the art software tools, but also allows the use of existing commercially available packages. This has the advantage of being able to re-use existing courseware developed in various applications. The system developed uses client-server technology, operates in both Macintosh and Windows environments, and is platform-independent, with the exception of the inter-application communications. It involves three levels of development. The course structure and the instructional strategy are defined by the authors, using the Instructional Plan Editor. Using the Concept Network Editor the simulation is defined for use within the learning process. The multimedia material is developed in commercially available packages such as HyperCard, Authorware and LabView. The packages run under the control of the SAM Controller with the help of a Monitor which can compare actual learner behaviour with expected behaviour under the control of an instructional strategy specified by authors.

The COSYS project was concerned with organisational changes, the quality of courseware, cost-effectiveness, changed work roles and skill requirements for producers, authors, trainers, and the learning environment. Its aim was to establish an integrated distributed environment for the production, publishing and delivery of course material using electronic mail, computer conferencing and ISDN networks. The project has investigated "at grass roots level" the long-term shift of education and training towards a more open structure in which the role of the teacher is no longer just a content provider but a coach and a guide to learning resources.

Pilot testing in five different real-life user environments was used to validate the feasibility and market potential of the system which has proved technically functional, providing a range of products and services, and producing significant organisational learning outcomes. Using a "Pick and Mix" system, the project enabled teachers, trainers, publishers and educational providers generally to view and select materials within a given learning domain in order to customise teaching for their own context. The Pick and Mix database has been used as a source of course material in a wide range of end-user contexts. It enabled the customer to pick and mix different modules and categories of course and/or resource material corresponding to the actual educational situation: classroom, on-the-job-training, self-study, training of trainers, in-house training. It also enabled the customer to get an overview of the objectives, the target group, the course description and existing course material within a given learning domain in order to deliver customised books and training materials and/or sales of training information.

COSYS – Pick and Mix Production and Delivery System

3.2   Improving access to learning facilities

One of the main potential benefits of using telematics in education and training is to increase access to learning facilities. This challenge has been met in various ways.

Some projects have focussed on finding solutions to increasing accessibility by developing new systems using innovative technologies. They have developed new learning systems consisting of various component parts which could all be integrated together or used separately. In most cases standard hardware systems have been used with commercially available software and communication systems, but they have been integrated together by developing "linking" software tools to form production, delivery, tutor-supported and management learning systems.

Other projects have tended to start with stable technologies and establish pilot courses in various subject areas. This has either been with new or existing training infrastructures. At a later stage they have tested newly developed technologies.

Projects have focussed on meeting the learning needs of:

- professionals, through on the job training
- higher education
- small companies, and individuals.

Many of the technologies and communication systems used in one learning environment could also be used in other environments. The communication technologies include both terrestrial and satellite-based networks which increase accessibility through distributed education and training systems.

Meeting the needs of professionals – On-the-job training

Today's organisations are placing increasing value on conducting the continuing education of their employees on the job, in order to minimise the cost of losing work-time or to avoid the cost of travelling and hotels. The problem, so far, has been that the teaching competence needed is not always available where it is required. This results in a growing need for individualised and self regulated learning.

The ACT and the ECOLE projects have developed and tested distributed learning systems which utilise advanced communications for both delivery and interactive tutorial support. Looking at the issue from a different perspective the JITOL project has developed a mechanism which will enable the changing and informal nature of professional knowledge to be represented in a particular way to allow that knowledge to be shared. Focussing on a specific training sector – banking – the MALIBU project has developed a flexible and distance learning delivery. The MTS project has implemented large-scale pilots using proven distance learning courses but testing them with "stable" communication technologies to increase student accessibility to tutorial support. The VALAM project has converted the prototype developments of the ACT and MATHESIS projects in order to pilot a distributed training course in the banking sector. The DEDICATED project has installed and pilot tested a European-wide network of local training centres with the purpose of using advanced learning technology to train users in the use of computer aided design and computer aided manufacturing.

ACT – Advanced Communications for Training

Aiming to develop telecommunication facilities which can be integrated in educationally sound and cost-effective ways for corporate training, the ACT project developed telecommunication facilities based on three types of learning modes: interactive remote tutoring, interactive distributed learning and interactive teleteaching. Implementation is based on ISDN technology and satellite video broadcasting, resulting in a complete system for the distribution of learning materials and cross-national delivery and monitoring of training courses. The research and development activities focussed on developing "software tools" which have enabled existing commercially available hardware and software products to be integrated in order to be used in the three types of learning mode. This resulted in the development of prototype demonstrators which have been tested in "virtual classroom" experiments, where the tutor is offering courses to remote learner groups at different company sites.

Interactive remote tutoring

A multimedia Learner Station was developed for use within the "interactive remote tutoring" learning scenario. This consists of a CD ROM player and a personal computer with access to basic rate ISDN. It provides direct point-to-point connection between tutor and learner and enables screen transfer, allowing real-time remote intervention by the tutor in a program at the learner station in order to assist the learner in a situation when additional help is required. It also includes a facility for data transmission.

Delivery of learning materials and the management of learning

For operating within an interactive learning environment an Administration and Delivery Centre was developed. This facility enables the delivery of learning materials and the management of learning, linking a remote host computer, via an ISDN link, to a corporate local area network. The role of the Administration and Delivery Centre is to centralise all necessary functions for course management and distribution by tutors, course providers and learners. This can provide a common training service which companies can access via their own local area networks. The learning materials are stored and accessed from a common host computer. Within the course provider's environment this

administration and delivery system operates within a local area network, which interconnects an administration centre, a delivery centre, tutor stations, one or several course manager stations and an ISDN/LAN gateway for connecting a remote tutor station.

The corporate training server consists of one or several physical machines, located on the learning sites. Its role is to provide a common resource sharing facility among learners located on a given site. This is very useful in freeing the learner stations from heavy storage and communication processing requirements. This corporate training server receives all training materials from a remote course provider's delivery centre, keeps it stored and forwards it onto the learner station when required by the learner. It also collects any work done by the learner and stores it for later forward transmission to the course provider's centre. The course provider's delivery centre connects periodically to the corporate training server via an ISDN link.

Software tools have been developed for use in a learner station, enabling interactive distributed learning. The learner has access, via a local area network, to different kinds of training received and stored on the corporate training server. An extension to the learner station has been developed to enable voice messages and annotated files to be used.

A "smart card" facility has been developed to enable restricted access to the Learner Station. Once the smart card is inserted into the smart card reader (which can be attached to or integrated into the Learner Work Station), and a PIN number is typed in, the learners will have immediate access to their training resources exactly at the stage they have reached within a particular learning programme.

The studies conducted by the ECOLE project show that tele-tutoring and collaborative learning are possible ways of promoting this kind of learning in a purposeful way.

The ECOLE project has developed a prototype and field tested a cost-effective, interactive, ISDN-based environment for educationally advanced distance learning and flexible training. In particular it has addressed the problem of providing real-time and deferred-time learner-tutor interaction and group communication as a component of a large-scale multimedia distance learning service.

The prototype used for field testing included four major components:

- an ISDN-based telecommunication network, based on an open network architecture, connecting both individual workstations and groups of workstations connected via local area networks and, as a demonstration, broadband digital networks

- telecommunication software

- communication and productivity tools allowing different participants in distance learning to exploit the facilities offered by digital telecommunications, for example through synchronous and asynchronous remote multi-user interfaces

- a unified computer environment facilitating user access to the various tools present in the system.
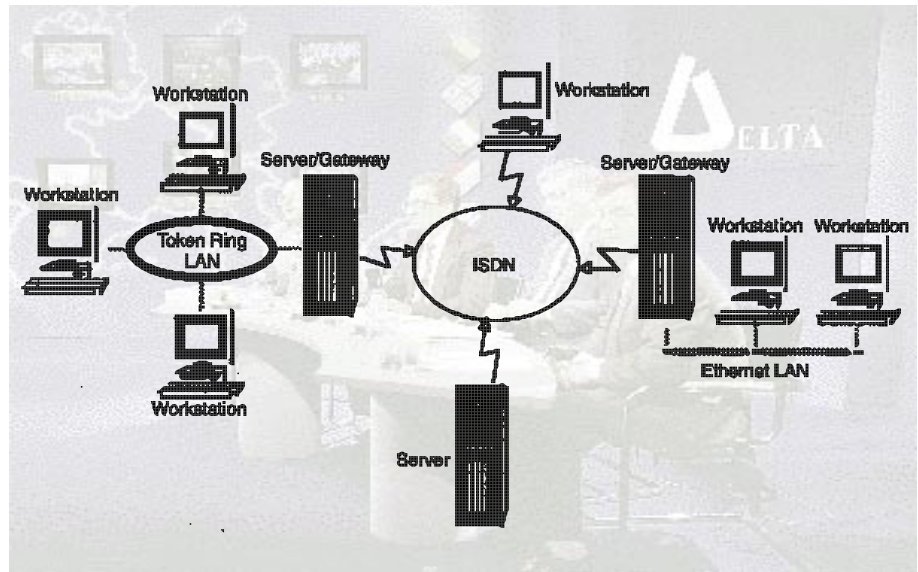
A common resource sharing facility

Interactive distributed learning

**Learner "smart" card**

ECOLE – Towards a Large-scale Multimedia Distance Learning Service

A systems view of the ECOLE prototype

Three field tests were performed in operational distance learning and training situations, aiming at an assessment of the educational and cost-effectiveness of the collaborative learning environment, as well as its technical performance. One of the field tests was across national borders and involved the use of Euro-ISDN. The prototype system can provide individual users (learners and tutors) with access to a range of servers. To the end-user, the facilities on the workstation should appear as illustrated in the diagram below.

Facilities available to a user
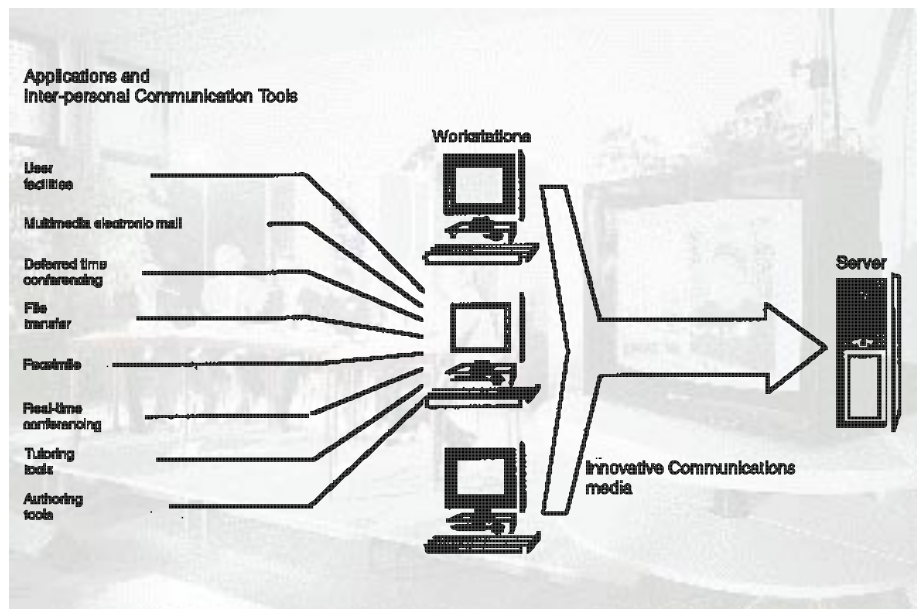

JITOL – Just in Time Learning

The term "just in time learning" in contemporary terminology refers to the ability of a learner to have access to the education or training that a person requires at the time of need. The JITOL (Just In Time Open Learning) project has expanded that concept by recognising that an individual's knowledge is developed not just by taking courses but by collaboration with other

professionals (individually or in groups), access to information resources, interaction with teachers and tutors, and accumulation of knowledge resources. The project has developed a telematic support system and the conceptual and methodological framework to implement the concept.

The project focussed on the development and evaluation of IT-based learning environments to support the professional development of individual professionals. It concentrated on capitalising on the contextual expertise and skill of professionals and also on stimulating and supporting the exchange and collaborative sharing of expertise. This was amongst "communities of interest" of professionals who were in different or the same organisations.

One of the JITOL project's major innovations was to develop a mechanism which would enable the changing and informal nature of professional knowledge to be represented in a particular way to allow that knowledge to be shared. JITOL concentrated on the contextual knowledge which evolves during peer interactions. Although the initial interaction amongst peers may be stimulated by a formal process, such as taking a course or working on a common project, the project examined ways in which the expertise is made explicit during interactions. The research also studied ways in which the interactions could be captured and transformed into knowledge that was progressively incorporated into an evolving knowledge resource base. The project called this process "reification".

To implement the process, JITOL developed a system to help individuals develop their knowledge. This system is based upon a four-stage metaphor for individual knowledge development which involves: the private note-making function of paper and pencil; the personal communication function of documents, telephone, fax machines, post; access to documents, reports, books, and wide communication with colleagues and peers. This metaphor, called the "four window concept" was the conceptual basis for the Lotus Notes implementation as shown in the following diagram.
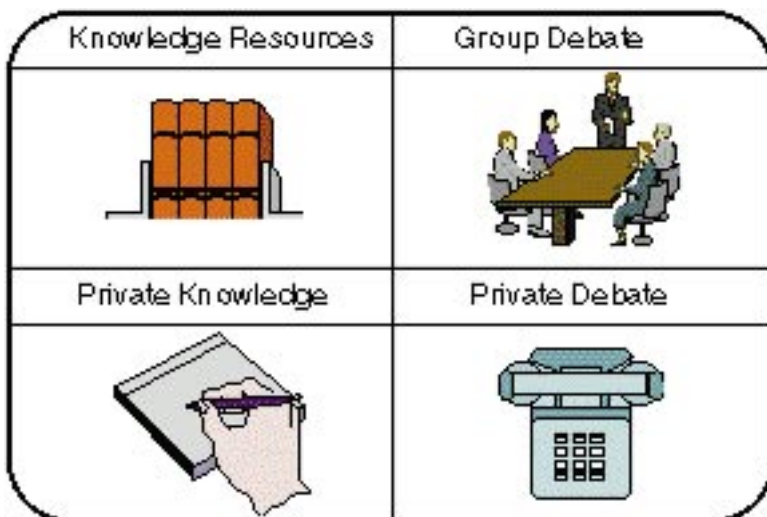
The JITOL four window concept

The JITOL project tested the system in several different settings. This included advanced learning professionals who were working together to design learning

materials and with medical doctors and nurses who were concerned with diabetic self-help therapy. It also involved staff in large corporations who were engaged in learning through courses or other training materials and female managers from international companies who engaged in debate on the role and issues of women in management.

The JITOL project represents a major step in the practical implementation of the concept of "learning organisations" that is receiving much attention in business and institutional publications. The JITOL project has developed the conceptual, procedural, and technological basis on which to build such an organisation.

MALIBU – Multimedia and Distance Learning in Banking and Business Environments

The MALIBU project developed a flexible and distance learning delivery service specifically aimed at the banking sector, although the principles of the system could be used in other environments. Involving three banks in different countries, the project built upon existing in-company training systems to provide services that emphasised customisation of the learning process to individual learner needs. It stressed interactivity while seeking to enhance the learner's active and creative knowledge acquisition.

MALIBU system
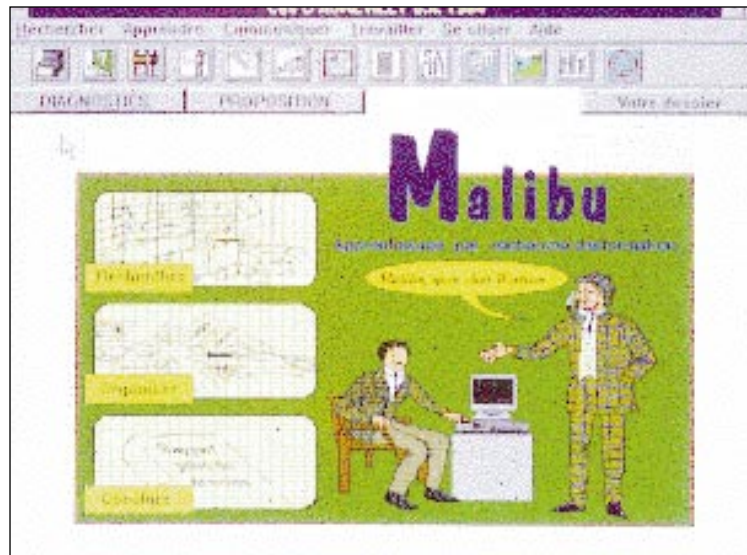
Three different methods to support the learning process were developed:

■ The Exploratory Learning Delivery system aims to facilitate learner driven interaction

■ The Multimedia Role Playing System stresses interaction between all the actors in the training system

■ The Remote Tutoring Monitoring System supports learner-tutor interaction.

