

eContentplus

Annex I - Description of work

Joining Educational Mathematics

JEM

Description of Work

Project Summary

The real challenge of e-Learning is to produce content that brings a general improvement in the way students learn and instructors teach. The design and the production of high-quality digital content has turned out to be harder than expected, the main reason being that it requires expertise in several subject matters as well as expertise in several technologies. In the case of mathematics, the required areas of expertise include that of professional mathematicians, software engineers, publishers, and perhaps learning theorists.

There is a critical mass of activity around the area of semantic markup for mathematics which is directly related to enhancing digital content, in particular e-learning of mathematics. Much of this activity is or has been sponsored by the EU (OpenMath, OpenMath-TN, WebALT, LeActiveMath, Genesis), some is sponsored by national agencies (MatTaFI, Serving Mathematics, EMILeA-stat, Moses, Mumie, MEMBERS, math-kit), some by multi-national consortia (W3C's MathML Interest Group, OpenMath Society), and some by private enterprise (NAG Ltd., Liguori Editore, Maths For More, ISN).

The goal of the JEM thematic network is to pool together the required expertise and to contribute to the coordination of content enrichment activities in the area of mathematics, to the maintenance of agreed standards and to the delivery of powerful synoptic high-quality user information and support pages, invoked in e-learning platforms operated by the partners. These activities will have tremendous long-term benefits for the quality of e-learning in mathematics in Europe and the wider world.

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1 Rationale

1.1 Description of the issue addressed

Mathematics is a fundamental discipline in science, technology, engineering, and society. Moreover, fundamental problem solving skills, acquired when learning mathematics properly, such as structuring a problem or a situation, analyzing prerequisites and implications, go beyond doing mathematics and influence social capabilities and behaviour in our increasingly technological society. Yet, the number of undergraduates in mathematics has been decreasing all over Europe in the past 10 years and as a result, there is a lack of new mathematicians able to entice new generations of schoolchildren and to tutor university students.

One way to overcome the crisis of mathematics education is to improve the didactic tools and the lecture material. Recent technological advances in the representation of mathematics on the web make it possible to create and to deliver high-quality, interactive mathematical content to users' computers worldwide. Centres of excellence in mathematical research and education are scattered across the continent and all too often their efforts fail to add up in the absence of an efficient system for collaboration. In Europe alone, educators of mathematics lecture students in about 4000 establishments of higher education every day of the week. They hold basic classes consisting of more or less the same notions but they cannot share the didactic material with each other because they are unaware of a suitable language-independent easy-to-use platform. It is an enormous waste of human resources in an area where lack of teachers is an increasing problem. Numerous educational institutions have to meet a growing demand for teaching with diminishing resources.

It is clear that students, regardless of their location or language, have to learn a common corpus of basic mathematical facts. They should all have easy access to a structured multi-lingual and multi-cultural repository of mathematical lectures, notes, problems and test questions, whereby they could train develop skills independent of time, place and pace. In the OpenMath Project and the Thematic Network that followed it, the European Union supported the development of OpenMath and MathML, two complementary standards for content and presentation markup of mathematics. The original intention was that these would be used to exchange mathematical objects between software systems, and to facilitate the development of active texts where the mathematical components could be extracted, manipulated and checked. As such, these technologies have been a great success and are now being used in advanced e-Learning projects such as LeActiveMath Serving Mathematics, iClass, and WebALT.

However we still have to raise and train a new generation of authors who are informed about the advantages of using mathematical markup, and who are willing to devote the extra effort that is still needed to produce high-quality materials. Current authors see no benefit in learning new technologies. This results in a scarce production of semantically marked up digital content even when new tools become available to produce much better material.

The network intends to bring together the markup technologies developer community (OpenMath, MathML, PhysML, LeActiveMath, MathDox, WebALT, STACK, iClass, EMILeA-stat, math-kit) with the user community (TUB, FernUni, UPC, UH, ISN, UOC, UNED) and in particular with the authors of e-learning content in mathematics. Developers of mathematical markup standards and tools will obtain feedback from key users of the technologies and vice-versa, users of state-of-the-art web languages will have access to in-depth training and be able to influence future developments. The developer community will also profit by sharing their commonalities and working towards promoting common standards and interoperable solutions. The network will be able to promote Europe wide comparison studies on didactics using digital mathematical material and use-case surveys will give directions on how to further develop the technologies. The overall goal of the network is to become a focal reference point for all mathematical eContent stakeholders and:

- to foster and extend the multicultural and multilingual use of semantic markup for mathematics within the European e-learning community
- to monitor the developments of learning technologies so that mathematical content can be integrated and delivered by state-of-the-art and leading systems.
- to structure, coordinate and support the user and authoring community of e-learning content in mathematics.

2 Proposed Solution & Objectives

2.1 Description of the proposed solution and the objectives

One of the next challenges for the e-learning community is how to maintain and to enhance the quality of digital content. Even though the benefits of having a semantically rich representation for the mathematical information are multi-fold and widely accepted, it is still very hard to produce digital material with such quality. There are several reasons for this situation in mathematics:

- editing formulae is hard, editing semantic markup is even harder
- authors tend to stick to the tools they have used until today
- authors do not realize the full potential of semantic markup
- technology developers are not aware of learning objectives of authors and/or users of digital learning resources.

The main focus of the JEM network is to bring together the authors of digital content used for e-learning in mathematics with the groups that are actively developing semantic web technologies and tools for the representation of mathematical content. The major work of the network will be to establish the appropriate way in which these two communities can interact and cross fertilize. Promoting the dialogue between the developers and the user/author community will be done using web channels such as a central JEM network portal, discussion forums, establishing hotline support and a collaborative wiki space. JEM will provide a direct line for authors to contact not only the technology developers on problems arising from enhancing their materials, but also other authors who have used different solutions to deliver mathematics with eLearning. Likewise, since JEM collects the main

technology developers, all working in semantic web standards for e-mathematics, it can act as a cohesive force to ensure cross-compatibility among the software solutions.

Activities to raise awareness on the benefits of enhancing digital lecture materials by semantic markup and metadata include the organization of special sessions at relevant user conferences, a series of tutorial workshops, a training-camp school, and providing a collection of sample high-quality material. Participants of the network that are involved in the organization of meetings at international level will be able to promote the network in these wider circles.

Tangible milestones for the network will be a procedure for quality evaluation and certification of eContent in mathematics that will be applied to e-authors published in the JEM directory. The network portal will collect sample material and instructions on how to obtain the most from the current technologies as an outcome of the training-camp JEM school. The self-sustainable JEM portal, designed as a collaborative effort, will remain operational beyond the lifetime of the project.

The partners are committed to collecting and enhancing currently available digital content in mathematics and using it for courses in mathematics at several universities across Europe. The success of the network will be directly measurable by several indicators in terms of joint activities undertaken by the partners:

- number of workshops participants
- number of online courses across Europe using partners' material
- number of accesses and downloads
- new joint projects
- new network partners

2.2 Analysis of demand and user needs

The target groups that are going to benefit most from the activities of the JEM network are university students, teachers, engineering education providers, instructional designers, and managers of educational institutions.

In Europe alone, there are about 4000 higher educational institutions that every day of the week offer lectures and courses in mathematics to roughly 5 million students in the age group 20-24 years old. The number increases considerably, to 32 million, if we take into account high school students, namely the age group between 15-19 years old. Let us consider just the 5 million university population. For an average class size of, say, 50 students, we get 100000 classes taught each day, most likely each one using its own lecture notes, and requiring the tutor to devise a number of exercise problems and tests.

These numbers give an idea of the incredible effort spent by mathematics lecturers in tutoring, and especially in devising homework questions, and finally grading exercise problems and tests. In almost every university, digital material is made available to students by the professors and seldom is the material re-used outside the university or even outside the specific class. One major reason is that the online lectures and problems are not described using metadata and made available to everyone using online repositories of learning objects.

PLS RAMBOLL Management has carried out a strategic study of virtual models of universities for the European Commission, DG Education and Culture during 2002-2003 . The aim of the study was to provide the Commission with a report concerning the current and potential future use of ICT by European universities. This study points out that 65% of universities stated that increasing the number of courses offered in e-learning format will be one of their key priorities over the next few years. These universities felt that among the key obstacles and challenges towards the extended use of ICT and e-learning were the facts that

- most academic staff lacked knowledge concerning the potential of ICT and new ways to use it,
- there is a shortage of high-quality, ICT-based, inspirational material.

The same study points out that several countries have suggested that an association should be formed that comprises those European universities which are experienced in e-learning and are interested in publicizing good practice and experience relating to ICT pedagogy and content development. JEM is such an association that promotes and raises awareness about technologies to enhance available mathematical didactic materials so that it becomes sharable and reusable.

2.3 Description of the underlying data and sources

The JEM network collects together leading European universities and companies which have high-quality special knowledge and experience in digital content in mathematics. Each of the universities in 6 different European countries (Germany, Netherlands, Finland, Spain, United Kingdom, Portugal) involved are experienced in creating and using digital content. There are also four companies involved in this network: Liguori Editore (Italy), Maths for More (Spain), Numerical Algorithm Ltd and Institute for Science Networking. An inventory of the digital content with the network of this proposal shows that all partners qualify as stakeholders for eContent in mathematics, statistics, and theoretical physics. The following list illustrates the quality and volume of the content owned by some of the partners of this proposal:

- Algebra Interactive by H. Cuypers, H. Sterk and A. Cohen. Pioneering e-book in basic mathematics.
- A full two semester on-line course in calculus (available in English and in Spanish) of M. Seppälä. Over 110 000 downloads of lectures in 2005 (by November 22). Collection of PowerPoint Slideshows, available also as pdf files, and Maple worksheets.
- Self-study materials in Classical Geometry by S. Xambó. Available in Catalan over the FME/UPC intranet, English version will be published in 2006.
- A collection of advanced problem templates in calculus and in algebra. These problems use the system STACK. Copyright University of Birmingham. Chris Sangwin, a partner of this proposal, is the key developer of STACK.
- Self-assessment system, in German, for two courses in linear algebra based on the flashcard concept [2]. Copyright FernUniversität Hagen. The flashcard concept has turned out to be very successful. Requires Mozilla Firefox.
- Descriptive Statistics of Udo Kamps. On-line materials for different usages of learning and teaching, e.g., self-study and exploratory learning. This is an extensive collection of materials in statistics, and is accompanied by several other statistics and probability theory on-line courses by the same author.

These on-line materials have been produced by the support of the EMILeA Project.

- Calculus Lecture Notes (in Portuguese) by J. F. Rodrigues and P. Duarte.

All universities involved in the proposal typically have collections of examinations, homework problems, and lecture notes of all the basic courses in an electronic form, mostly produced in LaTeX. Many partners of this network also have extensive collections of interactive content powered by computer algebra systems like Wiris, MapleTA, or Java illustrations of mathematical content. Liguori Editore has, in addition to the above list, a full line of commercial on-line books and other publications. Some of the content is open source and will remain as such. Some of the freely available content will be used to build commercial applications based on offering services such as multilingual adaptive problem databases with solutions. These services would be made available against a subscription. For sustainability of the network, it is important that some of the eContent produced by JEM authors may also have commercial use.

2.4 IPR issues and solutions

IPR issues vary from country to country. In some countries the professors authoring digital content also own the IPR of that content. In some other countries, the IPR belongs to the university at which the authors are working. One of the services provided by the JEM network will be to address IPR issues and explain them to authors.

