**IST-2002- 507382**

**EPOCH**

**Excellence in Processing Open Cultural Heritage**

# New Tools Selection Procedure

Due date of deliverable: 7 10 2005
Actual submission date: 7 10 2005

Start date of project: 15 March 2004
Duration: 4 Years

University of Leuven

| Project co-funded by the European Commission within the Sixth Framework Programme (2002-2006) | | |
|---|---|---|
| **Dissemination Level** | | |
| **PU** | Public | |
| **PP** | Restricted to other programme participants (including the Commission Services) | |
| **RE** | Restricted to a group specified by the consortium (including the Commission Services) | |
| **CO** | Confidential, only for members of the consortium (including the Commission Services) | X |

# Table of Contents

**Introduction/Executive Summary** ..... **3**

**Priorities for the Research Agenda** ..... **7**

**Call for NEWTON projects** ..... **13**

**List of submitted proposals** ..... **16**

**List of reviewers** ..... **18**

**Selection report** ..... **19**

**Accepted projects** ..... **35**

**Appendix I: Submitted proposals** ..... **39**

*1. POPULATE* ..... 39
*2. TATOO* ..... 46
*3. CULTOURIST* ..... 55
*4. WEBTOARCH* ..... 65
*5. WBTLK+* ..... 74
*6. CIMAD* ..... 88
*7. VIRTUMAN* ..... 101
*8. CRMAP* ..... 109
*9. TOOLS&GROOVES* ..... 116
*10. UNDERWATER* ..... 120
*11. 3DSOUND* ..... 123
*12. 3DKIOSK* ..... 128
*13. AMA* ..... 138
*14. UBISCAN* ..... 146
*15. IMODELASER* ..... 155
*16. UPGRADE* ..... 163

**Appendix II: reviews** ..... **173**

# Introduction/Executive Summary[1]

In workpackage 3.2 the development of New Tools for the Cultural Heritage community was envisaged.

**Objectives**

1. Developing effective solutions for priorities on the Research Agenda for which no tools exist or where the tools exist but there is priority defined for improving performance or functionality
2. Filling gaps in the EPOCH Common Infrastructure in order to let it function seamlessly.

The organisation of the call for Newton proposals, their selection and their follow-up, to make sure that the work is carried out according to the criteria put forward in the EPOCH review criteria for research (focus, quality, feasibility, track record, sustainability, contribution to NoE integration).

**Rationale**

Many tools have been designed and developed with other than CH applications in mind (3D capturing systems, database software, graphics packages, etc.). CH stakeholder needs may require adapted, additional, or enhanced tools. This Activity will remedy such situations in as far as the budget allows.

**Methodology**

Each New Tool will be developed by a small team, assembled from the EPOCH partnership, after a selection among bids based on project internal calls. These teams will each have a lead partner, who takes responsibility for the daily management of their team. At the 6-monthly Concertation meetings these teams will all meet to exchange experiences and to present their results. These meetings will also serve as regular moments to check compliance with user demands and with the guidelines and specs of the Common Infrastructure. Also the teams' contributions to the open repositories and the prospects for brokerage services will have to be commented on at these occasions, and whenever possible, demonstrated.

Workpackage 3 coordinator Leuven has undertaken the following activities, helped by the WP3 partners:

[1] Although this deliverable is in principle open to all members of the consortium, it is advisable not to distribute this document beyond the EC, the BoD and the EXC. It contains the names of the Newton reviewers.

1. A ***roadmap*** was drafted for the organisation of the Newton calls, as well as for the reviewing and selection process. Newtons are the internal efforts for the creation of "New Tools that are Needed" within the realm of CH. They are meant as completions to the Common Infrastructure (Activity 3.3)). This roadmap was proposed to the Executive Committee at its 2nd August 2004 meeting in Brussels. (It had been sent previously to the former PO, for approval, but no response came from the EC).

2. A ***list of priorities*** was drafted for the Research Agenda, as a collaboration of the Activity 2.5 team (Developing the Research Agenda) and the Activity 3.3 Management Board. This list of priorities was presented to the Epoch Assembly and partners were invited to select items that would be either topics for the Common Infrastructure or for the Newtons. In this poll, partners also expressed the level of importance of each priority and could add additional topics to the list, to be subject to the same priority assessment.. This ensured that all constituencies had a direct influence on the technical work to be carried out, not leaving such decisions at the hands of technologists only. The poll started just before Christmas 2004.

3. Based on the list of priorities selected to be handled through Newtons, a ***call for Newton proposals*** was drafted and launched on 11th January 2005. A preferred structure of the proposals was sent out together with the call, as well as the criteria that reviewers would be asked to take into account when assessing the quality of the proposals. Project proposals were required to be sent in by February 9th, 2005. As this time was short, proposals could be kept quite short. The response was excellent. Sixteen high quality proposals were received, covering the priorities very well. It was immediately clear that the reviewing process would have to be very selective, as the budget was oversubscribed by a factor of about 3.

4. At the Activity 3.3 Management Board meeting in Leuven on February 7th 2005, 5 ***reviewers were selected*** for every proposal, from the Review College[2] and based on their expertise. Care was taken that a proposal would be reviewed by members of the different constituencies. Reviewers were selected who were not themselves involved in a Newton proposal. Reviews were asked to be ready by the 2nd of march 2005. Reviewers were given a list of criteria to be kept in mind, which was also in agreement with the related specifications in the Technical Annex.

5. Based on these submissions, a ***summary report*** was drafted and finalised on 7th march 2005, giving an overview of the reviews, the requested budgets, and a proposed outcome of the review. This outcome was by and large accepted by the Executive Committee in its meeting on 10th march 2005, and later by the Board of Directors on the 21st of march. Four projects were accepted, and three sets of two projects were asked to merge. All budgets were reduced (but the reduction wasn't flat). One project was basically turned down, but its partners were offered funding to write a report that

[2] Members of the Review Panel are highly regarded experts in their domain. They had been previously nominated by partners, and their admission was based on a vote by all partners. This panel is called upon when unpartial opinions are needed in general, not only for the Newtons.

would help them to submit to another call (2nd Newton call or otherwise). The other projects were rejected.

6. These ***decisions were*** first ***communicated*** to the partners at the Epoch General Assembly meeting on march 24th (@CAA05, Tomar). The week after, a mail was sent to the partners who submitted a proposal about the detailed decisions regarding their proposal. Those involved in a successful bid were asked whether they wanted to go ahead irrespective of the budget cuts, and what parts of the projects they would possibly propose to be eliminated or reduced. For the project mergers, in each of the three cases a coordinator for the merger has been appointed. The partners' response has been very positive. All accepted to go ahead. Most teams wanted to go ahead without any major change to their project and were mergers were proposed, partners welcomed such move.

Based on the priorities on the 1st version of the Research Agenda and the subsequent poll among partners about the best strategy to achieve them, the following topics were selected for the 1st Newton call:

1. semi-automatic mapping to CIDOC
2. two-way communication
3. mobile applications from data capture to public dissemination
4. versatile 3D acquisition
5. underwater data collection and photogrammetry
6. recording of archaeological excavations
7. authoring tools for 3D experiences
8. web tool for joint experiences
9. populating 3D environments

.