These services are used to support training management, learning materials distribution, information retrieval, exploration enabling tools, tutoring and feedback-generating monitoring, self-learning, co-operative learning in real-time and either among learners or between a learner and a tutor.

A variety of different courses were implemented and evaluated on the systems at the three sites. These included training for "front office employees" who have direct contact with customers, and "back office employees" who run the administrative and technical systems of the banks. The system was implemented over internal local area networks and company-owned wide area networks.

As a market oriented project, the MTS project has implemented and evaluated large-scale pilots based on using proven distance learning courses, tutors working for existing course providers and real learners from large and medium sized companies throughout Europe. These pilots were set up in a realistic European training environment, using courses resulting in a long term qualification, which had to be paid for by the sponsoring partners and learners. Learners participated from their workplace, company training centres or even from their home.

Fifteen electronic distance learning courses were delivered by the course providers to more than 1400 learners in 60 European companies and institutions from 12 countries. MTS utilised in the first stage so-called "stable" technologies like computer conferencing and direct broadcasting by satellite (DBS). In the second stage it tested more innovative technologies for interaction between students and tutors – video-phones and video-conferencing using bundled ISDN across European borders.

MTS – Multimedia Teleschool for European Personnel Development

Scenarios for distance learning
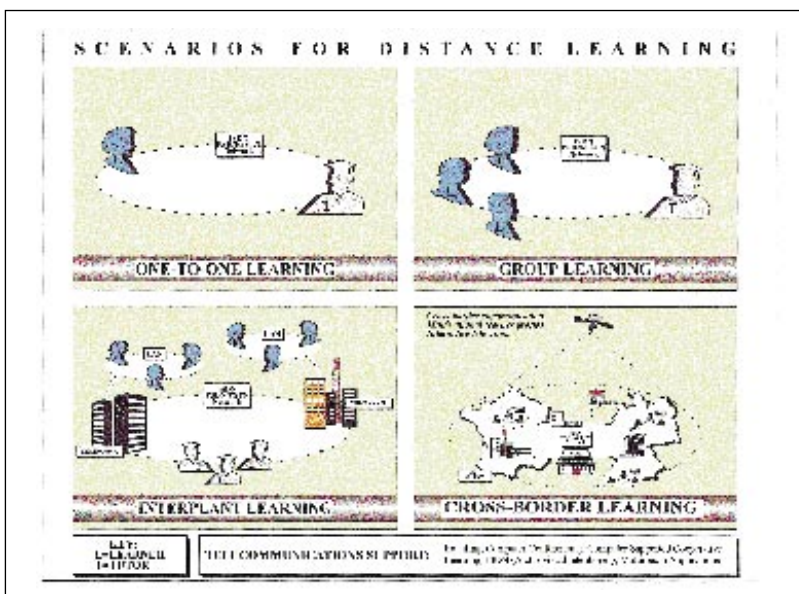
The MTS concept is based on the idea of a "virtual classroom". This means that self-study learning is combined with group and collaborative learning via telematic technologies. The main form of technology is computer conferencing which makes use of client-server technology. All students have access to a personal computer and can connect to a server (host) computer via a normal telephone line. By using a specially modified version of the CAUCUS software, students had access to electronic mail and computer conferencing facilities, which enables them to communicate with their tutors and other students as well as take part in a range of conferences on different topics. Assignments can be sent to tutors who can mark and make comments and rapidly return them to the students, via electronic mail, with the next study letter. The project also used an especially modified version of the EDWIN software based on the PortaCOM communication software to evaluate a different form of tele-training software.

A complementary but "highly visible" component of the overall learning experience offered to students has been live interactive TV broadcasts via satellite. Here students have had the opportunity to communicate directly with the "experts" and tutors in the studio via telephone, fax, email, video-phone and video-conferencing. With ISDN video-conferencing as a feedback link from various international receiving sites it has been possible to create an "international virtual classroom", in which student groups from different

locations could interact in role plays, simulations, games, and debates in a real time multimedia communication mode. The tutors and experts in the TV studio acted then as moderators and facilitators and were able to link four different international groups at the same time on one TV screen broadcast all over Europe.

Despite the common "virtual classroom" concept and the use of similar technology, each of the six courses has its own focus and learning style. Three of the courses focus on language learning: English for Banking, English for Telecommunications and English for Business. There were also courses in Environmental Awareness, Agrofood, Telecommunications and Innovation Management.

A brokerage concept was also tested, to find out what types of telematic based solutions "best fit" the needs of different types of companies. This involved improving the variability and flexibility of distance learning by offering different course types which have, selectively, combined several delivery mechanisms, including the extension of interactive DBS using bandwidths from 128 to 384 kbit/s for the feedback link to the TV Studio.

Experience gained from the MTS project is adding to the body of scientific knowledge accumulating in the area of economics, pedagogy and ergonomics of flexible and distance learning as to what learning experiences and what use of technologies is acceptable to learners and what their companies are willing to pay. A study conducted revealed that over two-thirds of students on MTS courses can access the computer conferencing system directly from their own computer networks. Based on this evidence it is likely that future work could lead to more integration of training systems into individual workstations resulting in "on-the-job" vocational training.

VALAM – Distributed Training in a Banking Environment

The purpose of VALAM was to pilot test the broadened repertoire of training methods made possible by the fusion of the ACT and MATHESIS technologies, and to develop new training strategies based on this broadened repertoire. Pilot test sites were at six branches of an Italian bank. A training course was developed on "Productivity in selling bank services" which was oriented to the training needs of customer service staff for small and individual accounts targeted to promote the use of credit cards by such customers. The project has accumulated experience, in a real training needs situation, of the issues relating to converting prototype developments from the ACT and MATHESIS projects.

DEDICATED – A European Network for CAD/CAM Training

The main objective of the DEDICATED project was to install and pilot test a European-wide network of local training centres with the purpose of using advanced learning technology to train users in the use of computer aided design and computer aided manufacturing (CAD/CAM). It developed a learning structure, learning scenarios and course libraries to give learners access to training materials. The established local training centres were used as centres of local teaching expertise, and were interconnected to supported courseware designers and developers, learners and teachers, administrators and managers.

The centres used the Modular Training System and extensive multimedia capabilities as a way to improve the education and training results. They also demonstrated the feasibility of a system to operate across both MS-DOS and UNIX platforms, accessible when connected by use of TCP/IP and a wide area network.

# Meeting learning needs in higher education

Across Europe universities are increasingly being encouraged to co-operate through initiatives like ERASMUS. The changing nature of higher education is also creating increased competition for "new markets" of remote students or "bringing" expertise to more locally based students. Universities are also having to find more cost effective solutions and increase accessibility to learning for a larger number of students. Telematics based learning systems could offer solutions to these issues.

The JANUS project focussed on building a prototype for a future "virtual" European open university network. This involved students based in EuroStudyCentres and in their own homes. The CO-LEARN project developed and pilot tested a technology-mediated distance learning service between universities and their remote students. However the technologies developed could also be used in many other educational and training contexts. From a different perspective the NECTAR project tackled the issue of student mobility within Europe and the need to be able to more easily compare courses from different universities for credit transfer. Overcoming this problem will also increase student accessibility to European learning resources.

Having identified and analysed the basic pedagogical processes for communication and collaboration amongst learners, the CO-LEARN project developed and pilot tested a technology-mediated distance learning service that used readily available PCs connected over local area networks and ISDN to each other and to a CO-LEARN server. The system was designed to support collaborative learning and teaching at a distance, and thus to enhance communications both between teachers and learners and between learners themselves.

The CO-LEARN system consists of a multi-point audio-graphics conference system, called "Real-Time Teleteaching", for communication in small groups; a real-time teleconferencing system; a shared screen application to facilitate communication among tutors and learners; and a courseware library with hypermedia editing facilities. Despite difficulties with cross border ISDN links the prototypes have been assessed and evaluated in trial schemes, in different types of educational, operational and geographic environments and are due to be exploited in the commercial market.

CO-LEARN – Towards a Telematic Collaborative Learning Environment
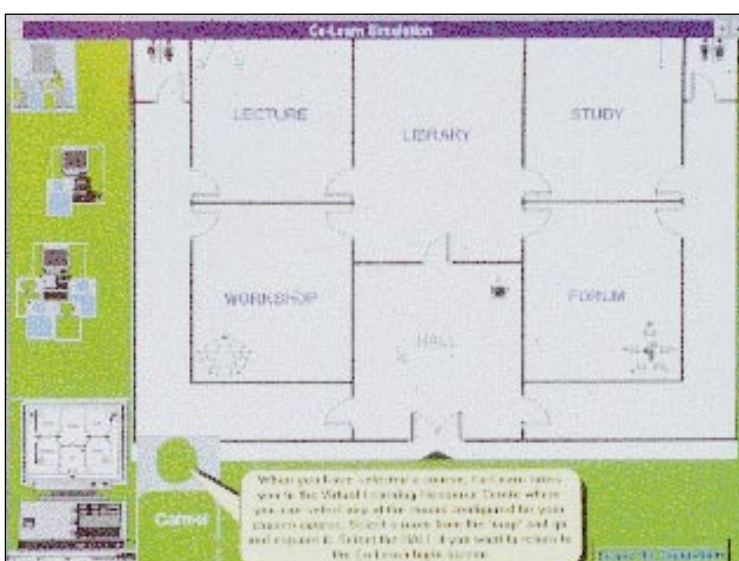
CO-LEARN system

JANUS – A European Educational Integrated Telematic Network utilising VSAT Technology

Focussing on building a prototype required by a future European Electronic Open University, the JANUS project developed an integrated European-wide telematics data network for distance learning, which partially utilises satellite-based VSAT technology. This has involved large-scale systems integration involving a six-node "Internet in the Sky" using VSAT services connected to local area networks and the terrestrial Internet.

A JANUS VSAT. (Photo courtesy of Open University by Mike Levers.)

Utilising the commercially available FirstClass client-server software (but with substantial customisation), over 100 servers have been linked across Europe – over VSAT, Internet and PSTN. Users have access to the FirstClass server with their client graphical user interface software via PSTN, X.25, VSAT, ISDN and Internet. The hub FirstClass server has also been linked to Internet email and Usenet News, to SQL (relational) databases and to other conferencing systems. A number of utilities have been developed within the project to add value to FirstClass, including links to existing but older conferencing systems, an accounting system and user registration. With over 2000 registered users, the system now provides an easy to access and use asynchronous communication tool, for remote individual learners across Europe.

DM863 "Lisp" course – welcome screen from FirstClass on JANUS network
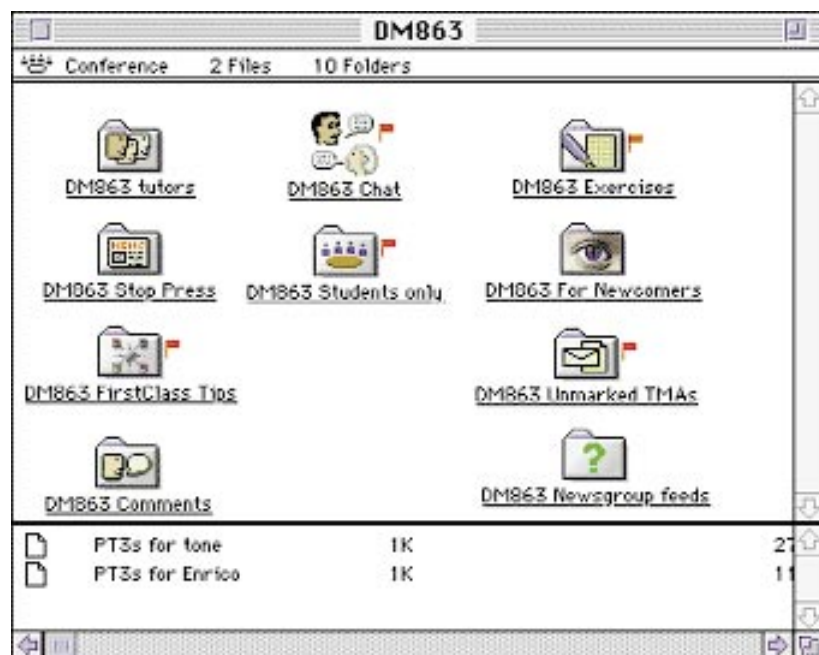
Focussed on home-based learners the system has been piloted with innovative courses like the "Renewable Energy" course (which heavily featured co-operative learning) and with courses involving fee-paying students like the ISDN, Lisp Programming and Artificial Intelligence courses. Other courses included "What is Europe" and an international business administration course using a business game.

The project also piloted the concept of courses taught across Europe using the same basic material, but with local tutors who use local criteria and additional material. For example, in the ISDN course, the basic material was in English, but the tutorials in Portugal were in Portuguese and the UK students were allowed access to additional Usenet news groups of relevance only to UK.

By 1996 there are plans to have over 6000 fee-paying students using the system for their courses. The project has announced a collaboration between Hughes Olivetti Telecom and the UK Open University to further develop the JANUS VSAT services and offer them across Europe (including East Europe and Russia) based on a VSAT hub site connected to Internet and Open University servers.

Based on market research in the project it was found that there was a demand for reliable telematic services at affordable rates, but also a large demand for information about the use of telematics in education and training. As a spin-off of the project the JANUS User Association has been established as a vehicle for the dissemination of knowledge and know-how in using telematics in education and training. One of the main methods of dissemination involves the electronic news which is available via the JANUS telematic network. In addition the project has taken very seriously the issue of teacher training, which it sees as fundamental to the widespread use of telematics. This has involved a strong user focus and the organisation of several large workshops and international conferences.

Transfer of credits among European universities has long been an objective of various programmes, such as the ERASMUS European Credit Transfer Scheme that is concerned with promoting student mobility. However, the problems of establishing equivalency between courses at two universities with dissimilar cultural and curricula structure makes the process difficult. The NECTAR project developed a conceptual method and practical systems through which university course credits can be recognised and transferred among educational institutions. In order for this to happen satisfactorily, the participating institutions have to know enough about each others' courses to be able to place students in host institutions. They must also have a consistent approach to the acceptance of credits that the students have obtained abroad when they return to their home institution. This involves not only knowing about the course content but also about the socio-economic and legal system of the host institution and country.

The NECTAR project has developed knowledge trees (Les Arbres de Connaissances) as a method of demonstrating and classifying the knowledge content of university courses – or, for that matter, general communities of knowledge. The system is based on a number of concepts. A unit of knowledge, know-how, skill or competence can be represented by a "brevet" with a specific position in a tree (metaphorically, part of the trunk, or branch, or a leaf). An individual's "blazon" can be represented by his collection of brevets, representing his combined competencies, part of which will be depicted on the tree of a particular community of knowledge. A complete tree

NECTAR – Knowledge Tree for Negotiating European Competence Representation and Recognition

can represent the combination of competencies held and used by members of a knowledge community.

Universities may employ the concept as a way to display knowledge and competence development associated with a given field of study. Other universities then can illustrate how their curriculum maps onto the knowledge tree. The Knowledge Tree provides a detailed mapping of competencies. The NECTAR method employs software tools that support the brevets, blazons and tree and provides measures of relationship and proximity. The software makes the needs and competencies of the community and individuals visible so that participants can negotiate credits transfers and recognition.

Meeting the learning needs of small companies and individuals

Increasing the accessibility of learning facilities to small companies and individuals who may have limited funds for buying new technologies is one of the most difficult challenges. Focussing on smaller companies the EAST project has developed facilities for accessing and distributing computer-based learning materials. Where possible the tools consist of "off-the-shelf" products which may already be used by small companies but have been integrated together to be used in a learning environment. The FARMERS project addressed the needs of agricultural and rural communities. The MMF-DM project addressed one part of the health care sector increasing the accessibility of knowledge aimed at people with insulin dependent diabetes, their carers and non-specialist medical professionals. The SMILE project established a European-wide network based on Training Technology Support Units for increasing the access to learning resources for small and medium enterprises. The potential of cable TV for individual learning was also investigated through a concerted action.