2.5 Multilingual and/or multicultural aspects

Since different types of context may influence the choice of a mathematical notation and language, state-of-the-art technologies need to be employed to derive localized presentations of the mathematical fragments in digital documents from language-independent semantic representations of the content of its subject material. Among the many factors that influence the way mathematics is written, the following are always taken into account:

- semantics of the mathematical operation e.g., the kind of multiplication (the notation for cross-product differs from that of scalar product of vectors)
- level of mathematical sophistication of the target audience e.g., using \times notation for simple multiplication in elementary school, but “invisible” multiplication in secondary and higher education or expressing formulae in natural language instead of using a compact symbolic presentation
- typographic conventions arising from the specific area of study or from the geographic location e.g. using (a,b) or $]a,b[$ for denoting the open interval between two points a and b , or using i or j for the imaginary unit depending whether it occurs in complex analysis or in electrical engineering
- individual stylistic choices (e.g. the use of a mirrored capital E , , vs. a big O or notation, for existential quantification, with corresponding changes in layout positions for the respective parts of the quantified expression)
- cultural or linguistic distinctions (e.g. \tan vs. tg in different parts of the world, and the different notations for the greatest common divisor in different languages gcd in English, ggT in German, mcd in Spanish, MCD in Italian, and so on in different languages, all abbreviating the respective languages’ translation).

- choice between formal or informal rendering (e.g. “ f where x is an element of S ” vs. “ $\lambda x:S.f$ ”)
- choice between different rendering modes (e.g. visual vs. aural)

Content markup, in particular mathematical information in MathML and OpenMath provides semantically rich, high-quality representations of knowledge at a level of abstraction that is suitable for electronic communication and processing. Typically using XML, this representation of mathematical content is designed to be independent of the cultural, regional and notational influence which is so important when presenting mathematics in a written or spoken form. The XML representation is intended for automated processing by software tools but at the same time it maintains a certain degree of human readability. Both MathML and OpenMath emphasize the distinction between content markup and presentation, the former providing a set of primitives for typesetting mathematical notation in the markup language called MathML Presentation. It is during “rendering” that, for instance, the MathML content representation of the concept of greatest common divisor is localized and presented in English as $\text{gcd}(12,27)$, in German as $\text{ggT}(12,27)$, and in Spanish as $\text{mcd}(12,27)$. Since the content representation can be unambiguously evaluated by computational software whereas the presentation can be inferred depending on the client location, this XML verbose format is the preferred format for storing digital material containing mathematics. Thus, the mathematical content markup provides, on the one hand, a standard format that is rich enough to allow the invocation of any computational software for performing mathematical manipulations, and, on the other hand, a language-independent format that can be fed to natural language generation software and to stylesheets for producing the mathematical vernacular and notations used in the final presentation.

3 Expected results and performance of the project

3.1 Expected results

The principal result of the JEM network will be the creation of an active portal which uses the latest web technologies to provide a forum in which potential developers of mathematical content can interact with experts in digital content technologies.

3.2 Performance and success indicators

Progress monitoring and reporting of the network activity will include data based on indicators such as the number of:

- project web site hits (year 1: 300K, year 2:1M, year 3:4M)
- participants contributing to JEM workshops/meetings
- core members present to JEM meetings
- countries covered in any JEM meeting (targeting a minimum of 10 countries)
- relevant meetings/conferences/workshops where a representative of the network has participated
- meetings/conferences/workshops where results of the network have been presented
- stakeholders (authors of eContent, technology developers, and disseminators of eLearning practice) which have been informed about the Network and its result
- take-up of any standards/common practice promoted by JEM

Performance of the JEM network will be evaluated periodically based on the portal statistics in terms of the number of subscribers, hits, and articles, most used pages, most active discussions, and so on. These network assessment reports will be published for review and evaluation by the participants who will then be able to improve the services of the JEM portal. A more ambitious indicator of success will be the offer of new virtual courses in mathematics. These courses will be developed collaboratively by participants in the network through the exchange and augmentation of their existing eContent.

4 Relevance to the objectives of the eContentplus programme

The JEM network plans to carry out a wide range of awareness activities that address educational content stakeholders in mathematics on the benefits demonstrated by enriching digital content with semantic markup and technology developers with learning objectives of authors and deliverers of digital content. It will enlist the developers of the technologies as instructors for author of eContent and distribute sample material via established servers of virtual universities, commercial publishers and professional societies. The JEM portal will be designed to offer an appealing platform where the necessary expertise for devising high-quality eContent for eLearning in mathematics can converge and offer a centralized view of the stakeholder community. By delivering authors' and developers' support, the JEM portal ensures that a constant flow of information on the production of eContent will be available and recorded in terms of re-usable documentation. Moreover, the contribution of news and success stories coming from synergistic national and European project will stimulate cooperation and exchange.

4.1 Community added value and contribution to related EC policies

The network will contribute to create greater compatibility within European higher education in mathematics in the spirit advocated by the Bologna process. Implementation of the European Credit Transfer and Accumulation System will be more easily achieved if high quality courses and curricula can rely on a common repository of educational content. Moreover, it strongly promotes, within its network of authors, cooperation in quality assurance by enforcing a tradition of excellence.

Such a network also facilitates the mobility of teachers since it aims at training content development that is multi-cultural and multi-lingual.

Europe contains many different mathematical cultures and traditions which share the same basic concepts but describe those using different notations. Using semantic markup within educational material allows a student to view it using the notations he or she understands even if they are different from those of his or her instructor. This will help to ensure that Europe's different traditions continue to develop and co-exist, rather than be replaced by a single dominant one.

4.2 Contribution to economic development and social objectives

Quality of teaching and learning can be substantially improved using high quality digital learning resources. The network's contribution will be that such content for mathematics education will be made shareable since it will be based upon common

standards. As a consequence learning resources will be usable by numerous institutions and independent study will be supported. This will unburden in particular small mathematics institutes from developing and maintaining digital learning resources.

The challenge of maintaining a strong research community in mathematics is an especially important one, given the contribution that many mathematicians go on to make in other scientific fields such as physics, biology, engineering and economics. Improving the quality of teaching and learning of mathematics is even more important in today’s increasingly technological world which requires a firm grasp of scientific reasoning.

An adequate mathematical education for everybody, including adequate abstract reasoning abilities, is an indispensable requirement for a society that aspires to have a knowledge-based economy. This is the more so in an epoch in which technology (especially telecommunications), computing and conceptual systems have converged to a degree that was unthinkable only a few years ago. However, the human resources needed to provide this adequate education for everybody are simply beyond the possibility of the richest of societies, because of the large numbers of teachers that should be involved, and because the levels of competence required from them. The way out of this awful dilemma is to use technology [in the ways disseminated by the JEM network] to take care in tutoring of the most mechanical aspects of learning, which constitute a large part of the student’s time. This will also spare the priceless teacher/instructor time for the more subtle aspects of learning. Thus, the JEM network aims at contributing expertise for tackling two highly conflicting societal goals: adequate mathematical education to everybody whilst not wasting teachers’ time and specialized competence on mechanizable tasks such as assessment of students’ skills.

5 List of Participants

| List of Participants | | | | | | |
|----------------------|-----|------------------------------------------------------|------------|-------------|---------------|-----------|
| Role | No. | Name | Short name | Country | Entrance date | Exit date |
| CO | 1 | Helsingin Ylopisto | UH | Finland | 1 | 36 |
| NM | 2 | Universitat Politecnica de Catalunya | UPC | Spain | 1 | 36 |
| NM | 3 | Technische Universiteit Eindhoven | TUE | Netherlands | 1 | 36 |
| NM | 4 | Technische Universität Berlin | TUB | Germany | 1 | 36 |
| NM | 5 | International University Bremen | IUB | Germany | 1 | 36 |

| | | | | | | |
|----|----|-------------------------------------------------|-----------------|----------------|---|----|
| NM | 6 | Universiteit van Amsterdam | UvA | Netherlands | 1 | 36 |
| NM | 7 | The University of Birmingham | UB | United Kingdom | 1 | 36 |
| NM | 8 | FernUniversität Hagen | FernUni | Germany | 1 | 36 |
| NM | 9 | Maths for More | M4M | Spain | 1 | 36 |
| NM | 10 | Numerical Algorithms Group Ltd | NAG | United Kingdom | 1 | 36 |
| NM | 11 | Liguori Editore | LI | Italy | 1 | 36 |
| NM | 12 | Institute for Science Networking Oldenburg GmbH | ISN | Germany | 1 | 36 |
| NM | 13 | University of Aachen | RWTH | Germany | 1 | 36 |
| NM | 14 | Universidad Nacional de Educacion a Distancia | UNED | Spain | 1 | 36 |
| NM | 15 | Open University of Catalonia | UOC | Spain | 1 | 36 |
| NM | 16 | Universidade de Lisboa | FC/Univ. Lisboa | Portugal | 1 | 36 |

Legenda: CO=Coordinator, NM=Network Member

6 Project Management, Dissemination and Sustainability

6.1 Project management

The network intends to adapt the management systems that have worked successfully in the OpenMath project and other networks to which several of the nodes belonged. The following key individuals will be involved in the management of the network.

Project Chairman: Mika Seppälä

Project Manager: Olga Caprotti

Site Leaders: Each site will nominate one site leader.

Work Package Leaders: The Project Manager will nominate one for each Work Package (with himself as the leader of Work Package 1) from the site that has taken

lead responsibility for drafting this work package. These may be changed by the Project Board.

Task Leaders: These are nominated by the Project Manager on the advice of the work package leaders.

The first three categories will elect, in a meeting conducted electronically during the first month of the project, five persons which, together with the Project Chairman and the Project Manager, form the *Steering Committee* of the Project. The Steering Committee has the ultimate responsibility for managing the project. Work package and task leaders, if not already members, may be invited for the discussion of particular issues, but will not be allowed to vote.

The 16 participants (coordinator and the 15 network members) form the core administrative structure. The Steering Committee elected by these Core Participants, will have ultimate responsibility for admitting new members. The Project aims at having as wide geographical coverage as possible.

New partners to join the project must have demonstrated results in one or more of the following:

- developing and using eContent in education in sciences,
- developing relevant technology for e-Learning,
- developing theoretical background empowering new and innovative ways to use technology in education.

In the case of having more candidate institutes, associations or companies to join the Project than what can be admitted (because of budgetary restrictions) preference will be given to organizations from countries not yet represented within the network.

The membership of a partner may be terminated in the event of non-participation in the work of the Project. The Steering Committee will have the responsibility of terminating a member's participation in the Project.

The project will actively seek new partners by solicitations to be published on the project's web site, and any changes in the list of participants to the project will be promptly communicated to the Commission.

The first task of the Steering Committee is to allocate travel budgets to the Beneficiaries of the Project. Travel costs will be compensated according to the internal rules and regulations of the travelers' home institutes. The home institutes will then bill the Project Coordinator for the travel occurred. The amounts will depend on the sites where the network will meet, and can be decided only after the plan of the meetings has been agreed upon. The coordinating partner, University of Helsinki, will hold travel allowance for all partners, and the actual compensations will be made by the University of Helsinki. The detailed rules for allocating the budget to partners will be defined in the network agreement.

Commission approval is required for a) admission of new members b) termination of membership b) adoption of the network rules, and any amendment of them. In the absence of observations within one month of receipt of the request made by the coordinator, the approval of the Commission shall be deemed to be given.

Day-to-day management will be in the hands of a smaller *Management Board*: Project Chairman and Project Manager together with the Leaders of active Work Packages. The Management Board, as advised by the Project Manager, has the responsibility for the management of the project within the grant agreement between the Commission and the Coordinator.