At month 18 most of the 1st generation Newtons were planned to start, at which point a Concertation Meeting was planned (could still take place at VAST, Nov. 05 in Pisa) and they would be regularly followed-up (short progress reports required every 3 months), from which the following aspects will be monitored:

- realisation of the intended functionalities
- inter-operability with CI modules and other Newton tools
- compatibility with EPOCH-supported standards / formats

This report gives an overview of the different steps in the Newton selection process:

- Section 2: a concise description of the priorities selected by the partners for the Research Agenda
- Section 3: the call as sent out to the partners
- Section 4: A list of the submitted proposals
- Section 5: the selected reviewers (all members of the review panel as composed through a poll among all partners)
- Section 6: the report by the WP3 coordinator to the EXC
- Section 7: the list of selected Newton projects as selected by the EXC and approved by the BoD
- Appendix I: the submitted proposals
- Appendix II: the review reports returned to the WP3 coordinator by the reviewers

# Priorities for the Research Agenda

**December 24, 2004**

Recently, DigiCult has produced its Thematic Issue 7, 'The Future Digital Heritage Space, an Expedition Report'. The following are two interesting excerpts from this document (p.22):
'However, there are millions of Euros being spent on digitising heritage resources, with little likelihood of an educational, social or economic return on investment, because the next step towards creating engaging cultural experiences with these resources is not being considered.', and
'Consequently, the RTD agenda for the heritage sector should strongly concentrate on applications that enhance experiences and novel ways of imparting knowledge. It should focus on fostering cultural learning at all levels, from school children to lifelong learners.'

## 1 Multi-lingual / semantic data processing

***Tools for conversion of existing catalogues:***

The advent of the CIDOC-CRM provides a potentially common ontological basis for disparate current digital catalogues. However manual conversion is extremely labour intensive. This area would investigate the use of meta-language to describe common features in catalogues and use the meta-language as a basis for automatic production of tools to assist catalogue conversion.

***Multilingual systems for collection interrogation:***

Common ontologies record more information than unstructured language descriptions in language independent structures. This will assist the production of natural language responses to interrogations of collections descriptions and avoid some of the difficulties of translation between languages. These tools would seek to address the production of responses in a range of EC official languages.

***Characteristics of engaging stories:***

As the Digicult quote notes there is a need for a sense of engagement in story-telling in order to create demand for the digitised collections and the knowledge of the artefacts, etc. This area of work would be to conduct experiments on particular experiences and through comparison of usability and engagement to produce tools to attempt to assess the likely engagement of alternative ways of conveying particular experiences.

## 2 Databases / knowledge management

***Link repository for 3D primary data:***

To set up a web portal with a reference (link) database for publishing captured 3D datasets as a central resource a) to permit searching based on metadata and/or shape, b) to permit browsing based on thumbnail models/ images, and c) to link to the 'true' repository that actually holds the primary data. The portal should also assure the quality of the published 3D data.

***Multi-modal data retrieval:***

Current retrieval approaches strongly focus on text, but a) other cues should be used in combination. Examples are image content, 3D model shapes, and spoken language on audio reels, and b) search possibilities should take CH ontologies into account. This includes bridging the infamous 'semantic gap'.

***Semi-automated mapping to CIDOC:***

There is a need for semi-automated tools that map data from existing databases to CIDOC, and that make the search of tools like those developed in Showcase 7 more usable - i.e. parametric, according to the above mapping system. Such tool would improve the usability of CIDOC-CRM itself. The tool must adapt to diverse cases, such as museum collections (well dealt with by the current CIDOC-CRM), archaeological sites (currently with a variable goodness of fit and with some flaws), monuments (much work to do), and landscape (nothing available).

## 3 Mobile / wearable / ambient systems

***Contextual cultural information:***

With the use of mobile devices, there is a need for much stronger contextual frameworks. Personal access to CH which is aware of what people are looking at (local context), but also what is popular among similar users, ie. what my user profile is and what the behaviours of different user groups are, as well as what I have seen before and where (global context). Furthermore, there would need to be a shift from predominantly single-user applications to cooperative situations.

***Mobile applications from data capture to public dissemination:***

A common, standards-based infrastructure for smart CH environments to support all stages from data capture through to public dissemination. At the capture end, enable existing prototype mobile data capture and information delivery tools to inter-operate with desktop and server-based recording systems in networked smart environments. Tool and environment support for information access and process recording throughout the conservation, analysis, interpretation and general management processes at CH sites, museums and other institutions: tools to support consultation and annotation of records anywhere, at any time, through to sensor networks for monitoring the condition of materials, structures, etc. At the dissemination end: tools to support the implementation of mobile visitor systems, integrated with parallel efforts aimed at more static systems, kiosks, etc.

***Supportive measures:***

On top of being integrated within the Common Infrastructure, multimedia contents need to be understandable, adaptable to multiple channels, and configurable to meet the variety of user needs and profiles. To this end, the research should also concentrate on: a) mobile user needs, b) conceptualization of the mobile communication process and access method, c) inter-disciplinarity required to manage and deliver heterogeneous media formats, and d) management of cultural objects complexity along the entire Common Infrastructure pipeline In this context, a toolbox needs to be developed with a) tools for *data import/export on mobile devices*, and more generally, for heterogeneous data interchange - to support the flow of data along the entire pipeline in any situation where a mobile device is involved; b) tools for *data customization and presentation* according to the technical requirements and constraints of mobile devices (production templates, coding, and annotation of multimedia-contents); c) tools for information authoring via mobile devices (e.g., production templates for on site data input, annotation functionality, etc.); d) *accessibility tools* that improve the accessibility of a mobile application for special needs, e.g., transforming the textual output into audio output (the so called 'screen readers'; e) *input tools* to support alternative input paradigms, e.g., voice as input channel for application control and data entry. (These tools can also be regarded as accessibility tools, for example voice input is a requirement for visually unpaired people)

## 4 Recording / data representation

***3D file format compendium:***

To resolve the issue of lacking suitable 3D file format standards by a) collecting existing file formats supported by most tools (.dxf, .3ds, VRML), b) setting up recommendations for using them, and c) to define requirements for an open 3D file format for CH.

***Versatile 3D acquisition:***

3D scanning apparatus that a) is portable and hence can be brought to the objects, b) that can deal with a wide variety of object shapes and surface types, c) that captures both the shape and the reflectance characteristics, and d) that shows at least preliminary results during scanning, in order to assess data completeness and quality during acquisition, instead of after leaving the site when imperfections are hard or expensive to remedy. Moreover, 3D patches or point clouds obtained from multiple scans ought to be registered and integrated automatically.

***Underwater data collection and photogrammetry:***

Underwater archaeology often is cumbersome or even impossible to carry out with divers, e.g. at depths larger than 60 meters. AUVs (Autonomous Underwater Vehicles) still is in need of streamlining: guaranteeing data quality through stabilisation of position and altitude, data fusion of positioning sensors for better control, self-calibrating and automated pbotogrammetry, integration of acoustic and optical geo-referenced imagery, and sub-bottom measurements.

***Recording of archaeological excavations:***

Integrated functionalities: on-site bringing in of finds (incl. photographs and videos) as well as metadata. Should preferentially also work on PDAs, should support coupling to D-GPS and total station, and should provide in the integration with maps, GIS layers, 3D stratigraphy, and geophysical data. The tool should support parallel use by multiple users (data update in central repository) and annotations / additions of metadata in standard CIDOC-CRM format.

