INFORMATION SOCIETY TECHNOLOGIES

(IST)

PROGRAMME

Contract for:

Shared-cost RTD

Annex 1 - "Description of Work"

Project acronym: **COLDEX**

Project full title: **Collaborative Learning and Distributed Experimentation**

Proposal/Contract no.: **IST-2001-32327**

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Overview of changes:

- New name of Univ. Gerhard Mercator - page 8
- Clarification of work description, resources per work-package and submission dates of deliverables (pages 6, 10, 12, 14, 15, 16, 25, 31, 32, 38,39, 40, 47, 48)

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1. Project summary

Project Acronym	COLDEX	Contract No	IST-2001-32327

Objectives

COLDEX aims at developing and using new IT approaches and computational tools to foster scientific experimentation, modelling and simulation in distributed collaborative settings in an inter- cultural (European-Latin American) community of learners. Our efforts will result in the creation of innovative pedagogical scenarios. A common denominator for the learning domain is the study of visual and other perceptual phenomena, including astronomical and seismic measurements, from both a scientific and a subjective experiential perspective. The project will start with local learning communities sharing a rich everyday context. The target groups will range from higher seconary education to academic beginners. Computer-mediated collaboration tools will contribute to forming integrated synchronous/asynchronous access to a "group memory" on different levels.

Description of the work (maximum 2000 characters)

The scientific and engineering approaches used to discover and explore these phenomena will consider the following aspects:

- A small number of "remote sites" (mainly in Chile) will generate data. Among these will be an observatory with a high quality telescope and a seismic measurement station in Chile. Technological challenges lie in the ease of use in accessing these data and in communicating the learners requests to the remote sites. The stress is put on re-usable components and protocols.
- The "construction of realities" includes the setting of (real) experiments, the provision of 3D virtual scenarios, artefacts that support other types of perceptual experience. An important point are "mixed reality" technologies.
- Concrete modelling & design includes 3D models with sound and tactile I/O as well as physical models with IT components (e.g. Lego Mindstorms).
- "Abstract and conceptual modelling" using formulae, diagrams as well as informal sketches will be supported through a combination of visual concept mapping tools with more formal representations such as "system dynamics" and other formalisms.
- “Synchronous collaboration tools (including face-to-face group work) will contribute to forming a "group memory" which is also accessible in asynchronous mode. Conversely, the use of archives and repositories will be tightly integrated with synchronous activities.
- Local learning communities will exchange their ideas, results and problems in an international network, established by an "Open User Scheme". A speciality of COLDEX lies in its origination from a European-Latin American co-operation incentive (Eurolat-IS). COLDEX is in this sense trans-continental and aims at cross-fertilisation of experience and scientific understanding in a multicultural and multi-experiential community.

Milestones and expected results

- definition, practical exploration and evaluation of an educational model using innovative technologies to propagate the sharing of experience and the construction of scientific knowledge from local to global
- development of a toolset to support and integrate various types of scientific modelling (from concrete to abstract) in a collaborative learning community
- development of a flexible distributed architecture to maintain a transcontinental educational network in science education

2. Objectives

This project aims at developing and using new IT approaches and computational tools to foster scientific experimentation, modelling and simulation in distributed and collaborative settings in an inter-cultural community of learners. Our efforts will result in the creation of innovative pedagogical scenarios to address these issues. There is a common denominator for the learning content to be addressed: the study of visual and other perceptual phenomena from both a scientific and an experiential perspective, i.e. by combining of scientific and engineering methods with the subjective inter-personal communication of phenomena in the learning community.

Examples of the experiential phenomena to be studied are:

- astronomy (remote access to observatories)
- seismic phenomena (provision of continuous data of seismic activities in an "active region", as e.g. Chile)
- (inter-)acting and navigation with limited perception in everyday scenarios (e.g. a blind person using the metro)
- reactions of plants, animals and humans to environmental conditions (e.g. seasonal changes of climate, biodiversity)
- optical phenomena in mechanical engineering and chemistry (e.g. photo-elasticity)

The scientific and engineering approaches used to discover and explore these phenomena will consider the following aspects:

a) Generation and provision of source data: Here, a small number of remote sites will be established which generate data. Among these will be an observatory with a high quality telescope and a seismic measurement station in Chile. Technological challenges lie in the ease of use in accessing these data and in communicating the learners' requests and specifications to the remote sites. The stress is put on re-usable components and protocols which are not only tailored to the specific case. As part of the COLDEX technical environment a Learning Object Repository (LOR) will be set up. All registered users will have access to the LOR. The added value here stems from a set of extended metadata which enables reuse, retrieval, and heuristic filtering. The COLDEX-specific metadata projects on standards like LOM to allow reuse in other contexts, too.

b) Construction of realities: The "construction of realities" includes the setting of (real) experiments, the provision of 3D virtual scenarios, artefacts that support other types of perceptual experience (e.g., tactile experience). An important point here is the use of "mixed reality" technologies which allow for a smooth transition between the physical and the digital worlds.

c) Concrete modelling & design: The notion of concrete modelling and design refers to the use of concrete representations to model and simulate the phenomena to be studied. These range from 3D models which include sound and tactile I/O to physical models with IT components (e.g. Lego Mindstorms). Here, we do not expect to invent new genuine technologies but we want to adopt existing state-of-art techniques to educational needs.

d) Abstract and conceptual modelling: The question is to bring "paper work" (formulae, diagrams, sketches) used to analyse and describe the phenomena into the digital information cycle. This will be achieved through a combination of visual concept mapping tools with more formal representations such as "system dynamics" or other mathematical and computational formalisms.

Beyond the science and engineering methodologies, we want to stress the aspect of formation of learning communities on different levels. Based on the known difficulties encountered with "virtual learning" approaches, we will start with local communities which share a rich everyday context as e.g. in a school class or in study group of academic students. (One partner will explore similar basic scenarios in academic distance education.) The target groups will range from higher secondary education to academic beginners. A rich potential of human resources will be taken into account (teachers, tutors, peer interaction).

Collaboration and networked interaction will arise from these basic groups, using both synchronous and asynchronous collaboration techniques. Yet, we do not simply intend to add both techniques but we see them related in a specific way: Synchronous collaboration tools (which may b.t.w. not only be used in remote scenarios but also in face-to-face group work!) should contribute to forming a "group memory" which must also be available in asynchronous mode. Conversely, the use of archives and repositories should also be tightly integrated with synchronous activities. We still see big technical challenges in integrating these two learning modes under the notion of easy re-use and formation of group memories.

Only on a second level, basic learning communities will exchange their ideas, results and problems in an international network. We expect teachers to take an active role in creating, filling with content and structuring this network. The specialty of COLDEX, on this level, lies in its origination from a European-Latin American cooperation incentive (Eurolat-IS). COLDEX is in this sense trans-continental: Whereas science and engineering are typically seen as "neutral" to different cultural and geographic backgrounds (which might also be questioned), this is certainly not the case for the "experiential" level. It is evident that, e.g., Swedish high school students would benefit from communicating with their South American counterparts to better understand the concrete meaning of seismic phenomena in everyday situations.

Other areas in which we expect a mutual enrichment are the discussion of social aspects of living with perceptual disabilities or the discussion of different environmental conditions. But even when it comes to modelling and constructing scientific understanding, we believe that cross-cultural fertilisation will occur.

The COLDEX group has ideal conditions for a addressing the cross-cultural aspects since the core teams are themselves multilingual. The group will produce and share learning material not only in the national languages but also in Spanish. An adaptation to Portuguese is possible if there is enough demand. An "open user scheme" will invite educational institutions in Latin America to join the COLDEX community and use this material in their practice. In return, these associated users will be report their experience and contribute to enrich the international educational network of COLDEX.

As for the creation of learning communities, COLDEX can count on existing experience with several partners as e.g. in Chile (participation in the existing nation-wide network ENLACES) and Sweden (local teacher and school network in the area of Växjö) as well as on the large user groups of the associated "science museums" or "exploratoriums" (Deutsches Museum, Experiment Huset).

The consortium will be able to face the complex technological challenges since it can count on a rich body of existing experience and achievements which originate from several European project with direct relevance to COLDEX.

3. Participant list

List of Participants

Partic. Role*	Partic. no.	Participant name	Participant short name	Country	Date enter project**	Date exit project**
C	1	Universität Duisburg-Essen	UDUI	DE	Start	End
P	2	Universidad de Chile	UCH	CL	Start	End
P	3	Växjö University	VXU	FI	Start	End
P	4	Universität des Saarlandes	USB	DE	Start	End
P	5	Fundacion Universidad Empresa	UNED	ES	Start	End
P	6	Universidad Politécnica De Madrid	UPM	ES	Start	End
P	7	Instituto de Engenharia de Sistemas e Computadores - Investigação e Desenvolvimento	INESC-ID	PT	Start	End
P	8	Universidad Catolica del Norte	UAN	CL	Start	End

4. Contribution to programme / key action objectives

COLDEX aims at developing and using new IT approaches and computational tools to foster scientific experimentation, modelling and simulation in distributed and collaborative settings in an inter-cultural community of learners. While the project addresses mainly **Action line III.2.2**, the following table points out how the project will contribute to K A III objectives.