If a conflict arises, or is noticed by the Project Manager, she may attempt to resolve it herself. If she does not, or if this fails, then she refers the conflict to the Project Chairman. The latter may also attempt to resolve it himself. If he does not, or if this fails, then the Project Chairman refers it to the Steering Committee. He can either call a special meeting of the Committee (with at least two weeks notice given to all members by e-mail) or wait until the next scheduled meeting of the Committee, depending on the timing and the importance of the conflict. At the meeting, each member to the conflict may state their case. The Committee will then vote. In the event of a tie, the Chairman will have a casting vote.

In practice, and based on experience in other EU projects to which many of the members have belonged, it is generally possible to manage such a network very largely by e-mail, though it is probable that conference calls of the Steering Committee will be necessary as well.

It is envisaged that, under the Steering Committee, there will be Committees responsible for

- Standardization of the technologies
- Quality of the content

However, the full structure of these Committees would have to await the first meeting of the Steering Committee to approve the Management Board's recommendations.

6.2 Risk management

Risk management is perhaps the main task of the "Assessment and Evaluation" WP (WP 2). Emerging new technical solutions may render some of the work done by the Project obsolete unless the materials and methods promoted by the Project are adapted accordingly. The JEM Network comprises of partners representing all aspects of the value chain of eLearning. It is, therefore, likely that, among the Project Partners, the emerging new technologies can and will be assessed correctly and used whenever appropriate. Ultimate responsibility of this lies in WP 2.

During the Project it is likely that some partners will not perform their tasks in a satisfactory manner. In this type of situations, the Steering Committee needs to act and reallocate the tasks. This is likely to be the most important duty of the Steering Committee. Especially in a project like JEM, where the partners of the project will have to work without compensation, this type of problems will occur.

6.3 Dissemination and awareness

One of the main tasks of the network is to raise awareness of mathematical markup for digital content and to disseminate best practice guidelines. Mathematical markup

languages within eLearning include languages for knowledge representation, e.g. OpenMath, MathML, OMDoc, MathDox, MathQTI, and languages for metadata representation such as the CCD languages or vocabularies for describing a taxonomy in mathematics. Authors' guidelines about these languages will be produced as a side result of a summer school or training camp during which technology developers will demonstrate the usage of the various representation standards and tools in authoring digital mathematical content. The network intends to promote the uptake of semantic markup in mathematics by dissemination in teachers' education conferences and via the channels provided by the network partners, such as via mailing lists, learned societies, including those of applied fields (EPS, DPG), via the IuK (Initiative for Information and Communication of the learned societies in Germany) of DINI, SPARC, JISC, etc. Besides the training-camp school, a regular series of events will be organized by the network, the first of which will be held immediately at the start of the project, followed by another one every six months. Each workshop will begin with a one day project meeting attended by all the partners, and be followed by a two day open event. Additionally, the Project plans to organise special sessions or events alongside other meetings. The proceedings resulting from the workshops and from the hands-on training sessions will form the core guidelines for authors to start using markup technologies when developing new materials. Envisioned special events where the network would disseminate:

- Online Educa Berlin (annually)
- LearnTEC
- In 2007 the Open Universitat de Catalunya will host an ICDE (International Council for Open and Distance Education) International Conference in Barcelona, Spain
- E-Learn—World Conference on E-Learning in Corporate, Government, Healthcare, & Higher Education organized by the Association for the Advancement of Computing in Education (AACE)
- SITE, Society for Information Technology and Teacher Education (organized annually in the US)
- ICTM, International Conference on the Teaching of Mathematics at the Undergraduate Level
- The annual Spring Conference of German Physical Society, section Arbeitskreis Information 2007
- GIREP, Modeling in Physics and Physics Education
- COMPSTAT—Statistical Education and Web Based Teaching
- Annual International Conferences on Technology in Collegiate Mathematics (ICTCM, organized annually in the US)
- Annual Joint Meetings of the AMS and MAA (New Orleans, January 2007; San Diego, January 2008; Washington D.C., January 2009)
- The Evolution of Mathematical Communication in the Age of Digital Libraries, December 2006, Minneapolis, Minnesota.

In addition, the following dissemination activities should be carried out:

- prepare a multimedia PowerPoint presentation of the project that can be automatically run. The presentation should be for the general public describing consortium, project objectives, challenges and benefits.
- provide links/information about activities related to the eContentplus Programme on the project web-site.

- provide articles, fact-sheets, project descriptions, specific PowerPoint presentations at the request of the Commission to be used for the dissemination of project activities/results.
- monitor and update the project information published on the eContentplus website
- participate in events (e.g. conferences, meetings, workshops, trade fairs, exhibitions) at the request of the Commission.
- collaborate with related Thematic Networks funded by eContentplus, providing input to and taking into account relevant outcomes.

6.4 Sustainability of the project

The JEM network intends to promote communication among technology developers and authors of eContent in mathematics who will benefit most from the technologies. The JEM portal aims to become a focal source for all those interested in semantic markup of mathematics and its application to eContent and will be implemented as a collaborative platform in which the information is provided in a distributed fashion. Newsfeeds, community forums, and wiki pages will rely on each JEM participant for contribution and build upon past experiences for choosing the best solutions.

The network intends to carry on negotiation with community-specific servers to post and offer the semantic math-content modules and services beyond the lifetime of the project, e.g. for applied fields such as physics this is (served by ISN for a worldwide community).

7 Detailed Implementation plan

The core network activities are mainly structured as three work packages

- **WP 3** Identification of e-content stakeholders
- **WP 4** Coordination of the development of mathematical markup languages
- **WP 5** Usage of mathematic markup for mathematics in e-learning

Additional work packages are meant to provide overall steering of activities for evaluation of the network, for concerted dissemination and for the administrative management of the project:

- Project management is captured in **WP 1**, which is active throughout the project’s lifetime.
- **WP 2** acts as Evaluation and quality control and ensures the flow of information among various eContent projects in the network.
- **WP 3** covers dissemination and awareness of the results achieved by the network partners. Hence it runs throughout almost the entire project.

7.1 General description of network and work plan

The network assembles leading developers of semantic web technologies for the representation of mathematics (T), mathematics content stakeholders (S) and experienced distributors of software and eLearning solutions (D).

| Role | Applicant | Relevant Projects |
|------|-----------|-------------------|
|------|-----------|-------------------|

| | | |
|-------|----------------|------------------------------------------------------------------------------------------|
| S,T | UH | OM-TN, WebALT , EUREA , MATTIA , MatTaFi |
| S | UPC | WebALT |
| T,S | TUE | OM, OM-TN, LeActiveMath , WebALT |
| S | TUB | MuLF-Center , MuMiE, Genesis, MEMBERS |
| T | IUB | OM-TN |
| D,S | UvA | |
| T,S | UB | Serving Mathematics |
| S,D | FernUni | math-kit |
| T,D | M4M | WebALT , LeActiveMath (subcontractor) |
| T,D | NAG | OM, OM-TN |
| S,D | LI | MATTIA |
| T,S,D | ISN | physik-multimedial , PhysNet |
| S | RWTH | EMILeA-stat , MuMiE |
| S,D | UNED | |
| S,D | UOC | |
| S,D | FC/Univ.Lisboa | |

A more detailed description of each member organization, key personnel, and relevant projects is given in Appendix.

The current number of European countries covered by the network is seven (FI, DE, ES, NL, I, UK, PT), however it is planned to contact and extend the membership to up to ten new members from the very beginning. Precedence will be given to outstanding eContent stakeholders in countries in which JEM is not yet present.

7.2 Identification of mathematical e-content stakeholders

All partners in the JEM network applicants are mathematical e-content stakeholders since they are either developers of technology for the enhancement of online mathematics, they are actively pursuing online tutoring, distance education, or they lecture in mathematics or its application fields. This gives an excellent starting point to try to compile a directory of e-content stakeholders, for instance compatible with the directory listing PERSONA MATHEMATICA available at http://www.mi.uni-koeln.de/Math-Net/persona_mathematica/ and compiled by Math-Net, an effort towards a global electronic information and communication system for mathematics.

For instance, we will reach European authors using mathematics in theoretical physics via the Action Committee on Publication and Scientific Communication of the

European Physical Society. In Germany we will use direct email contact (List available), and we will contact the math-authors of modules in Physik-Multimedial eLearning platform and its eLearning module collection LiLi .

An initial directory will be made available at the JEM portal to allow mathematics e-content stakeholders to register during the first year of the network. However, the first official release of the JEM e-authors directory will list those stakeholders whose content has been reviewed and classified according to the evaluation criteria established by the JEM Quality Committee. This kind of quality certification is in line with the Bologna process since evaluation criteria may take into account requirements arising from the implementation of the European credit transfer and accumulation system.

7.3 Coordination of mathematical markup technologies

As a result of the previous projects there is now a broad community of people using semantic markup for mathematics, like MathML and OpenMath , in a variety of ways. Activities in the areas of publishing, e-learning, web services and conventional mathematical software are all in progress and all contribute to the production of high-quality digital material in mathematics. In Europe and in this network there are several key players in the development of technologies for the delivery of mathematics on the semantic web. This task aims at coordinating the developer community of standards for semantic markup of mathematics such as:

- [MathML](#) and [OpenMath](#), in particular Content Dictionaries (CDs) support ,
- [WebALT](#) Course Content Dictionaries for e-learning metadata, in addition to the standards LOM and SCORM , and multilingual technology
- [OMDOC](#) and MathDox for mathematical documents
- [MathQTI](#) for mathematical exercises
- [LeActiveMath](#) for adaptive e-Learning in mathematics and metada

Several conversion tools, for example XSLT stylesheets, have been developed to transform between the various formats and to allow capturing notational preferences arising from regional and cultural differences. Members of this network have developed several tools to handle mathematical markup and will provide support and guidance on how these techniques will enhance the quality of digital mathematical material. It is an important task of the network portal to make sure that the possibilities of converting legacy material, and of authoring semantic markup in LaTeX, MS-PowerPoint, and Mathematica are made visible to content stakeholders.

One of the main aims of this network is to provide a basic infrastructure in which the key developers groups can collaborate and monitor new developments in the eLearning community to ensure compatibility with the current standards for mathematical markup. All the groups mentioned here are represented in the network thus creating a unique combination of expertise in the emerging technologies for the next generation of digital content in mathematics. The web sites of the various standards developed within this network will be maintained as part of the tasks of this work package and made reachable from the centralized portal of the JEM network.

To improve user support, technology developers will provide web-based services such as

- hands-on training examples and online tutorials
- user mailing-lists and discussion board
- bug reporting system.

They will also organize special sessions at the regular workshops of the network and lectures during the summer school. The summer school lecture material will be the basis of the online tutorial on mathematical markup.

7.4 Usage of semantic markup for mathematics in e-learning

Novel usage of markup languages for mathematics comes from the eLearning community. To e-learning developers, OpenMath offers the advantage of being a rather simple language for the representation of mathematics that also offers the possibility for multilingual presentation of the content. Additionally, authors can produce electronic lectures in a format that can be visualized on the screen, read out automatically to visually impaired students or printed on paper for careful study. The same source may be used to produce handouts of specific lesson-trails or dynamically adapted to the user profile. The mathematical expressions can be directly fed to a variety of software packages and to mathematical web services that compute with them.

Many existing documents are still encoded in LaTeX, or other dialects of the TeX typesetting system. Despite the higher level of consistency that can be achieved by using an XML-based format, it is anticipated that support of migration activities from LaTeX to a markup-based format will be of major importance during the lifetime of this network, both because of the large volume of existing documents in this format (LaTeX has been available since around 1985) and because LaTeX remains a popular authoring format.