EAST – Accessing and Distributing Computer-based Learning Materials

Focussing on the educational and learning requirements as well as the technical requirements to enable them to happen, the EAST project defined and developed a set of server facilities for accessing and distributing computer-based learning materials, for learners, tutors, training managers and training administrators. This set consists of 26 tools to support various users through an "Interaction Management System". A learner coming to the system's intuitive graphical interface is provided with information about courses available through browsing tools, and can move from this phase directly into a learning phase. Users can also get further assistance in a pre-learning phase which matches their capabilities against job or career requirements and helps define training needs and course planning. In the learning phase, the learner is provided with the courseware delivered by the training server and the results are monitored. In this phase tutor and manager intervention is supported, allowing private communication with a specific learner for whom new services can be installed. The courses are then evaluated against the learners' achievements and each learner's goal is adjusted with revised skill levels and job role options. There are also particular tools provided to administer and manage the provision of learning services in terms of planning, accounting and monitoring service quality.
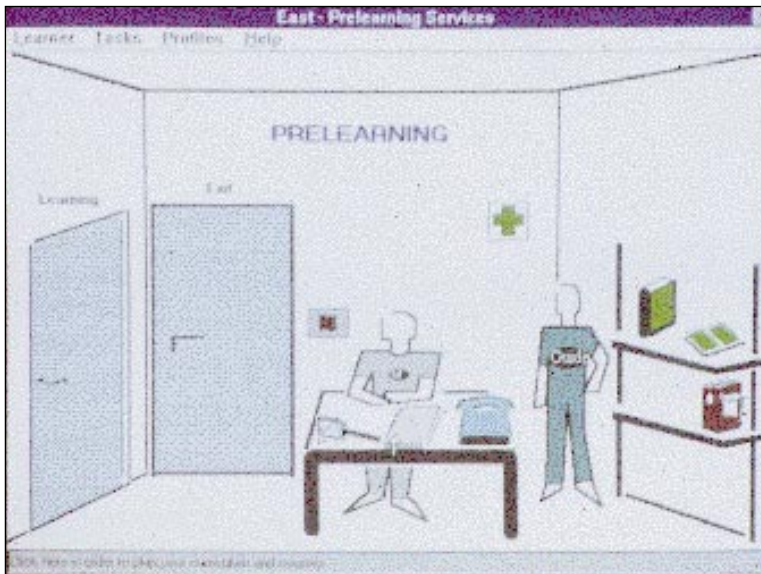
The system conforms to commercial system engineering and architecture principles. Individual tools are integrated into a single multi-user database. Some of these tools have been specifically developed for the project and others, wherever possible, were selected from off-the-shelf products.

Analysing the factors governing the development of flexible distance learning in European agricultural and rural communities, the FARMERS project focussed on the conditions determining the feasibility of transferring a national system from one country to another; the conditions for a common system designed directly on a transnational scale; and the conditions required for creating a European institutional network to provide facilities and support for the use of flexible distance learning. The body of knowledge and know-how from this exploration has showed that the best resource is not one which is ideal in terms of content and form, but one which is sufficiently flexible to allow the trainer to adapt and appropriate it in the light of his or her own training practice and style, and the particular circumstances of the pedagogical situation.

**FARMERS – Towards a Multimedia Training Network for Farmers**

The project prototyped a common system, using interactive video-conferencing sessions involving around 150 participants – consisting of wine producers, technicians involved in wine making, and young people in vocational training who used native languages. The project demonstrated that the common system was not "the best course", but it was shown to be a powerful means of focussing the trainee's attention on the European professional dimension and the benefits of inter-cultural exchanges and a very powerful cross-cultural learning medium. It had a major impact in three areas: teacher training, language and audience issues, and the wine growing/producing sector. A deeper understanding was gained of which component parts of a course could be adapted to varying degrees depending on local group needs. This does have implications for developing multi-national skills-based vocationally-oriented courses.

MMF-DM – A Multimedia Framework for Diabetics Education

With the aim of developing an interactive multimedia framework which can be used for a range of health care learning programmes, the MMF-DM project piloted a CD-ROM on "Learning Diabetes." This is aimed at people with insulin-dependent diabetes, their carers and non-specialist medical professionals. Experience gained from testing this framework will enable the further development of multimedia learning applications. An interesting

feature is the facility for the user to complete a profile at the start of the programme, which will influence feedback throughout its use, thus tailoring it to user needs. The program uses the full range of multimedia – text, graphics, photographic stills, and full motion video – with the core program held in a series of files so that it is relatively easy for files to be changed, to accommodate different language versions, or videos reflecting local practice.

MMF-DM system
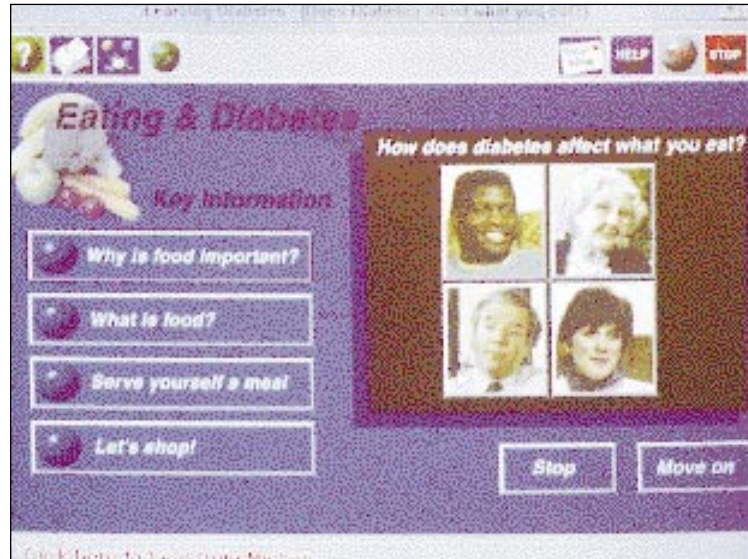
SMILE – Training Technology Support Units for SMEs

The SMILE project demonstrated the need to adapt training systems and methodologies to the specific needs of small and medium enterprises (SMEs). SMEs tend to identify their training needs in terms of specific problems they want solving. These needs are usually short-lived and sporadic. What training they need to have must be in their native language and usually involves small numbers of people. The project found that SMEs are receptive to flexible and distance learning, but that they do not usually have the equipment to use advanced technology or the ability to invest in it.

Therefore, the purpose of the SMILE project was to develop an organisational, technological, economic, and social infrastructure that would increase the availability of training for small and medium enterprises. The project implemented a system of 15 Training Technology Support Units (TTSU) in 12 European countries plus Canada, to support the promotion of flexible and distance learning for SMEs, then designed and tested a system to provide a variety of services by connecting the TTSUs with a network. The TTSUs are based on existing local or regional SME support structures and are open to the SME owners/managers, their employees, young adults seeking employment in local enterprises, the unemployed seeking re-entry into the job market, vocational trainers, local trainers, suppliers, and other interested individuals.

The project also developed support systems through which programmes for SMEs can be delivered. The TTSU services include: training needs analysis, information on alternative learning technology materials, demonstration, training consultation, hot line and technical support. All TTSUs provided the foregoing services. Additional services were offered only in certain TTSUs, for instance, training, inter-mediation with producers, research and development, and production and adaptation of course materials.

Virtual European Resource Centre

Each TTSU implemented one or more existing products based on a technology – these included satellite, multimedia/video disc and video/software/computer conference products. During the latter part of the project innovative technologies were used involving the training of SME managers and employees through direct broadcast satellite (DBS), digital audio servers and ISDN. The lack of standardisation of ISDN and its unavailability in peripheral regions did create some problems.

The TTSU course offerings and service were also improved by networking the TTSUs together which resulted in a "Virtual European Resource Centre". This concept included a "virtual library" of learning products distributed to the TTSUs, and had the facility to demonstrate, at a distance, learning products installed on the publishers' servers. There was also the facility to demonstrate and use training materials available at another TTSU. A computer conferencing system and electronic data interchange was implemented between the TTSUs for global co-ordination and direct access to a centralised SMILE database, and there has been diffusion of technical training modules and management information via direct broadcast satellite.

The project also highlighted issues that arise in designing systems to support SME training and development. For example, SME demand is not expressed in traditional "training needs" terminology, but rather in terms of technical and organisational problems to be solved. SMEs needed help in collection of unpaid invoices, how to use computers, and how to implement a safety and security programme. It was also found that SMEs are poorly equipped with the appropriate computer and telecommunications hardware and software necessary to use multimedia materials.

Although none of the projects focussed on utilising cable TV networks for flexible and distance learning, the concerted action on "Potential of Cable Television for Education" addressed the issues surrounding this form of technology which could give accessibility to large numbers of individuals. It concluded that little use was being made of cable systems at the time of the survey (1993). But within the coming years technological developments will provide affordable interactivity on cable networks, and some cable operators could be receptive to developing value-added learning services. However, the development of the technology and its implementation is hampered by regulatory and legal restrictions. In particular, where interactive services are not allowed on the cable TV network, cable operators will not move fast to upgrade their networks for fully two-way traffic. Another obstacle is lack of standardisation.

Educational potential of Cable TV for individual learning

3.3 Improving quality, defining standards, understanding and stimulating the market

In order to stimulate an eventual large scale uptake of advanced learning technologies, a number of issues have to be addressed, particularly in a heterogeneous market as can be found in Europe with its wide cultural and linguistic diversity. A common understanding and a common vocabulary has to be found when having discussions about new learning technologies. Common standards have to be agreed and adopted concerning hardware, software and communications, otherwise the market will become fragmented

and lack of interoperability will reduce the potential for creating value-added products and services. All these issues have been addressed by the CTA (Common Training Architecture) project.

In addition, there have also been a number of horizontal actions which have addressed market, dissemination and evaluation issues. The BEACON project created a European market observatory, with some conclusions as to the present stage of the market and some future predictions. The T3RT project established a Training Technology and Telematics Round Table to stimulate wide acceptance of information technology and telematics for training and education. It aimed to identify and resolve the key road blocks, from a market perspective, for the effective utilisation of training technologies.

The TRIBUNE project aimed for widespread dissemination of the projects' activities and the ARTICULATE project has worked with the pilot application projects to encourage the refinement of their evaluation processes in order to enable them to gain a deeper understanding of the complexity of the processes involved, thus helping to improve quality. There have also been a number of concerted actions and studies which have brought experts together from outside and within the Telematics for Flexible and Distance Learning Programme, to discuss and gain a deeper understanding of particular issues relating to the Programme.

CTA – Harmonisation of Technologies that Support Learning

The Common Training Architecture (CTA) project has focussed on the harmonisation of technologies that support learning in a wide sense, that is including production, delivery and support of education and training. It has contributed to the development of proposals and the achievement of consensus on the adoption of common standards, particularly in the key areas of communications, information management and user interfaces.

The project has produced an 11-volume CTA Handbook with annexes. Each volume is aimed at different actors. The Management Summary is aimed at senior decision makers who wish to gain an overview of the relevance of the CTA. The CTA Overview is aimed at learning professionals interested in the CTA and the Open Communication Interface is aimed at telematics implementors. The Common Information Space is aimed at database implementors whereas the Common User Interface is aimed at user interface experts. The CTA Scenarios and ELT Framework are aimed at learning professionals who wish to use the Common Training Architecture.

The follow-up project CTA-II is validating and updating the Common Training Architecture by applying CTA to the implementation of a distributed CTA demonstrator in collaboration with some of the projects. The CTA project took great care to justify the development of the CTA in terms of the benefits both to users and to implementors of learning technology, in particular to assist "learning businesses" to harmonise existing technologies that they use and describe their longer-term needs in a way that would maximise their chances of satisfying them cost-effectively using standard products. It is doubtful that such an activity as CTA would have been supported except with European Union funding.

BEACON – Understanding the European Market

The BEACON Market Observatory concluded that 1993/94 resulted in the emerging development of flexible and distance learning (FDL) markets in some individual European countries, but that it is still not possible to talk in terms of a Europe-wide market. However, during the last year, activities were observed that suggest the European Market is at its birth. The BEACON "Delphi" survey involving European experts predicts that the market will become fully developed in ten years time. Therefore, the BEACON project considers that in the meantime there should be continuous and coherent

support and awareness-raising activities amongst public and private bodies to make sure that the market does not fail to deliver its potential.

Telematic-Based Training
Infrastructures

The market for FDL and learning technologies still only constitutes a small part of the European education and training market. However, many education and training organisations are being forced by commercial, financial and competitive pressures to consider and examine new learning methods and the advantages which they give.

The project considers that a number of areas should be highlighted as high priority investments. These comprise: infrastructure creation and mobilisation, training of tutors, trainers and teachers, awareness raising programmes and the development of European networks. In some countries more than others the role of public funding should still be to reduce the risk of investment in new innovative learning and teaching approaches and to improve information and communication within the market. In all countries, public funding should be targeted at increasing the accessibility of education and training to the disabled and otherwise disadvantaged people within the Union – and technology-based solutions have a significant role to play as well.

Economics of Flexible and Distance Learning

Some of the Union Member States contain a comparatively high number of FDL and learning technology producers – however, most of these producers are small in size, produce a small range of products and lack the necessary capital resource to make any real impact on the open market. The Delphi study panel expressed a lack of confidence in the ability of the specialised "middle-person", such as training institutions, to fully implement FDL. Instead they considered that the development of multimedia producers and the new position of the Telecom operators as major training providers is expected to be of much greater influence. According to the ARTICULATE evaluation, market research on the use of new technologies for learning tended to show that the current situation of a myriad of broadly similar products will mature in time to produce a smaller number of de facto standard commercial products offered by those companies which have good financial and marketing resources.

Investigation on Telematic Networks for Tertiary Education

The BEACON consortium considers that so far in Europe the diffusion of learning technology has been largely supplier-led and dominated by publicly funded research and development, but by the late 1990s this seems set to be replaced by a diversity and sophistication in the demands of user organisations, which will be coping with the increased importance of knowledge and continuous and rapid change in their operating environments. In the less developed parts of Europe, organisations have less learning technology research and development experience and these countries will still provide public funding for large numbers of research and development projects.

The Study on "Telematic-Based Training Infrastructures" found that education and training does represent a big market with an existing supply and a large potential demand. But, the lifelong learning market is not fully optimised, nor even yet sufficiently established. The costs for information retrieval and further education (and for services in general) are not accepted by the customers. The pressure to co-operate and to enable benefits from scales of economies is not yet strong enough. As it was considered that this situation would not change in the short term, the idea of value-added services was recommended – these would not be in competition with existing market players, but would greatly profit all players and potential customers/learners.

This added value concerns mainly the gathering and processing of training-relevant information, the marketing and brokering of this information and the establishment of a clearing point between training and producing organisations. Detailed recommendations were made as to the establishment of a transparent telematic infrastructure to support these value-added services.

The BEACON project has produced an "Implementation Handbook" based on substantial surveys of the European learning technology market, offering advice to the open and flexible learning providers, and thus to helping to create a growing market. The Implementation Handbook provides practical guidance on tactics and operational procedures to follow when implementing learning technologies. Each section is followed by questions to assist self or institutional assessment of current practice with implicit advice for future direction. The advice draws on the outcome of research undertaken by the project.

Very few of the projects have explicitly conducted an economic analysis of the cost-effectiveness of the learning experiences they have developed. This is partly because most of the developments have been at a research and development level and have only reached a "proof of concept" pilot stage towards the end of the project. However, as has been concluded in the Concerted Action on "Economics of Flexible and Distance Learning", there is a need for all pilot projects to conduct an economic analysis when presenting an application for funding. This may not eliminate the risk of failures, but it will force projects to face the issue of cost-effectiveness more seriously and at a much earlier stage.

T3RT – Training Technology & Telematics Round Table

The Concerted Action study considered that economic analysis of a flexible and distance learning (FDL) system is not something that can be separated from pedagogical or organisational analysis, because some of the important benefits depend on learning effectiveness and organisational impact. Effectiveness of learning systems largely depends on the capacity to stimulate an active involvement of learners. This involves moving from the dominant "teaching" paradigm towards a "learning" paradigm in the design of technology-based learning systems. The existence of benefits in FDL largely depends on this condition, without which an economic analysis looses much of its value.