Key Action III objectives	**COLDEX**
Improve functionality, usability and acceptability of future information products	Learner centred approach to design and evaluation of the technology and the scenarios.
Enable cultural diversity	In COLDEX cultural diversity is considered an important mean of education
Stimulate creativity	A variety of modelling tools and experimental scenarios allow a wide range of open learning activities. Collaborative approaches together with opportunistic coaching facilitate initiative and exploration.
Enhance education and training systems for lifelong learning	Organisational memories for learning communities provide a framework supporting lifelong learning systems.
Cover new methods, technologies and systems for creating, processing, managing, accessing and exploiting digital content	Methods: Collaborative learning in mixed intercultural synchronous/asynchronous settings. Technologies: Non-standard input devices, next generation mobile devices. Systems: Remote and local experimentation connected to collaborative discussion and modelling tools.
New socio-economic and technological models for representing information, knowledge and know-how	The project will combine science and engineering methodologies with informal and experiential knowledge, to create organisational memories tailored to learners communities.
Improving natural and user friendly interaction	Use of a variety of input/output devices as well as visualisation tools. Support for multilinguality. Consideration of standards (e.g. XML, LOM, Java)

III.2: Education and training	
Trend towards greater individual control	Open user group, flexibility in time, place and access to specialised equipment
Paradigm shifts in the way of learning	Sharing resources and experiences, active role of the learner, potentially flexible user groups
III.2.1 self-learning for work	
Communities of learning	Two levels of organisation (1) basic learning communities will exchange their ideas, results and problems in (2) an international network
III.2.2: e-learning futures	
Provide insight into next generation e-learning systems and services	The use of “mixed reality” technologies which allow for a smooth transition between the physical and the digital worlds
Enhancement of human learning and cognitive processes	Active science discovery in mixed groups (closed / intercultural / open), support for individual and group access, remote and local scenarios. Development of collaborative and team working skills.
Innovative and unique nature of the research proposed	Promote collaborations through remote and local scenarios with mutual benefit for participants, use and share resources in a suitable framework for discussion and modelling
Help to build a multidisciplinary research community	By the profile of the consortium, the target groups as well as the variety of applications

5. Innovation

Background: innovative pedagogical approaches

A variety of substantive issues confront education technology with respect to supporting students learning increasingly complex knowledge. How can learners acquire and maintain deep understanding about difficult-to-understand subjects in science and engineering? How can scientific modelling and experimentation with complex phenomena be facilitated among learners? There is reason to believe that many of the core ideas associated with new ways of thinking about these complex topics may be challenging for students to learn. Considerable research has documented a variety of difficulties students have with learning concepts relevant to understanding complex systems that are currently taught in existing science courses (Kozma, Russel, Johnston and Dershimer, 1990).

At the same time, current and emerging technological advances in information and communication technology (ICT) make it possible to develop interactive learning environments to support new ways of learning. Interactive learning environments (ILEs) play an increasing role in teaching and learning (Wasson, 1997). In particular, those tools and methods that encourage and enhance discovery, creativity, thinking and expression are very much-needed (Fischer, 1999; Shneiderman, 1999).

Over the past two decades, there has been a significant increase in our understanding of the developmental, cognitive, and social dimensions of learning. Emerging trends in education are increasingly moving towards learner-centered approaches. In these, learning becomes an active process of discovery and participation based on self-motivation rather than on more passive acquaintance of facts and rules (Sfard, 1998).

New approaches to learning with interactive technology

Recent socio-cognitive or "constructivist" (Jonassen and Land, 2000; Bransford, Brown and Cocking, 1999) perspectives regard knowledge as an emerging characteristic of activities taking place among individuals in specific contexts, to view learning as a developmental process occurring first in an interpersonal domain (i.e., socio-cognitive or between people) and later in an interpersonal domain (i.e., cognitively or within an individual), and to recognise that learning is a constructive activity that often requires active and substantial reorganisation of existing conceptual structures. An increasing amount of research has been documenting how new constructivist models may be used to reconceptualise curricula, teaching practices, and learning activities, and to effect significant and rich types of learning gains (Cognition and Technology Group at Vanderbilt, 1997). Many new constructivist models of learning utilise the affordances of new computational and communications technologies as part of learning environments in which students engage in challenging problem and project-centred learning activities. The COLDEX project will offer the technical possibilities to learn with collaborative computational objects. It will combine both the computer-mediated communication scenarios as well as interactive-constructive environments.

Furthermore, the notion of interactive tools for modelling and simulating (Turkle, 1997) is quickly gaining importance as a mean to explore, comprehend and communicate complex ideas. However, the extent to which it is helpful to attempt to use these interactive tools to model reality in too many aspects is less evident (Dowling, 1997). While a number of features of the real world which are thought to be relevant to the learning process can be replicated to a certain extent by computer programs, others cannot, and indeed it may well be that maintaining a distinction between the real and the virtual is an important aspect of the transfer of learning from computer-based environments to the wider world. Frequently, the design of these *"simulation-based"* learning environments focuses exclusively on computers and the virtual environments they provide, excluding the physical environment. Moreover, few contemporary researchers or practitioners question the importance of interaction in computer-supported learning (Gavora and Hannafin, 1995). With the emergence of new technologies, and the continued refinements of existing technologies, design potential has expanded dramatically. What kind of interactions should be cultivated, for which types of learning tasks? How should differences in learning tasks influence the design of interaction strategies?

In this project we will put our efforts in exploring the integration of physical and computational media for the design of interactive learning environments to support learning about complex scientific phenomena. This effort will involve the design of interactive learning environments to integrate systems supporting alternative ways of interaction with simulation and modelling tools - with an emphasis upon support for shared interaction to mediate social aspects of learning, knowledge construction, reflection and design. These interaction paradigms integrate the use of computationally-augmented physical objects - to support and encourage face-to-face interaction among learners - with virtual objects - to provide computational support for the model underlying the simulation. Many models of learning and collaboration need to emphasise the creation of shared interaction, social structures, and cultural embeddings for meaningful learning (Dillenbourg, 1999). In the next section, we describe a set of general design principles for creating learning environments and tools to help students understand scientific perspectives on complex phenomena.

Design issues and conceptual framework

Land and Hannafin (1996) point out that researchers and designers need to identify frameworks for analysing, designing, and implementing interactive learning environments that embody and align particular foundations, assumptions, and practices. There is a need for learning activities that stimulate an interest for understanding *complex phenomena*, challenge current understandings and facilitate experience sharing between learners. Spector, Davidsen and Wasson (1999) claim that instructional scientists and designers have not fully understood the socially situated learning perspective and its implications for human learning in and about complex domains. According to this we lack a well-articulated design framework with sufficient detail to take us from a socially-situated, problem-based, collaborative learning perspective to the design of a particular learning environment for a particular subject domain.

In this research project we will investigate how best to design and support learning in and about complex phenomena. More specifically, we are proposing a general approach which might best be characterised as socially-situated, problem-oriented learning in authentic and collaborative settings. This design framework is based on a experiential, problem-based and decision-based learning perspective.

We suggest that the design of interactive environments for collaborative learning and distributed experimentation should be guided by:

- *Authentic activities:* presenting authentic tasks that conceptualise rather than abstract information and provide real-world, case-based contexts, rather than pre-determined instructional sequences. Learning activities must be anchored in real uses, or it is likely that the result will be knowledge that remains inert;

- *Construction:* learners should be constructing artefacts and sharing them with their community;

- *Collaboration:* to support collaborative construction of knowledge through social negotiation, as opposed to competition among learners for recognition;
- *Challenge-based learning:* to allow students to act as an active designer and constructor, whereas teachers take the role of coach, co-experimentor and designer; the cognitive focus is on knowledge interpretation, inquiry and construction
- *Reflection:* fostering reflective practice;
- *Situating the context:* enables context and content dependent knowledge construction; and,
- *Multi-modal interaction:* providing multiple representations of reality, representing the natural complexity of the real world.

The different components of this design framework are rooted in situated cognition which emphasises the importance of situating thinking with complex contexts. Learners are expected to generate problems to be solved and then, learn, develop and apply relevant knowledge and skills through progressive problem generation, framing and solving. The different learning activities which will be designed upon this framework require learners to identify research questions and variables, set hypotheses, build and construct experiments, test results, analyse observations and then refine hypotheses and casual variables accordingly. In the next section we present some examples of experiential phenomena to be studied during the project and the learning activities based upon the ideas described in this framework.

Overcoming existing deficits in the state of art

Many of the existing approaches to supporting learning in science and engineering by using information and communication technologies fall short in several respects:

a) They generally do not take into consideration the global perspective of the phenomena being analysed. This means, these tools serve for an individual use or at most for a relatively small (culturally homogeneous) group.

b) When applied to real educational situations, most efforts have been of short term nature. This may be suitable for some domains (e.g. specific simulation experiments) but to really contribute to the aim of supporting science education a longer term effort and more coverage of the curriculum is desirable.

c) Many efforts claim to include virtual experimentation as the core of the student's activities. Usually, this excludes the "handcrafting" in the physical preparation of experiments on the part of the learner which is one of the most important experiences that students can get from laboratories. Realistically seen, curricula are typically organised in such a way that theory is not discovered in the laboratory but taught before. Thus, laboratory work can at best be about connecting theory to practice. Accepting these premises implies that hands-on experimentation should not be given up if it is easy to provide. We suggest to concentrate on such virtual scenarios in which hands-on experience is not easily accessible.

Innovative design and technological orientation

In this project, we want to develop a framework which provides tools and methods for collaborative science learning which includes experimentation and modelling in local and distributed scenarios.

The project also considers the application of this framework in a real intercultural community of users.

Taken into account the problems mentioned above, the core principles of this project will be:

1) Support for remote experimentation (and experience!) in educationally meaningful environments. By remote experimentation we understand the carrying out of an experiment in a certain location which can only be accessed through a computer network.

2) Support for distributed experimentation: By distributed experimentation we mean learners (or group of them) repeating the same experiment in different places and then comparing results. This should enable them to collaboratively build knowledge through discussion and modelling.

3) Support the use of virtual experiments (or virtual reality) in educationally meaningful settings. It is meaningful, e.g., when the real experiment is impossible to carry out, or when the virtual experiment is a preparation for the real experimentation, or when the virtual experimentation complements the real one.

4) Development of communication methods to foster or create educational scenarios by creating interactive spaces for “reflective practitioners”. This also means connecting experts with students. Special attention is given to problems and potentials of multicultural and multilingual exchange.

5) Innovative use of interactive media to enrich curricula. This means to go beyond uniform computers as such towards mobile devices, non-standard input devices and “tangible interfaces”.

6) Support the communication of subjective and culturally/geographically dependent views of natural and experimental phenomena.

7) Build upon existing relevant and tools to enhance and adapt them to the requirements of this project. This involves the development of tools for modelling, experimentation and discussion in a potentially globally spread user group. Several COLDEX-specific DEXTs (Distributed Experimentation Toolkits, e.g. Lego Mindstorms, water rocket, fuel cell etc. combined with software tools and instructions) are put at the learners' disposal. Involved are also low cost components like a biosphere toolkit made of a plastic water bottle.

8) Establishment of a lasting and growing link between European and non European organisations (universities, schools, enterprises) through an open user scheme. Sharing of singular infrastructure and/or experimentation devices and location.