The network intends to promote the uptake of semantic markup in mathematics by dissemination in teachers' education conferences, and by collecting and distributing easy-to-follow self-contained examples of digital lectures notes, slide presentations and exercises. Since this a core activity, the network will also organize a series of training activities such as hands-on workshops geared at authors of e-learning content.

To reach out to scientific communities which use mathematics, special emphasis will be given by linking the JEM portal page to the Physics Network world network¹ and to the eLearning platform physik-multimedial.de.

A public wiki will collect the expertise, the background knowledge, the common mistakes and misconceptions, and will be collectively managed and developed as part of this work package. The feedback from the digital content stakeholder community identified in work package 4 will be used to steer the development of the wiki so that introductory tutorial articles will appear addressing both simple and advanced teachers' requirements.

7.5 Assessment and Evaluation

This work package will setup evaluation criteria to certify the quality of the standards, and of the digital content. Interaction with e-Learning quality assurance and standardization bodies is strategic. Quality assessment for learning resources is the object of study of the European Quality Observatory (<http://www.ego.info>) and has been funded at European level in projects such as the Socrates e-Quality (<http://e-quality.uta.fi/en>). Standardization activities are pursued by several organizations, for instance the European CEN/ISSS Learning Technologies group (CEN/ISSS LT), the Education working group of the Dublin Core Metadata Initiative (DC Education), the IEEE Learning Technology Standardization Committee (IEEE LTSC) and the Instructional Management Systems project (IMS).

Several partners of this network are actively pursuing eContent projects both at European and at national level as shown above in the general description of the consortium. Thus, another task of this work package is to ensure information flow among the various eContent and eLearning projects in which the network participants are partners of.

This may occur by promoting the usage of news feeds that can be distributed by the network portal to a subscribers' list. Based on this information flow, the network may issue feedback and requests to synergistic projects to improve mutual effectiveness. For instance, user studies that are carried out by an associated Content Enrichment Project should be made available to all stakeholders in the network to generate a wider feedback.

Periodic assessment of the network portal will be based on the online public statistics constantly available for review and evaluation by the participants who will then be able to improve the services of the JEM portal. The portal assessment reports will summarize the results and performance of the portal in terms of indicators such as:

- number of subscribers
- number of accesses
- number of articles
- most used pages
- most active discussion.

7.7 Work package overview

The work plan of the JEM network is centered on six work packages, one for each area identified in the previous sections. As the work packages are relatively orthogonal, they can basically run in parallel, and will run for the whole duration of the project.

The following table gives an overview of the work packages.

| Work package overview | | | |
|------------------------------|--------------------------------------------------------|-----------------------------|------------------------------------|
| Work package No. | Work package title | Lead participant No. | Lead participant short name |
| 1 | Project Management | 1 | UH |
| 2 | Assessment and Evaluation | 10 | NAG |
| 3 | Dissemination and Awareness | 3 | TUE |
| 4 | Identification of mathematical e-content stakeholders | 2 | UPC |
| 5 | Coordination of mathematical markup technologies | 1 | UH |
| 6 | Usage of semantic markup for mathematics in e-learning | 5 | IUB |

7.8 Work package descriptions

Work package description

Work package number: 1 **Start date:** 1 **End date:** 36

Work package title: Project Management

Participants involved: UH (38.2), all

Objectives

To co-ordinate the work and monitor progress in order to maintain focus on successful delivery of the expected results and on the accomplishment of the objectives, on time and to budget. To manage the project, liaise with the Commission and the reviewers appointed by them, to respond to external events, and to ensure that the aims and objectives of the overall project are met.

Description of work

This work package is responsible for the overall coordination and financial management of the network. Among other duties are the installment of necessary committees for deciding the network activities, revision of ongoing progress and work plan, communication with the Commission and with synergistic eContent projects, negotiations with community-specific servers to post and offer semantic math-content. The first due deliverable is the *Network Agreement*, signed by all members of the network, that should contain clear indications on criteria for membership of the network and how decisions are taken on admission to membership or suspension/termination of membership, as well as a description of the network internal rules on the allocation of the travel budget. A draft network agreement will be presented at the kick-off meeting with the Commission at the beginning of the project.

(Inter-) Dependencies of work, milestones and expected results

Timely and high-quality production of all deliverables in all other work packages.
 Early establishment of the management structure:
 M1.1 Steering Committee and Management Board

Deliverables

D1.1 Network Agreement
D1.2.1-D1.2.6 Midterm Progress Report
D1.3.1, D1.3.2 Annual Report
D1.4 Final Report

Work package description

Work package number: 2 **Start date:** 1 **End date:** 36
Work package title: Assessment and Evaluation
Participants involved: all, NAG

Objectives

To establish criteria for assessing and evaluating the quality and usability of both the technologies developed by the technological partners and the content produced by the authoring community.

Description of work

This work package will setup committees whose task is to put forward evaluation criteria for the certification of the quality of the standards and of the digital didactic content. The committee will take all necessary steps to ensure interaction with e-Learning quality assurance bodies and relevant standardization organisms and report to the network the actions taken.

This work package also performs evaluation of the network portal by assessing the usage based on actual online statistics of the portal. These results are published twice a year and should be used to ensure that the network is reaching its goals.

A direct outcome of this activity is the establishment of a review process for e-content to be adopted by the network. The review process will follow a clear quality rating scheme according to the guidelines described in D2.1 and D2.2 and incorporate suggestions and revisions that might arise during the network lifetime.

(Inter-) Dependencies of work, milestones and expected results

Standardization committee and e-learning committee aim to ensure a transparent way to interact with authors and with developers concerning quality aspects of eContent promoted by JEM:

M2.1 Standardization Committee

M2.2 E-Learning Quality Committee

Portal assessment reports D2.3.1-D2.3.6 depend on activities of the network portal being readily in place by D3.2.

Deliverables

D2.1 Evaluation criteria for e-content quality.

D2.2 Establishment of review process and related criteria for assessment.

D2.3.1-D2.3.6 Portal assessment report.

Work package description

Work package number: 3 **Start date:** 1 **End date:** 36

Work package title: Dissemination and Awareness

Participants involved: UH(12),TUE,UB,M4M,ISN,UNED,UOC,FC/Univ.Lisboa

Objectives

Disseminate information on, and awareness of, the progress, achievements, and results of the project to all segments of the potential target audience.

Description of work

This work package is responsible for setting up a network portal and maintaining supporting services, in particular the distribution of news and articles relevant to the activities of the participants, starting from the information included in the Appendix of this Annex. The portal is the main publishing vehicle for the deliverable of the network so it will host the directory of e-authors, the guidelines, and the good-practice sample material. It will be continually updated to reflect achievements, progress and results. Due to the dissemination nature of the network, the multilingual aspects of the portal will also play in role in making it accessible to a wide audience. To this end, the portal software will have to ensure multilingual features of the user interface. Statistics of the usage of the portal will be available online.

Further activities include the organization of a series of JEM workshops that meet twice per year and the publication of annual proceedings arising from these meetings. A training-camp school on semantic markup for eLearning in mathematics is planned as extra network event. The JEM training-camp event will host lectures by leading experts in semantic markup technologies for eLearning in mathematics and advanced authors of eContent. They will focus on the benefits of enhancing digital material by new technological solutions and aim at producing a comprehensive online tutorial and a collection of sample lectures profiting of the most advanced audiovisual solutions.

(Inter-) Dependencies of work, milestones and expected results

D3.2 is a crucial prerequisite for the implementation of D5.1 and D6.1, the authors' and developers' wiki. The network portal statistics, object of D2.3.1-D2.3.6 also depend on the portal activities being readily in place.

Deliverables

- D3.1** Project Initial Presentation
- D3.2** Network Portal
- D3.3** JEM Training-Camp School
- D3.4.1-D3.4.3** Workshop Proceedings Annual Collection
- D3.5** Project Final Presentation

Work package description

Work package number: 4 **Start date:** 1 **End date:** 36
Work package title: Identification of mathematical e-content stakeholders
Participants involved: UH (3), UPC, UB, FernUni, LI, ISN, UNED, UOC

Objectives

To identify authors of high-quality content for teaching mathematics in Europe that may contribute and benefit from the activities of the network.

Description of work

Authors of digital material for mathematics educations will be identified and contacted using the channels provided by partners' organizations and collaborators and invited to register as network authors. The JEM directory of authors of e-content will target publicity using national bulletins, professional societies, and department pages.

Periodic contact and outreach to new authors will be pursued during the lifetime of the project although self-registration in the authors' directory will be possible via the network portal and ensure self-sustainability.

After the release of the directory, the network will monitor its usage and take necessary steps to ensure its uptake by the community.

(Inter-) Dependencies of work, milestones and expected results

Outreach to new content stakeholders and invite up to 9 new members to the network from those countries not yet represented.

M4.1 First official release of the JEM online directory of authors of e-content in mathematics and its application fields, such as theoretical physics. A subset of authors listed in release D4.2 have submitted digital content which has been reviewed according to the criteria and review process established by D2.2. Feedback concerning the review process will be provided to the committees established in M2.1-M2.2.

Deliverables

D4.1 Preliminary JEM directory of e-authors.

D4.2 Online JEM directory of e-authors.

D4.3 Final report on usage of the JEM directory

Work package description

Work package number: 5 **Start date:** 1 **End date:** 24

Work package title: Coordination of mathematical markup technologies

Participants involved: UH (10), TUE, TUB, IUB, UB, M4M, NAG, ISN

Objectives

Coordinate and promote the development of mathematical markup standards with a special attention to their usability in e-learning.

Description of work

Key developers will be assigned responsibilities for user support, dissemination activities and technology watch. Users/developers support will be implemented via the portal by setting up a wiki to collect users/developers requirements, a hotline, FAQs and bug reporting facility.

The standardization committee, established in M2.1, is also responsible for coordinating within the network the various technology developments and ensuring maintenance of accepted standards. This includes providing synoptic descriptions of standards, software tools and examples of usage to be published on the network portal as reference material.

(Inter-) Dependencies of work, milestones and expected results

Activities in WP6 should provide continuous user feedback to this work package. D3.2 is a crucial prerequisite for the implementation of D5.1. Part of the wiki articles of D5.2 will lead to the collected tutorial in D5.3.