Some analysis of cost efficiency was conducted under the Study "Investigation on Telematic Networks for Tertiary Education." By conducting a comparative cost analysis of four educational scenarios using telematic and conventional methodologies, the study concluded that a general assumption of cost efficiency of telematic network applications, relative to conventional modes of course delivery and teaching, is unwarranted. However, the analysis did indicate that there are circumstances in which the application of telematic networks for education and training does offer a potentially cost-efficient alternative.

TRIBUNE – Dissemination Activities

The results of the cost analysis for some media is highly sensitive to the context. The exclusion of direct costs incurred by students in purchasing computers and modems, for example, or the inclusion of the opportunity cost of student travel time, significantly alters the throughput required to achieve unit costs equivalent to those for more conventional modes of course delivery.

At a specific level the analysis showed that satellite TV in most cases is less cost-effective than postal delivery of videos; but can become more cost-effective as the number of students grows large. In addition, given the under-developed character of postal services in some parts of Europe, and the complexity of working with several national systems, satellite TV offers a single integrated solution to the requirement of Europe-wide delivery of video. The analysis further suggests that, given large student numbers, where the cost of domestic satellite receivers are omitted, and overnight transmission rates apply, satellite delivery of video to students' homes can provide a cost-effective method of delivery.

The "Telematics based Training" multi-site conference (Photo courtesy SNE)

Even though computer conferencing can be shown to be cost-effective given reasonable student travel and opportunity costs, computer conferencing has limited economies of scale from a provider viewpoint because of the need for tutor/student ratios similar to conventional tutorials. However, if students have home or workplace access to the appropriate hardware, software and telecommunications, it can provide an effective method of extending access and support even for small study programmes.

Video-conferencing used for video lectures can be cost-effective at a relatively low hours of usage per year, where the distance between centres is above 50 km. At present, however, the initial capital outlays required are substantial. A potentially significant factor affecting costs is the decreasing requirement for bandwidth, opening the way to the use of ISDN in video conferencing and substantially reduced charges.

The study into the "Potential of Cable TV for Education" concluded that educational programming is an important and rapidly expanding element in the cable TV market, but that even in North America, it is not yet commercially viable, with programmes still subsidised. Therefore, in Europe with its uneven spread of cable TV provision and its linguistic variety the prospect of self-sufficient educational programming would seem to be even less likely.

The Training Technology & Telematics Round Table T3RT was established under a charter as a "club" to bring together European providers and users of training technology and telematics in an informal setting. It considered strategic issues and problems related to the training technology and telematics market and produced recommendations which were made available to any interested party. It also aimed to stimulate the demand and market uptake of existing and emerging training technology and telematic systems.

The Round Table established seven working groups focussing on design migrations, delivery mechanisms, technology for traditional trainers, the market aspects of a common training platform learning, organisations, stimulation of publishers and copyright issues. This provided knowledge and know-how of the current and future training needs of major corporate organisations which will be useful to identify where there is a need to find technological solutions. It also added to knowledge in this developing field of using technology based training from an end user perspective.

"Telematics for Education and Training DELTA '94"

The TRIBUNE project has primarily been responsible for on-going dissemination activities throughout the Programme. It has produced a series of eight publications in English with some in German and French, reporting and explaining activities in advanced learning technology, in general within the wider Europe and on the activities of the projects in particular, resulting in the printing of over 35000 copies. The project has also created 20 national networks in Europe, involving over 150 actors consisting of persons and institutions, and has produced 59 issues of the Fax and Email Bulletin sent to project contractors and other interested persons. It has acted as a news agency and placed articles in key magazines throughout Europe. A Common Database of project information has been created in an electronic format, some of which is publicly available via the Internet.

The project has collaborated with the Commission in the organisation and co-ordination of conferences including the National Networks' Delegates conference in Geneva in October, 1994, the "Telematics for Education and Training DELTA '94" conference in Düsseldorf, in November, 1994, and the Concertation Meetings

(DeCoMes). The DeCoMes have been held four times a year and have enabled each project to give presentations of its activities and provided an opportunity for discussion amongst the projects on topic of common interest.

Live satellite broadcast at the Telematics for Education and Training DELTA '94 Conference

"Telematics based Training", a major trans-European multi-site conference, was organised in October 1993 by the Commission with the support of France Telecom and the EU Value Programme (which is responsible for dissemination activities). With central theme of the conference related to the question "How can Telecommunications networks and multimedia tools improve lifelong learning for the citizens of Europe?", the conference provided on-line demonstrations and exchanges about the state of the art in the projects and more widely of distance teaching research. During the two days, researchers, decision makers, and other experts in distance learning met in seven European sites. At various times during the conference they were all linked together via satellite and ISDN video feed-back facilities enabling Pan-European discussion.

NORDIC countries

EU-Canada FORUM

ARTICULATE – Evaluation Activities
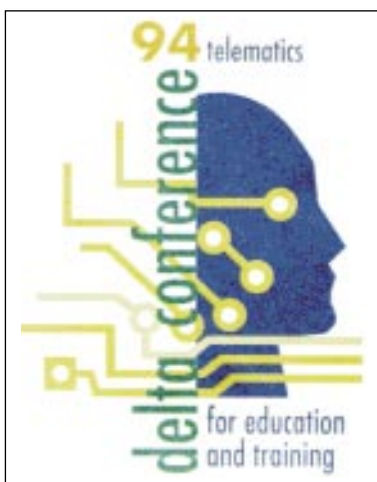
Cross-Cultural Issues

In November 1994, over 900 people attended the "Telematics for Education and Training DELTA '94" conference near Düsseldorf in Germany. There were

Innovation Transfer

over 100 presentations in plenary sessions, parallel sessions and workshops, where there was an opportunity to present the results of the Programme and find out about other activities from speakers all over the world. Almost all the 30 projects gave demonstrations in the exhibition area and there were also live video and satellite links to Canada, Mexico, France, Belgium and Greece. The proceedings of the conference have been published.

Organisations in the Nordic countries who were not involved at the start of the Programme have been actively encouraged to share experiences with the projects through the NORDIC Concerted Action which has established an information brokerage. The aim has been to be "demand led" rather than "supply driven" in terms of what services have been made available.

Links with Canada have also been established through the formation of the EU-Canada FORUM between the projects and interested Canadian organisations. This has resulted in five pilot collaborative projects with existing project partners including a permanent dissemination link with the TRIBUNE project.

The ARTICULATE project has been responsible for assessment and evaluation within the Programme. The consortium has undertaken its own evaluation activities and worked collaboratively with the evaluators and the partners of all the projects. Along with the associated project DEVAL and the Concerted Action on Learning and Pedagogic Research, it has implemented and refined an approach to evaluation and assessment that has helped projects to clarify their decision making process. This has helped to improve the quality of project management.

The project considered that evaluation involves systematic organisational and inter-organisational learning during the process of implementing innovative technology applications into education and training. This learning process is intended to involve all the potential stakeholders in an innovation, all of whom will bring their own criteria and objectives to the evaluation. Evaluation is therefore acknowledged to be part of a negotiated and essentially political process. Placing organisational learning at the "centre stage" also highlights the importance of linking evaluation with decision-making. It is therefore

important to embed an evaluation culture as a continuous on-going process throughout a project.

Cultural differences have long been perceived as a potential barrier to the diffusion of learning technologies in Europe and the establishment of trans-European markets and infrastructures. Consequently, the issue of cultural barriers and the need for a solution is a significant aspect of the programme. In some projects this has led to the translation of products for different cultural or national institutional settings, whilst in other projects, studies have been carried out into differences in learning styles between cultural groups.

ARTICULATE also studied this issue in relation to three projects, looking particularly at the structure and management of projects and how cultural issues affect co-development and transfer activities. First of all, it highlighted culture as an on-going process rather than a set of factors that research can isolate and handle in a rationalistic way. Secondly, ARTICULATE has shown the extent to which the projects create a very complex context for co-development where cultural differences are only one of a number of differences. Professional differences, inter- and intra-institutional differences, as well as the various specific project characteristics are all shown to have affected the ability of projects to work harmoniously and to transfer their know-how outside the project. Thirdly, the projects have, in general, been dominated by the classical hypothesis about technology progress: that it is neutral and transcends the real world of differences in language, class and gender. In terms of the partnerships within the projects, the ARTICULATE consortium found that "culture is almost never addressed, either from an ethical, organisational or professional point of view" and has therefore made a number of recommendations.

A critical feature for any research and development activity involves the successful transfer and embedding of the innovation into its "normal working environment". A number of projects have gained useful practical experiences in this area.

The ARTICULATE evaluation found that most of the pilots extended and supported existing social, institutional and pedagogical arrangements; but they did not develop new paradigms. However, the new technologies have provided vehicles for extending traditional teaching forms such as lecturing and group learning to the distance learning environment. It also found that the uptake of new technologies is most successful when teachers and trainers are truly and decisively involved in their design and use from the beginning, and when they are provided with appropriate resources and support.

The MALIBU project also demonstrated the practicability of integrating technology-based training support with existing industrial training systems. It highlighted the need for the continuing involvement of tutors in these new learning processes, for good user interfaces, robustness and functionality of the systems, adequate training of learners and tutors, and for careful planning of organisational integration. The project emphasised the need for training systems to be integrated with the organisation's existing computing and telematic communication system.

The ARTICULATE evaluation found that in order to realise the potential of new learning technologies, their use must be fully embedded in an institutional setting with key people within the organisation supporting and promoting the programme. Furthermore, large scale initiatives require considerable support at the local level.

Introducing an innovation into an organisation was foreseen by the MTS project as a process that needed to be understood, so that a study on management innovation was carried out within the project – however it found

"Interactive Learning"
(Photo courtesy of Sheila Forman
Open University)

4   Overall Conclusions

Based on the three main challenges of the current programme the following conclusions have been drawn.

Improving access to learning facilities

The Programme has laid the foundations for improving access to learning facilities. It has enabled the creation of a number of networks for specific learner groups, although this has not resulted in the establishment of an integrated infrastructure for flexible and distance learning.

Based on 15 existing Training Technology Support Units a European-wide network has been established for increasing the access to learning resources for small and medium enterprises.

SMEs

Aiming to develop the concept of a virtual European Open University Network, a European-wide integrated telematic network has been established, which by 1996, will be used by over 6000 fee-paying students working from home or from 50 local EuroStudyCentres.

Virtual European Open University Network

An experimental multimedia teleschool was established involving the delivery of 15 distance learning courses to more than 1400 learners from 60 European companies and institutions within 12 countries. It utilised computer conferencing and satellite TV broadcasting with interactivity through ISDN. Aspects of these experiments are now being commercially exploited.

Multimedia teleschool for companies

Prototypes have been developed involving systems integration of commercially available hardware, software and communications systems. These could develop as value-added products and stimulate the emergence of an important niche market for customised learning systems, tailored to the needs of a particular training activity.

Customised learning systems

The Programme has increased considerably the perceived value and expertise in the customisation of existing materials for "new technology" methods of delivery – for example, the transformation of printed material into video lectures or computer conferencing courses. It has provided a vehicle for extending traditional teaching forms such as lecturing and group learning to the distance learning environment.

Customisation of existing materials

Positive learning outcomes were observed in pilot applications, particularly where distance teaching and learning was combined with periodic face-to-face interactions in the form of seminars and residential meetings. As yet, this has tended to support existing social, institutional and pedagogical arrangements, but it does provide the basis for the development of new paradigms for learning.

New paradigms for learning

Many projects have highlighted uneven communications technology development across the European countries, resulting in numerous delays in system installation and, in some places, lack of availability. The availability and reliability of cross-border ISDN was a particular problem despite claims by the telecom companies of cross-border European accessibility.

Cross-border ISDN

The study into cable TV developments found that there is a particular need to monitor technological advances (for example in telephony and interactive services) due to the dynamic nature of this sector. There is also a need to stimulate awareness amongst the cable operators and educationalists of its potential for education and training, and thus to encourage greater co-

Cable TV

operation which could lead to pilot projects which will explore the mutual benefits to all.

Satellite TV

Some projects have tried satellite TV – as yet there appears to be little evidence of real sustainable uptake due to the relatively high costs involved, particularly for the use of the satellite and studio time. Deregulation of Telecoms, new digital compression techniques and alternative production techniques could create new cost-effective opportunities in the future.

Computer conferencing

Those projects that used computer conferencing found that it can offer cost and logistical savings over face to face classes, but it may not provide economies of scale. There is also some evidence that teaching via computer conferencing can take more tutor time than an equivalent course taught face to face, but it can increase flexibility for both the tutor and the learner as well as increasing accessibility. This does increase the opportunities for more students throughout Europe to have access to a wider variety of learning resources with remote tutorial support.

Meeting the increasing demand for cost-effective solutions

Cost-effective methods for design and production

A number of software "tools" have been developed which will enable more cost-effective methods to be utilised for the design and production of multimedia learning resources.

Re-use of learning materials

A cost-effective process has been developed which will allow providers to re-use course learning modules in new combinations.

Pick and Mix – materials on demand

A system has been developed to enable tutors to "pick and mix" their own courses and to publish the necessary materials on-demand.

Complexities of cost-effectiveness

A number of studies have been conducted which looked at the cost-effectiveness of telematics-based flexible and distance learning. This has created a body of knowledge but has highlighted the complexities looking at cost-effectiveness in real user environments. There is a need to collect more concrete evidence of cost-effectiveness of advanced technology-based training solutions as part of an on-going process within a project. The early involvement of commercial companies, or those with the capability to implement the results, is essential.

Speed of technological development

Studies conducted within the Programme seem to suggest that the tight linear planning imposed on the projects can be at odds with the flexibility needed for the exploratory research and development nature of the projects. This has been highlighted by the speed of technological developments in telecommunications and information technology in a purely commercial environment. For example, the emergence and importance of the Internet with the World Wide Web (WWW) as a transportation system for distance learning has only recently been recognised by a few projects. In order to ensure that the technological impact of projects is not reduced, greater flexibility is still needed to enable them to rapidly adopt new developments or easily change direction towards more appropriate solutions.

Improving quality, defining standards, understanding and stimulating the market

Catalyst for European co-operation

The Programme has provided a focal point for starting to raise awareness of the potential of new technologies in education and training and has acted as a catalyst for European co-operation amongst pioneers from many different types of organisations and disciplines.

The projects have highlighted the complexity of issues which need to be addressed when introducing new technologies into what is still a very traditional environment of education and training. Embedding a new innovation into an organisation requires the active involvement of a number of key players.

It has also highlighted the cultural, linguistic, pedagogical and organisational issues which have to be addressed in the emerging but diverse European market for technology-based education and training.

A framework for common standards has been established for hardware, software and communications used in learning technologies. This will reduce the possibility of fragmenting the market due to lack of interoperability.

A market observatory study concluded that a European-wide flexible and distance learning market has only recently started to emerge, although the markets in some individual European countries were more developed than others. A survey based on the opinions of European experts predicted that the market is likely to become fully developed within ten years. During this period there is likely to be an increased demand for lifelong learning, a growing acceptance by traditional education and training providers to adopt telematic systems and increased competition due to deregulation of telecoms which will stimulate new pricing structures and telematic infrastructure development.

Emphasis has been placed on trying to achieve a Europe-wide education and learning system, but it is evident that this "Europeanisation" has not been successful yet. Markets are still predominantly local, regional or national, hence the market for European products and services will still need to be nurtured at a European level.

Whilst experts in a given field are able to come together to co-produce learning materials at the European level, the delivery and support for learners will continue in the main to be provided at a more local level. However, as education and training provision becomes more "Europeanised", providers will increasingly use technologies for widespread delivery.

Many projects have highlighted the need for proper training in the use of the telematic system for tutors, students, and other users. This factor was largely underestimated. This training needs to recognise cultural differences and to adapt the training to local cultures.

Projects involved in market research and dissemination activities found that there is still widespread ignorance of the implications of using telematics in education and training, and scepticism about the benefits. Further demonstrations and validations are needed, and there is a need for broader dissemination activities to encourage the education and training market to really "take off".

Evaluation studies within the Programme have also found that the user base needs to be broader in order to establish durable education and training service networks. One way to accomplish this could be through larger-scale projects, which are driven by demands from the users and not by technology. The Fourth Framework programme will focus on users in large-scale demonstrators and less on research and development of new technologies.