To reach the goals, we will develop a framework consisting of systems and methodologies for enabling

- <u>students</u> to carry out experiments on remote laboratories according to a defined workflow,

- <u>students</u> to discuss and share of results and *subjective experience* aimed at fostering collaborative knowledge building,

- teachers to easily integrate and make available new resources. (These can be in particular real and/or virtual experiments, documentations to carry out the experiments as well as multimedia material with relevant background information.)

The members of the project have vast experience in developing and applying computer-based collaborative methods and educational environments (Hoppe, 1995; Paiva, 1997; Mühlenbrock and Hoppe, 1999; Barros and Verdejo, 1998). We do not conceive modern e-learning as the mere delivery of knowledge and the billing of knowledge downloads from learners (which could be described as the "e-commerce model of learning"). Although learning is ultimately an individual process, it can be enhanced, enriched, and better motivated by collaborative activities, especially if it brings learners with different cultural backgrounds together. The speciality of this project in CSCL terms is that it aims at developing methodologies to create and maintain large learner communities around complex experiential phenomena rather than focussing on small highly controlled laboratory situations.

The crucial factor which is responsible for the difficulties with building collaborative educational scenarios around computer-mediated communication is *context*. Computer-mediated communication can hardly capture the full variety of non-verbal signals and situational references. But this is not even the biggest problem: context stems from shared history, from shared external environments (e.g., on a campus), from shared daily routines. All this is important in collaborative learning but hard to transmit through computer networks between humans who do not have regular face-to-face contact. So, when we say that the creation of global learning communities is a central issue for COLDEX, we have to consider the context problem. There are two consequences: (1) Build communities bottom-up, starting with local, usually face-to-face, communities such as school classes or study groups and let these establish contacts with other communities; (2) take subjective experience seriously (and not only scientific understanding). The problem of subjective experience and perception will even be a subject of modelling and investigation in COLDEX (by addressing problems of navigation/orientation and interaction with restricted perceptual and sensory input).

A specific toolbox for COLDEX will be specified. It contains third party tools as Apache, Linux, Java, VRML, lejOS for Lego Mindstorms, etc. There is also third party hardware, e.g. RCX (the programmable device for Lego Mindstorms robots), or PDAs. The core is built on tools of project partners: Active Documents (UNED), Cool Modes (UDUI) and Agent Framework (INESC).

Although this project does not aim at technological innovation per se, there are several lines of innovative technological developments:

- integrating synchronous and asynchronous communication/collaboration tools to support the creation of group memories (and the access to these memories from outside the original group, e.g. repository of learning objects - LOR),
- easily manageable and resource-adapted services (and servers) for distributed group archives
- smooth transitions between different types of model representations (physical – virtual/3D – abstract),
- a toolbox approach to 3D modelling of physical objects with known structure (e.g., virtual 3D models of Lego Mindstorms objects),
- component engineering and standardisation of remote experimentation.

6. Community added value and contribution to EU policies

E-Learning futures is conceived as an action line open to fundamental and visionary contributions to shape the future of net-based educational systems and services. On the other hand, there is a popular understanding of e-Learning defining it essentially as "e-commerce with learning-related IT products and services". We believe that a very direct commercialisation of learning similar to other business-to-consumer marketing strategies will neither be pedagogically desirable nor will it be economically successful. The "magic factors" neglected in this model are *context* and *culture*. To be effective, learning in groups and also in virtual communities should take place in a common context of habits, orientations, persons, locations etc. which serve as a frame of reference and allow for more implicit communication and shared understanding. In this sense, *inter-operability* is not only a technical feature but also a social and cultural phenomenon. If this is true, virtual learning communities have to be established by building up context and common culture which we believe has to proceed bottom-up, i.e., from the local to the global communities.

If inter-cultural communication is already an issue for European cooperation, this is even more the case for building communities between Europe and developing countries which is the special challenge taken up by this project. On the one hand, science and technology may be seen as neutral to cultural backgrounds, as long as certain material resources for experimentation and modelling are given. However, for learning, we believe that cultural and "experiential" differences play an important. In the 1960's, Martin Wagenschein, a German classic in science education, coined the slogan "save the phenomena!" and claimed that scientific understanding should be deeply rooted in subjective experience (objectivity would be a goal and later step). The phenomena that we have chosen have to do with perception and environmental conditions and some of them, such as seismic events or the impact of climate on biodiversity, are evidently very different for say countries such as Sweden or Chile. But this is also a source of learning from each other in a multicultural community! We want to stimulate curiosity (for the other's different living conditions) followed by "experiential exchange". In this context, the technological challenge lies in the provision of adequate tools for supporting and communicating rich experiences as well as for maintaining communities archives and "memories".

With the "Open User Scheme" we have foreseen a flexible method to open up the COLDEX community particularly towards more Latin American participants, without giving up the quest for commitment and community spirit. Participation will be based on mutual exchange. It will be supported if there is a need, but it will not be at zero cost.

Most of the European partners in the consortium can count on key personnel with special personal relations to Latin America or the Ibero-American culture (and good mastery of Spanish or Portuguese). On a cultural level, this will allow us to address the Latin American community without resorting to English as a "neutral" common denominator. Accordingly, we plan to deliver material and services also in Spanish and potentially Portuguese.

With this general orientation, COLDEX promises the following facets of European value added:

- the study of multi-cultural aspects in science learning,
- the building of bridges between European and Latin American learner communities,
- stressing the common elements (language, epistemological background) between the two continents,

- putting new educational technologies in a rich social context,
- fostering European identity in future e-Learning by opposing simple models of commercialisation.

To credibly represent the idea of international co-operation on an equal level, the European perspective is clearly superior over bi-national projects (e.g. between Spain and a Latin American country). On the other hand, European co-operation is also needed to address the complex technical and non-technical goals of COLDEX. The Chilean partners do not only provide high quality input in terms of remote scenarios but act also as technology co-developers and users.

7. Contribution to community social objectives

The main social challenges taken up and addressed by COLDEX are:

- to make the European e-Learning future more human-centred (as opposed to driven by technology and business);
- to strengthen the role and particularly the autonomy local communities in by equipping them with flexible innovative technology;
- to foster inter-cultural understanding, respect and the motivation to learn from each other across national and cultural boundaries.

The strengthening of the role of local communities is of special importance to the development of e-Learning. If e-Learning offers and opportunities were to be defined in a top-down manner, driven by big economic interests, this would diminish local and direct responsibility. Currently, our school environments allow several local groups to influence school life and local educational decision making. Among these are local administrators who see "their" schools in the framework of the social community life, teachers and especially parents who should take the highest personal responsibility and "care" for children and young adults in their learning and socialisation processes. COLDEX' bottom-up approach to forming e-Learning communities allows for respecting and supporting this role of parents.

The target group learners addressed be COLDEX consists of young adults who should be supported in making their own choices within the spectrum of learning offers. Crucial factors here are "orientation" and "judgement", which – as we believe – have to be developed in a rich social context. Here again, the COLDEX approach provides the necessary "social embedment".

8. Economic development and S&T prospects

8.1 Dissemination Strategy

The dissemination strategy for all project products will be defined and agreed upon in a detailed action plan as part of WP 7 (OUS), which will be revised semi-annually and will include details about all planned activities. Main activities, which will detail expected results and estimated costs and will be running throughout the project's life, include:

- Develop and maintain lists of potential users / active members of academic, developer, authoring and educational communities, who will form the target group for diffusion activities.
- Develop and distribute informative material addressing each target group: Publicity, advertising and trade articles, brochures, white papers, presentations, project leaflets and an electronic bulletin will be developed for this purpose. Distribution: via direct mail (mailing lists), post-office (leaflets, etc), at various events and via web pages.
- Provide demo and pre-releases of computational components, educational activities and development platform to active community members
- Demonstrate projects products and other project results: Organise and participate in workshops, conferences, tradeshows (regional, national and international events) and organise demonstrations at partners' sites. A list of potential events will be generated and maintained; the audience, the location and the budget and effort required for participation will be judged each time with respect to the prospects and expected impact.
- Co-organise and/or co-sponsor scientific workshops within European and international contexts.
- Set up and maintain WWW servers and project home pages.

8.2 Exploitation Strategy

Project's products and especially a) the software tools and components and b) the educational materials built with these, may well have the potential of commercial exploitation beyond the scope of the project. Partners interested in investigating this prospect, will work through a process of identifying how these deliverables can be rendered marketable. At the end, the project will deliver a strategic exploitation plan for further exploitation of the results. The exploitation plan will involve actions like the search for collaboration and exploitation through the support of Commission services (e.g. Cordis Technology Marketplace) or active participation in European networks of exellence (of the type of i3net), and will incorporate strategic investment opportunities (e.g. joint ventures) and an extensive marketing analysis (market segmentation, trends, competition, profiled target groups, product positioning in the market, Strengths-Weaknesses-Opportunities-Threads analysis, distribution channels, etc).

Although academic institutions dominate in the COLDEX consortium, several of these pursue an active "spin-off" strategy, cooperating with "incubators" (in the case of VXU such an incubator is on-campus, in the case of UDUI, the COLLIDE group is partly located in the "Medienzentrum Duisburg" which is an incubator for the printing and media industries).

Exploitation of results for the consortium as a whole

At the beginning of the project a Consortium Agreement will be agreed and signed by the Consortium. The COLDEX Consortium Agreement will, amongst other provisions such as organizational, legal, etc., specify and assure Intellectual Property Rights (IPR) for all partners, including patents, patent applications, registered designs, copyrights, and technical know-how. The Consortium Agreement will incorporate the access rights guidelines, as stated in the Contract with the European Commission for the COLDEX contract. The agreement's provisions will cover the rights for the exploitation of the software components, platforms, tools and activities and will form the basis for potential future business plans.

The main goal of the agreement will be to ensure a common property of the results, proportional to the individual investments and background rights. Confidentiality levels will be set prior to the project commencement and will only be amended by the Project's Steering Committee. An agreement to this effect will be included into the Consortium Agreement. All documents produced will be circulated to Partners, the Commission and the Reviewers, who will have signed an agreement concerning the confidentiality of the information disclosed.