Deliverables

D5.1 Developers wiki

D5.2 Implementation of developers support

D5.3 Online tutorial on mathematical markup

| Work package description | | | | | |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|--------------------|----------|------------------|-----------|
| Work package number: | 6 | Start date: | 1 | End date: | 36 |
| Work package title: | Usage of semantic markup for mathematics in e-learning | | | | |
| Participants involved: | UH(9), UPC, TUE, TUB, IUB , FernUni, LI, ISN, RWTH, UNED, UOC, FC/Univ.Lisboa | | | | |
| Objectives | | | | | |
| Promote the usage and uptake of semantic markup in e-learning in mathematics, including the description of resources by using standard metadata records. | | | | | |
| Description of work | | | | | |
| This work package is responsible for organizing promotion activities and disseminating sample material which shows the benefits of using semantic markup in e-learning in mathematics, including education about proper usage of eLearning metadata standards. Dissemination of user experience, guidelines, howto's will be organized by a authors' wiki on the network portal and be followed by the implementation of a hotline, a forum with discussions, FAQs, and collection of success stories. | | | | | |
| (Inter-) Dependencies of work, milestones and expected results | | | | | |
| D6.1 and D6.2 depend on D3.2 since the portal will provide the entry point to authors for the wiki and for the support hotlines. D6.3 depends on D3.3 since it is expected that lecture material used in the JEM Training Camp will be the starting point for the Best Practices document. | | | | | |
| Deliverables | | | | | |
| D6.1 Authors' wiki D6.2 Implementation of authors support D6.3 Best Practices in e-Learning in Mathematics | | | | | |

7.9 Deliverables List

| First Activity Period | | | | |
|------------------------------|---------------------------------------------|-------------|---------------|----------------------------|
| No. | Title | Date | Nature | Dissemination level |
| D1.1 | Network Agreement | 3 | R | PU |
| D3.1 | Project Presentation | 3 | R | PU |
| D3.2 | Network Portal | 3 | P | PU |
| D2.3.1 | Portal Assessment Report | 6 | R | PU |
| D4.1 | Preliminary JEM directory of e-authors | 6 | P | CO |
| D5.1 | Developers' wiki | 6 | P | PU |
| D6.1 | Authors' wiki | 6 | P | PU |
| D1.2.1 | 1st Periodic Report | 6 | R | CO |
| D1.2.2 | 2nd Periodic Report | 12 | R | CO |
| D1.3.1 | 1st Annual Report | 12 | R | PU |
| D2.1 | Evaluation Criteria for eContent Quality | 12 | R | PU |
| D2.3.2 | Portal Assessment Report | 12 | R | PU |
| D3.4.1 | 1st Workshops Proceedings Annual Collection | 12 | R | PU |
| D5.2 | Implementation of developers support | 12 | P | PU |
| D6.2 | Implementation of authors' support | 12 | P | PU |

| Second Activity Period | | | | |
|-------------------------------|---------------------------------------------------------------------|-------------|---------------|----------------------------|
| No. | Title | Date | Nature | Dissemination level |
| D2.2 | Establishment of review process and related criteria for assessment | 15 | R | PU |
| D1.2.3 | 3rd Periodic Report | 18 | R | CO |
| D2.3.3 | Portal Assessment Report | 18 | R | PU |

| | | | | |
|--------|---------------------------------------------|----|---|----|
| D4.2 | JEM directory of e-authors | 18 | P | PU |
| D1.2.4 | 4th Periodic Report | 24 | R | CO |
| D1.3.2 | 2nd Annual Report | 24 | R | PU |
| D2.3.4 | Portal Assessment Report | 24 | R | PU |
| D3.4.2 | 2nd Workshops Proceedings Annual Collection | 24 | R | PU |

| Third Activity Period | | | | |
|------------------------------|---------------------------------------------|-------------|---------------|----------------------------|
| No. | Title | Date | Nature | Dissemination level |
| D1.2.5 | 5th Periodic Report | 30 | R | CO |
| D2.3.5 | Portal Assessment Report | 30 | R | PU |
| D3.3 | JEM Training Camp School | 30 | O | PU |
| D5.3 | Online tutorial on mathematical markup | 30 | R | PU |
| D1.2.6 | 6th Periodic Report | 36 | R | CO |
| D1.4 | Final Report | 36 | R | PU |
| D2.3.6 | Portal Assessment Report | 36 | R | PU |
| D3.4.3 | 3rd Workshops Proceedings Annual Collection | 36 | R | PU |
| D3.5 | Project Final Presentation | 36 | R | PU |
| D4.3 | Final report of usage of JEM directory | 36 | R | PU |
| D6.3 | Best Practices in e-Learning in Mathematics | 36 | R | PU |

7.10 Milestones List

| Milestones | | | | |
|------------|------------------------------------------------|------|--------|---------------------|
| No. | Title | Date | Nature | Dissemination level |
| M1.1 | Steering Committee and Management Board | 1 | O | PU |
| M2.1 | Standardization Committee | 6 | O | PU |
| M2.2 | E-Learning Quality Committee | 6 | O | PU |
| M4.1 | First official release of JEM online directory | 24 | P | PU |

8 Events and meetings

| List of Events & Meetings | | | |
|---------------------------|----------|------|----------------------------|
| Name | Location | Date | Nature |
| JEM kick-off meeting | UH | 1 | Coordination |
| JEM 1st Workshop | TBA | 6 | Coordination/Dissemination |
| JEM 2nd Workshop | TBA | 12 | Coordination/Dissemination |
| JEM 3rd Workshop | TBA | 18 | Coordination/Dissemination |
| JEM 4th Workshop | TBA | 24 | Coordination/Dissemination |
| JEM 5th Workshop | TBA | 30 | Coordination/Dissemination |
| JEM 6th Workshop | TBA | 36 | Coordination/Dissemination |
| JEM Training Camp | TBA | 30 | Coordination/Dissemination |

9 Other Contractual Conditions

The JEM Network will collaborate with similar Projects globally. This will require some travel outside of Europe as well as the invitation of non-European participants in the events organized by the Project. Travel costs of invited EU or non EU experts will be covered by the travel budget of the Coordinator. The following persons, residing outside of the EU, will be invited to participate in the work of the Network:

- Prof. Don Allen, Texas A&M University, USA
- Prof. Douglas Meade, University of South Caroline, USA
- Prof. Chen Min, University of Suzhou, China

- Prof. Gilbert Strang, MIT, USA
- Dr. Andreas Strotmann, University of Alberta, Canada
- Prof. Stephen Watt, University of Western Ontario, Canada
- Prof. Phil Yasskin, Texas A&M University, USA

The above mentioned experts have contributed in e-learning mathematics in an essential way. The JEM Network aims at having a global reach and making EU the leading player in the area of e-learning mathematics. Getting the above persons to contribute to the work of the project is necessary for global coverage and leadership.

The JEM Network will use the deliverables of the WebALT Project when appropriate. In particular, the Project will use the WebALT Repository for making relevant materials available to the partners of the Network, and to the general public. The Project will enter into an arrangement with Oy WebALT Inc. for hosting the project web site, and for WebALT software and tools like Mediawiki, and conferencing systems. These costs together with those incurred in for organizing network events will be covered under "Other specific costs".

10 Appendix

10.1 Indicative budget distribution and pre-financing schedule

The following table provides the indicative costs and maximum financial Community contribution for the project. The maximum financial Community contribution might be reduced in accordance with the provisions set out in Article 8 and Article II.17 of this grant agreement.

| Ben. No. | Beneficiary Short Name | Total Costs | Maximum Community Contribution | Community prefinancing | | |
|----------|------------------------|-------------|--------------------------------|------------------------|--------------------|--------------------|
| | | | | First installment | Second installment | Second installment |
| 1 | UH | 800000 | 800000 | 213330 | 213330 | 213330 |

The budget reserved for travel and subsistence of network members is estimated to € 180000.

The coordinator may request the payment of the pre-financing installments subsequent to the first according to the following schedule:

- Second installment as of month 12.
- Third installment as of month 24.

10.2 Description of network

Helsingin Yliopisto

The Department of Mathematics and Statistics of the University of Helsinki has, since 1985, been actively involved in developing protocols and software for the electronic

representation of mathematics. It coordinated the European Union project HCM network Editing and Computing (1995--1996). The aim of this project was to develop a character based communication protocol for mathematics. This project marked the starting point of a large scale international development work that has produced MathML and OpenMath protocols making it thus possible to represent mathematical information in a meaningful way on the web. The University of Helsinki was a contractor in the EUREA project and is the coordinator of the WebALT project (EDC-22253-WEBALT), Web Advanced Learning Technologies. Both projects are part of the eContent program of the European Commission for promoting digital content on the global networks. Through its collaboration with Florida State University, it has developed a substantial body of material for teaching undergraduate calculus.

Professor Mika Seppälä (<http://www.math.fsu.edu/~seppala/>) is a professor of computer-aided mathematics at the University of Helsinki and Professor of Mathematics at Florida State University. He was the Finnish representative in the Database Committee of the European Mathematical Council and later in the various Euromath projects (1984-1994). He is the secretary of the OpenMath Society and he was the coordinator of the first OpenMath project (1994-1996) to get community support. Seppälä has extensive experience in creating educational on-line materials for calculus. He is currently the coordinator of the eContent project WebALT-EDC-22253 and involved as partner in the Leonardo MATTIA project. Competences:

- Expert in mathematical knowledge management
- Experienced developer of on-line materials in mathematics
- Experience in developing adaptive multilingual on-line exercises

Dr. Olga Caprotti is project manager of the Web Advanced Learning Technologies, WebALT, EDC-22253 eContent project at the University of Helsinki since January 2005. She has been working in technologies for the electronic communication of mathematics since joining the European OpenMath Esprit Project (1997-2000) after graduation in symbolic computation at RISC-Linz. She has substantially contributed to the latest version of the OpenMath language and is one of the editors of the standard and of the primer. She is a member of the OpenMath Society and of the technical advisory board of CEIC, the Committee for Electronic Information and Communication of the International Mathematical Union. Competences:

- Mathematics on the semantic web
- Mathematical knowledge management
- Mathematical web services
- Interactive books

Universitat Politècnica de Catalunya.

The Technology University of Catalonia (UPC) imparts, among others, engineering degrees (Civil, Industrial, Telecommunications, Computer Science) and Mathematics and Statistics degrees. It is involved in research and technology transfer, with many quality doctoral programs, including one in Applied Mathematics and one in Statistics. Starting September 2006, it will offer three new international masters degrees: Applied Mathematics, Mathematical Engineering, and Statistics and Operations Research. For selected students, many double degrees in Mathematics and Engineering are possible with an additional year of studies.

Professor Sebastian Xambo-Descamps is Full Professor of Information and Coding Theories at the Applied Mathematics Department at UPC (since 1993), held a position of Full Professor of Algebra at the Algebra Department of the Universidad Complutense of Madrid (1989-1993) and a position of Professor of Geometry and Topology at the University of Barcelona (1982-1989). Was the President of the Executive and Organizing Committees of the 3ecm (Third European Congress of Mathematics, Barcelona, July 2000) and the President of the Catalan Mathematical Society (1995-2002), and institution that belongs to the Institute of Catalan Studies (which in particular acts as the Catalan Academy). From 1998 to 2002 served as vice-rector of UPC for Information and Documentation Services (the platform Athenea, which supports most of the e-learning at UPC, was developed under his mandate). The work on WIRIS began in the mid nineties, first on the design and development of the computational engine and later in connection with Maths for More. He is the author of the WIRIS-propelled e-book on Block-Error Correcting Codes. At present serves as Dean of the Faculty of Mathematics and Statistics of UPC (which has two doctoral programmes with certified quality). Competences:

- expert in internet platforms for doing, teaching and learning mathematics
- developer of on-line, mathematically interactive, materials
- broad experience in interactive geometry
- experience in mathematical knowledge management

Technical University of Eindhoven

The group at Eindhoven has been involved in the development of electronic mathematical textbooks, notably Algebra Interactive for some years, using OpenMath to communicate between user interfaces and a range of mathematical engines. They contributed a significant number of Content Dictionaries during the OpenMath Thematic Network project and have played a key design and development role for the MONET project.