Some projects have started to exploit their results, but many useful ideas, interesting experiences and lessons learnt from the Programme are not yet

Embedding new innovations

Cultural, linguistic, pedagogical and organisational issues

Common standards

Understanding the market

Need for nurturing the market

European co-production of learning materials

Need for training in the use of telematics

Need for dissemination activities

Broadening the user base through large-scale projects

Capturing useful experience

"Individual Learning from home"
(Photo courtesy of Adrian
Rawlings)

5 The Future – Telematics for Education and Training

Aimed as a bridge between the Third and Fourth Framework Programmes and as a preparation for the new SOCRATES and LEONARDO Programmes, the European Commission, during 1994, opened a joint call for proposals involving three Directorate-Generals – DG XIII, DG XII and DG XXII.

Bridging the Third and Fourth Framework Programmes

The aim was to demonstrate effective open and distance learning at the European Union level and establish models for further deployment of network and infrastructure. Projects conducted research into the non technological aspects of open and distance learning within a European dimension.

Three million ecu has been made available which was shared between four projects. TELESCOPIA is implementing a service infrastructure for open and distance learning in Europe based on existing telematic systems. LOGOS is producing adaptable open and distance courseware for small and medium enterprises and persons in rural environments. The EOUN project is focussing on the first-stage development of an open university network for Europe. The HUMANITIES project is focussing on the integration of telematics based training into traditional university curricula. These projects are due to finish at the end of 1995.

"Telematics for Education and Training" is building upon these experiences and those gained within the Third Framework Programme. It is one of twelve sectors in the new "Telematics Applications Programme" under the European Commission's Fourth Framework Programme for Research and Development. The new focus is on using the emerging information and communication infrastructure to convey services which are going to shape the information society of the future.

Telematics Application Programme
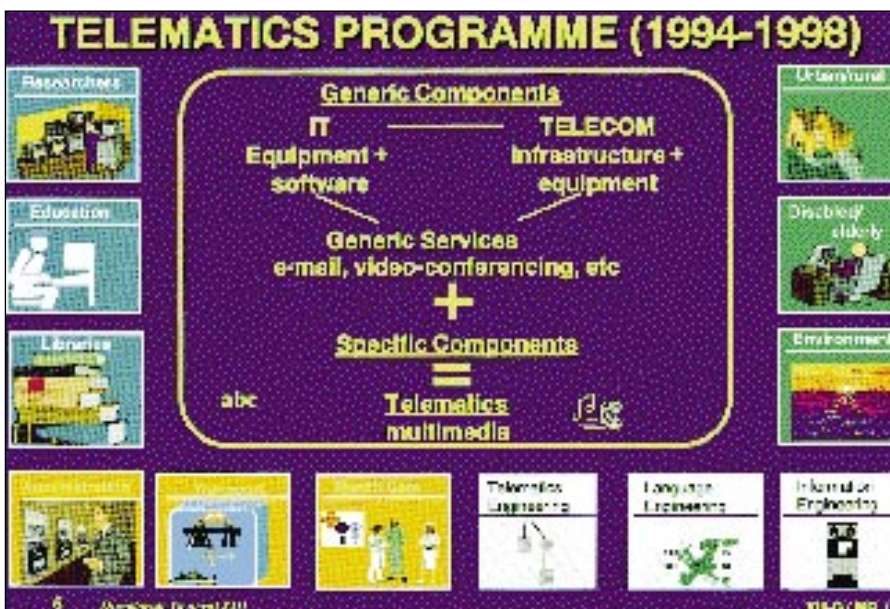
The Telematics Applications Programme has the objectives of improving the competitiveness of industry and the employment situation as well as enhancing the quality of life for citizens, particularly by facilitating equal and universal access to citizens to the information infrastructure. Thus, a wide range of basic policies of the Union are considered, from industrial policy and cohesion, to the more specific ones, such as education and training, research, health care, transport and environment.

From data telematics to multimedia telematics

Research and technology development (RTD) in telematics applications makes it possible to establish a closer link between technological progress and the users' needs. It will concentrate efforts on cost-effective solutions driven by the requirements of the users, whose representatives will be associated at each stage of the projects, from the needs' assessment up to validation. It will address primarily advanced applications involving multimedia. Traditional data telematics will give way to leading-edge multimedia technologies. The Programme will devote important resources to the technical validation proposed, with a view to define standards and utilisation guidelines, enabling intercommunication and inter-operation. It will strive to maximise the generic content of the solutions provided for the various areas. Exploitation of results will be at the forefront of this research.

Application areas encompass most of the public-interest services

The application areas to be tackled encompass most of the public-interest services, which are essential for the smooth running of the Internal Market and to meeting the new obligations of the Treaty of the European Union. The fields to be addressed are all of major political, economic and social importance, such as services for administrations and transport systems, services for improving the quality of life (such as health care, or those for elderly and disabled), urban and rural teleservices, and environment.

Future knowledge infrastructure

A final cluster of applications will define the future knowledge infrastructure which will enable all Europeans to have at their disposal a repository of available knowledge and information, in the form of a network to access the knowledge pool stocked in libraries, in a common research space, and to lifelong learning services whenever and wherever learners will need them, regardless of their location, language or time constraints.

Advanced services will be developed and validated

In all these areas a new generation of advanced services will be developed and validated with users. All these will enable new methods of access, sharing and updating the knowledge.

Telematics for Education and Training Sector

The Telematics for Education and Training Sector has two major focus areas:

■ Experimental Services

■ Innovative Tools and Applications.
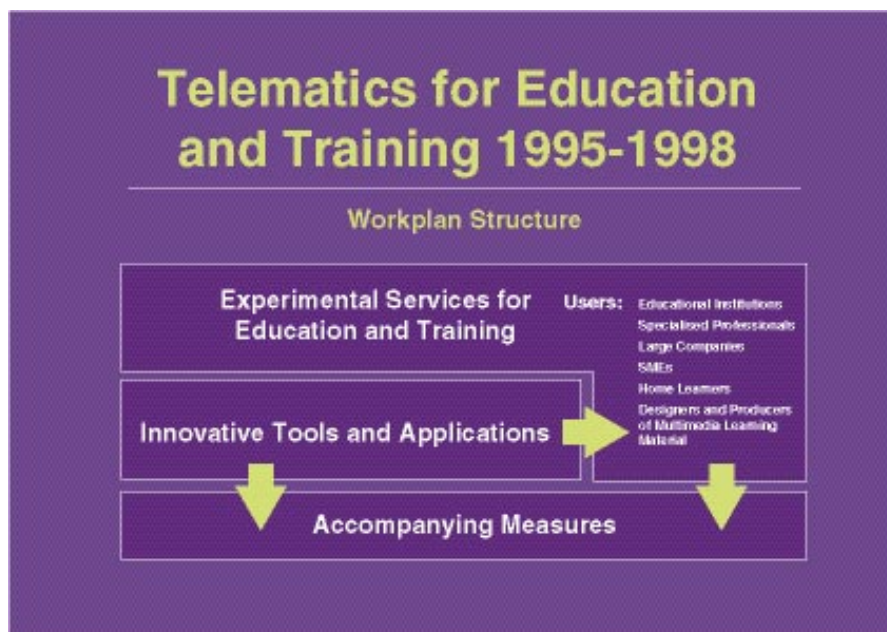
The budget is 66 mecu over the four years from 1995 till 1999.

Most of the effort will go into the Experimental Services. The objective of projects in this area is to carry out validation projects of experimental telematic services for specific user groups. The user groups to be addressed include:

■ educational institutions

■ specialist professionals

■ employees in large companies

■ employers and employees in SMEs

■ home learners

■ designers and producers of multimedia learning material.

It is foreseen that the projects will be large in scale and that more than one user group can be targeted within a given project. By selecting fewer, more strategic projects with a larger budget per project, it is hoped that the impact on the market will be bigger. The main emphasis is going to be on validation of technologies in terms of usability and effectiveness, financial and pedagogical. This can be done on different scales – from the regional to national to a transnational scale. But the result of the projects shall in all cases be a set of guidelines for service implementation that can serve as blueprints for establishment of telematic learning services in Europe.

An important element in all the projects will be the demand or market-driven nature. Projects must demonstrate that there is a user demand for the service and that user groups are involved in all phases of the project from definition of user requirements to the final validation. All projects must thus have a clear path towards implementation. The projects should exploit the technologies as they become available and be innovative both in the pedagogical concepts and in the organisational forms they foster.

The part of the sector addressing Innovative Tools and Applications will be directed towards development of specific tools and also to investigate new scenarios and concepts for telematics-based learning, made possible by evolving technologies, such as digital broadcasting, broadband networks, virtual reality and knowledge-based techniques. These new applications should bridge existing gaps in the provision of learning services. It is envisaged that these projects will generate new products, applications and services which can subsequently be incorporated as part of longer-term telematics experimental services. Some projects will be directed towards increasing the efficiency of the learning situation and the delivery of learning materials – "personal learning systems", "multimedia delivery systems through broadband communications" and tele-classrooms." Other projects will be directed towards the design and production of learning materials. These projects will be smaller in size and will develop innovative educational concepts as potential appropriate approaches for specific user groups. They will be targeted towards the development of tools and applications, but still with the full involvement of users in all phases.

A number of accompanying measures will be tackled. Work in this area will have two major elements: implementation and market studies, and dissemination activities. This will involve specific market studies for the education and training sector, and studies into the implementation of telematic services in market segments not directly addressed in the projects – like for instance primary and secondary education. The dissemination activities will involve the publication of results of the findings in the projects in the Member States and will involve the establishment of user groups

LEONARDO and SOCRATES
Programmes

specially targeted towards market segments not directly involved in the projects, like for instance education and training managers, administrators and decision makers.

The aim of the actions in the Fourth Framework Programme will thus be to boost establishment of telematic education and training networks by supporting user lead experimental service networks, which will validate the factors crucial to success of such networks and demonstrate the benefits to be derived from such service networks. The Fourth Framework Programme can however only play a catalytic role in this process. The service networks will only be a success if they are established by organisations and private companies with a strategic commitment. The Telematics for Education and Training Sector will work closely with other EU programmes and activities in the education and training field including the LEONARDO and SOCRATES Programmes. This will ensure that the research and development work undertaken falls within the broader context of European and member state policy in this field, thereby building on, and exploiting, existing and new education and training facilities and services.

Annex

ACT – Advanced Communication for Training

Purpose

The main objective of ACT was to develop telecommunication facilities which can be integrated into educationally sound and cost-effective ways for corporate training, based on the concept of developing a European Training Network, using a technological backbone of ISDN and satellite communications. The development of the telecommunication facilities was based on three types of learning modes: Interactive Remote Tutoring (IRT); Interactive Distributed Learning (IDL); and Interactive Teleteaching.

Key results

A Multimedia PC CD-ROM based Learner Station using ISDN was developed to give a direct point-to-point connection between tutor and learner, with software enabling screen transfer, data transmission and remote intervention by the tutor to assist the learner in a situation when additional help is required. The Administration and Delivery Centre enables the delivery of learning materials and the management of learning linking a remote host computer, via an ISDN link, to a corporate local area network, so as to centralise all necessary functions for course management and distribution by tutors, course providers and learners. The Corporate Training Server provides a common resource sharing facility amongst learners located on a given site.

Methods used

The Learner Workstation has a smart card facility enabling restricted access and has an extension for voice messages and annotated files to be used in an interactive remote tutoring and distributed learning environment. The Distributed Information Resource, based on earlier work in the DELTA Captive project, has been further developed and a Switching Feed Management system has been produced to facilitate and enable several ways in which pictures and sound can be feedback into the studio from the remote learner sites via ISDN links at various speeds.

Much of the ACT work involved software integration and adaptation of existing systems. There were two short trials of ACT systems, involving training sessions in "English for telecommunications", in order to test the mode of interactive teleteaching and a second course on "Multimedia Communication & Networks". In the extension phase, two further industrial training courses were delivered in automobile mechanics and on electro-pneumatics.

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ARTICULATE – Evaluation of Delta Pilot Applications

Purpose

Through evaluating the project pilot applications, the purpose of the ARTICULATE project was to understand the actual and potential contributions of learning technologies, and to develop new methods for evaluation learning technologies. It sought to understand the actual and potential contribution of learning technology, as well as to promote the emergence of an embedded evaluation culture across all the projects.

Key results

The "Common Evaluation Framework" document, which was developed, provides a conceptual template for each of the components of the total evaluation enterprise. Related to this is a set of guidelines for evaluators, taking them through the stages of designing their own evaluation, and simultaneously providing a common set of evaluation building blocks to ensure cross-programme coherence.

ARTICULATE also produced a "monitoring system" that used both intrusive and naturalistic measures to track the evolution of the projects. The exploration of various themes within the projects was carried out through a series of comparative case studies.

A project liaison system, a programme of workshops and a "help desk" were also set up and run by ARTICULATE.

Methods used

The evaluation strategy of ARTICULATE involved a combination of three fundamental elements: participative project-level evaluation, independent project assessments and an overarching quantitative and qualitative monitoring system. Empirical research was based on both observation of learners, teachers and other actors (at training events such as residentials, meetings, video conference sessions) and the use of semi-structured interviews with the main actors (learners, teachers, co-ordinators, training managers, administrators). The project used a contextual approach which views learning as a social, environmentally embedded activity, and therefore strongly emphasises the importance of both the socio-cultural environment and the institutional or organisational settings within which such training practices take place.

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BEACON – Market for Advanced Learning Technology

Purpose

The BEACON project aimed at developing a market intelligence system so as to provide information on the European Flexible and Distance Learning market, in order to advise the projects on the potential market for their products and the marketing strategies needed to be considered at all stages of project development, thus bringing users and producers together and exploring possible marketing collaborations.

Key results

An "Implementation Handbook", based on substantial surveys of the European learning technology market, was produced to offer advice to the open and flexible learning providers, and thus to help create a growing market. The Implementation Handbook provides practical guidance on tactics and operational procedures to follow when implementing learning technologies. Each section is followed by questions to assist self or institutional assessment of current practice with implicit advice for future directions. The advice draws on the outcome of research undertaken by the project.

A Market Observatory was established and has produced several reports. This was based on the activities of the country-based 11 Market Observatory Points (MOPs).

Methods used

The MOPs conducted National Surveys and compiled a European overview. Regional Surveys were also conducted through desk research, meetings, interviews, analysis of documents, developing partnership and case studies; and specialised surveys were conducted to cover gaps left by the main Market Observatory activities.

National, Regional and Specialised Surveys were supplemented by case studies of 30 policy makers, Learning Technology (LT) User organisations, LT developers and providers, in relation to their strategies for LT implementation, and comparing these with BEACON scenarios. A Delphi survey aimed at projecting future developments in the learning technology marketplace was also conducted

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CO-LEARN – Co-operation in Learning

Purpose

The purpose of CO-LEARN was to develop and pilot a technology-mediated distance learning service that used readily available PCs, local area networks and ISDN connected to a CO-LEARN server. The system was designed to support collaborative learning and teaching at a distance and thus to enhance communications between teachers and learners and between learners themselves.

Key results

CO-LEARN developed a working system that is due to be moved to the commercial market. This consists of the following components: a multipoint audio graphics conference system, called "Real-Time Teleteaching" for communication in small groups; a tele-assistance facility that enabled a tutor to monitor learner's workstations; a real-time teleconferencing system; a shared screen application to facilitate communication among tutors and learners; an asynchronous computer mediated conference system for structured communications in larger groups; and a courseware library with hypermedia editing facilities.

The project demonstrated and documented the complexities of managing, designing and installing a complex learning system in multiple technical, software, pedagogical and national environments.

Methods used

The project identified basic pedagogical units in which communication and collaboration among participants in the education process could be analysed. This analysis formed the basis for the design of technical architecture of system prototypes. The prototypes were then assessed and evaluated in trial schemes, half of which involved trans-European Networks, in various educational, operational and geographic situations.

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COMPILE – Compact Disc Publishing for Interactive Language Learning

Purpose

The overall aim of COMPILE was to demonstrate the effective use of database technology to support the specific area of language teaching. The central idea of the project was to develop a database-supported set of tools for the effective and timely development and production of multimedia language learning materials. In addition, COMPILE had a secondary objective of testing and validating the experiences concerning learning design drawn from the ILDIC project. ILDIC has developed a methodology for integrating learning design into the development process and COMPILE is using the ILDIC results as a point of departure for the development process of its pilot applications.