All members of the COLDEX Consortium shall agree that they have publication rights within the framework of the project dissemination and exploitation policy. It is intended that the project will produce a number of deliverables, including software prototypes, which soon after project completion can be further developed into one or more commercial products. All participants recognize already the potential benefit of producing a commercial product based upon the deliverables for marketing in Europe and elsewhere. Within this framework the following principles are agreed:

- All participants will be free to use prototypes and other deliverables developed on a royalty free basis but not to incorporate them in other products except in accordance with the Consortium Agreement provisions.

- All participants in the project will have the opportunity to participate in the commercial exploitation of the results of the project.

Individual exploitation of results by project partners

The principle here will be that common results will be owned jointly and thus, each partner will be free to use and exploit the results, based upon IPR consortium agreements and as they see it appropriate and in compatibility with their business activities. However, some of the considerations regarding the individual exploitation of results by project partners are:

- To optimise effectiveness, individual commercial utilisation may be subject to restrictions like territorial division between the participants (e.g. different countries) and/or division of application markets (e.g. exploitation in business sectors relative to partner's activity).

- In the event of a result being solely the work of a single co-operation party rather than of shared effort and knowledge, that certain party may be the exclusive owner of the results - subject though, to restrictive clauses like free licensing for the other parties.

- In cases of partners that are not involved in the commercial exploitation of project results.(e.g. due to constitution/legal obligations), it will be specified that such partners may still use the results for their own purposes -e.g. for research. At all events, the consortium aims to foresee such clauses and restrictions and draftly include them in the Consortium Agreement, in a way though, that maximum flexibility for the exploitation of all project outcomes is ensured for all partners. Moreover, accordance the principle of the free trade of goods within EC (Treaty of Rome) will be ensured.

9. Project Work-plan

9.1 General description

Relating scenarios and workpackages

The following workplan reflects the technical and design aspects of the different scenarios (astronomy, seismic phenomena, interaction and navigation with limited perception, reactions of plants, animals and humans to environmental conditions, opto-mechanics) on a more abstract level by grouping them in the following way:

WP 3: Platforms and tools

This workpackage gathers the aspects of making available and adapting existing tools (particularly for 3D modelling and for net-based communication and remote access) and of defining an interoperable architecture for local activities as well as global exchange (distributed server model). Tools will be extended and further developed to comply with the specific needs of scenarios and networking. These developments will continue in the respective workpackages (see below) after WP 3 is completed.

WP 4: Remote scenarios

We define remote scenarios as those that work with data which cannot be generated locally. This is particularly the case for observatories and seismic measurement stations. These data will be provided by Chilean partners and are usually not generated as a result of educational activities. Working with remote data sources has to be distinguished from exchanging results of local experiments in educational settings (as e.g. experiences with growing plants in a green house, or modelling perception). For the collaboration, it is important that the same source data are shared in the global community. In the case of seismic data, the raw data will be accompanied by "experiential reports" which indeed originate from local learning communities. Technological challenges lie in the ease of use in accessing these data and in communicating the learners' requests and specifications to the remote sites. The stress is put on re-usable components and protocols which are not only tailored to the specific case.

WP 5: Local scenarios

These are scenarios which are established bottom-up, starting from data and experience in the local learning group (usually face-to-face, with one exception in academic distance learning). "Construction of realities" is an essential part of this WP. The "construction of realities" includes the setting of (real) experiments, the provision of 3D virtual scenarios, artefacts that support other types of perceptual experience (e.g., tactile experience). An important point here is the use of "mixed reality" technologies which allow for a smooth transition between the physical and the digital worlds.

The aspects of *concrete modelling & design* (3D models with sound and tactile I/O, to physical models with IT components) and of *abstract and conceptual modelling* (integrated working environments for formulae, diagrams, sketches) are important in both WPs 4 and 5. Yet, the more general technologies will rather be developed in WP 5. Abstract and conceptual modelling will be supported by new combinations of visual concept mapping tools with more formal representations such as "system dynamics" or other mathematical and computational formalisms. This line of development draws on existing work done by one of the partners (Hoppe, Gassner, Mühlenbrock and Tewissen, 2000) and is currently being extended and applied in an the ongoing IST project DiViLab.

The modelling and simulation of (human) perception under specific limitations as part of WP 5 is inspired by the work of the Universidad de Chile on supporting spatial navigation of blind children in virtual spaces with certain maps and sound objects (Sánchez and Lumbreras, 1995 & 1999). In COLDEX, we want to extend this approach with more sophisticated 3D models, including 3D sound. We do not intend to work particularly with disabled learners, but want to foster understanding and empathy for certain disabilities in the learning groups mixing groups or communication with disabled learners. Two perspectives will be supported (including a flexible change between perspectives): *immersion* in which the user is virtually acting and perceiving, and *observation* in which the simulation is followed from an outside perspective. These perspectives will be facilitated by an agent architecture and model under the responsibility of INESC (Martinho and Paiva, 1999).

The issue of collaboration between local scenarios and of asynchronous support in general will be dealt with in WP 6. Beyond technical details (see below), the central intention is to facilitate the sharing of experience and co-construction of understanding starting from the local, highly contextualised level and extending smoothly to more global communities.

Architectural principles

The Coldex network integrates remote experiments in a collaborative educational meaningful framework. It supports/offers

- access of learners to remote experiments (control of the experiment and/or data acquisition) and data from remote learning communities (in the LOR)
- complementary learning material (multimedia and simulation)
- collaborative learning tools (synchronous, asynchronous discussion tools)
- learning support by definition of learning activities (as "learning workflow") which integrate remote as well as local experiments, simulations, revision of complementary learning material, discussions to support collaborative knowledge building.

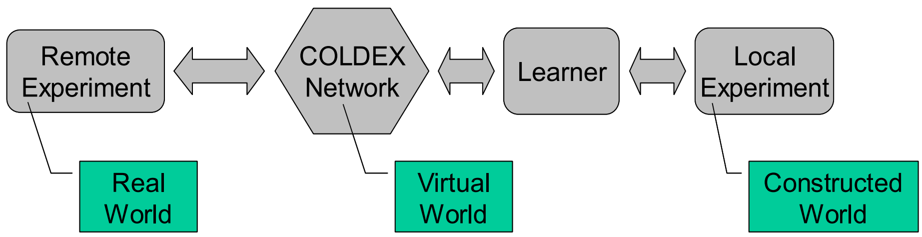

Figure 3: Real, virtual and constructed Worlds

Learners may carry out experiments in a real, virtual or constructed world with the following characteristics:

- Real World: data gathering by controlling monitoring devices, difficult to replicate for the learner, carried on mostly remotely

- Virtual World: Simulations and interactive 3D visualisations
- Constructed World: a real experiment which uses artefacts constructed by learners and carried on locally

Different learning scenarios are defined by the type of experiments, learner group settings, choice of learning material and alternative learning workflows (syllabus).

- Experiments can be carried on remotely or locally
- Learning groups can be either individual learners or groups of learners with or without a (remote) tutor.

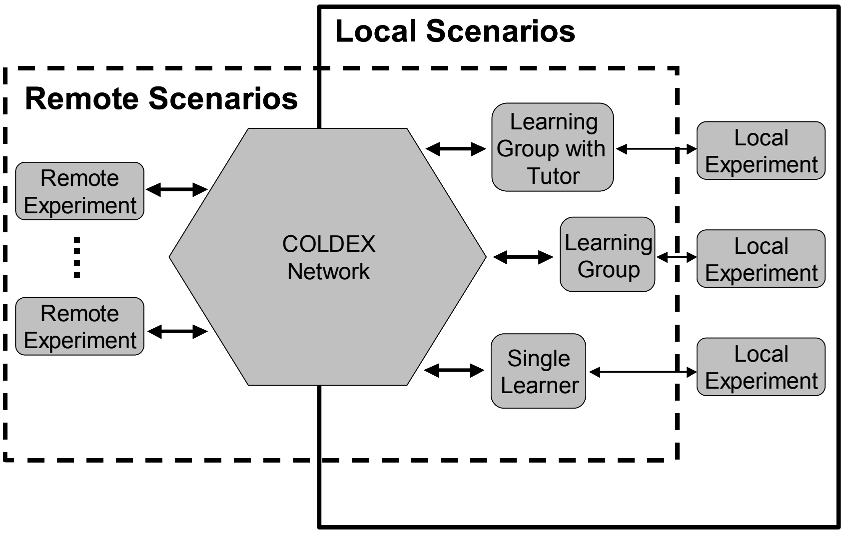

Figure 4: Remote and local scenarios

Technical framework for communication and pedagogical networking

The COLDEX network is a network of people, institutions and resources supported by a computer network providing specific services for collaborative learning with remote experimentation. A distributed server architecture should be implemented in order to achieve

- Better performance for serving local learning groups (proxy)
- Customised server profile for serving certain learner groups, e.g. language, interest areas, educational background
- Replication of data improves scalability and fault tolerance

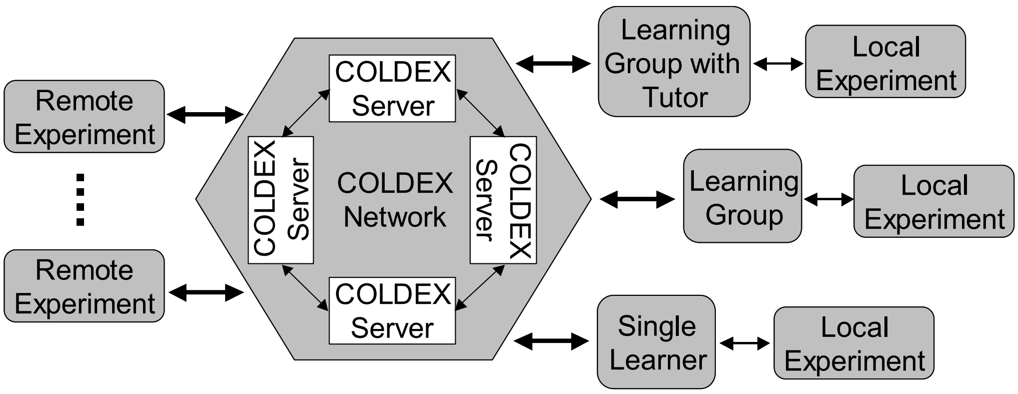

Figure 5: The COLDEX distributed server architecture

Updating of relevant information to be stored by a server may be achieved by multicasting of learning material, multicast groups are formed on the basis of user profiles. Distribution of learning material should be resource adaptive, i.e. depending on bandwidth as well as hardware and software resources on the client.