**5 Visualisation / rendering**

***Unified framework for 3D applications:***

To define a standard at the application level that bridges the gap between research and use of innovative visualisation techniques. Key is an extensible framework such as a scene graph engine that permits to integrate viewers for different 3D data formats into the same 3D application.

***Authoring tools for 3D experiences:***

To come up with an easy-to-use toolkit to create 3D multimedia presentations and good-looking 3D exhibitions, e.g. in museums. Target users for the authoring application are museum curators and CH professionals, whereas the user community for the virtual worlds is the public. Only secondary focus should be the internet delivery of CH experiences. The tools should support the visualisation of sites as they evolved over time, and with a possibility to distinguish between fact and interpretation.

***Real-tine underwater experience:***

Realistic experiences of underwater sites have so far been off-line and non-interactive. New tools should provide graphical representations of marine life, sea-bed features, underwater visibility and illumination effects, and audio effects. Other modalities should preferably be added or other VR tools used, in order to reinforce the feeling of immersion.

***Web tool for joint experiences:***

A web tool to build multi-user cooperation mechanisms in 2D and 3D multimedia content spaces. The system should be flexible, modular, and scalable. Developers should be able to build their own 3D cooperative applications in CH by reusing and adapting a set of existing modules, middleware structures, interaction and communication tools, and templates of 3D virtual spaces. An example would be a visit to a virtual museum, while exchanging information and opinions with the (avatars of) other visitors, and interacting with virtual exhibits, like operating a CAD model of some old apparatus in an industrial archeology setting. Visitors see the same 3D space, and what other users are doing. Issues of the choice of 3D description and visualization formats and tools will need to be carefully considered, and so should issues of sharing the same space, authorisation, load distribution,

## 6 Multi-modal interfaces

***Human - Idea - Thing Interaction:***

Interaction can be given an extra dimension by integrating powerful agent based simulation techniques for complex adaptive systems, wireless communication and new sensor technology. By that we can extend traditional Human-Computer Interaction and Human-Machine Interaction to Human - Idea - Thing Interaction (HITI). 'Thing' stands for all kinds of stationary and mobile physical artifacts equipped or integrated with information technology. 'Idea' represents information in various forms such as numbers, texts, pictures, emotions, sounds, simulations that is captured, stored, presented, processed and transmitted with the help of information technology.

***Emergent interaction***

How can we create multimodal interfaces that a) allow for emergent interaction, i.e. the system responds adaptively to the visitors' behaviour and emotions, allows 'what if? scenarios', b) support interactive multimodal communication with agent driven 'intelligent' virtual humans responding with emergent adaptive behaviour, and c) pick up a visitor's emotions, joy, enthusiasm, frustration, contentment, annoyance, rage, etc.

## 7 Virtual humans / avatars

***Populating 3D Environments:***

It is useful to add interest to 3D presentations of objects or sites using avatars, but this involves further expense and generally relies on bespoke tools. EPOCH is developing standards for representing 3D models and for attaching rich metadata to support a range of presentations of models and enquiries about them. New tools would make it possible to render the 3D models in an environment where avatars, acting in response to the model metadata, could add interest and realism. Further, avatars could provide interactive guides that would respond to the visitor according to their language, interests, and past experience. An application of the tools would be automatic generation of populated environments as prototyped in Showcase 4.

***Avatar Standards for CH:***

Just as standards are required for representing 3D models of CH assets, to encourage reuse, so it is desirable to employ standards for avatar definition and animation parameters. Some commercial formats are proprietary and inadequate for detailed animation of manual gestures. Formats, including MPEG-4 FBA are avatar-specific. Work is needed not only on use of existing formats and tools but also in the development of formats that handle CH metadata. In order to achieve maximum reuse of resources, it will be highly desirable that motion files will be usable with a range of avatars. This will require the ability to retarget captured or key-framed motion, or to synthesise motion for a specific avatar definition. The aim of the new tools would be in conversion between formats, preserving CH metadata, so that existing commercial and open source tools could be used to process avatars in the EPOCH pipeline.

***Avatar Development Tools:***

Avatars and their associated motion files are generally developed for a specific application. It is envisaged that EPOCH applications will have some common

requirements for using avatars. To develop compatible avatars, it may not be enough to provide methods for linking authoring tools, since it is often necessary to return to an earlier stage in the development pipeline, thus losing detailed work further on. New tools would either provide a complete open source system for developing EPOCH avatars, importing simple avatars from other tools, or would provide a system for merging changes made during different stages of development.

***Mobile Avatar Platform:***

A benefit of using avatars as opposed to video for presentation of information is that animation data can be considerably more compact than video. The user has control of the presentation style and animation can be generated interactively. However, processing and memory resources on mobile platforms tend to be tuned for video and not always sufficient for full 3D animation. In order to make avatars available on mobile platforms it would be desirable to track the development of devices and available multimedia tools. If available platforms are adequate, then new tools would be developed to transfer avatar animation specified in EPOCH formats to such platforms. Otherwise investigation would be made of the feasibility of porting existing avatar players to mobile devices.

***Scripting avatar behaviour:***

The value added to EPOCH presentations by the use of avatars will depend on the avatars exhibiting realistic behaviour. It will be important that scripts can be generated in response to metadata about EPOCH sites and objects. This will require a sufficient repertoire of moves, gestures, and mouth-movements for speech, along with avatars that are able to perform the repertoire. Several EPOCH partners have developed XML-based notations for scripting dialogues and avatar movement. New tools would combine these notations into a common framework for use in the EPOCH infrastructure, along with at least one reference implementation. Such a notation will have wider application outside the CH area.

# Call for NEWTON projects

This section contains the text of the call for Newton proposals, sent out to the partners on 13 January, 2005.

**EPOCH, 1st Call for NEWTON projects**

**13 January, 2005**

**General information**

NEWTON projects (= NEW TOols Needed) are meant to produce effective solutions for priorities on the EPOCH Research Agenda for which no tools exist or where tools exist but their performance or functionality needs to be improved. The list of priorities for this call will be settled when voting is completed on the current priority list (circulated to all partners separately). **Voting will now close on the 19th January** and the **definite list of topics will be issued on the 21st January**. A second call for Newtons is expected to be issued in month 21/22 of the project, and the total amount of budget expected to be allocated to each call will be announced with the final call issued on the 21st January 05.

Each new tool is expected to be developed by a small team, assembled from the EPOCH partnership. The budget must not surpass 200 kEuro and the maximal duration is 2 years. The requested budget and the duration of the Newton project should be kept as limited as possible, and will be among the criteria for selection (see further for the list of selection criteria). If a Newton project spans more than one project year then it will be reviewed internally as part of the cycle for the revisions to the JPA, and will be subject to the annual review by the Commission.

The **deadline for sending in proposals** has been moved back from the 7th February to **9th February 2005**. Proposals should be sent as a single pdf or Word file, to Luc Van Gool, vangool@esat.kuleuven.ac.be

**Note on related, additional funds**

As usual, the work should not be financed through other means (i.e. no double financing is allowed), but Partners may make provision to co-finance proposals from other sources to produce more complete solutions than possible within the scope of an EPOCH Newton project alone.