Key results

Based on a thorough review of learning theories, linguistic theories, and multimedia and computer-aided language learning products, the project has produced a set of specifications, consisting of the basic functionalities which a generic system should support. A complex data model has been developed to support a highly specialised and yet flexible authoring system necessary for the production of language learning materials.

The project has also developed prototypes, which have moved away from the fixed templates originally envisaged, to a more flexible and open-ended system. The final data model supports a library of templates, such as a template editor, a flow editor and a number of content editors.

Methods used

The project produced authoring and production system tools which have been validated by users, consisting of design teams, teachers and learners in three pilot applications. Teachers, multimedia designers and programmers were involved at all stages to evaluate the authoring and production tools, and learners in the three applications (Denmark, UK and Greece) provided feedback on the learning materials.

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COSYS – Design and Implementation of a Computer-Based Course Production and Delivery System

Purpose

The aim of the COSYS project was to establish an integrated distributed environment for the production, publishing and delivery of course material using electronic mail, computer conferencing and ISDN networks. It was concerned with organisational changes, the quality of courseware, cost-effectiveness, changed work roles and skill requirements for producers, authors, trainers, and the learning environment.

Key results

The Pick and Mix system has been developed enabling a customer to access a database remotely in order to get an overview of the objectives, target group and course description of existing course material within a given learning domain. The customer is able to "pick and mix" learning resource modules according to their specific requirements in order to create customised books and training materials.

The project defined the issues arising from the implementation of learning technologies across a mix of public and private organisations in SMEs, multinationals and educational institutions. It investigated at "grass roots level" the long-term shift of education and training towards a more open structure in which the role of the teacher is no longer that of content provider, but a coach and guide to learning resources.

Methods used

Using a "Pick and Mix" system, the project enabled teachers, trainers, publishers and educational providers generally to view and select materials within a given learning domain in order to customise teaching for their own context. This has been tested in a wide variety of end user contexts, focussing on five application pilots for production and delivery of multimedia course material. These were used to validate the feasibility and market potential of the system which has proved technically functional, providing a range of products and services. The use of Lotus Notes as the communications medium of the project was seen as a major learning experience by the project members.

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CTA – Common Training Architecture

Purpose

The purpose of CTA was the harmonisation of technologies that support (or will be able to support) learning in a wide sense (including production, delivery, administration and support of education, learning and training), thus contributing to the development of consensus on adoption of standards, particularly in the key areas of communications, applications and user interfaces.

Key results

The CTA Handbook, consisting of 11 volumes, has been produced. The Management Summary is aimed at senior decision makers who wish to gain an overview of the relevance of the CTA. The CTA Overview plus Annex is aimed at learning professionals interested in the CTA, and the Open Communication Interface plus Annex is aimed at telematics implementors. The Common Information Space plus Annex is aimed at database implementors whereas the Common User Interface plus Annex is aimed at user interface experts. The CTA Scenarios and ELT Framework, plus Annexes, are aimed at learning professionals who wish to use the Common Training Architecture.

Methods used

In close consultation with a number of applications-oriented projects, a common understanding and terminology was developed which led to the development of a common framework – the Common Training Architecture – which was based on a combination of enterprise and informatics architecture. This involved analysing six prototypical CTA scenarios including "professional expertise update" and "open distance institute telematic services".

The CTA project took great care to justify the development of the CTA in terms of the benefits both to users and to implementors of learning technology, in particular to assist "learning businesses" to harmonise existing technologies that they use and describe their longer-term needs in a way that would maximise their chances of satisfying them cost-effectively using standard products.

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(note the prime contractor was EPOS International)

CTA II – Common Training Architecture

Purpose

The purpose of CTA-II was to validate and update the Common Training Architecture by applying it to the implementation of a distributed CTA demonstrator in collaboration with some other projects.

Key results

These are expected to include the CTA distributed demonstrator; an expanded and updated CTA Handbook and a database on integration information.

Methods used

A co-operation request form was distributed to the projects. After discussion it was agreed that the projects ACT/MTS, ECOLE, INDIOS (integration of DISCOURSE and OSCAR), OSCAR, MATHESIS and VALAM would collaborate in various ways with CTA-II. As a separate activity, feedback from the evaluation project ARTICULATE was fed back into the CTA specifications in order to refine and update them (including the CTA Scenarios), and extend them to include evaluation aspects.

Integration work is in progress to update the CTA using the results of the various demonstrators.

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DEDICATED – Development of a New Dimension in European Computer-Aided Teaching and Education

Purpose

The main objective of DEDICATED was to install and pilot test a European-wide network of Local Training Centres with the purpose of using advanced learning technology to train users in the use of Computer Aided Design and Computer Aided Manufacturing (CAD/CAM). The project aimed to provide interpretability between the heterogeneous local training centre platforms with portable tools and develop modular multimedia courses and course elements with facilities for co-operative work and remote access by learners, tutors and teachers.

Key results

Local Training Centres were established in Portugal, France, Germany and Greece in order to test the philosophy and implement the DEDICATED Modular Training System with its extensive multimedia capabilities as a way to improve the education and training results. It was possible to demonstrate the feasibility of the system to operate across a local area network on both MS-DOS and UNIX platforms as well as using TCP/IP to connect to a wide area network so that wherever course files were located, a learner can locally play any multimedia sequence.

The Modular Training System consists of a number of different layers including a Generic Learning Support Layer which provided the generic interface to a local Training Centre. A device-independent Learning Material Layer provided facilities for course development and a technology-independent Course Material Layer supported course provision depending upon learning goals.

Methods used

The project developed a learning structure, learning scenarios and course libraries to give learners access to training materials and established Local Training Centres as centres of local teaching expertise which were interconnected to form a European-wide network of computer-based training sites. These centres supported courseware designers and developers, learners and teachers, administrators and managers. The LTC concept supported different scenarios: stand-alone learning, interactive teaching/lecturing, group learning and distance learning.

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DEVAL – DELTA Evaluation

Purpose

DEVAL was a horizontal project designed to extend evaluation methodologies to encompass the new pilot applications. Its purpose was to develop new frameworks, methodologies, methods and techniques for evaluating learning technology innovation.

Key results

DEVAL was an extension of the ARTICULATE project and built upon its results. The various reports from the two projects provided a theoretical basis for the evaluation and validation activities in other projects.

Methods used

Having studied the state-of-the-art in evaluation of learning technology innovation and observed the projects, the DEVAL project designed and developed methodologies for building evaluation, assessment and testing the learning technology development processes. It considered methods of combining process evaluation strategies with strategies for structured systems development. It also studied the impact of such evaluation strategies on learning technology development efficiency, effectiveness and economy through collaborative work with the projects and CTA (Common Training Architecture) project.

In the DEVAL project, evaluation was conceived as a structured learning and reflection process with ongoing decision and action consequences. It promoted the concept of embedding and dispersing the evaluation and assessment activities across projects and the Programme within an common evaluation framework.

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DISCourse – Design and Interactive Specification of Courseware

Purpose

The purpose of DISCourse was to provide an integrated workbench for courseware authors, with multimedia database access, production facility and a specialised authoring environment for multimedia simulation.

Key results

The DISCOURSE project developed and pilot tested a modular, multimedia authoring environment of tools to support authors in the various steps of the design and production of courseware – including special tools for multimedia comprising the Domain Authoring Tool, the Instructional Design Tool, the Learner Interface and Modelling Tool (which includes a Learner Attribute Database), Multimedia Production Tools, Simulation Tools (DISCOSIM) and the Common Information Space (CIS).

Methods used

The DISCOURSE Authoring tools were formed from a wide range of readily available off-the-shelf tools like editors to handle video, text, pictures and sound and the integration of the Generic Tools Environment (GTE) developed within the earlier project TOSKA. This formed the foundation for interaction with the learner during "instructional decision making".

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EAST – Educational Access and Support Tools

The purpose of EAST was to define and develop a set of server facilities for accessing and distributing computer-based learning materials – for learners, tutors, training managers and training administrators; and to examine the validity of a potential distribution service using these facilities.

Purpose

EAST implemented 26 tools to support various users (learners, mentors, tutors, training managers and administrators) through an "Interaction Management System" which conforms to commercial system engineering and architecture principles. Individual tools are integrated into a single multi-user database. Some of these tools have been specifically developed for the project and others, wherever possible, were selected from off-the-shelf products.

Key results

A learner coming to the system's intuitive interface is provided with information about courses available through browsing tools, and can move from this phase directly into a learning phase, or can get further assistance in a pre-learning phase which matches their capabilities against job or career requirements and helps define training needs and course planning. In the learning phase, the learner is helped to do the courseware delivered by the training server, results are monitored and tutor and manager intervention is supported, allowing private communication with a specific learner for whom new services can be installed.

The courses are then evaluated against the learners' achievements and each learner's goal is revised with new skill levels and job role options. Tools also administer and manage the provision of learning services in terms of planning, accounting and monitoring service quality.

After considerable needs analysis, prototype tools were tested at six sites within three organisations which have considerable experience in open learning; and results checked using structured questionnaires and audio-tapes of the sessions.

Methods used

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ECOLE – European Collaborative Learning Environment

Purpose

The goal of the ECOLE project was to prototype and field test an educationally advanced, cost-effective environment for collaborative distance learning, that is for learning by groups of learners, with members located in different, remote locations. It had the aim of improving the competitiveness of industry by allowing training to be delivered to the work place and adapted to individual training needs.

Key results

The main results of the project are the ECOLE concept, and its design and implementation as the ECOLE Prototype. This has involved the specification of functional requirements and strategies for collaborative use within organisations, as well as the design and prototyping of an integrated user interface, and a range of tools and facilities to enhance a collaborative, interactive learning environment.

In the field of interactive learning, the project produced a range of scenarios for technology-supported collaborative learning, tutoring, course production and delivery in the context of real training settings. Current market developments have also been taken into consideration in order to make the tools and applications future oriented.

In the area of digital telecommunication services, the main contribution of the project was to develop and test new applications for the emerging European ISDN network. A pilot broadband multimedia application has been demonstrated in the context of standardisation and interpretability with other projects.

Methods used

The linking of the participants is based on interconnected local and wide area (ISDN) networks. The first two years of the project involved the requirement definition and prototyping. The third year was devoted to field testing of the prototypes in educationally realistic settings provided by the partners. In addition the prototypes were extended to broadband networks. Validation of the ECOLE design and tests of user acceptance were derived from three field trials.

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FARMERS – Multimedia Distance-Learning for Farmers and Rural Development

The purpose of the FARMERS project was to analyse the factors governing the development of flexible distance learning in European agricultural and rural communities. Three principal types of action focussed on analysing: the conditions determining the feasibility of transferring a national system from one country to another; the conditions for a common system designed directly on a transnational scale; and the conditions required for creating a European institutional network to provide facilities and support for the use of flexible distance learning.

Key results

The major product has been the development of a prototype common system for flexible distance learning, harmonising of training courses, the production of resources, setting up of interactive video-conferencing, teacher training and evaluation. The project demonstrated interactive video-conferencing across four sites using native languages which were shown to be a powerful means of focussing the trainee's attention on the European professional dimension and the benefits of inter-cultural exchanges. It had a major impact in three areas: teacher training, language and audience issues, and the wine growing/producing sector. The project also identified several key conditions for the adaptation of training materials from one country to another, which could considerably decrease costs.

Methods used

The methodology of the FARMERS project was centred on the dynamic of a synergy between partners already embarked on the use of advanced technologies. An iterative method has been developed to understand the transfer processes which include translation and a systematic research into the levels of constraints like content, technologies, culture, pedagogy and economics. The technologies used to give support to the common system included interactive video-conferencing where between 130 and 150 participants took part in the sessions. They consisted of wine producers, technicians involved in wine making, and young people in vocational training. These sessions proved to be a very powerful cross-cultural learning medium.

Video-tapes have been produced by each participating country which related to production conditions and consumer needs.

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ILDIC – Integrating Learning Design in Interactive Compact Disc

Purpose

The principal aim of ILDIC was to improve the design of learning materials using interactive multimedia technologies. The purpose of this work was to provide interactive multimedia development teams with a practical set of guidelines for developing learning material which state the contribution of learning design to the development process and describe the learning design process in terms of outcomes achieved by the multi-disciplinary development team.

Key results

A design model has been produced for use in developing learning systems and applications. This consists of a template for evaluating the design quality of multimedia applications, from the perspective of learning; a set of standards for "learning design" and a description of the key roles filled by members of a development team. An interactive CD-ROM for design teams has also been produced, integrating the design model and the standards.

Methods used

The project brought together experts and practitioners in psychology, learning, software development and multimedia. This combination of theoretical and practical experience has enabled the project team to test ideas about design and development against the methods used by designers and evaluate the quality of results. The design model applies the broad concept of "learning design" to the development of interactive computer-based systems and applications. The project identified a cluster of factors that particularly affect the quality of a product.

ILDIC prototypes were subjected to field testing with users to determine the validity of the underlying learning design model. The standards for learning design have been evaluated by the project team and are subject to further validation by interactive designers in other development teams (for example COMPILE).

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INDIOS – Integration of DISCourse and Oscar

The INDIOS project aimed to integrate the results of the DISCourse and OSCAR projects between the development of collaborative and distributed multimedia courseware authoring tools. The DISCourse and OSCAR projects focussed, in a complementary way, on providing multimedia authoring environments to support collaborative courseware development.

Purpose

INDIOS architecture has harmonised the two projects, and incorporated the specific external tool, Bilko for Windows, for the image processing functions of application experiment which was used with courseware developed for learning about image processing techniques for satellite images. The courseware was developed on four sites and tested on students with various degrees of knowledge and differing learning styles.

Key results

Having identified which components of the DISCOURSE and OSCAR projects needed to be integrated, an external tool – Bilko for Windows – was incorporated to provide the image functions suitable for the INDIOS application experiment. The application used image processing from the remote sensing Landsat satellite with the courseware developed running on a common MS-Windows platform.

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JANUS – Joint Academic Network Using Satellites

Purpose

The principal aim of JANUS was to build a prototype of the telematic network required by a future European Electronic Open University, including the design, development and testing of a supportive, academic environment to assist with the exchange of information and collaborative working.

Key results

JANUS has implemented a mixture of satellite and terrestrial networking technologies. There is a core network of six leased "LanAdvantage" VSAT (Very Small Aperture Terminal) earth stations, all connected via the satellite, with extensions via terrestrial links, including Internet, X.25, ISDN (which allows high quality speech and data transmission) and analogue modem services. An extension into the France Telecom Transpac/Infonet network gives world-wide dial-up access to JANUS services. Access in many countries is nearly completely via local call, for example, in France (via Transpac) and in the UK via BT's DialPlus service. There is also access to the network via commercial Internet suppliers. JANUS VSAT nodes are located in Finland, Greece (Athens and Crete), Holland, Portugal and in the UK.

A spin-off of the project has been the formation of the JANUS User Association which aims to widely disseminate knowledge and know-how in using telematics in education and training, through conferences, demonstrations, and electronic and paper-based newsletters.

Methods used

After trialling several systems, the project decided in early 1993 to adopt, the now widely used Canadian "FirstClass®" software both for electronic mail and for computer conferencing. As well as being connected through the JANUS VSAT core, JANUS FirstClass systems are also connected to most other First Class servers in Europe and beyond.

This telematic network has been piloted with a number of courses oriented towards home-based distance learning, in particularly, utilising the computer conferencing component. Students across Europe have been able to access their most appropriate server in Finland, the Netherlands and Portugal, with students in Greece remotely accessing the UK server over VSAT and others directly through the Internet.

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JITOL – Just In Time Open Learning

The objective of JITOL was to develop and evaluate a new approach to a telematic learning environment for the professional development of individuals. The system used telematic network linking, data and knowledge bases, conferencing and communications to facilitate and encourage collaboration among tutors, students, and, in some cases, other users. It explored ways in which telematics could stimulate and support exchange and sharing of expertise among professionals of similar professional interests.

Purpose

JITOL developed a conceptual framework to support a learning organisation. The project produced a methodology, called "reification", to classify and store contextual knowledge that evolved during interaction among professional peers. Thus, a constantly evolving knowledge base for the professional group was developed. The project provided a method to help professionals explicitly define the knowledge in their professional experience, formalise it, share it with their community. Furthermore it helped them acquire and develop new knowledge and be given credit for their new knowledge.