<u>Interactions and interfaces with the network</u>

a) Remote experiments: The network should forward control commands from the learning groups to the remote experiment module and receives the monitoring data to pass them to interested learners.

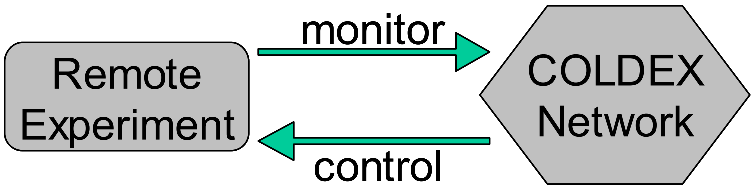

Figure 6: Interactions with remote experiment

Real experiments are physical installations which must be connected to a computer via sensors and effectors. The kinds of sensors and effectors very much depend on the kind of experiment and usually come with proprietary drivers. On top of these drivers we have to implement an API which responds to a certain protocol which should be common to all artefacts connected to the COLDEX network.

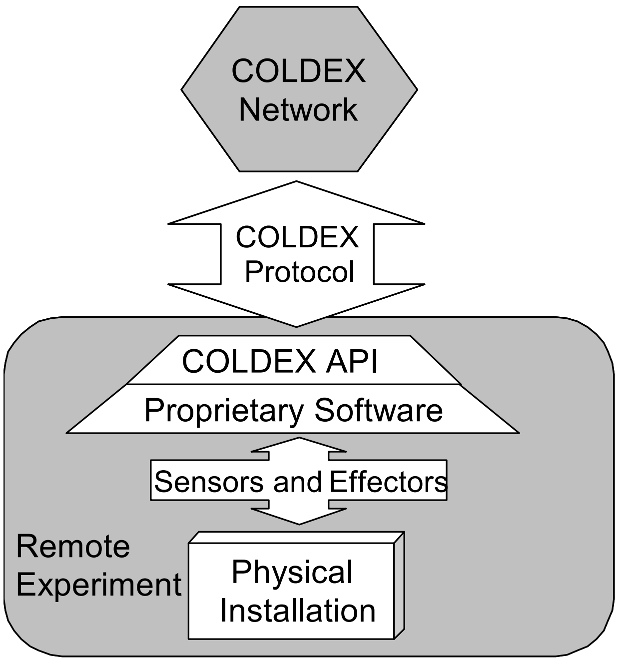

Figure 7: Connecting an artefact to the COLDEX network

b) Local experiments: The learning group controls and observes the experiment directly and shares the data, observations, and interpretations over the network with other learning groups. In addition, they can use the same mechanisms as shown in a) to control the local experimentation setting automatically.

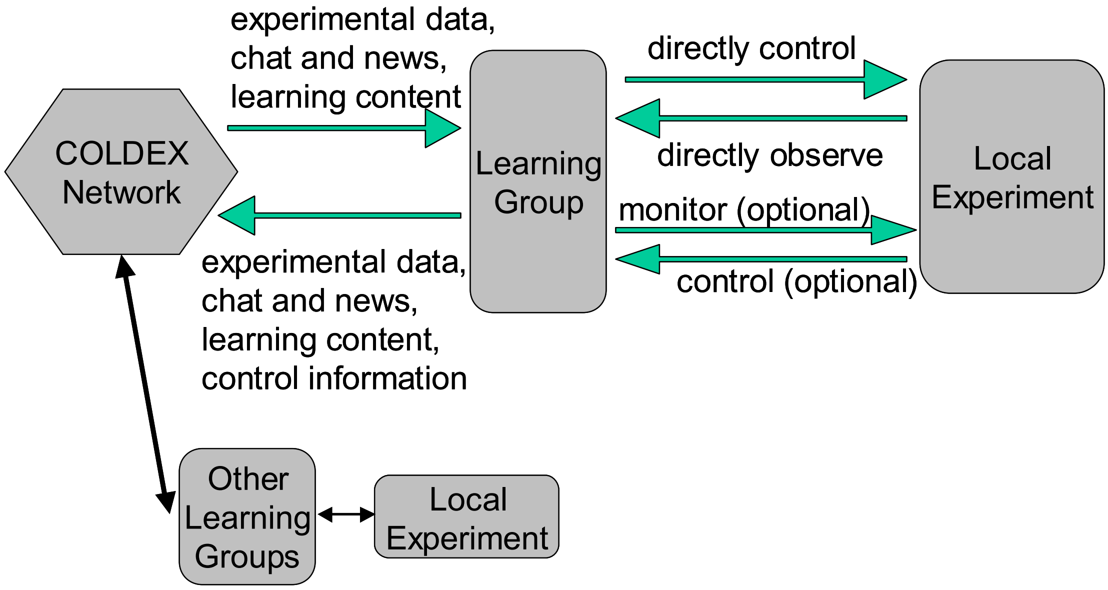

Figure 8: The local experimentation scenario

<u>Open User Scheme (WP 7)</u>

The "Open User Scheme" is a continuous dissemination activity with a dedicated workpackage starting after month 6. Its aim is to establish, organise and support the global COLDEX learning community. The idea of an Open User Scheme (OUS) is related to COLDEX' origin in the European-Latin American Eurolat-IS thematic network (www.ffii.nova.es/eurolatis). The OUS will allow for associating new user sites, particularly from Latin America, during the lifetime of the project. After the initial workshop on "Information Society Technologies for Education and Training" in Santiago de Chile (Dec. 11-13, 2000), there was a considerable number of participants, most of them from South America, interested in following up on a proposal which was initially presented by UDUI (as a representative of a group of European partners) and UCH. Yet, it turned out to be too difficult to shape this quite heterogeneous group with very different resources and contractual/budgetary conditions into a full IST proposal. The OUS will now allow for later association and defines a framework for dissemination, practical testing and community building.

OUS comprises the following activities:

- preparation of technical instructions and learning materials from the COLDEX context in Spanish and potentially Portuguese to facilitate the exchange with Latin American partners;
- the establishment of institutional contacts for the later organisation of dissemination workshops in Latin America in an early phase (months 7-16), including one "meta-level workshop" of future organisers;
- the organisation of 2-3 COLDEX workshops in Latin America or in Europe with strong Latin American participation in the period of months 18-28;
- the establishment of an OUS membership model with certain privileges (access to materials, remote scenarios and other web services) and commitments (participation in web-based exchange, reporting back).

- The OUS will provide financing for workshops and some travel support in cases of strong need. The OUS will not only connect users with COLDEX partners with additional users, it will also allow for additional providers (science centres, museums) to make their contributions and complement the COLDEX offers. OUS is the basic target of evaluation (WP 8).
- There is a close cooperation with the Chilean nation-wide school network ENLACES in which UCH runs a regional "node" in the metropolitan area. This network provides a very good coverage of secondary schools and well-trained teacher community.

Pedagogical models and scenarios and evaluation (WPs 2 and 8)

Beyond the science and engineering methodologies, we want to stress the aspect of formation of learning communities on different levels. Based on the known difficulties encountered with "virtual learning" approaches, we will start with local communities which share a rich everyday context as e.g. in a school class or in study group of academic students. (One partner will explore similar basic scenarios in academic distance education.) The target groups will range from higher secondary education to academic beginners. A rich potential of human resources will be taken into account (teachers, tutors, peer interaction).

Collaboration and networked interaction will arise from these basic groups, using both synchronous and asynchronous collaboration techniques. Yet, we do not simply intend to add both techniques but we see them related in a specific way: Synchronous collaboration tools (which may b.t.w. not only be used in remote scenarios but also in face-to-face group work!) should contribute to forming a "group memory" which must also be available in asynchronous mode. Conversely, the use of archives and repositories should also be tightly integrated with synchronous activities. We still see big technical challenges in integrating these two learning modes under the notion of easy re-use and formation of group memories

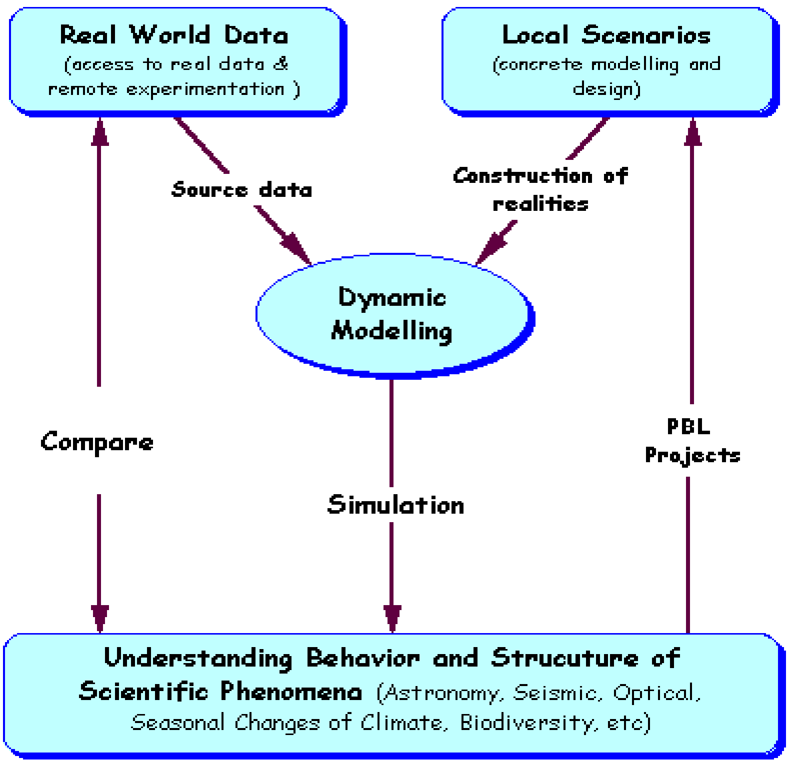

Figure 9: A schematic representation of the different learning activities. (PBL: "Problem Based Learning")

WP 2 will elaborate on the innovative pedagogical approaches (including problem-based learning) to develop special requirements and guidelines to shape activities around the envisaged scenarios and to stimulate and structure the communication in COLDEX learner network. WP 2 ends after month 12 and will be directly followed by the evaluation workpackage (WP 8). A concrete connection between WPs 2 and 8 exists in that WP 2 produces a preliminary "evaluation plan".