Prof. Arjeh Cohen has been a full professor of Discrete Mathematics at Eindhoven University of Technology since 1992. He is Chairman of the board of the Euler Institute for Discrete Mathematics and its Applications (EIDMA), scientific director of the Research Institute for Applications of Computer Algebra (RIACA), and President of the OpenMath Society. Cohen has been a key partner in the European OpenMath projects and he is an author of the highly popular electronic textbook "Algebra Interactive" and an author of the software system LiE. He is a partner in the EU funded project LeActiveMath (Language-Enhanced, User Adaptive, Interactive eLearning for Mathematics) and eContent project WebALT. Competences:

- Development of CAD and IT courses at the university level and completely distributed through web technology
- Design Systems developed a dedicated platform for supporting and monitoring students
- Design Systems group developed in depth knowledge and expertise on (interactive) graphics

Technische Universität Berlin

The Berlin University of Technology (TUB), with over 30,000 students and more than 300 professors is one of the largest universities of technology in Germany. It offers courses in a broad spectrum of disciplines, including philosophical and social studies,

but its main focus is on technology, science, and engineering. In addition to its regular research and educational activities, the TU Berlin participates in 46 interdisciplinary, inter-university research projects. The largest and most recent addition to this list is the "DFG Forschungszentrum Mathematik - Mathematics for key technologies: Modeling, simulation and optimization of real world processes (Matheon)", a research project aimed at developing new fields of application for mathematical sciences. Others include 15 so-called "Sonderforschungsbereiche", 8 research projects financed by the DFG (German Research Society), 14 graduate colleges, and a multitude of additional third-party-funded projects, many financed by the BMBF, the German Ministry of Research and Education, others financed by industrial partners. Following the dramatic shift in emphasis of the scientific and engineering workplace, education and research at the TUB has been reformed over the last years. New technologies and the new media have taken a key-role in these changes, providing wider and more flexible access to technology and knowledge than ever before. Numerous projects (TUB-internal and/or together with national and international partners) accompany these efforts.

Since 1999, Dr. Sabina Jeschke has initiated and headed numerous eLearning, eTeaching and eResearch projects (MuMiE, Moses, BeLearning, Members, Genesis, Ceres). After receiving her M.Sc. in Physics at the Berlin University of Technology in 1997, graduating with distinction, she worked as an assistant teacher at the math department and earned her doctorate in 2004. Holding a scholarship from the German National Academic Foundation, she spent several months of research at the NASA in Moffet Field, CA. In 2000 and 2001, she worked as an instructor at the Georgia Institute of Technology in Atlanta, GA. She is one of the principal forces behind the modernization of the TU Berlin's mathematical education, especially with regard to the courses offered to the engineering departments. She took part in the planning and realization of various campus-wide "Education and New Media" projects and is head of the MuLF-Center (Multimedia-Center for Learning and Research) at the TU Berlin. Her research is aimed at developing new concepts for cooperative virtual knowledge spaces, in particular their application in eLearning, eTeaching, eResearch and eScience in mathematics, natural sciences and engineering. She focuses on mechanisms for the creation, modification and storage of data in cooperative scenarios using various types of communication, on the development of interactive mathematical objects and the design of intelligent data analysis and validation schemes. Erhard Zorn studied Physics and Mathematics at the TU Berlin, where he received his Diploma Degree in 1990 and 1996, respectively. In 1994, he visited the University of Berkeley as researcher and cooperated from 2000 to 2001 at the Georgia Tech with Prof. Carlen in an educational program for undergraduate math courses. In 1991, he got employed as a scientific researcher at the TU, and already held numerous courses for physicists and engineers at the mathematical institute. Erhard Zorn furthermore demonstrated his outstanding interest in bringing the educational system forwards by not only by organizing various workshops, but also by contributing to the visionary "Mumie" and "Moses" project as a team leader since 1999. These projects benefited enormously from his experience in modern electronic media and teaching combined with his knowledge of physics and mathematics. Erhard Zorn also collected industry experience in developing professional web presentations for various companies and institutions, and now owns

together with Sabina Jeschke a company for internet presentations and database applications.

International University of Bremen

UB is a new private research university patterned after the Anglo-Saxon university system. The university was founded in 2000 and has an international student body (ca. 800 students from over 70 nations, admitted in a highly selective process). The IUB Group is the main center and lead implementer of the OMDOC mathematical representation format, an XML-based representation format for Open Mathematical Documents. OMDOC extends the web standards content-MathML and OpenMath by content-oriented representations for mathematical statements (Definition, Theorems, Proofs, ...) and a rich structure of mathematical theories and contexts.) Bremen is involved in the W3C Math Working group and was involved in the development of OpenMath 2.

Dr. Michael Kohlhase is professor for computer science department at the International University Bremen and an adjunct associate professor for computer science at Carnegie Mellon University. He studied pure mathematics at the Universities of Tübingen and Bonn (1983 - 1989) and continued with computer science, in particular higher-order unification and automated theorem proving (Ph.D. 1994, Saarland University). Since then, he has taken up research in applying techniques from automated deduction in natural language semantics.

His current research interests include automated theorem proving and knowledge representation for mathematics, inference-based techniques for natural language processing, and computer-supported education. He has pursued these interests during extended visits to Carnegie Mellon University, SRI International, and the Universities of Amsterdam and Edinburgh. Michael Kohlhase is recipient of the dissertation award of the Association of German Artificial Intelligence Institutes (AKI; 1995) and of a five-year Heisenberg stipend of the German Research Council (DFG 2000-03). He was a member of the Special Research Action 378 (Resource-Adaptive Cognitive Processes), leading projects on both automated theorem proving and computational linguistics. Michael Kohlhase is trustee of the Conference of Automated Deduction, a member of the W3C MathML working group and a member of the executive committee of the OpenMath Society. Competences:

- Expert in mathematical knowledge management
- Expert in Automated Reasoning and Natural Language Semantics
- Experienced developer of on-line materials in mathematics

Universiteit van Amsterdam

The Faculty of Science of the University of Amsterdam is a leading centre of academic research and education with a broad range of strong research groups. The research and educational activities are organized in one comprehensive faculty, with about 2000 students and 1500 employees. This is motivated by developments in both science and society, with new challenges often found in the overlap of several disciplines. It has led to a policy in which the faculty is setting up new research institutes across traditional disciplinary boundaries. This holds for the three institutes that will be mostly involved in the JEM Project: The Institute for Logic, Language and Computation (ILLC), The Korteweg-de Vries Institute for Mathematics (KdVI), and the AMSTEL Institute.

At ILLC, which was officially established as a university research institute in 1991 (director: prof.dr. F.J.M.M. Veltman; website: www.illc.uva.nl), researchers from the Faculty of Science and the Faculty of Humanities collaborate in the study of fundamental principles of encoding, transmission and comprehension of information. Emphasis is on natural and formal languages, but other information carriers, such as images and music, are studied as well. The research work relates to the usage of linguistic algorithms to give semantics for educational material in mathematics as foreseen in the JEM project. KdVI (<http://www.science.uva.nl/math>) aims to further the science of mathematics, both in its theoretical and applied aspects, and to stimulate the appreciation of mathematics in other academic disciplines, and in society as a whole. It has high standards in research as well as in teaching, and strives to collaborate with other institutes within and outside of the Faculty of Science for well-balanced contributions to the mathematical aspects of their research, teaching, and consultancy. The main interest of the mathematics department in the JEM project is to get access and be part of the development of e-learning material in mathematics, e.g., for use in joint courses of the Dutch Master in Mathematics, in the area of computer aided assessment and diagnostic testing of freshmen and remedial education in mathematics, and in web-based master classes for secondary school students and teachers.

The research work of the AMSTEL institute, which was started in 1998 (<http://www.science.uva.nl/amstelinstituut>), is concentrated around two themes:

- the use of ICT in mathematics and science education,
- conceptual development in mathematics and science education.

The research work encompasses all levels of mathematics and science education, from primary school to the university level. Many of the researchers are also teaching in the International Master of Mathematics and Science Education, in the teacher-training program of the university, and in courses for students of the Communication and Education Variant of the master programs at the Faculty of Science. The AMSTEL institute has furthermore a special interest in improving the quality of the programmes of the Faculty of Science at the University of Amsterdam. Several members of the Higher Education Group have more than eight years of experience in working together with university teachers to improve and innovate their teaching, in particular in terms of instructional design and in the usage of ICT.

Drs. André Heck studied pure mathematics and theoretical chemistry at the University of Nijmegen (1975-1983) and continued to work as research assistant in Lie theory (1984-1989). He began developing and teaching computer algebra courses in 1987, which led to the publication of "Introduction to Maple" (3rd ed. 2003). He continued his work in this area at the CAN Expertise Centre (1989-1996), which was established to stimulate and coordinate the use of computer algebra in education and research. In 1996 the CAN Expertise Centre was integrated into the Faculty of Science at the University of Amsterdam, into what became the AMSTEL Institute. In the early years, the main focus of his work was on incorporation of computer algebra and other ICT tools in several bachelor courses. He also contributed to the development of the core Java applets in "Algebra Interactive" (Cohen et al, 1999). Currently he is project manager at the Higher Education Group of the AMSTEL Institute and participates in many Dutch educational innovation

projects. IBL, Web-spijkeren, MathMatch, GSO are acronyms and names of some past and present projects on mathematics and science education that are financially supported by SURF and the Digital University. These projects are primarily concerned with education at bachelor level, but André Heck also participates in the GALOIS project that aims to realize an integrated algebraic learning environment in secondary school and tries to reach its goals through open source technologies and open standards. This small-scale project relates to the JEM project in its efforts to develop e-learning materials in school mathematics and to implement the use of these materials in school practice.

Besides his work at higher education level, André Heck is doing research on ICT applications in mathematics and science education at senior secondary school level. Areas of special interest are video-based labs, use of digital images in mathematics education, and dynamic modeling. This work aims at the development of the integrated computer-learning environment Coach.

Competences relevant to the JEM Project:

- Pedagogic theory in mathematics and science education, and in particular about ICT applications;
- Computer aided assessment and diagnostic testing;
- Development of on-line, interactive study material in mathematics and physics, from secondary school level to university level.

Universidade de Lisboa

The Faculty of Sciences has its roots in the Escola Politécnica of Lisbon, created in 1837, and became a unit of the University of Lisbon in 1911, in the modern refoundation of this institution originated in 1290 with the foundation of the Portuguese University. Currently that unit has 5060 students in licenciatura programmes (undergraduate), 636 in mestrado programmes (postgraduate) and 716 preparing the PhD, and its Mathematical Department is a national reference in teaching and research with its more than fifty professors. In addition to undergraduate and master courses in Mathematics it has a doctoral programme associated to its five mathematical research centers that have a significant degree of internationalization.

Prof. José Francisco Rodrigues is full professor of Mathematics at the Faculty of Sciences of the University of Lisbon, since 1994, and corresponding member of the Academy of Sciences of Lisbon. His field of research is nonlinear partial differential equations and applications in continuum physics, being a research member of the Centro de Matemática of the University of Coimbra and the coordinating-editor of *Interfaces and Free Boundaries*, a European Mathematical Society journal. He was director of the Centro de Matemática e Aplicações Fundamentais until 2002, where he became involved in the communication of mathematics; in particular, starting several related initiatives in the World Mathematical Year 2000. He is currently professor of mathematical analysis and the President of the National Committee of Mathematicians.

Birmingham University

The University of Birmingham is a research intensive university in the heart of England's second city. The University is one of the leading research institutions in the UK and with 26,000 students from 150 countries. Established in 1900, Birmingham ranks 5th in the UK for research excellence; in the most recent Research Assessment Exercise in 2001, seven areas of Birmingham's research achieved the six star rating – a rating only given to studies of significant international importance.

The School of Mathematics hosts the Maths Stats and OR Network, which is one of the subject networks of the National Higher Education Academy. This Network promotes, and develops learning and teaching in Higher Education Mathematics, Statistics and Operational Research.