Key results

It also developed an implementation package, including both software and methodology to run the JITOL system in a variety of domains. The concept involves a "four windows" computer interface to Lotus Notes as a metaphor for professional interactive and knowledge requirements. JITOL reports and documentation provided evidence of users' acceptance, pedagogical effectiveness, costs, technological, socio-legal and other barriers, together with guidelines for good practice. They have made important contributions to the actual implementation of the concept of a learning organisation.

The experiments were conducted over stable wide area networks, based on established protocols, and some small scale advanced local area networks using asynchronous electronic mail and conferencing. Project participants pilot tested the system with three primary user groups – advanced learning technology professionals; medical doctors involved in diabetic self help therapy; and corporate staff.

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MALIBU – Multimedia and Distant Learning in Banking and Business Environments

Purpose

The purpose of the MALIBU project was to assess the cost-effectiveness and pedagogical efficiency of distant and flexible learning delivery services by experimenting with specific applications in the banking sector. Three banks, in three different countries, participated in the project.

Key results

MALIBU demonstrated the practicability of integrating technology-based training support with existing industrial training systems. The project demonstrated the need for: the continuing involvement of tutors in the learning process, good user interfaces, robustness and functionality of the systems, adequate training of learners and tutors, and careful planning of organisational integration. The project also highlighted the need for training systems to be integrated with the organisation's existing computing and communication (telematic) system.

Methods used

The MALIBU-project built upon existing in-company training systems to provide services that emphasised customisation of the learning process to individual learner needs. It stressed interactivity while seeking to enhance the learner's active and creative knowledge acquisition. There were three different methods to support the learning process. The Exploratory Learning Delivery system facilitated learner-driven interaction. The Multimedia Role Playing System stressed interaction between all actors in the training system which included the central department, the local tutor and the learner. The Remote Tutoring Monitoring system supported learner-tutor interaction.

Each of the three learning methods was designed to meet specific training requirements and were tested in pilot sites at banks in France, Italy, and Germany. They supported training management, learning materials distribution, information retrieval, exploration-enabling tools, tutoring and feedback-generating, monitoring, self-learning, co-operative learning in real-time and either among learners or between a learner and a tutor.

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MATHESIS – Stand Alone Workbench for Learners and Teachers

The purpose of MATHESIS was to develop a workbench for the publishing and execution of multimedia courseware and to test this in education and training situations.

The project produced a workbench providing the user with a coherent and flexible "look and feel" both on Macintosh and Windows hardware platforms for accessing either local resources or distant facilities via local area networks and to some extent, ISDN. It contained features to support production and execution of multimedia and hypermedia courseware.

Following trials in real-life environments and validation of the courseware production environment delivered by an interactive multimedia CD-ROM for teaching algebra to teenagers, the project defined a methodology of production under commercial constraints, in close co-operation with two educational publishers.

MATHESIS reported differences in the likely uptake of the workbench between the publishing and the professional training area, with the former showing more interest in the complete system and the latter more in the methodology applied to commercial packages.

MATHESIS developed a stand-alone workbench comprising three tools, available on Macintosh and Windows. The Courseware Authoring System enables an author to create courseware consisting of modules (didactic or simulation) supported by a hypermedia network of information. The Resource Manager enables a learner to customise the learning environment and the Session Manager enables a learner or author to keep track of actions over time.

MATHESIS dealt with the issue of portability by organising the workbench into independent components within a layered architecture using an object-oriented approach, consistent with CTA recommendations. Experiments were conducted to validate the workbench before developing an interactive CD-ROM on teaching of algebra which was field-tested.

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MMF-DM – Medical Multimedia Framework – Diabetes Mellitus

Purpose

The MMF-DM project aimed to produce an interactive multimedia framework which can be used for a range of health care learning programmes and to demonstrate it with a fully functional pilot programme "Learning Diabetes". This was for people with insulin-dependent diabetes, their carers and non-specialist medical professionals (nurses and doctors), in order to promote a better understanding and behavioural change in the management of chronic diseases.

Key results

A CD-ROM "Learning Diabetes" has been produced which will help patients to improve their understanding and control of diabetes. It will enable carers to improve the support they give to people with diabetes and it will enable non-specialist medical professionals to respond more effectively to those with diabetes. It has also produced a framework with which to develop further multimedia learning applications.

Methods used

The program, written in Visual Basic, uses the full range of multimedia – text, graphics, photographic stills, and full motion video – with the core program held in a series of files so that it is relatively easy for files to be changed, and to accommodate different language versions or videos reflecting local practice. Users will normally use the program on a stand-alone 486 PC with a CD-ROM drive utilising MPEG decompression, or via broadband cable in hospitals or in the home. They complete a profile at the start of the programme, which will influence feedback throughout its use, thus tailoring it to user needs. However there is a default profile for a "typical" user.

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MTS – Multimedia Teleschool for European Personal Development

Purpose

As a market-oriented application project the purpose of the MTS project was: to evaluate the effectiveness and acceptance of advanced telecommunications technologies in corporate training; to stimulate the market uptake of telecommunications and DBS technology in order to reach a sectoral critical mass of users in the advanced learning technology market; and to expand and optimise the management of this system as a potential basis for a future European Training Network.

Key results

The project adapted a variety of courses for delivery by telecommunications to more than 1400 learners in 60 companies and institutions involving nearly 80 sites. The project developed considerable expertise, both technical and educational, in the use of interactive television and computer conferencing which could lead to establishing a flexible structure for marketing, implementation and delivery of European level teletraining services even to very remote locations.

The evaluation has shown that learners have very individual styles of arranging their leisure time as well as their pace, contents and learning modes. The MTS technologies opened up possibilities of individualising the training according to the special needs and organisational circumstances of the learners. Another key finding was that the interaction between learner and tutor was central to the teletraining process.

Methods used

The project developed, implemented and evaluated real-life, large-scale pilots, which were based on proven distance learning courses, tutors working for existing course providers, and real learners provided by large and medium sized companies throughout Europe. The subject fields included: English for International Business, Innovation Management, Agrofood, and Improving Environmental Performance. Valuable experience was gained with respect to implementation, acceptance and cost dimensions.

The technologies used were PSDN (X.25), ISDN and interactive satellite broadcasting (DBS). Satellite and terrestrial networks were linked to provide broadcast communications with interactive real time feedback – they incorporated the prototypes developed in the ACT project.

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NECTAR – Negotiating European Competence Representation and Recognition

Purpose

The aim of the NECTAR project was to develop methods through which university course credits can be recognised and transferred amongst institutions in the various nation states, thus facilitating student mobility in the EU. The project supports the ERASMUS European Credit Transfer Scheme.

Key results

A method of classifying and representing a body (community) of knowledge has been developed to support the ERASMUS European Credit Transfer Scheme and software system to support the concept.

Methods used

The NECTAR project developed "knowledge trees" (Les Arbres de Connaissances) as a method of demonstrating and classifying the knowledge content of university courses or, for that matter, general communities of knowledge. Universities may employ the concept as a way to display knowledge and competence development associated with a given field of study. Different universities then can illustrate how their curriculum maps onto the knowledge tree. The Knowledge Tree provides a detailed mapping of competencies.

Using the system developed in the JITOL project, the NECTAR method employs software tools that support the "brevets", "blazons" and tree, and provides measures of relationship and proximity. The software makes the needs and competencies of the community and individuals visible so that participants can negotiate credits transfers and recognition.

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OSCAR – Open System for Collaborative Authoring and Reuse

The OSCAR project aimed to support the training needs of the aerospace industry, by developing and pilot testing software facilities for collaborative and distributed authoring, courseware project management and re-use of existing training materials via local or wide area networks under realistic conditions.

Co-authoring services have been developed that are accessible from a computer desktop connected to a local area network or, on a wider area, via the Internet, or ISDN. Authoring services include tools for the design and production of multimedia. Co-ordinating services support the organisation and management of courseware projects. Collaboration services allow group communication and sharing of documents, information and tools by people working together in the same activity. Co-decision services support decision making by a work group about many factors relevant to the courseware development process, and Re-use services facilitate the re-use of existing training materials, allowing retrieval and adaptation.

The project analysed user requirements for multimedia courseware and decided to use an existing commercial Object Oriented Data Base Management System (OODBMS). The "Object Store" provides a multi-client/multi-server architecture and features a distribution and transaction manager for concurrent access to objects amongst members of a work group.

These production tools recognise the contributions of many actors in the process of courseware production and allows them to be physically widely distributed, and yet ensures that they can share each others' product from the very beginning, and put it all together at the end. The subject matter experts organise the material to be presented; the courseware designers lay out the instructional strategy and the details of the student interactions within that strategy. The graphic designers create interactive screens; programmers implement the instructional strategies and student interactions; and evaluators/testers can assure error-free courseware that meets the instructional objectives. This was actively piloted in the aerospace industry with real courseware planning demands provided the project with immediate feedback on which it has been able to act.

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SAM – Simulation and Multi-Media

Purpose

The purpose of SAM was to specify and then develop a modelling, authoring and learning framework, oriented to teaching using simulations, based on state of the art software tools and allowing the use of commercially available packages. The framework was to be easily extensible, portable across different platforms and operating systems, and supportive of a wide range of instructional approaches.

Key results

A specification of the SAM Development and the SAM Learner Environments has been produced. The SAM Environment controller software has been developed, as well as four SAM demonstrators, two on Mac and two on PC with feedback from users at the project workshops.

Methods used

The project began by specifying a general methodology for simulation-based environments and then developed a general architecture which was based on platform-independent client-server technology, with the exception of the inter-application communications method (such as Apple Events on Mac).

SAM analysed in detail the needs of learners and distinguished five categories of learner need for additional support whilst studying. These included: controlling the course and information space, understanding the subject and retaining that knowledge, analysing and displaying of simulation data, exploratory learning and communication. SAM also looked at the needs of the author and modeller and distinguished three levels: global design including instructional strategy, Instructional Objects – that is, units of learning material – and the actual simulation and multimedia material. Both learner categories and authoring levels were mapped into tools.

Two main experiments were carried out with SAM, based on a socio-economic model of small island states and on a spacecraft cooling system simulation. These used commercially available software (Excel and LabView) embedded in a SAM Environment.

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SMILE – Small and Medium-sized Enterprises Infrastructure for Distance Learning Experiments

Purpose

The purpose of the SMILE project was to increase the availability of training for small and medium enterprises (SMEs) by developing and testing a system of distribution and delivery of training.

Key results

The project implemented an infrastructure of 15 Training Technology Support Units (TTSUs) operating in 12 European countries and Canada, based on existing local or regional SME support structures, and developed an electronic network delivery system through which programmes for SMEs can be viewed and delivered.

The project also demonstrated the need to adapt training systems and methodologies to the specific needs of SMEs. SMEs tend to be solution oriented – they do not usually request training. Training for SMEs must be in their native language. Their problem-solving needs are usually short-lived and sporadic, and their training involves small numbers of people. The project also found that SMEs are open to flexible distance learning, but do not usually have the equipment to use advanced technology or the ability to invest in it.

Methods used

The TTSUs were open to the SME owners/managers, their employees, young adults seeking employment in local enterprises, the unemployed seeking re-entry into the job market, vocational trainers, local trainers, suppliers, and other interested individuals. They used different technology configurations for delivery and support services and tested a variety of learning situations and different content areas. Initially, use was made of existing stable distance learning technologies but later use involved innovative technologies like the training of SME managers and employees through direct broadcast satellite (DBS), digital audio servers, and ISDN. This idea was to develop a "Virtual European Resource Centre" including a "virtual library" of learning products distributed to the TTSUs.

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SMISLE – System of Multimedia Integrated Simulation Learning Environments

Purpose

The purpose of SMISLE was to develop a flexible simulation-based environment for authors and learners integrating the pedagogic aspects, and to test this in pilot applications.

Key results

A requirements study on the use of simulation in education and a functional specification of the SMISLE toolkit was produced. Toolkit software was developed and validated with five pilot applications, two in industrial training and three in education (physics).

Methods used

The software development methodology was iterative with the toolkit substantially upgraded several times in the course of the project. Evaluation was carried out at both the authoring and learner levels. For the former this involved authors of different backgrounds (computer experts, pedagogical experts and domain experts) creating either complete or partial applications under laboratory conditions as well as the creation of the five pilot applications. These five applications were used for the learner evaluations where pre- and post-activity questionnaires were used to evaluate how much was learnt. Learners were either university students or engineers in industry.

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TRIBUNE – Awareness Creation and Information Dissemination

The TRIBUNE project had two key functions: disseminating information and building consensus between the various actors through animation activities.

The TRIBUNE project produced a series of eight publications in English and French with some in German, reporting and explaining activities in advanced learning technology in general within the wider Europe and on the activities of the projects in particular, resulting in the printing of over 35000 copies.

It created twenty national networks in Europe, involving 150 actors consisting of persons and institutions. It also created a database consisting of 4200 entries of actors involved or interested in alternative learning technologies and produced 59 issues of Fax and Email Bulletin sent to project contractors.

It collaborated with the organisation and co-ordination of conferences including the National Networks' Delegates conference in Geneva in October, 1994, the conference in Düsseldorf, in November, 1994, and the Concertation Meetings (DeCoMes) – by chairing and reporting plenary sessions and the special interest pilot experiments group.

It acted as a news agency, placing articles in key magazines throughout Europe, and contributed to the EC-Canada FORUM by establishing a permanent communication link, extending TRIBUNE's work in Europe. A Common database collection of all information on the projects in an electronic format, has been created, some of which, is publicly available via the Internet.

TRIBUNE established two working panels of Experts, one on "Policy Impact" and one on the identification of good practices in the field of flexible and distance learning. These informed the project's working. In the latter five of the eight editions of the TRIBUNE Collection an evaluation questionnaire was attached, to gauge the level of satisfaction of the readers to the quality of information presented in TRIBUNE publications.

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Purpose

Key results

Methods used

Contact

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T3RT – Training Technology & Telematics Interest Group

Purpose

The Training, Technology and Telematics Round Table (T3RT – now known as TIG3) aimed to develop mechanisms to stimulate, on a large scale, the updating of the education technologies market. The Group aimed to give its members, and the market at large, pragmatic advice on the applications of technology for training.

Key results

T3RT identified an important gap between the project, initiatives dedicated to training technology and the daily activities of company training departments and other end-users. It recommended that there should be substantial and focussed action to involve real users all along the education and training chain.

Methods used

Through the operation of a market forum and seven working groups, members investigated a wide range of issues related to the barriers for large scale market uptake of training technology and the priorities for actions to remove these barriers. The results of these investigations were validated outside the groups and formed the basis of the final selection of key issues which needed to be addressed by the working groups.

The market forum held plenary meetings for general discussion and to provide feedback to the working groups. The seven working groups focussed on design migrations, delivery mechanisms, technology for traditional trainers, the market aspects of a common training platform learning, organisations, stimulation of publishers and copyright issues.

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VALAM – Distributing Training with Interactive Multimedia Courseware

Purpose

The purpose of VALAM was to assess and evaluate the broadened repertoire of training methods made possible by the fusion of the ACT and MATHESIS technologies and to develop new training strategies based on this broadened repertoire.

Key results

The project developed an organisational solution for distributed corporate training which included technical architecture for the various actors in the learning space including teacher and learner.

A training course of seven lessons on "Productivity in selling bank services" was developed for use in six branches of an Italian bank, oriented to the training needs of customer service staff for small and individual accounts targeted to promote the use of credit cards by such customers.

Methods used

VALAM began by re-analysing the ACT and MATHESIS systems in the light of CTA principles and the organisational needs. A decision was made to re-implement ACT based on Lotus Notes with attached multi-media courseware documents delivered over an SNA wide area network and to decouple the educational methodologies of MATHESIS from the particular MATHESIS tools, thus allowing a wider range of courseware tools to be deployed.

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D2101 & D2115 – Technologies in Language Learning and Teaching

Purpose

The purpose of these projects was to review a number of key issues involved in the present and future development of technology-based language learning and tutoring with a view to addressing the language learning challenge.

Key results

To achieve improved second-language learning and communication the Concerted Action Group recommended that concepts of life/work-embedded language learning, open integration of learning modes and user oriented technology are built into future strategic language learning developments.

A final report entitled "Flexible and Distance Language Learning – A Technological Perspective" was produced as well as a "digest" brochure of the results.