The evaluation will focus on the question of how the critical issues of "context" and "shared understanding" develop over the different levels of collaboration and community building. Ethnographic and sociographic methodologies will be used to analyse the experiences with a focus on the OUS. Another evaluation perspective will be the (changing?) role of teachers and their experience with the COLDEX scenarios. Based on positive results in ongoing projects, Activity Theory (Engeström, 1987) will be used as a theoretical framework for modelling and understanding the complex inter-relations between groups at different levels, individuals in different roles and the "social inter-operability" of tools provided. Teachers and lecturers will be involved in the educational design and evaluation processes throughout the project. This involvement will originate from the local perspective. Several partners (UDUI, UCH, VXU, UNED, UPM) will run local scenarios in higher secondary schools and undergraduate or "open" academic teaching. It is foreseen to "globalise" and share the experience of local teacher communities as part of the OUS.

9.2 Work-package list

Work-package No	Workpackage title	Lead contractor No	Person-months	Start month	End month	Phase	Deliverable No
1	Coordination and management	CO 1	13	M1	M36		D1.2.1 D1.3.1 D1.4.1
2	Pedagogical models and scenarios	CR 3	23	M1	M18		D2.2.1 D2.2.1 D2.3.1 D2.3.2
3	Platforms and tools	CR 4	29+3*	M1	M12		D3.2.1 D3.2.2
4	Remote scenarios	CR 6	29+32*	M7	M27		D4.2.1 D4.3.1
5	Local scenarios	CR 7	42+6*	M7	M27		D5.2.1 D5.3.1
6	Communication and pedagogical networking	CR 5	26+3*	M7	M33		D6.1.1 D6.2.1 D6.3.1
7	Open user scheme	CO 1	30+9*	M7	M33		D7.2.1 D7.2.2 D7.3.1
8	Pedagogical evaluation	CR 3	23+2*	M19	M36		D8.1.1 D8.3.1
	TOTAL		215+55*				

*: contribution of non-european partners

9.2 Work-package description

Coordination and management

Workpackage number :	1		**Start date or starting event:**			M1	
Participant number:	**1** (Lead)						
Person-months per participant:	**13**						

Objectives

- Quality assurance for the project
- Administrative, financial, formal and organisational coordination of the project
- Conflict resolution and intercultural management
- Coordination of cooperation between the workpackages to assure timely delivery and high quality of results
- Monitoring of the progress in each workpackage
- Guarantee for the efficient use of resources

Description of work

Task1.1:
Creation of six-monthly status reports

Task 1.2:
Very early in the project, a web site will be set up to facilitate information sharing among partners as well as dissemination of results. Most of the day-to-day communication will be by e-mail, archived mailing lists, and file sharing on the world wide web.

Task 1.3:
At the beginning of the project, the contractors will agree on a quality plan including project standards for documentation, methods and tools, as well as for testing guidelines.

Task 1.4:
Creation of a dissemination plan containing further steps for dissemination of results, as well as publication rules.

Deliverables

D1.2.1: COLDEX Web site

D1.3.1: Quality Plan

D1.4.1: Dissemination Plan

Milestones and expected results

Project review every six months (M6, M12, M18, M24, M30, M36)

Pedagogical models and scenarios

Workpackage number :	2	Start date or starting event:			M1		
Participant number:	1	**3** (Lead)	7				
Person-months per participa	6	**12**	5				

Objectives

Design of learning models and scenarios rooted in educational theory:

- independent of specific experiments
- taking into account the collaboration and tele-experimentation facilities provided by the proposed COLDEX network.
- design of specific learning activities

For these activities, formulation of claims with regard to learning efficiency and learning advantages of an intercultural learning environment (Validation of these claims → WP8)

Elaboration of an evaluation methodology

Description of work

Task 2.1:

As a basis for other workpackages, define an initial set of models and scenarios by
- the type of experiments
- learner group settings
- choice of learning material
- learning workflow with alternatives

These definitions will be used to determine what kinds of tools will be required (central element of the workshop in M3)

Task 2.2:

Redefine the set of models and scenarios to be the basis for WP 4 & WP 5, which will implement specific experiments as instances of those scenarios

Task 2.3:

Definition of an evaluation plan considering the learning activity design

Deliverables

D2.2.1: Learning Requirements

D2.2.2: Collaborative Scenarios

D2.3.1: Learning Activity Design

D2.3.2: Evaluation Plan

Milestones and expected results

Workshop on tools (M3)

Workshop on scenarios (M6)

Platforms and tools

Workpackage number :	3	Start date or starting event:		M1			
Participant number:	1	2	4 (Lead)	5	6	7	8
Person-months per participant:	2	2	**7**	8	7	5	1

Objectives

Definition and implementation of a toolbox for the different scenarios and the network which:

– supports authoring, visualisation, collaboration (e.g. discussion supporting tools), and sharing of data

- reuses specific developments from previous projects

- allows the employment of peripheral of common use at the present time, and of which foreseeable there will be an immediate future (PDA's, Webcams, etc.)

Description of work

Task 3.1:
Generation of a state-of-the art analysis of the existing possibilities and techniques (especially considering those coming from previous projects)

Task 3.2:
Development of the toolbox based on
- the technical requirement provided by WP2
- an equipment configuration agreed on by all partners

Adaptation of tools which have been developed in previous projects and implementation of new tools
- to model activities of learning and experimentation, adopting the active document principle as the framework for defining activities, integrating tools and outcomes.
- to produce interactive 3D virtual surroundings
- to facilitate the discussion, in particular to support decision-making tasks through argumentative discussion
- to enable remote access

(Integration of the tools into the COLDEX network → WP 6)

Deliverables

D3.2.1: COLDEX Toolbox

D3.2.2: The Toolbox Documentation

Milestones and expected results

Workshop on tools (M3)

Workshop on scenarios (M6)

Tool Prototypes ready (M12)

Remote Scenarios

Workpackage number :	4	Start date or starting event:			M7		
Participant number:	1	2	4	**6 (Lead)**	8		
Person-months per participant:	2	20	6	**21**	12		

Objectives

- Implementation of remote scenarios to enable the learning activities designed in WP2.
- Remote scenarios work with data that can not be generated locally, thus data must be retrieved from the experiment or monitoring site and control of remote experiments must be enabled where needed

Description of work

Task 4.1:
Analysis of technical requirements at different remote experiment sites

Task 4.2:
Development of a methodology
- for connecting experiments to the network;
- this includes adding external cameras for recording images, and adaptation of new sensors or
actuators to physical systems.

Development of the COLDEX Client API
- reflecting the methodology
- runs on the client computer controlling/monitoring the experiment; used to implement COLDEX-client software for different experiment sites
- interfaces between experiment and the COLDEX network

Task 4.3:
Test the prototypes and modify them according to the user needs and requirements

Task 4.4:
Support the users in the experimentation phase

Deliverables

D4.2.1: System prototype 1 (implementation of the remote experiments)

D4.3.1: Final prototype (implementation of the remote experiments)

Milestones and expected results

Workshop on scenarios (M6)

System Prototype 1 (M18)

Final Prototype (M24)

Workshop on dissemination and evaluation (M27)

Local Scenarios

Workpackage number :	5	Start date or starting event:				M7	
Participant number:	1	2	3	4	5	**7 (Lead)**	
Person-months per participant:	5	6	9	7	9	**12**	

Objectives

- Implementation of local scenarios to enable the learning activities designed in WP2.
- Local scenarios work with data that is generated by the local learning group.
- Essential part: Construction of realities and smooth transitions between the physical and the digital world
- Simulation models of limited human perception using an agent oriented approach

Description of work

Task 5.1:
Analysis of technical requirements at different local experiment sites

Task 5.2:
Implementation of local learning environment (COLDEX-client software for the learner)
- extend and/or adapt tools developed in previous projects
- develop tools to define collaborative workflow of the experimental learning activities
- automate the acquisition, storage and sharing of data from experiments

Construction of realities
- support the setting of (real) experiments
- develop 3D, interactive virtual models (visual perception)
- develop (computer-controlled) physical artefacts (in particular tactile perception) possibly using construction kits

Task 5.3:
Test the prototypes and modify them according to the user needs and requirements

Task 5.4:
Support the users in the experimentation phase

Deliverables

D5.2.1: System Prototype 1 (implementation of the local experiments)

D5.3.1: Final Prototype (implementation of the local experiments)

Milestones and expected results

Workshop on scenarios (M6)

System Prototype 1 (M18)

Final Prototype (M24)

Workshop on dissemination and evaluation (M27)

Communication and pedagogical networking

Workpackage number :	6	Start date or starting event:		M7			
Participant number:	1	2	**5 (Lead)**	7			
Person-months per participant:	5	3	**18**	3			

Objectives

- Development of institutional as well as technical infrastructure that enables tele-experimentation as well as collaborative learning according to the activities designed by WP2.
- Specification, implementation, testing and dissemination of the infrastructure.

Description of work

Task 6.1:

Specification of the distributed COLDEX Server infrastructure: communication protocols, resource exchange mechanisms (LOR) and fault tolerance and scalability

Task 6.2:

Development of the COLDEX-server software, including interfaces for people and institutions, the tools developed in WP3 and generic, also external, learning resources as well as real world, virtual world and constructed world experiments

Implementation of services for the support of collaborative learning activities with regard to customisable user and group profiles including different user roles, learning workflow as defined by WP 2 and integrated support for asynchronous/synchronous collaboration

Development of intelligent learning material transfer mechanisms, especially considering resources (e.g. bandwidth, client software and hardware) and availability on proxy servers in the COLDEX network

Development of retrieval mechanisms using task- and tool-specific metadata

Integration of the active document archives (WP3) with group archives

Task 6.3:

Test the developed COLDEX-server software and modify it according to the user needs and requirements

Task 6.4:

Support the users in the experimentation phase

Task 6.5:

Dissemination of results

Deliverables

D6.1.1: Network specification

D6.2.1: System Prototype 1 (implementation of the network of servers)

D6.3.1: Final Prototype (implementation of the network of servers)

Milestones and expected results

Workshop on scenarios (M6)

Network and interface specification (M12)

Server network ready (M24)

Workshop on dissemination and evaluation (M27)

Dissemination of the infrastructure via the Open User Scheme to external users (M27)

Open User Scheme

Workpackage number :	7	Start date or starting event:			M7			
Participant number:	**1 (Lead)**	2	3	4	5	6	7	8
Person-months per participant:	**11**	6	4	2	7	4	2	3

Objectives

- Forming a self sustainable trans-continental user community for the COLDEX network that lasts beyond the scope of this project
- Provision of COLDEX material (web-based and CD-ROM) in Spanish and English (also in Portuguese if needed)
- Dissemination of project results through user communities and publications

Description of work

Task 7.1:
Establishing of connections to Latin American educational institutions.
Carry out activities for the formation of an initial user community in Europe and Latin America.
Training and coordination of users and "key multipliers".