Dr Chris Sangwin is a lecturer in Mathematics at the University of Birmingham. After graduating from the Universities of Oxford, then the University of Bath (2000), he worked as a Research Fellow for the Maths Stats and OR Network, part of the Higher Education Academy. Currently he is Deputy Director of the Centre for Educational Technology and Distance learning (CETADL), the University of Birmingham's innovation centre for educational technology. Dr Sangwin's research focuses on the use of computer algebra to automatically assess mathematics. His most recent project developed the STACK computer aided assessment system, see <http://www.stack.bham.ac.uk>. His ongoing work for the Higher Education Academy includes representing Higher Education, and/or Mathematics to various National bodies, including the Department for Education and Skills (DfES) mathematics experts group and JISC's e-pedagogy experts group.

Competences

- Mathematical computer aided assessment
- Pedagogic theory in mathematics education
- Networking within United Kingdom Higher Education Mathematics
- Development of computer aided assessment

FernUniversität Hagen

FernUniversität is an integral part of the higher education system in Germany, being a public university of the state of North-Rhine Westphalia. As the first and only distance teaching university in the German-speaking region FernUniversität in Hagen offers degree programmes (Bachelor, Master) at the undergraduate and graduate levels as well as research-oriented academic further education, and allows for achieving a Ph.D. (Dr.). Since its foundation in 1974 the FernUniversität in Hagen / University of Hagen has developed into one of the biggest universities in Germany with currently around 43,000 students - mainly from Germany, Austria, Switzerland, but also from more than 100 countries around the world. Currently, about 1,700 courses (lectures, seminars ...) are offered in the fields of Computer Science, Business Administration and Economics, Cultural and Social Sciences, Electrical and Computer Engineering, Law, and Mathematics. The distance teaching offers of FernUniversität are based on the use of both traditional and new media continuously extending the use of the modern information and communication technologies and methods. FernUniversität has created its own "Education and Knowledge Space: Virtual University (LVU)" and is participating in several initiatives and projects for enhancing the use of new media and eLearning on regional, national and international level. Fundamental and Applied Research and Teaching activities at FernUniversität are executed under the responsibility of about 100 full, associate and

junior professors, together with some nearly 400 lecturers and academic staff, supported by mentors/ tutors, and administrative and technical staff. Funding of FernUniversität is coming from the state, from tuition and material fees, and from third parties.

Professor Luise Unger. Dr. Unger received her Ph.D. in mathematics from the University of Bielefeld in 1984 and her Habilitation from the University of Paderborn in 1993. Since 1999 she is professor of mathematics at the FernUniversität in Hagen. Her research interests focus on algebra, mainly representation theory of finite dimensional algebras and on web-based mathematical distance education. She was coordinator of the elearning project "math-kit" (2001-2003) which was financed by the German Ministry for Education and Research. Within this project, various multimedia units for mathematics education have been produced. Dr. Unger is experienced in presenting elearning solutions at international conferences such as 21st ICDE World Conference (Hong Kong 2004), ED-MEDIA (Montreal 2005), Online Educa (Berlin 2003) and international fairs such as Learntec (Karlsruhe 2002 and 2005) and CeBIT (Hannover 2004). Competences:

- Expert in distance education
- Developer of on-line, interactive study material

Maths for More

Maths for More is a mathematical software company based in Barcelona. The company main goal is to offer advanced calculation and presentation tools for mathematics education with emphasis on Internet technology solutions. Maths for More is responsible for WIRIS, a software suite of tools for mathematics education. The most relevant member of this family is WIRIS CAS, a multilingual on-line platform for mathematics calculation and contents. Today WIRIS is actively used by thousands of students and teachers in Spain, but also in Belgium, Finland, The Netherlands and Puerto Rico. The biggest WIRIS community is Catalan speaking since the first two WIRIS servers were in Catalan. Today there are WIRIS servers in English, Spanish, Catalan, Dutch/Flemish and Basque language.

The company commercial policy is to offer WIRIS CAS through a public education portal accessible for all the education community. The institution responsible of the portal assumes the cost of the server and license, which are reasonably low. The open access approach to the use of WIRIS increases the community usage of the tool and associated materials. See www.mathsformore.com for more info.

Ramon Eixarch. Mr. Eixarch is co-founder of Maths for More. The company was created in 1999 to commercially exploit the research developed by a group of teachers and students in the Technical University of Catalonia. Mr. Eixarch has been project manager in several company projects which include strong software developments for LeActiveMath and WebALT projects. Competences:

- Expert in on-line mathematical software
- Commercial expertise in on-line products for education

NAG Ltd

The Numerical Algorithms Group (NAG <http://www.nag.co.uk>), develops and provides world-leading software to solve complex mathematical problems. It has offices in the UK, Germany, Japan and the US and has created a world-wide

collaborative network of the world's best mathematical experts. In 1971 NAG developed the first mathematical software library that now has over 10,000 users world-wide and contains over a thousand mathematical and statistical functions. The range of products and services that NAG offers has continually expanded into statistical, symbolic, visualization and numerical simulation software, compilers and application development tools and wide-ranging consultancy. Recently NAG has launched a product (N-SEA) for teaching statistics based on part of the UK national curriculum for schools.

To support its products and tailor them to particular users' requirements, NAG has adopted XML technologies for both software documentation and as a means of representing abstract specifications of software components. In addition NAG coordinated the OpenMath-TN and MONET projects, and is a member of the W3C Math Interest Group, and provides the current co-chair of that group. The documentation of the NAG Library consists of over 7000 A4 pages and contains more than a quarter of a million mathematical expressions, and has evolved from plain text via typesetting languages such as TSSD and LaTeX to XML, so NAG has a wealth of relevant experience of maintaining and translating mathematical legacy documentation.

Dr. Mike Dewar is the Vice President for Research & Development at The Numerical Algorithms group Ltd, and as such is responsible for managing all the activities undertaken by NAG's Development Division. This includes the design and implementation of the NAG family of products, the investigation of new and emerging technologies, and participation in collaborative projects with NAG's partners in industry and academia. Mike joined NAG in 1994, originally to manage the development of the Axiom computer algebra system, and has since worked in a variety of areas within the company. In particular he has coordinated four major projects funded by the European Union: A Framework for Symbolic-Numeric Computation (FRISCO, 1996-1999), OpenMath (1997-2000), The OpenMath Thematic Network (2001-2004) and Mathematics On The Net (MONET, 2002-2004). A common thread running through all these activities is a desire to make mathematical computations accessible via the internet, and to automate and simplify the process of using mathematical software as much as possible. Recently he was elected as Vice-President of the OpenMath Society, and he was an editor of the most recent version of the OpenMath standard.

Dr. David Carlisle has worked at NAG since 1998 where he has played a key role in the conversion of the NAG documentation base to XML and introduction of XSLT and other XML technologies. Before joining NAG, David was one of the designers of the LaTeX2e typesetting system and still a member of its core development team. David is an editor of the MathML 2 Recommendation (the standard extension of (X)HTML to encode mathematical expressions). He is currently co-chair of the World Wide Web Consortium (W3C) Math Interest Group. Related to this work he is an editor of a draft update to the ISO entities for characters. He is also an editor of the OpenMath Standard and a member of the OpenMath Society.

Liguori Editore

Since its foundation, in 1949, Liguori Editore has been interested in promoting advanced research in the social, human, and applied sciences. The publishing house

production includes series about literary criticism, linguistics, social sciences and economy, as well as construction theory and mathematics, psychoanalysis and psychotherapy, anthropology, new multi-media, which have been developed with the collaboration of influential scholars from Italy and abroad. The general catalogue comprises more than 3300 titles, and about 180 are the new or reprint volumes which are published every year. The production includes a number of periodicals, often published in collaboration with different University Departments. During the last years Liguori Editore has been actively engaged with researching into innovative fields of publishing and communication, and has taken part to some projects founded by European Union and MIUR (the Italian Ministry of the University and Research) The attention given to new technologies has in fact characterized the activity of Liguori in the past years: through the publication and management of the publishing house web site, Liguori has been working with a model of communication which is particularly effective for the diffusion of its catalogue, and offers a series of products and innovative services. E-commerce is also managed through the web site, thanks to a sophisticated implemented search system, which allows users to visualize a great bulk of information regarding each title (cover, presentation, index, available reviews and even a preview of some pages). Along with the production of traditional printed books, Liguori produces electronic format books (eBooks). The management of a software dedicated to these technologies and of a system of Digital Rights Management (DRM) has allowed Liguori to build up a system for the endowment of services which allow the users to use the contents of the book choosing each time the most appropriate way to satisfy their needs: the eCompile system, for example, allows to browse all eBooks present in the catalogue and to buy even just single pages or chapters; the ePrint system offers the possibility to print single pages of an electronic book directly on the users' personal computer; eSubscribe is a sophisticated system which allows the user to access for a period of time eBooks from the catalogue in online or offline mode. In the light of the reform of the University, Liguori has nonetheless elaborated a mode for endowing the contents for home learning (eLearning). Through the use of multimedia, in fact, our eLearning products make it possible to speed up the learning process without reducing the quality or the quantity of the contents offered.

Guido Liguori graduated in Philosophy with first class honors at the University of Naples "Federico II", from 1972 to 1982 has been responsible of OGL, the printing works of Liguori Editore, and from 1973 manages the editorial production of Liguori Editore (college textbooks). Since 1996 he is Vice President and Managing Director of the "Consorzio Editoriale Fridericana" (a consortium between three Italian publishers and the University of Naples), and since 2005 he is also President and Managing Director of Liguori Editore.

Institute for Science Networking Oldenburg GmbH

The aim of the ISN is to develop new concepts and services for the management of information in science and elearning, and to advance it according to international standards. The institute designs and programs online-document- and workflow-systems, retrieval and entry point strategies for scientific societies, institutions and libraries, particularly for those with distributed locations.

On behalf of learned societies and other scientific institutions the ISN develops and operates Internet portals for science such as the worldwide PhysNet and MareNet.

The ISN also developed and runs the eLearning platform physik-multimedial for physics for eight Universities, and offers supporting services for the learning management system Campus Virtuell. ISN plays an active role in national, international and interdisciplinary boards and initiatives concerning standardization and information services for sciences. Researchers of ISN are members of several W3C working groups on Semantic Web development and of the Dublin Core Advisory Board. ISN has sent representatives into advisory boards of several national and international projects and institutions. ISN is experienced in technical and conceptual evaluation of projects, using advanced techniques of e.g. questionnaires.

Prof. Dr. Dr. Eberhard R. Hilf (<http://www.isn-oldenburg.de/~hilf>) was up to 2000 full professor of Theoretical Physics at the University of Oldenburg with the research fields Quantum Statistics, Small Systems, Theory of Measurement, Mathematical Physics Methods and Teaching. He is since then CEO of the University-outsourced Institute for Science Networking Oldenburg GmbH (ISN) with its expertise in metadata, document management, intelligent retrieval, and physics eLearning services for academic and school teaching. He is member of boards such as the Executive Board of the German Initiative for ScienceNetworks (DINI), of the Centre pour la Communication Scientifique Directe (CCSD of the SNRS), the Action Committee of Publication and Scientific Communication (ACPSC) of the European Physical Society (EPS), of the International Academic Contributor Information System (ACIS), and others. He is former Chairman of Initiative for Information and Communication of the German Learned Societies. Competences, relevant to the project:

- Design and Development of Physics Markup Language (PML)
- Metadata profiles, intelligent retrieval and services in eLearning
- Reach out activities in the Science Community with regard to Open Access, Metadata

University of Aachen

Founded as a Polytechnikum in 1870, the RWTH Aachen is the largest university of technology in Germany and one of the most renowned technical universities in Europe, with around 28,000 students, more than the half of which in engineering. Every year numerous international students and scientists come to the RWTH Aachen to benefit from the internationally recognized high level of courses and the excellent work facilities at the RWTH.