In these cases, the overall result should be available to EPOCH and its partners. It should in these cases also be made very clear what the added value of the Newton project is exactly. In particular, partners active under Activity 3.3 (Common Infrastructure) should indicate why their proposal is not achievable using that finance, what their contribution to the common infrastructure funded under 3.3 will be and how their Newton submission complements this if in the same area. Similarly, if partners have been actively working on integration issues in Activity 2.4 (Showcases) the partner should indicate if and how the Newton work would relate to the showcase (such relation may be absent though, in which case this should be stated).

There is a possibility that successful Newton projects will be matched with an additional funding of about 10% for dissemination. The additional funding will be decided on later. This dissemination work - developing a showcase - may or may not be carried out by the Newton partners. It would normally be undertaken by the Newton partners if they so desire. In any case, partners should report on potential ways of showcasing the Newton so as to disseminate results.

Finally, self-contained software developed under an EPOCH Newton project without co-financing from outside EPOCH, should be open source or come with an open licensing policy, so that the source code is freely available to all EPOCH partners.

**Selection criteria**

Before assessing the Newton proposals, reviewers – typically 5 per proposal and from different constituencies (as in the technical annex description of the review college) – will be asked to take into account the following criteria in particular:

- *quality*: is the scientific level of the proposal sufficiently high, both from a technical and a cultural heritage point of view?
- *focus*: does the project target the needs as specified in the call? Will the results define the state-of-the-art in its area?
- *feasibility*: are the goals realistic and is the budget reasonable?
- *usability*: does the project include usability testing, to ensure that claims are validated?
- *track record*: do the proposing parties have sufficient expertise in the area(s) of the proposal? A strong multidisciplinary base of the partnership is an advantage to ensure relevance of the results to real applications.
- *impact*: will the technology be affordable? The opinion of the reviewers drawn from the constituencies of public authorities and CH field workers will be especially important here.
- *sustainability*: is there a clear path towards continued availability after the project and towards applicability at other sites than the partners' test site(s)? How difficult would it be to integrate the work into the Common Infrastructure? Will the work continue to have support and potential further development?
- *additional contributions*: additional contributions like the production of open datasets, contributions to standardisation, etc. will be regarded as a plus.

**Structure of the proposal**

Please, give your proposal the following structure, with the different components in the same order and with the same number:
*1. Project title*: Title of the proposal

*2. Partnership*: names of key researchers and their affiliation (incl. EPOCH partner number) and full contact details (address, tel., fax, e-mail) for key contacts at each partner involved

*3. Priority*: to which priority on the research agenda the proposal is a response

*4. Technical proposal*: short proposal text, indicating what the goals are, how the partner(s) expect to achieve them (with indication of the role of each partner), what are the milestones and the deliverables. As part of the latter, also contributions to open repositories (e.g. data, models, etc.) and standardisation efforts should be mentioned.
This whole part has a suggested length of 4 pages.

*5. Related activities*: for each partner involved in Activity 3.3 (Common Infrastructure), describe your achievements and future plans there. Then, describe the possible relations with the work in the Newton project.
Partners involved in existing showcases should do the same for that activity.

*6. Newton showcasing*: if you were to showcase your Newton results, what would you propose to show and how. This section should be filled out in any case, also if the partners would not be interested in doing the showcase themselves. Epoch may call for partners who would. Half a page is the suggested length.

*7. Timetable*: give a concise roadmap. How are subparts of the project planned to proceed over time. This can be shown as a diagram. Indicate what milestones and deliverables will be used to monitor progress and where they fit in this description.

*8. The project in numbers*:

overall figures:
1. duration of the project
2. requested project budget

per partner:
1. number of person months
2. labour cost
3. other costs, with short justification
4. overhead (as allowed within standard FP6 costing models applicable to each partner)
5. total for partner

The overall proposal is not expected to be more than 10 pages.

# List of submitted proposals

| | |
|---|---|
| **Proposal Name** | Tool creation for populating environments with interactive avatars and crowds for cultural heritage applications (POPULATE) |
| **Partners** | University of East Anglia, University of Brighton |

| | |
|---|---|
| **Proposal Name** | Telearchaeologyst Toolkit (TATOO) |
| **Partners** | UAB (Barcelona) |

| | |
|---|---|
| **Proposal Name** | Cultural heritage services for touristsn (CULTOURIST) |
| **Partners** | Brunel University, National Museums of Scotland |

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|---|---|
| **Proposal Name** | Web-based tool for archaeological data processing and storage (WEBTOARCH) |
| **Partners** | New Bulgarian University |

| | |
|---|---|
| **Proposal Name** | Webtalkplus (WBLTK+) |
| **Partners** | Politecnico di Milano, Tekniska Museet Stockholm, Universita della Svizzera Italiana |

| | |
|---|---|
| **Proposal Name** | Common Infrastructure, Context Influenced (CIMAD) |
| **Partners** | ARCES (Bologna), University of Kent, Politecnico di Milan, Ducati, IBC – Regione Emilia Romagna |

| | |
|---|---|
| **Proposal Name** | Virtual Human Open Simulation Framework for Cultural Heritage (VIRTUMAN) |
| **Partners** | UNIGE-MIRAlab, University of Brighton, EPFL |

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|---|---|
| **Proposal Name** | CIDOC CRM Data Mapping Tool (CRMAP) |
| **Partners** | Paveprime, University of Southampton, Oxford ArchDigital, University of Oslo |

| | |
|---|---|
| **Proposal Name** | Tools and grooves – matching tool marks with tool profiles on archaeological artefacts (TOOLS&GROOVES) |
| **Partners** | KTH, Museum of Science and Technology Stockholm, Stockholm University |

| | |
|---|---|
| **Proposal Name** | Calibration and 3D modeling in underwater photogrammetry (UNDERWATER) |
| **Partners** | ETH |

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| **Proposal Name** | Immersive culture heritage experience through wireless 3D-sound system for binaural reproduction (3DSOUND) |
| **Partners** | Interactive Institute, Swedish University of Agricultural Sciences |

| | |
|---|---|
| **Proposal Name** | The EPOCH 3D multimedia kiosk (3DKIOSK) |
| **Partners** | Computer Graphics Braunschweig, IST-CNR Pisa, Computer Graphics Bonn |

| | |
|---|---|
| **Proposal Name** | Archive Mapper for Archaeology (AMA) |
| **Partners** | PIN, VARTEC, University of Oslo, University of Kent, CIMEC, UNIREL, CISA |

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|---|---|
| **Proposal Name** | Versatile and ubiquitous scanning (UBISCAN) |
| **Partners** | CNR-ISTI, K.U.Leuven |

| | |
|---|---|
| **Proposal Name** | Integration of image and laserscan data for 3D modelling (IMODELASER) |
| **Partners** | ETH |

# List of reviewers

***Michael Loveday***, Norwich Heritage, Economic and Regeneration Trust (HEART), United Kingdom

***Dov Winer***, The Jewish Agency for Israel, Israel

***Isaac Gilead***, Ben Gurion University, Israel

***Jeremy Huggett***, University of Glasgow, United Kingdom

***Paola Moscati***, ISCIMA, Italy

***Henrik Hansen***, Kulturarvsstyrelsen, Denmark

***David Bearman***, University of Toronto, Archives & Museum Informatics, Art Museum Image Consortium Inc., Canada

***Tim Child***, Televirtual Ltd., United Kingdom

***Michele Furnari***, CNR, Italy

***Jürgen Mrosek***, Staatl. Museen zu Berlin, Germany

***Augustin Diez Castillo***, Universitat de Valencia, Spain

***Pierre Drap***, École d'Architecture, Marseille, France

***Robert Sablatnig***, Vienna University of Technology, Austria

***Vincenzo Tiné***, Museo Nazionale preistorico ed etnografico "Luigi Pigorini", Italy

These reviewers were selected by the WP3 management Committee at its meeting of 5 July 2004 in Leuven. The reviewers were selected from the Review panel. The Review Panel had been composed by the entire partnership, based on a plenary poll and vote. The above people were selected as to avoid conflicts of interest (not being involved in a Newton proposal themselves) and as to ensure that representatives from different constituencies (cultural heritage professionals, technologists, public authorities, …)would have a say in the selection process. For every Newton, 5 reviewers were requested (but unfortunately not always received).