Task 7.2:
Defining rules (business model) to establish user communities of learners and content providers.

Task 7.3:
Pre-evaluation of the system considering the established user group.

Task 7.4:
Establishing of learning communities
Organisation of Workshops

Deliverables

D7.2.1: Learning material and guidelines

D7.2.2: Functional documentation

D7.3.1: System Report

Milestones and expected results

Initial user community established and users trained (M18)

Continuous enlargement of the user group (M18-M33)

Workshop on evaluation and dissemination (M27)

Pedagogical Evaluation

Workpackage number :	8		Start date or starting event:			M19		
Participant number:	1	2	**3** **(Lead)**	5	6	7		
Person-months per participant:	4	2	**8**	4	4	3		

Objectives

Analysis of claims defined by WP 2

Evaluation of the system from different points of view
- usability
- affordance and acceptance
- learning efficiency and development of transversals skills
- problems of institutional resistance to change
- learning advantages of an intercultural learning environment

Production of recommendations for the re-engineering of the system before widening the scope of users

Description of work

Task 8.1:
Testing of the functionality of the first prototype with pre-defined users

Task 8.2:
Pre-evaluation of the first prototype with learning material produced by WP7
Definition of evaluation settings to test the pedagogical claims produced by WP2
Development of methods for evaluating collaboration, based on approaches based on formative evaluation.

Task 8.3:
Evaluation with user communities established by WP7

Deliverables

D8.1.1: Evaluation Plan

D8.3.1: Evaluation Report

Milestones and expected results

Technical evaluation done (M21)

Pre-evaluation done (M27)

Workshop on dissemination and evaluation (M27)

9.3 Deliverables List

Deliverable No	Deliverable title	Delivery date	Nature	Dissemination level
D1.2.1	Project presentation (brochure, web site, video)	M6[1]	O	PU
D1.3.1	Quality Plan	M6	R	CO
D1.4.1	Dissemination and Use Plan	M6	R	CO
D2.2.1	Learning Requirements	M6	R	CO
D2.2.2	Collaborative Scenarios	M12	R	PU
D2.3.1	Learning Activity Design	M12	R	PU
D2.3.2 D8.1.1	Evaluation Plan	M20	R	CO
D3.2.1	COLDEX Toolbox	M12	P	CO
D3.2.2	The Toolbox Documentation	M12	R	CO
D4.2.1 D5.2.1 D6.2.1	System Prototype 1	M20	P	CO
D4.3.1 D5.3.1 D6.3.1	Final Prototype	M25	P	RE
D6.1.1	Network Specification	M12	R	PU
D7.2.1	Learning Material and Guidelines	M21	R+O	PU
D7.2.2	Functional Documentation	M25	R	PU
D7.3.1	System Report	M30	R	PU
D8.3.1	Evaluation Report	M36	R	PU
	Technology Implementation Plan / Exploitation Plan	M33	R	PU
	Final Report	M36	R	PU

1 Video – to be released in after 12 months with subsequent updates in the following years

Prototype deliverables will be accompanied by a short document summarising the functionality supported by the current version of the prototype and the additional features (compared to the previous version).

Ref.	Project Management Deliverables	Frequency
MRx	Quarterly Management Report	Every 3 months
PRx	Progress Report	Every 6 months
CSx	Cost Statement	Every 6 months

9.4 Project Planning and timetable

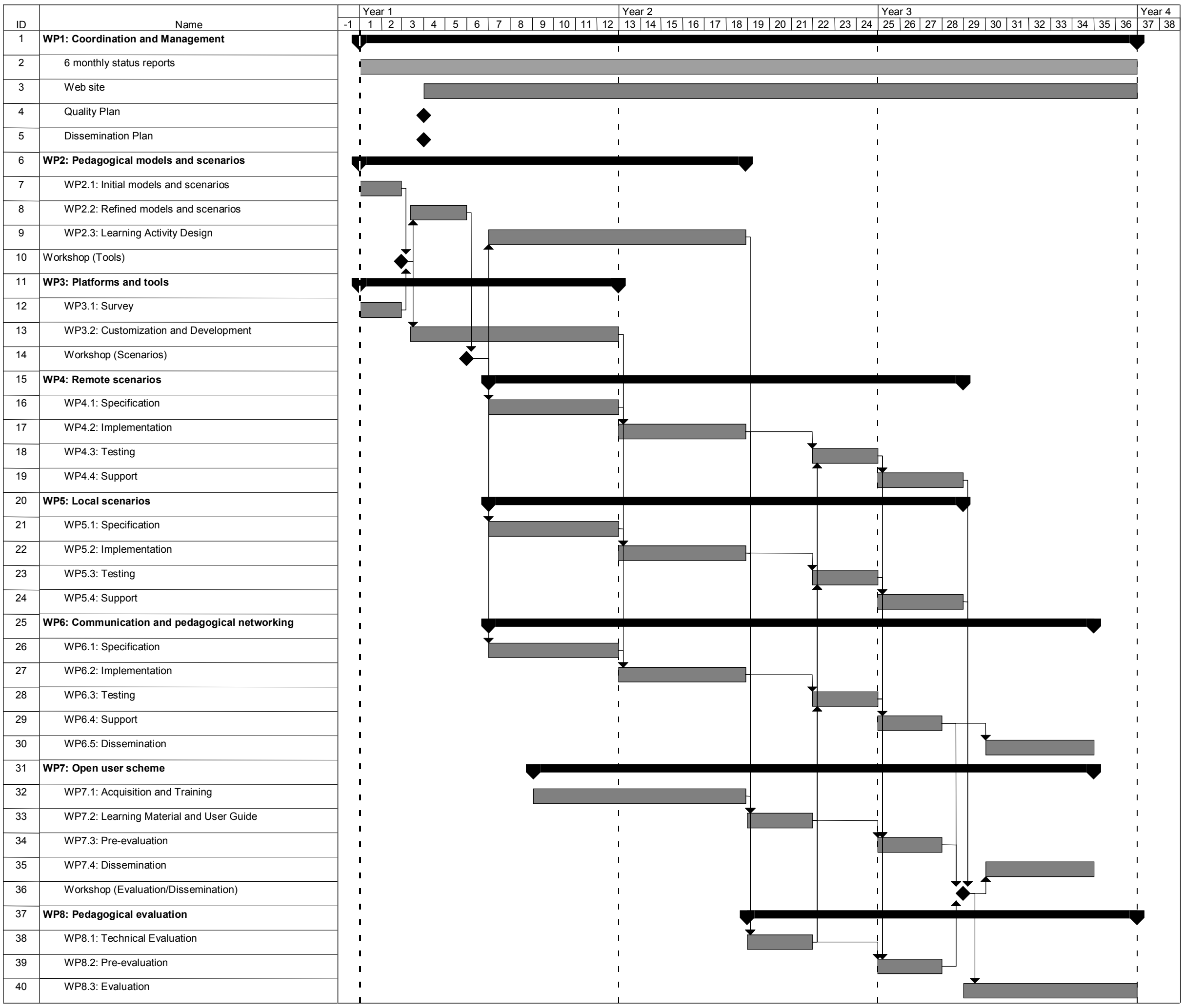

Figure 10: The Gantt Chart

9.5 Graphical presentation of project components

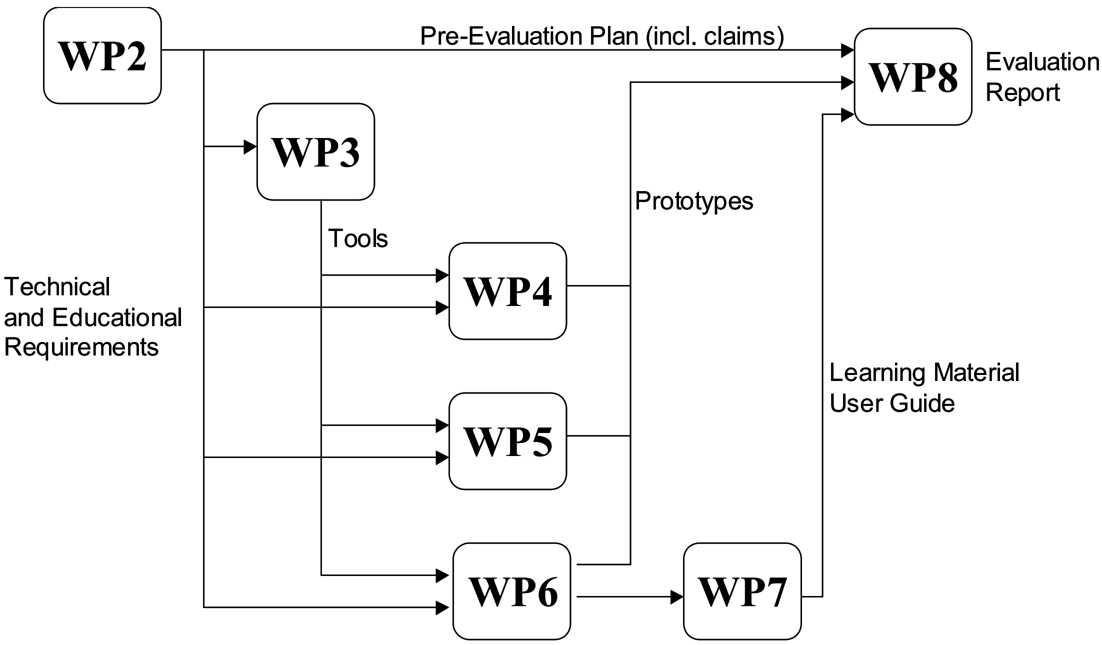

Figure 11: The workpages dependencies

The work packages are subdivided into tasks. Most tasks produce one or more deliverables. The project management WP1 coordinates the cooperation of all workpackages. Certain tasks produce specifications. These specifications are needed by other tasks to start their work without having to wait for the real data or a prototype implementation of the specified tool or technology.