The Institute of Statistics and Business Mathematics (ISW) resides under the Faculty of Mathematics, Computer Science, and Natural Sciences, one of the nine faculties of RWTH Aachen University. ISW provides education to students from across the university in the field of statistics, probability, and business mathematics. Besides mathematical research in this area a main interest of members of ISW are new media in eLearning and eTeaching. The focus is on both production of multi-media based statistical content (e.g., texts, visualizations, applets, animations) and further development of the web-based learning and teaching environment EMILeA-stat (\url). Statistical content is produced on different levels of abstraction which addresses, e.g., students, pupils, and teachers as well as people in further vocational trainings.

ISW is integrated in the eTeaching and eLearning concept of RWTH Aachen University. It offers several services like, e.g., statistical consulting, further education (in particular, for teachers), and advanced vocational training.

Professor Udo Kamps is Full Professor of Statistics at RWTH Aachen University since 2004. He received his diploma and Ph.D. in mathematics from RWTH Aachen University in 1985 and 1987, respectively, and then had positions as Assistant, Associate, and Full Professor at the Universities of Aachen, Kiel, Dortmund (Heisenberg grant), and Oldenburg. Kamps is an elected member of the International Statistical Institute (ISI). His fields of interest are stochastic modeling, applied and mathematical statistics, and eLearning. Besides other project activities in eLearning and content production, e.g., in cooperation with Microsoft, he has been project leader of "e-stat", where a large internet-based, multi-media and interactive learning and teaching environment in applied statistics has been designed and realized (2001-2004). Several German universities were involved (grant: 2.9 Mio.Eur.). His scientific work comprises six monographs and more than 80 articles in the fields of Statistics, Probability Theory, and eLearning. Competences:

- Expert in learning and teaching environments
- Project leader of a large content project in e-learning
- Experience in the conception and realization of a learning platform
- Developer of online contents for learning and teaching mathematics (in particular statistics)
- Broad experience in developing interactive visualizations for statistics.

Universidad Nacional de Educación a Distancia

UNED is a Spanish public university that provides distance education at national and international levels. It was founded in 1972 to enable priority access to university and further education for all those who were unable to attend campus courses for any reasons. At present, it has a network of more than 60 Centres throughout the country where students have access to all kinds of academic services, including libraries, audiovisual material, face-to-face tutorials, videoconferencing and virtual campus (telematic tutoring). UNED is the largest university in Spain with more than 140000 students enrolled in its different modalities of education and training. The degrees include Sciences (Mathematics, Physics, Environment, and Chemistry), Computer Science, Humanities, Social Sciences, as well as more than 100 doctoral programmes, master degrees and Professional Development Programmes. The UNED has an international dimension with 16 Study Centres abroad and use extensively distance methodology and complementary pedagogical tools (television, radio, video and virtual university campus). The staff includes 1200 teachers, 4000 tutors and 1200 administrative and technical staff. UNED is now providing technical assistance and consultancy services to many institutions in Latin America and in Europe in matters such as networking and production of distance education courses. UNED provides strong institutional capacity in the use of ICT for higher education. UNED has the largest existing educative videoconference network in Europe, set up in 61 centres in Spain and the centres in Miami and Paris.

Dr. Antonio F. Costa is Full Professor of Geometry and Topology at the Department of Mathematics of UNED (from 1994). At the present serves as Director of such Department (is the 9th year in such position). He has been also Director of the

Centre of Audio-Visual Production in UNED. Costa has experience in creating educational materials for Geometry: author of several texts for distance education and an educational Video (Arabesques and Geometry) with several international awards. Competences:

- Experience in creation of materials for distance education
- Expert in internet platforms for teaching mathematics
- Experience in mathematical knowledge management

Universitat Oberta de Catalunya

The Open University of Catalonia (UOC) is an online, on-the-Web university with no physical campus, yet with an online teaching and management structure, capable of facilitating interactive communication between professors and students, with complete timetable independence, a characteristic normally known as synchronism. The virtual campus contains everything that can be found on a conventional university campus: teaching, research, dissemination of knowledge, as well as student services.

Since its creation, on 6 October 1994, the UOC has shaped a widely diverse university community and has brought together over 37,000 people in more than 45 countries. It is an innovative institution, created at the request of the Autonomous Regional Government of Catalonia (Generalitat de Catalunya). It has become a reference point throughout the world in the area of virtual education, or e-learning, and aims to lead new initiatives in education, research and dissemination of knowledge.

UOC courses are organized into undergraduate, graduate, postgraduate and doctoral programmes, designed according to the criteria of the 1999 Bologna Declaration for the construction of a European Higher Education Area. Current knowledge areas of UOC programmes are Law, Political and Administrative Sciences, Psychology and Educational Sciences, Economics and Business Sciences, Humanities and Philology, Information and Communications Sciences, Computer Studies, Multimedia and Telecommunications, Health and Environmental Sciences. Details are available at <http://www.uoc.edu>.

Dr. Maria-Antonia Huertas is a lecturer in mathematics at the Department of Computing, Multimedia and Telecommunications (UOC) since 2002. She received his Ph.D. in mathematics from the University of Barcelona in 1994, and had a position as associate lecturer at the Department of Mathematics of the Autonomous University of Barcelona (1992-2000); and as a visitor lecturer at the Institute of Logic, Language and Information of the University of Amsterdam (1996). His fields of interest are eLearning of mathematics and knowledge representation. She has publications on both fields. Besides other activities in eLearning and content production she has been designer and coordinator of mathematics on-line courses and author of e-content for the UOC; and she is the coordinator of the mathematical eLearning research group of the UOC. Competences:

- Expert in online and distance education
- Developer of online, mathematical study material
- Research in eLearning (learning objects and personalization)
- Knowledge representation for the semantic web

10.3 Relevant Projects

WebALT

The Web Advanced Learning Technology project is sponsored by the EU in the framework EContent on the Global Network (2005-2006). The WebALT Project produces:

- A showcase of exercises in mathematics, stored in a language-independent format, that can give rise to versions in several languages, including English, Finnish, Swedish, Spanish, and Italian by using language generation technologies.
- Meaningful metadata for educational on-line materials in mathematics.
- Repository of on-line materials in mathematics.

In addition to the above, the WebALT Project advances best practices in on-line learning in sciences by promoting proper use of the most advanced applications in education. Several of the deliverables of the WebALT Project will have direct applications in the activities of the JEM Network.

MuMiE

“Multimediale Mathematikausbildung für Ingenieure” is a project funded by the German Federal Ministry of Education and Research programme: “New Media in Education” with a budget of 2.4 Mio (2001-2004) and was coordinated by TUB. Other German universities included Munich, RWTH and Potsdam. The aim of the project is drafting, design and realization of a learning and teaching platform for content development based on modern mathematical pedagogical viewpoints.

MuLF

Multimedia-Center for Learning and Research is a coordination center for elearning and research at TUB, Germany. The tasks of the Multimedia Centre for Learning and Research are: coordination of initiatives and projects, counseling and training, allocation of multimedia laboratories, development and integration of software, supporting of third-party project and industrial cooperation, as well as coordination and promotion of inter-disciplinary research in the areas of eLearning, eTeaching, eResearch and eScience. Due to its resources, both technical, educational, platforms, and LMS it is suited a testing ground for JEM reaching the large community of TUB members, staff and students.

Genesis

“Gender sensitivity in eLearning” is a recently awarded project to address specifically gender sensitive software and content development in eLearning & eTeaching, funded by ESF (European Social Fond), 01/2005 -- 09/2007.

MEMBERS

“Cross Culture Mathematics”, is a project funded by TUB to address concepts of mathematical education for non-native students, 01/2005 -- 10/2007.

math-kit

math-kit (2001-2003) was a joint project of the FernUniversität in Hagen (coordinator), the University of Bayreuth, the University of Hamburg, the University of Paderborn and the industrial partner Sciface GmbH & Co. KG. It was financed by the German Ministry for Education and Research. Within this project, various

multimedia units for mathematics higher education have been produced. math-kit contains elements for motivation, exploration, applications, visualization as well as drills and exercises. These elements may be combined in several ways in order to support different learning objectives. math-kit comprises Java applets, makes use of the dynamic mathematics software GEONExT and is supported by the computer algebra system MuPAD through the web. For further details refer to <http://www.math-kit.de> and the publications mentioned there. Examples for math-kit learning material can be found at <http://algebramcs.fernuni-hagen.de/mathkit-hagen> and <http://www-math.upb.de/~mathkit>.

EMILeA-stat

Within the “New Media in Education Funding Programme” the German Federal Ministry of Education and Research (bmb+f) supported the project “e-stat” (April 2001-March 2004) to develop and to provide a multimedia, web-based, and interactive learning and teaching environment in applied statistics called EMILeA-stat. The project was set up by 13 partners working at eight German universities: Augsburg, Bonn, Berlin (Humboldt-University), Dortmund, Karlsruhe, Münster, Oldenburg (leading university; now Aachen), and Potsdam. The project is also supported by further partners in advice and it cooperates with economic partners such as SPSS Software, BertelsmannSpringer Science+Business Media (Springer Verlag), and MD*Tech Method & Data Technologies (XploRe-Software). Within the project period about 70 people were co-working in developing und realizing the learning environment and its content. EMILeA-stat is developed as a system suitable for teaching statistics at schools, universities, and in further vocational training. Its design offers on the one hand the opportunity to tailor individual courses covering specific learning needs. On the other hand, EMILeA-stat serves as an environment for self-directed learning as well as an intelligent statistical encyclopedia. The support of learning and teaching by offering interactive visualizations, such as Java-Applets, is another main concept of EMILeA-stat. For more details about the project we refer to its webpage <http://www.emilea.de>. The URL of the learning environment EMILeA-stat is <http://emilea-stat.rwth-aachen.de>.

physik-multimedial

<http://www.physik-multimedial.de> is an eLearning management system for Physics. It was developed in the last five years by the ISN for and within a consortium of five Universities in Germany. It comprises sophisticated interaction between students, staff, tutors, and creators of modules. It contains services for importing elearning material from anywhere, course management, and for mathematical and theoretical physics exercises, as well as for experimental work-projects (Praktikum). It is now used by 8 Universities, some 200 staff and about 10.000 students, thus is suitable to serve as reach out for JEM to a large chunk of physics. Among other services, it offers link lists for physics, a collection of at present 2.726 entries for free access elearning Material modules from anywhere, which is carefully checked for didactics, techniques used, content, level. ISN has developed for this a specific metadata set of about 70 entries used in the retrieval engine of LiLi. This is a retrieval machine going across professional physics institutions around the world (see PhysNet) with at the moment about 10.000 entries. Retrieval results can be directly imported into classes of “physik-multimedial”.

PhysNet

<http://www.physnet.net> Physics Documents in the World, is a portal collecting and synoptically posting all relevant material of all professional Physics Institutions around the world, such as addresses, scientific documents, teaching material, conferences, jobs, etc. PhysNet is an official service of the EPS European Physical Society, and developed and operated by ISN. It is run by a large set of national Physical Societies, Research Institutions and Universities around the world with 23 internationally distributed active clones (independent mirrors with locally operating gatherers). PhysNet-Education will be an ideal international outlet platform for JEM. PhysNet is supervised by the "Action Committee for Publication and Scientific Communication" of the EPS.

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