Methods used

As there are common elements between both the Telematics for Flexible and Distance Learning and LINGUA Programmes a common conference was organised to explore related issues. This conference also launched the start of this DELTA concerted action activity from which came the final report which contains practical experiences of using technology for language learning including some comments about the use of technology. It also provides sound guidelines for future research and technology developments in language learning and the understanding of cultural diversities.

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D2102 – Potential of Cable Television for Education

The purpose of this study was to assess the potential of cable television (CATV) for educational purposes with regard to its potential for flexible and distance learning, both as a complementary service to other infrastructures like telecom networks and satellites and as a stand-alone service.

At the time of the survey (1993) it found that 23 million homes were connected to CATV networks in the countries of the European Union, which covers an area passing 37 million homes. Some CATV operators already use two-way networks, while for others upgrading their networks could easily make them bi-directional and ready for many new applications, such as pay-TV, pay-per-view, provision of high quality radio and TV programmes, data communication and data distribution, tele-working and telephony. However, most operators still restrict their services to audio-visual services for a number of reasons. Strong state control of CATV in most countries often restricts or prohibits services other than signal distribution and prohibits interconnection either between cable operators or between cable and Telecom networks. Telecom operators who are often active as CATV operators limit their use of the cable infrastructure to audio-visual services only. They prefer to provide the other services on their telecom networks.

Specific advantages of interactive cable TV are its capacity for delivery of high-quality moving images and being an easy-to-use and low-cost medium. However, different types of cable operators have different interpretations of organisational goals. Most cable operators are interested in providing value-added-services on their cable but do not see it as their task to invest and promote in such services and feel that it should be left to the programme providers. The limited amount of survey material that was collected has made it clear that the use of cable for educational purposes is mainly limited to the traditional educational activities broadcast on national channels for schools or for vocational training purposes. However, in the USA, Canada and Australia – where there is a strong tradition for distance learning – there are already available programmes, relevant experiments and actual certificated courses.

A comprehensive survey of the cable television networks in Europe was undertaken, including a review of current developments in the use of Cable TV that could be used for educational purposes. The potential of cable television was assessed from five viewpoints – educational, organisational, economical, technical and international.

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Purpose

Key results

Methods used

Contact

D2103 – Multimedia and Distance Learning for Science and Technology

Purpose

The aim of D2103 was to study the use of new technologies in the teaching-learning process in distance education and in particular the role of psycho-pedagogical and didactic theory.

Key results

The proceedings of the conference were produced in Italian and English.

Methods used

A conference was organised in Rome to exchange ideas, experiences and for reflection. It aimed to encourage synergies between research in the psycho-pedagogical and didactic fields and technological research. It was an opportunity for Italian and international researchers and operators to discuss the state of the art of research into cognitive processes and the relevance of this research to the new technologies on a national and international level. Projects from the programme and other projects were presented.

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D2104 – Economics of Flexible and Distance Learning: Cost-Effectiveness of New Media in Flexible and Distance Learning

Purpose

This concerted action was originated by the perceived need to establish a renewed conceptual basis and support tools to analyse costs and benefits of flexible and distance learning when technology-based solutions are adopted.

Key results

It was considered that economic analysis of a flexible and distance learning system is not something that can be separated from pedagogical or organisational analysis as some of the important benefits depend on learning effectiveness and organisational impact. Analysis of costs and benefits is simply part of quality and good practice in the design of learning systems.

Effectiveness of learning systems largely depends on the capacity to stimulate an active involvement of learners. This involves moving from the dominant teaching paradigm towards a learning paradigm in the design of technology-based learning systems. The existence of benefits in FDL largely depends on this condition, without which an economic analysis loses much of its value.

In order to provide concrete evidence of cost-effectiveness for alternative technology based training solutions, there is a need to further develop the existing theoretical models and to acquire new evidence from pilot projects and other empirical sources.

Methods used

In order to define the requirements for future research and action and to compare the existing expertise on the economics of flexible and distance learning with the experience of pilot projects, an expert group was established. The group, who met at four meetings, included some of the most reputed European experts on the economics of distance education and some more technology-oriented experts more familiar with the projects environments.

In addition, more than sixty experts and policy makers from all over Europe attended a workshop, which produced a considerable set of recommendations, collected together in a report.

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D2105 – Pedagogy and Learning: Research for Flexible and Distance Learning

Purpose

This concerted action had several objectives: to gather information on state-of-the-art research and who-is-who in the field of telematics-based learning; to identify requirements for research; to bring together experts in the field; and to bring together experts with project-based expertise both in horizontal actions and in pilot projects. It also had a brief to examine how telematics and technology configurations being used can be capitalised in the right way to cope with different learning styles. It also looked at the selection of appropriate learning strategies and the relationship between various flexible and distance models.

Key results

The substantive findings relate to the theoretical, methodological and policy application understandings that have emerged as the Action has developed. They include generic "pedagogic guiding principles" applied to learning technologies and flexible and distance learning and are drawn from a synthesis of current state-of-the-art research. This resulted in a framework for the design and evaluation of learning technology applications and recommendations for the design and assessment of new pilot projects.

A book on "Designing for Pedagogy" was produced.

Methods used

The Action involved four main spheres of activity: exploration; concertation, dissemination and a theoretical dimension. These four phases were characterised by successive iterations of a "concertation-synthesising-dissemination" cycle through which the understandings gained at a given stage were refined at successive stages. The mechanism driving these iterations was the Pedagogic Forum – a think tank of experts engaged in the operationalisation and implementation of the project.

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D2106 – User & Learner Involvement in Advanced Learning Technology

Purpose

The study aimed to identify and describe good examples of the involvement of different types of users in the design, development and implementation of learning technology applications and to assess the potential and the constraints of user involvement. It also aimed to identify directions and strategies for enhancing user involvement in the future spread of learning technology applications.

Key results

A report was produced which is particularly aimed at those involved in the design, development and implementation of learning technology applications and who are seeking ways of involving users more effectively in the development process. This includes in particular project managers, developers and other stakeholders in exploratory projects where the users and the context in which an application is to be used is not well specified at the outset. The report also explores user involvement in a market and a specific organisational context.

Methods used

Following a search to identify projects in the learning technology field, which could provide lessons about involving users, ten projects were selected as case studies, all outside the programme. They exemplified a wide range of contexts in which stable as well as state-of-the-art learning technologies were being applied.

A concertation event was organised which brought together a group of experienced developers, researchers, evaluators and initiators of learning technology projects to explore emergent practice and thinking about user involvement in the domain of advanced learning technologies. The participants' contributions helped to inform enlarge understanding which had emerged from the research activities.

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D2107 – Flexible and Distance Learning in Remote and Peripheral Regions

Purpose

Since the beginning of the DELTA Exploratory Action a number of relevant national efforts have been initiated in Greece and other remote and peripheral regions of the European Union. The objective of this activity was to facilitate the concertation between key research initiatives being carried out in Greece and in other remote and peripheral regions, through the organisation of two workshops

Key results

The workshops increased awareness about the importance of modern methods of flexible and distance learning (FDL) for finding cost-effective solutions aiming at meeting training needs especially in rural areas and the service sector. They have acted as a catalyst for a wider implementation of FDL in particular in the Banking Sector, where the Hellenic Banks' Association decided to carry out a feasibility study followed by initiating a pilot project.

Methods used

The first workshop "Training the Personnel in the Banking Sector with the Modern Methods of Flexible and Distance Learning" was organised in Athens in June 1993. This was attended by 51 persons representing 15 Greek Banks and other relevant institutions and included presentations from two DELTA projects – MALIBU and MTS – plus presentations from the Directors of the Training Centres of three important Greek Banks and the Hellenic Banks' Association.

The second workshop "Training in the Agricultural Sector with the Modern Methods of Flexible and Distance Learning" was organised in Athens at the end of September 1993. A team from the project FARMERS presented their activities along with representatives of the Greek Ministry of Agriculture, the Agricultural University of Athens, the Agricultural Bank of Greece and the AGRO-UETP, a sectoral COMETT UETP in the Agricultural sector. The workshop was attended by 51 high-ranking staff members from various Greek institutions, government departments and other enterprises.

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D2108 – Design and Production of Multimedia and Simulation based Training Material

The purpose of this concerted action was to bring together experts from DELTA projects and beyond, who were involved in the field of design and production of multimedia and simulation-based training materials, by holding an international conference.

Purpose

The conference produced a useful volume of proceedings, concluding that there was a "remarkable" degree of convergence between the proposed approaches and opinions from the Programme and other projects in the area. It also considered that there was a "surprising" degree of convergence on the need to clearly separate the conceptual representation of the knowledge to be taught, the learning material, and the instructional strategies.

Key results

It felt that multimedia training materials, in order to be cost-effective, must be produced for a large customer base requiring high-quality design and production standards, and production processes that are to a large extent independent of the selected delivery mechanism.

The two-day workshop was attended by more than 90 people from 10 countries and included a workshop which was divided into three parts: Design of Learning Material, Simulation in Training, Production of Learning Material.

Methods used

The programme consisted of survey presentations from invited experts, project reports from the key projects – DISCOURSE, SAM, SMISLE and MATHESIS; reports from other projects related to the area – OSCAR and JITOL; and presentations from other active research projects in the general area.

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D2110 – CANADA

Purpose

The overall aim of this concerted action was to establish a Forum to facilitate, promote and encourage co-operation between EU and Canadian organisations in the field of flexible and distance learning. This included the exchange of information on R&D activities; identification of possible joint R&D projects; and promotion of "test-bed" opportunities, especially in take-up of the project outputs.

Key results

An EU-Canadian FORUM was established with representatives from EU and Canadian organisations. The FORUM has proved effective in strengthening and extending the development of EU–Canada linkages in the field of RTD on Telematics for Flexible and Distance learning and has resulted in five pilot projects being supported as a consequence of the FORUM activities which will provide useful insight on how such joint projects can be implemented successfully. As such the FORUM is providing a valuable platform for future EU–Canada developments; particularly in the context of the EU–Canada Science and Technology Agreement.

The first edition of the EU–Canada Forum newsletter has been produced.

Methods used

Following an EU mission to Canada, where an interest was expressed in co-operative activities, including the launching of EU–Canada projects, the FORUM was established. It assisted in the process of finding partners especially in each other's region, although it did not play any role in the pre-selection or assessment of any project proposals. This has resulted in a number of pilot projects being established. The FORUM continues to be a vehicle for the active co-operation between the EU and Canada.

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D2112 – NORDIC

The purpose of this concerted action was to develop, through a programme common to the Nordic countries, national and regional nodes for DELTA-related information brokerage and partnership support.

The brokerage activities within the NORDIC project had as its prime focus three main target areas: (1) to increase the awareness about and involvement of Nordic actors within the area of telematics for education and training through development and application of findings, outcomes and results from the different initiatives and projects implemented under the Programme; (2) to enable the European actors within the DELTA projects to obtain a better awareness about the actors and developments made in the area of telematics for education and training within the Nordic countries; and (3) to initiate linkages, interactions and potential partnerships between these two actor categories by supporting potential joint actions, collaborative initiatives and partnerships.

Partners have organised a number of workshops and seminars. In addition an electronic information system for exchange of information and brokerage support materials between the project partners was established. This on-line system based on client-server technology using FirstClass software is linked to numerous other servers across Europe and beyond.

The project had as a deliberate strategy to make the regional, sectoral and national brokers involved in a number of events in which they could both inform about the NORDIC project and what it could offer to actors in the area of telematic for education and training, as well as to promote the awareness about and collaboration initiatives between actors from the Nordic countries and participants in the programme. In order to avoid that the initiatives taken became overly "supplier-driven" a unique stakeholder sponsoring system was established in which the support funding was distributed to different stakeholder categories, which in turn could sponsor initiatives proposed by different parties.

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D2114 – Workshop: Flexible and Distance Learning in Remote and Peripheral Regions

Purpose

As a follow-up to the earlier activity D2107, a third workshop was organised which focussed on the links between traditional and open universities and the situation in remote and peripheral regions. Greece is one of the few countries of the European Union without an open university although the Greek Parliament did pass a bill for the establishment of one in October 1992. Since then little progress has been made due to a lack of clarity concerning the modus operandi of the new university. The workshop was oriented to discussing future developments particularly in the context of telematics-based open and distance learning.

Key results

The workshop highlighted the importance of the establishment of closer co-operation between traditional and open universities in Europe. It has also led to many departments and individual university staff, to prepare proposals for the EC Telematics Applications Programme (1994-98). As a follow-up to the workshop, public discussion has started in Greece aimed at the clarification of the points which hindered the beginning of the operation of the Greek Open University.

Methods used

The workshop "Strengthening the links between traditional and open universities: The case of Remote and Peripheral Regions", took place in Athens in June 1994. It was attended by 33 persons representing 16 Greek institutions and enterprises and 11 institutions from other parts of Europe. The first part of the programme consisted of presentations by the projects CO-LEARN, JANUS and JITOL and representatives from other open universities and distance learning associations from various parts of Europe. The second part included presentations of a number of Greek projects including the electronic library for Byzantine History and Art by the Lambrakis Foundation, distance teaching initiatives of the Organisation for Vocational Education and Training and distance learning activities of the Macedonia UETP.

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Telematic-Based Training Infrastructures Study

The purpose of this series of four related studies was to look at the developing use of telematic networks for education and training in Europe, and to make recommendations as to the work programme which in the short, medium and long term would aid the effective use of telematic networks in this area.

Education and training represents a big market with a live supply and a large potential demand. This market is not fully optimised, with lifelong learning not yet sufficiently established and the costs for information retrieval and further education (and for services in general) not accepted by the customers. The fear of contact between the supplying and providing players of the education and training market remains substantial, while the pressure to co-operate and to have benefits from economies of scale is not yet strong enough.

As it was considered that this situation would not change in the short term, the idea of value-added services was recommended which would not be in competition with existing market players, but would greatly profit all players and potential customers/learners.

The added value concerns mainly the gathering and processing of training-relevant information, the marketing and brokering of this information and the establishment of a clearing point between training and producing organisations. Detailed recommendations were made as to the establishment of a transparent telematic infrastructure to support these value added services.

Four studies were carried out in parallel in order to bring together the different experiences and approaches in the field of distance education and training and to develop together a common operational environment for telematics based training infrastructures. Three studies investigated the use of telematic and organisational infrastructures in the market segments of tertiary education, vocational training and for the professional updating of engineers, scientists and managers. These studies were carried out by representatives of the market segments: EADTU (European Association of Distance Teaching Universities), CONDAT and EuroPACE respectively. In addition, a co-ordinating study was carried out by IDATE with the aims of harmonising the project, of investigating the interpretability of the given market segments and of synthesising the outcomes and recommendations of the three studies.

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Virtual Reality – Toy and Tool Workshop

Purpose

This purpose of this workshop was to explore how the different techniques collectively known as virtual reality will influence future system applications and planning of research and development activities. The objective of the workshop was to get to know the people and the organisations that work in the field and to reach an understanding of the present possibilities and limitations of these techniques.

Key results

"Virtual environment" (VE) is the preferred term. It is "virtual" somewhat in the same sense that a lens forms a virtual image (an image which provides the illusion of an object extended in space when in fact there is no object there). It is an "environment" in the sense that it provides a surrounding medium which becomes the temporary world inhabited by the human organism, where things that the human does are reflected in that world, and objects in that world can effect changes to what the human perceives. A crucial determinant is total human immersion where major senses are wholly taken over by at least one output medium of the virtual environment generator, and external "real world" sensory input is blocked.

Changes in the conception of new human-machine interfaces, which will involve a much more "immersive" approach, will affect the way many professionals carry out their work. One of the most important emerging markets for Virtual Reality applications relies on the field of entertainment or edutainment. There are very exciting and potentially promising forms of human-computer/human-human interaction but large numbers of problems still to be solved as there is no standard software architecture and no standard way of building or representing worlds and their dynamics. Eye-movement monitors exist but are bulky, motion sickness is a major problem and sensors which still use magnetic sensor technology are unreliable and inaccurate. There is a vital need for interdisciplinary funding, including partnership between industry and research institutes – but it must be independent of short-term commercial goals. It was considered that the training market alone is not big enough to drive or even sustain the VR market. The cost benefit will depend largely on the cost decrease stemming from the spreading of VR in non-training market.

Methods used

This workshop was organised jointly by three units of the EC DG XIII Telematics programme: AIM (Advanced Informatics in Medicine), Telematics for Flexible and Distance Learning and DRIVE (Road Transport).

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