There are 3 phases in the project, which partially proceed in parallel to reduce the overall duration of the project:

- Specification
- Development of Scenarios
- Pedagogical Evaluation

At the first workshop representatives from WP2 and WP3 will discuss an initial set of pedagogical models and scenarios and a first survey of what kinds of tools are available. As an outcome of this meeting, requirements for tools will be formulated. Based on these requirements, further models and scenarios will be designed by WP2, while WP3 will make existing tools available or develop new tools. In a subsequent workshop, pedagogical models will be presented and concrete scenarios will be specified in cooperation with WP4, WP5 and WP6. After the work on these scenarios has begun, first steps to form a user community will be done, e.g. publishing a call for users. With the availability of the first prototype at the beginning of the second year, evaluation will proceed in close cooperation with the open user scheme, which will also increase dissemination of project results.

9.6 Project management

COLDEX is a complex project that calls for a detailed and gradually scaled planning and monitoring. Apart from common project management procedures discussed below, the following points are considered to be important factors for success:

- Several partners have been collaborating in the past in similar project or research contexts and thus there are already well established communication links among them.
- Several partners have long and rich experience in structuring system development processes using software engineering methods and tools.
- There will be an explicit monitoring and follow-up of the effectiveness of the internal communication among the teams of people coming from different backgrounds so that proper message conveying is guaranteed (e.g. misunderstandings due to the different meanings attributed to technical terms by different people, etc).
- Web-based tools supporting "distributed management" and collaboration will be used (e.g., BSCW or Innovie's TeamCenter™). These will facilitate visualisation of project status, support threaded discussions and collaboration on specific project topics, resource management analysis, tracking of progress, manipulation of assignment-lists, etc..
- Trans-continental coordination and cooperation can be realistically met due to the mixed cultural and language backgrounds also in the European teams. There will be informal trans-continental exchange based on personal visits at a rate of about 5 per year. At least one dedicated trans-continental face-to-face meeting will take place every year. All partners have experience in using a variety of synchronous and asynchronous communication tools to support international cooperation at a distance (time difference ranges between 4-6 hours).

Management structures and procedures

The following primary roles are foreseen for managing the COLDEX project:

Project Coordinator (*PC*, Prof. Ulrich Hoppe, University of Duisburg-Essen) The PC operates at the strategic project management level, having the overall project responsibility and in particular for:

- Scientific quality of the project (with support from the Scientific Board – see below)
- Co-ordination and continuous collaboration with the appointed deputy managers (project manager, technical manager, financial manager) and Partner Project Representatives (see below), for smooth implementation of the project.
- Official representation of the project to the EC or elsewhere as required.
- Establishment of consensus procedures, recommendations for taking correcting action when required and interventions to attain issue resolution.
- Policies regarding dissemination and exploitation of project outcomes.

Prof. Wolfram Luther, University of Duisburg-Essen, will act as deputy PC, entitled to replace the coordinator in all situation if needed.

A *Project Manager* (*PM*) will be appointeded and contracted at University of Duisburg-Essen. The PM will have the overall responsibility for monitoring the project works on a daily basis and in particular for the:

- Follow-up of the project's contractual obligations in compliance with EC requirements.
- Co-ordination of the development and implementation of the workplan in close collaboration with WP Leaders (see below). Re-scheduling where necessary.
- Working-out of action-lists (in co-operation with the PC and Technical Manager – see below) and follow-up.
- Timely preparation, internal review and submission of deliverables to the EC.
- Organisation and substantiation of project-wide meetings.

The Project Manager will also support the PC and deputy PC in managing and monitoring the technical progress and framework of COLDEX, i.e.

- Decisions on technical issues, i.e. tools & platforms, based on project context, requirements, international trends, product availability, etc.
- Supervision and co-ordination of the technical work through Workpackage or Task Leaders (see below).
- Call and co-ordination of project-wise or focused technical meetings.
- Compliance of deliverables with project quality standards.
- Technical issue resolution and establishment of consensus.

A *Financial/Administration Manager* (*F/A*) will be assigned in the Administration of the University of Duisburg-Essen. There is successful prior experience with financially administrating several European consortia. The F/A Manager will be responsible for the overall financial administration of the project and in particular for ensuring compliance with the rules of the fifth framework programme including the compilation, editing and timely submission of all administrative reports and cost statements.

Project Management Board:

This will be the formal decision making body of the consortium consisting of one PR (see below) from each of the Principal Partners, the PC and the PM. Management Board meetings will be held about twice a year (with European partners) and whenever unanimity is impossible the majority rule shall apply. The PC chairs the Boards' meetings.

Partner Representatives (*PR*):

Each Principal Contractor designates one Partner Representative (PR), who is responsible for all project aspects and communication on behalf of his/her organisation. Among others, responsibilities include:

- Representation of the partner in the Project Management Board.
- Responsibility for the timely production of reports, deliverables and cost statements assigned to his/her organisation.

- Monitoring of the implementation of the workplan and the timely preparation and submission of all deliverables on his/her part.

A PR may opt for being represented on a permanent or ad-hoc basis for specific matters (e.g.administration, technical issues, etc) by someone else from the same organisation.

The PC will take special care for informing and consulting the overseas PRs (in Santiago and Antofagasta) in all relevant issues, particularly also in the preparation of decisions in meetings without direct overseas participation.

Workpackage Leaders:

Each responsible leading WP partner (shown in table of Part B) will assign a WP Leader for each corresponding WP who will be responsible for the detailed co-ordination and execution of tasks. A Workpackage Leader may assign certain task(s) to a task leader who will be in charge of the execution of the particular task(s).

Communication flow within the consortium:

A communication strategy will be adopted by the consortium that will guarantee maximum transparency for all involved and will increase the synergy of the co-operation. Interactive meetings (see below), will have an important role in the communication strategy. Daily communication flow within the consortium will be facilitated by web-based and other tools. In addition, a project web-site will be set up for the circulation of various kinds of materials. The communication strategy of the project, which includes planning for publications to be made, presentations to be given, conferences to be attended on behalf of the consortium and communication with organisations outside the consortium will be a topic at each Project Management Board's meeting.

Meetings:

Meetings can be technical, administrative or otherwise focused in scope (e.g. for pedagogical issues) and can be called project-wide or in focused clusters, in person or based on video/telephone conference. Project-wide meetings can be called by the PC, PM, or any of the WP Leaders. All partners are invited (regardless the topic) through the PRs who decide on who -and if- is representing them, depending on topic and available resources. Smaller meetings can be selectively called ad-hoc, essentially by any PR.

The typical anticipated frequency of combined technical/administrative meetings will be one in three months between the European partners. Overseas partners will be interactively involved in all issues (decisions) of mutual relevance using synchronous communication tools. At least one meeting per year will be organised in such a way that there is full representation of all partners, including overseas partners.

Scientific Board:

A Scientific Board will be informally installed and act as a "think-tank" in content-related issues, comprising of all the scientific personnel across partners (regardless discipline). It will be stimulated and called by the PC. Its main duty is the quality assurance of the project's products and results. Among other things it performs the internal evaluation of the project's deliverables, recommending and consulting accordingly to the PC.

10. Clustering

The Consortium will participate actively in the activities of project clusters and will co-operate with the relevant support actions, launched by the Commission in the context of the activities of the IST Programme – Education and Training.

11. Other Contractual Conditions

11.1 Sub-contracting

P1: University of Duisburg-Essen

The total amount of 25000 EUR allocated to sub-contracting reflects the need to engage technical staff for programming the hardware / software interfaces with seismic measurement station and telescope observatories and associated travel costs (to Chile). Part of this work will probably involve a local sub-contractor (estimated amount 11000 EUR).

11.2 Other Specific Costs

P1: University of Duisburg-Essen

The total amount of 74000 EUR allocated to this cost category is divided as follows:

- Development of the prototypes and set-up of the demonstrators in the actual locations (estimated amount 15000 EUR)
- Preparation of several (2-4) workshops in Europe and Latin America in order to promote the Open User Scheme described in more detail in WP7.
  A first workshop will be held in Argentina or Chile in the period of March-May 2004. The workshop is planned for a group of 150 participants, mainly from Latin America. We will support participation by providing free meals and accomodation to a maximum of 50 Euro per participant and day on a three day basis. We estimate 2500 Euro to be paid to the local organisation for infrastructural facilities (rooms, equipment, technical support). Also, we reserve a maximum of 5000 Euro for invitations of special participants with full, travel support (incl. airfare). On the whole the cost of the initial OUS workshop amounts to 15000 Euro. The following workshops will be of more regional nature and potentially with less subsidies for the participants, so that these will be less costly. The overall estimated amount of workshops costs and external travel support within the OUS is 42000 Euro.
- Preparation of a written documentation (in English and Spanish) and digital material (software) for several construction kits to be delivered on CD/DVD-ROM or as download material at an estimated cost of 13000 Euro including specific workforce for document preparation, translation and technical assistance.
- Audit certificates (4000 EUR)

P6 UPM:

UPM will purchase and install a telescope with an estimated cost of 10000 Euro as part of the project infrastructure.

P7: INESC ID

The total amount of 17500 EUR allocated to this cost category is divided as follows:

- Conference fees and specific technical arrangements to host project meetings (estimated amount 7500 EUR)

- Development of some specific components of the prototype - user-interface for local scenarios (estimated amount 4000 EUR)
- Audit certificates (6000 EUR – only 50% funded)

The amounts mentioned above include the costs incurred with:

- The acquisition of electronic components, necessary to build the prototypes, the technical staff in charge of assembling the prototype and installing it in the various project locations, as well as the associated travel costs.
- The workshops to be carried out in Europe and in the location of the Chilean partners. They require, in some cases, the use of special technical facilities (higher speed connections with guaranteed bandwidth, high resolution video-projectors, etc.). The budget also covers the preparation of support material ("construction kits" and CD/DVD-ROMs) for the participants. The attendance costs of some participants is also considered in order to be able to reach a wider audience and reinforce the value of the project.

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