# Selection report

**EPOCH**
**1st Call for NEWTON projects**
**report by Luc Van Gool**
**call: 11 january, 2005**
**this review outcome: 7 march, 2005**

## Overview of the response to the call

We have received 16 proposals, for a total requested budget of about 2 MEuro (1841.698 kEuro). Almost all priorities of the Research Agenda were covered by at least one proposal, except in multi-lingual technologies and multi-modal interfaces, which were covered more as a side-issue. Multi-modal interfaces may have suffered from the rather vague descriptions in the call.
Reviewers were asked to give scores from 1 to 5 (1 = very poor, 2 = poor, 3 = moderate, 4 = good, 5 = very good) for the quality, focus, feasibility, usability, track record, impact, sustainability, and additional contributions to the network (more precise meanings of these categories were given in the guidelines for reviewers). The average scores that are given in the sequel, represent the average of the above 8 scores. This gives a rough indication of the reviewer's overall appreciation.
Note that not all acronyms/short names used in the following section for the projects were specified by the authors. I have made a couple of them up to have a nickname for each and ease discussions.

### Project reviews and proposed decisions

We received a total of 16 Newton proposals, requesting a total budget of over 2 MEuro.

| **Name: *POPULATE*** | |
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| Tool creation for populating environments with interactive avatars and crowds for cultural heritage applications | |
| **Requested budget** | 134.4 kEuro |
| **PM** | 22 |
| **Duration** | 18 months |
| **Reviews** | |
| Three reviews available, but one only contains comments not to be passed on to the authors... One reviewer agrees that what is proposed is well in line with the call, but he also raises the issue that not all requirements of the call are responded to (e.g. ... respond to the visitor according to their language, interests, and past experience). This reviewer also believes that many pre-requisites are required for the completion of the work and that it is not clear whether all of them will be ready in time. Another criticism is a rather vague commitment to standardisation. (*average score = 3.625*).<br>The second reviewer judges the scientific quality of this proposal to be high. This reviewer also argues that the proposal needs to articulate the project's ability to understand and respond to the heritage requirements for crowds. There is little articulation of the need for crowds in an historic period to behave and appear as though they were from that period. The reviewer sees the project as well targeted and believes it will deliver a state-of-the-art solution, as an 'extremely robust proposal'. The scientific track record of the proposers is considered to be extremely impressive, but the reviewer misses a demonstration of heritage experience to give the avatars historic authenticity. 'From the information provided the project appears to provide an easy to use populating tool at an affordable price'. 'On the basis of virtual environment creation work developed by theUEA, part of the partnership already has a good track record in translating research into practical, sustainable applications'. (*average score = 4.25*) | |
| **Comments** | |
| I don't consider the priorities of the call as topics that have to be covered up to the last point. So, one of the main criticisms is not really damaging, given the fact that a sufficient number of relevant topics is being covered by the proposal. The standardisation one I also believe to be not a serious problem in this case, although the authors could have been a bit more assertive on this issue: these groups are working on an OpenSG compatible proposal, actually using this framework heavily.<br>A tricky issue is whether to take this one or VIRTUMAN, or insist on a merger. The second reviewer - who only gave comments in the section not meant to be passed on to the reviewers - explicitly mentions that if the network has to choose between POPULATE and the overlapping VIRTUMAN proposal, we should choose POPULATE, as this one is 'more clearly laid out and specified', and as the other 'mainly seems to recycle already developed (or under development) technologies by the same authors, its only novel objective, behind all the complex verbosity and nice pictures, being to re-release them as open source'. But another reviewer - not commenting so explicitly on the relative strengths - gave higher scores to VIRTUMAN. Another rationale for choosing this one is that John Glauert is coordinating the 3.3 - subarea 7 (avatar) activities, and it is good to support people who support the network. The main proposers of VIRTUMAN decided to stay on the sidelines in 3.3 so far, 'because they had no budget during the first year', even when being among the partners with the largest budgets in Epoch overall. The framework they offer to become 'open' and that will also the | |

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| basis for their work under the Newton - VHD++ - has hardly any real user base except for the proposers themselves. My feeling is that this Newton would rather defocus our standardisation efforts. On the other hand, these partners have now just entered a phase where they do have a budget under 3.3, so the question is how we can tie their efforts in when we go for OpenSG and nothing else, as I think we should. A search with Google suffices to see the massive difference in support and use of the two frameworks. This said, I find the level of realism demonstrated by the VIRTUMAN avatars more convincing than what we can expect to come out of POPULATE. Taking all these considerations into account, I would propose to earmark a budget of 100 kEuro as reserved for this activity, but the different players should agree on a joint, OpenSG compatible proposal. John is already trying to get activities in this subarea synchronised (see his recent mail), and fleshing out such updated proposal could be a specific part of these activities. |
| **Proposed Decision** |
| put on hold, and await the possible creation of a joint project with VIRTUMAN, but reduce the combined budget to 100 kEuro. Discuss the issue of pre-requisites upon resubmission, raised for this part. 100 kEuro is not a large amount, but the activity was considered of lower priority by the partnership in the poll. |

| **Name: *TATOO*** | |
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| Telearchaeologist Toolkit 1.00 | |
| **Requested budget** | 26.565 kEuro |
| **PM** | 2 |
| **Duration** | 1 year |
| **Reviews** | |
| The first reviewer considers the members of the team to be well established experts, but believes the team may be lacking in terms of geographic spread and interdisciplinary range. This reviewer didn't see the methods how the goals would be achieved described clearly enough. The same reviewer also raises doubts about the feasibility of the vision that 'you can understand activity areas, occupation floors, walls, etc. because you can recognize them as such when integrating all the data at the same moment you obtain them'. The reviewer also believes that the lack of CIDOC-compliance may limit the sustainability. (*average score = 3.375*)<br>The second reviewer was very positive about the project. This reviewer considered the pursued aims to be good, although not too innovative. The reviewer highlighted the interesting synchronisation aspects and the introduction of barcodes for labeling. The reviewer believes more focus should be put on the end-user needs. The reviewer is also convinced that the staff is very skilled and already acquainted with the issues involved. The reviewer sees the specific aim of applying the tool to the Tirra del Fuego site (Argentina) as positive, as it will help to get results soon enough and as 'the technological tool will be reproducible also in different contexts'. (*average score = 4.125*)<br>The third reviewer believes that the proposed toolkit addresses the needs of the archaeologist in a modern, complex excavation and finds the setup interesting. This reviewer also notes that the proposal lacks some clarity. The reviewer is also not convinced about the usability by other partners, as it is not clear what will be available to others after the work has finished. The third reviewer finally also notes that the standardisation issues are not well documented in the proposal. (*average score = 3.5*)<br>The fourth reviewer finds this an interesting proposal, but also states that it is unclear at times | |

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| as to exactly what is to be done, and where it differs from other products that are already available. The goals are considered very generic and therefore it is difficult to judge whether the partners can achieve them. The reviewer notes that testing will only be done at the very end, so that conclusions cannot be taken into account (but of course, this being a Newton project, it will have a short duration...). Also this reviewer would have preferred to see a broader partnership to reduce the risk of the tools becoming overly site-specific. Again, the comment is made that there is no information on subsequent licensing of the product, etc. (*average score = 3.125*)<br>The fifth reviewer considers the scientific level of the proposal to be 'high enough' from a technical and CH point of view, but feels it falls short from being state-of-the-art. The budget is considered to be very realistic and reasonable. The project includes some testing for validation of the claims. The partners are believed to have the necessary expertise. The reviewer thinks the technology would be affordable, but limited to specific archaeological sites. It lacks further explanations on the availability to other sites and other areas than archaeobotany. The reviewer cannot see additional contributions to standardisation or open datasets. (*average score = 3.625*) |
| **Comments** |
| On the whole, the reviewers had quite some doubts about this proposal. Even then, scores can be seen to be still quite high. This is useful to calibrate your interpretation of these numbers. My main worry with this work is that it is very decoupled from all the rest that is going on in the network: all researchers are from the same partner (UAB), no mention is made of the activities that are going on in parallel for the recording of excavations (e.g. the ongoing Showcase...), standardisation issues are hardly mentioned, no future licensing or open soft strategy is discussed, ... |
| **Proposed Decision** |
| reject |

| **Name: *CULTOURIST*** | |
|---|---|
| Cultural heritage services for tourists | |
| **Requested budget** | 199.085 kEuro |
| **PM** | 52 |
| **Duration** | 24 months |
| **Reviews** | |
| The first reviewer likes the project and sees the expertise of the lead partner as a convincing argument in favour. This reviewer also raises a note of caution. Business model claims for mobile TV have largely ignored the imminent introduction of HDTV standards for domestic users in the US and Europe. As this involves 6 times more image pixels and a hike in framerate, the gap between mobile and domestic is due to grow again drastically. The reviewer summarises as follows: 'a strong proposal, on-target as to cost but perhaps slightly overreliant on a telecoms area which is subject to rapid revision against business models'. (*average score = 3.875*)<br>The second reviewer feels there is a lack of technical content and fears that the work will actually lag behind actual commercial developments. This reviewer also finds the concept of repurposing content from museum databases to broadcast video far from reasonable. 'This is a most unlikely way to produce a compelling broadcast medium'. The reviewer also feels that usability testing is not a strength of this proposal and criticises the lack of business development partners (but the restricted size of these consortia should be kept in mind...). On | |

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| a more positive note, the reviewer notes as to impact that 'except for the notion of semi-autonomously created content, the models could fit with a variety of technology directions, one of which is certain to succeed in the market'. Then again, the reviewer also has doubts about the sustainability of the work. Overall, according to this reviewer still, 'it's not clear what this project is contributing - scenarios and model contracts need to fit into a business model that presently doesn't exist and which the CH sector is not going to influence'. (*average score = 2.75*)<br>The third reviewer makes the interesting observation - from experience in the sector - that the information by on-site-users differs considerably from that of website users in that they are much more interested in up-to-date info (what's going on there now, when does the next tour starts, opening hours today, ...). This requires a dynamic database at the CH site. This reviewer furthermore questions whether CULTOURIST will become a major marketing instrument for CH sites in the next years because the acceptance of the service will be restricted (costs, end-user terminals not very widespread) and the content providers will in the long run not be able to provide the actual information at the high quality that is required. This reviewer concludes 'I wouldn't give CULTOURIST a very high priority'. (no scores given)<br>The fourth reviewer thinks that the scientific contents are sound. This reviewer doesn't see a clear contribution to CH in particular. It rather will be another type of content, next to many, similar services. The reviewer also has some questions regarding the even spread of PMs over tasks of different duration and regarding the availability of such technology for the partnership after the end of the project. (*average score = 3.625*) |
| **Comments** |
| I think this is a clear reject. Not a single reviewer is clearly supporting this proposal. It is also very expensive in comparison to most others. |
| **Proposed Decision** |
| reject |

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| **Name: *WEBTOARCH*** | |
| Web-based tool for achaeological data processing and storage | |
| **Requested budget** | 34.025 kEuro |
| **PM** | 34 |
| **Duration** | 12 months |
| **Reviews** | |
| The first reviewer has multiple, serious criticisms on the proposal: 'falls well short of the integrated recording system, focussing instead on several specific areas...', little attention to the integration of data for artefacts with survey, stratigraphy, etc. which the call requires, 'in the end this is not an excavation recording system - this is a system for bringing together some of the results of a number of excavations, which is rather different', 'the budget seems rather light in significant areas for what is being attempted' and 'it's noticeable that the tool highlighted at www.csisb.org/arcada is far from complete'. 'There has to be a suspicion that this will be a tool that is developed and goes no further. Questionable application beyond its development area.' (*average score = 1.875*)<br>The second reviewer is more positive: 'this is a clear and well written proposal covering both the technological and CH points of view', but also has some doubts, qualifying the planned work as 'somewhat limited' and stating that 'the creation ... of the tools seems to cost more than the relatively small sum requested'. 'The text ... suggests that only the stone artefacts module will be ready after 12 months, thus the usability will be limited...'. 'Although one of | |

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| the declared aims is museum information, no related expert is on the team.' And more positive again: 'If the modules will prove successful, it seems that there is a potential for further development.' (*average score = 4.125*)<br>The third reviewer states that 'the quality and the scientific level of the project is good and the proposal is well structured'. 'The aims - which focus on standardisation and integration of archaeological information and above all on multilingualism are remarkable and fit well the needs specified in the call'. 'The impact could be impressive, but the archaeological case-studies should be more precisely detailed in order to test the effectiveness of the technological solution'. (*average score = 4*)<br>The fourth reviewer finds the description 'not very clear' and the proposal therefore difficult to evaluate as to its scientific quality. This reviewer believes the timetable and the budget to be realistic, but believes there is lacking focus on usability. This reviewer highlights that the WebToArch tool will be made available to the Epoch community and since the technology is based on open source products such as MySQL it seems affordable, but the fact that this project is carried out by a single partner may weaken its acceptance by the community. (*average score = 3.125*)<br>The fifth reviewer thinks the proposal aims high and has a very complete scope. The reviewer 'likes it' and looks 'forward to download the WebToarch, as it also takes PDAs into account. As to the track record the reviewer has more reservations: it is a one-country initiative and the proposers may lack some expertise. (*average score = 4*) |
| **Comments** |
| Even if the scores are quite high, the proposal got quite a few critical comments. The networking value of the proposal also seems weaker than that of most. |
| **Proposed Decision** |
| reject |

| **Name: *WBLTK+*** | |
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| Webtalkplus: a flexible tool for effective creation of 3D shared worlds | |
| **Requested budget** | 198 kEuro |
| **PM** | 55 |
| **Duration** | 18 months |
| **Reviews** | |
| The first reviewer is very cricital: 'Shared world simulation with it's low fidelity representation and high levels of interaction have been around for over 12 years and may no longer be considered state of the art unless a proposal brings something fresh and innovative to the table. Perhaps more importantly, this approach has consistently failed to appeal to CH operators, and its support base remains academic.' The reviewer agrees that it is an accurate address to the call and considers the budget to be reasonable. The presence of the Museum as a partner is considered a clear plus and the reviewer believes the track record is good. But as to the impact: 'This technology, and tools to enable it are undoubtedly affordable, but remain unattractive to the professional CH community. This situation is likely to prevail until a next generation shared world approach emerges - probably - but not necessarily on the current model of network on-line gaming. As with this comment, should a new model and subsequent specification for shared world activities emerge, the toolset as projected is likely to be of very limited use. Although WBTLK moves not to preclude higher fidelity approaches, the languages it has chosen for programming are not the tools of choice for high fidelity practitioners.' 'I would have scored this one lower, but for the fact that it is clearly | |

roadmapped in the Epoch agenda for research. And it is modest.' (*average score = 2.875*)
The second reviewer recognises the strong track record of the proposers, but doesn't consider shared presence VR environments as high priority in CH. The reviewer believes that the shared environments and the tools are state-of-the-art and that the presence of POLIMI will ensure good usability testing. Also the presence of the Swedish museum is highlighted. The reviewer doesn't see a clear path towards sustained availability. (*average score = 4.125*)
The third reviewer likes the fact that the project has a clearly defined target group (users aged 12 to 19) and a clearly restricted topic (energy), and believes that the proposal is in good agreement with the call. Usability testing is well planned and the presence of a museum as one of the partners is a strong point. The reviewer summarises 'In general I am in favour of that proposal'. (*no scores given*)
The fourth reviewer appreciates that the proposal is well-written and that the proposed activities seem to be sound, but is not sure whether the goals can be achieved within the planned period and whether the resources spent on usability testing should not have been increased. Availability of the tools is not fully guaranteed according to the reviewer. (*average score = 4.25*)

**Comments**

For me yet another proof that we urgently need a strong link with the gaming world. My impression is that the first reviewer is right. But the community is not keen to follow our suggestion to get stronger connections with gaming. The net result by rejecting this may that we are left empty-handed for this type of technologies, something the EC nor the partnership will like to see.

**Proposed Decision**

I suggest to put the submission on hold (i.e. not to let this project start as part of the first generation of Newtons), because of the issues that have been raised. We should get a clearer view on the evolutions in gaming first. We could let the decision depend on what comes out of a survey and spend some unallocated 3.3 budget to have someone knowledgeable look into that and the gaming issues more generally. If we would accept later on the basis of the outcome, then I propose to do so with reduced budget: 120 kEuro. This cut will mainly hit POLIMI, and might therefore weaken the usability testing which one reviewer already regarded to be underfunded.

| **Name: *CIMAD*** | |
|---|---|
| common infrastructure, context inuenced mobile acquisition and delivery of CH data | |
| **Requested budget** | 113.95 kEuro |
| **PM** | 14 |
| **Duration** | 15 months |

**Reviews**

The first reviewer doesn't consider himself qualified to judge all aspects of this proposal, therefore gave a number of 'neutral scores'. The reviewer considers the proposers to have a strong track record. 'Smart environments, as defined under CIMAD, represent a cost effective, non-invasive and location-sensitive approach to many forms of CH site, and are likely to prove attractive to planners, environmentalists and other stakeholders. Contributions to CIDOC CRM and shared effort with MOBICOMP are noted'. (average score not calculated as it would be 'contaminated' by the neutral scores)
The second reviewer confirms that 'a framework for context aware mobile applications is very critical at this time'. The reviewer also believes that the partners have the requisite

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| technical expertise. The reviewer points out that links with industry will be important, as industrial partners are lacking in the current consortium. Furthermore. 'a great deal depends on whether this work is made available under an open-open licensing framework and involves industry in the process. Sustainability will come from buy-in by industry and there are no obvious plans for that. The project shows appropriate regard from standards framework but is not in itself contributing to standards which will limit the utility of the CIMAD framework.' (*average score = 3.375*)<br>The third reviewer worries that it may prove difficult to 'generate information which will satisfy researchers and public in the same way - both user groups not only expect different information, also the required semantic coding must be different to meet the expectations of these user groups'. Nevertheless, he thinks this is a very interesting proposal combining the areas of CH and ubiquitous computing and states 'I am very much in favour of this proposal because of its use of advanced technology and the potential it has for CH sites'. (*no scores given*)<br>The fourth reviewer thinks the proposal is well written and the proposed activities are sound. The reviewer suggests that conceptual and spatial context should be distinguished more clearly as to their respective use. The reviewer finds the goals and the requested budget reasonable. One suggestion is to increase the coordination between A2-A3-A4 and A1 activities. The reviewer expects that the results could be used at many different sites, esp. if commodity apparatus will become available. (*average score = 4.5*) |
| **Comments** |
| We should address the question raised by one of the reviewers about the licensing policy. |
| **Proposed Decision** |
| accept, but discuss licensing before writing it in stone. Proposed budget: 90 kEuro. |

| **Name: *VIRTUMAN*** | |
|---|---|
| Virtual human open simulation framework for cultural heritage | |
| **Requested budget** | 173.6 kEuro |
| **PM** | 28 |
| **Duration** | 24 months |
| **Reviews** | |
| The first reviewer raises the issue that no hint is given as to how possible changing behaviour patterns over time would be taken into account. The reviewer believes the approach is technically sound and that state-of-the-art results can come out. (*no scores are given*)<br>The second reviewer likes the releasing of tools as open source and points out that the proposers have already done so. The reviewer sees a lack of usability testing within a CH instead of a technological context. The reviewer states that the proposers have a great track record in this area, and have been active within the context of MPEG. (*no scores are given*) | |
| **Comments** | |
| As already mentioned with the POPULATE proposal there is a lot of overlap between the two. The authors of this one say that they would have submitted a joint proposal if they would have had the time to prepare for it. | |
| **Proposed Decision** | |
| Put on hold for a second batch, but earmark 100 kEuro for the activity. We should have a single, CI compatible (i.e OpenSG compatible) proposal at the end. | |

| **Name: *CRMAP*** |
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| CIDOC CRM data mapping tool | |
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| **Requested budget** | 113.923 kEuro |
| **PM** | 10 |
| **Duration** | 12 months |

**Reviews**

The first reviewer sees a clear link with the call, but would like to see a clearer division of work among the partners. This reviewer also feels the costs are high compared to the PM resources that would be invested. Plans for usability testing are deemed to be rather weak. The partnership is judged very suited for the job. The impact of this work is expected to be high, given the availability of the product under GPL. The mapping wizard is thought to be an interesting idea. (*average score = 4.5*)

The second reviewer feels the proposal is overly focusing on the technical aspects. This reviewer also considers the specification of the materials to be accommodated, the role of the English Heritage subcontractor, as well as the testing procedures to be too vague. The reviewers also has doubts on the sustainability without additional funding. (*average score = 4; but 2 entries left unspecified*)

The third reviewer considers the quality of the proposal to very good, as well as the scientific level of the team. The qualification `probably' with reference to the involvement of the research sector is less appreciated. Also this reviewer notes that the cost of the proposal is high. On the other hand, the duration of one year is considered too short to test the data mapping tool. The team's expertise is judged to guarantee the feasibility. (*average score = 4.125*)

The fourth reviewer judges the scientific level of the proposal to be high and the proposed tool would be an important step forward for the CH sector. The duration is believed to be rather short for the 6 milestones and 5 deliverables. The impact of the usability testing on the tool is considered uncertain and a stronger focus on such testing would have been preferred. The partnership is seen to be strong. The fact that the tool will be available in GPL is considered positive, there is unclarity about the costs to ensure future availability of the tool, even if the CIDOC CRM community can be expected to keep the ball rolling. The project is believed to contribute to standardisation within the CH community. (*average score = 4.25*)

The fifth reviewer feels the proposal is `somehow weak on the CH side', but well in focus with the Research Agenda. The reviewer criticises the high budget and the fact that all testing is internal to the project. The reviewer believes that the project would have a limited impact. (*average score = 3.5*)

**Comments**

Expensive for the 10 PMs... The proposal got rather high scores, BUT... Steve Stead seems to have taken the initiative for this proposal. Honestly, I find it quite irritating that a partner who takes about 2 months on average to answer mails with simple questions suddenly finds the time to write a proposal within a fortnight as soon as more budget is involved. Will we get anything in return if this Newton is funded? His track record has been less than convincing. If work so far would have been OK, I would have supported this submission.

**Proposed Decision**

Reject; First see some results coming out of funding that was already assigned to Paveprime. If we decide otherwise, we could ask Oxford ArchDigital Ltd to take the lead. They have the largest nmb of PMs (6, vs. 2 and 2 for the other partners)

**Name: *TOOLS&GROOVES***

| Matching tool marks with tool profiles on archaeological artefacts | |
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| **Requested budget** | 51.650 kEuro |
| **PM** | 7 |
| **Duration** | 6 months |
| **Reviews** | |
| The first reviewer doesn't find the match between the proposed work and the call is particularly strong, the proposed work being mainly a 2D contour matching problem. Proposed solutions remain rather vague and the benefits for the CH community are not described appropriately. The reviewer is also not convince that the proposers have the necessary expertise and therefore believes the 5 month duration would be too short. The reviewer points out that there are no adequate algorithms so far that can solve 2D or 3D puzzles and therefore doubts whether this project could solve a similar problem so swiftly. (*average score = 2*)<br>The second reviewer feels the problem is described clearly. It is felt that metadata documentation should have been covered, and that more info should have been given on the underlying 3D scanning process that is a prerequisite. Wider use of the proposed tool should have been sought. The duration of the project is believed to be too short. (*average score = 4.25*) | |
| **Comments** | |
| Very expensive for the nmb of PMs involved (and this is basically the only cost apart from overhead). Too much of a niche application, without sufficient expertise of the partners. | |
| **Proposed Decision** | |
| reject | |

| **Name: *UNDERWATER*** | |
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| Calibration and 3D modeling in underwater photogrammetry | |
| **Requested budget** | 55 kEuro |
| **PM** | 12 |
| **Duration** | 12 months |
| **Reviews** | |
| The first reviewer considers the proposal more a letter of intent than a genuine proposal. The reviewer states that the weaknesses of this proposal have been resolved by another proposal, and suggests that both could be merged. (*no score given, as most entries have been left blank*)<br>The second reviewer feels the archaeological part is lacking, and that the application is too narrow for the proposal to be an effective response to the call. (*average score = 2.875*) | |
| **Comments** | |
| Too narrow and too weak | |
| **Proposed Decision** | |
| reject | |

| **Name: *3DSOUND*** | |
|---|---|
| Immersive cultural heritage experience through wireless 3D sound system for binaural reproduction | |
| **Requested budget** | 156.5 kEuro (59 kEuro overhead, not clear according to which rule that is...) |

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| **PM** | 12 |
| **Duration** | 21 months (proposed starting date 1/8/05) |
| **Reviews** | |
| The first reviewer sees a good match between the proposal and some priorities on the Research Agenda. The usability would depend on a strong integration with other technologies, e.g. for visualisation, and this aspect is not covered. The proposers are considered experts in the proposed area. The active participation of a CH professional is noted. The application scenario (Lennaeus garden) is found to be convincing. The contributions to / use of standardisation efforts is not clear. (*average score = 3.9375*)<br>The second reviewer feels the proposal boils down to showcasing a non Newton project. It is not clear whether new technology will be developed. The reviewer believes that the impact of the tested technology on other, appropriate CH sites could be high. (*no score calculated as several entries were left blank, but where there was a score, it tended to be quite low*)<br>The third reviewer feels that specific CH aspects have not been covered well. The reviewer also suggests to look into alternative options, as the addition of headsets is an inconvenience that may not outweigh the added value. The reviewer would also have liked to see the previous track record being spelled out more clearly. Also the sustainability is not considered to have been demonstrated convincingly. (*average score = 3.5*) | |
| **Comments** | |
| If new technology would come out of this, the authors should have explained that more clearly, now it seems that will not be the case. | |
| **Proposed Decision** | |
| Reject | |

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| **Name: *3DKIOSK*** | |
| The Epoch 3D multimedia kiosk | |
| **Requested budget** | 150 kEuro |
| **PM** | ? |
| **Duration** | 18 months |
| **Reviews** | |
| The first reviewer likes the proposal: 'a well integrated proposal bridging between cutting edge technologies'. The reviewer feels it is well in line with the call. The 3D Powerpoint authoring toolkit is highlighted as having an excellent prospect in terms of usability. On the other hand, the massive image acquisition system will limit the usability of that part of the project. The partners have a strong track record, but there is no direct involvement of a CH partner. Several tools seem to come out that can be expected to be of use for the CH community at large. (*average score = 4.5*)<br>The second reviewer confirms that the project can be expected tools that are very relevant to the CH field. The usability of the tools could have been guaranteed in a more convincing way. The partners have a strong track record. A weakness is the lack of portable acquisition tools, which are now left open-ended as something that will be considered. (*average score = 3.875*)<br>The third reviewer considers the scientific level to be high and that there is an encouraging series of CH applications to be hoped for. The budget is believed to be reasonable and the track record of the partners to be sufficient. The multidisciplinarity of the team is highlighted, as well as the wide applicability of the results. (*average score = 4.125*) | |
| **Comments** | |
| A lot is promised in this proposal, ranging from using a multi-camera setup for the joint | |

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| modeling of 3D geometry and reflectance characteristics, up to massive mesh cleaning and visualisation, a city rendering node, a 3D authoring toolkit, etc. All highly relevant. Yet, I also have some doubts about some of the parts. The acquisition work (1/3 of the labour costs) seems to partly reinvent the wheel: getting 3D from images and using it in an Image-Based Rendering framework has been done (e.g. by Leuven in the 5FP Inview project, where also Ename was a partner delivering some of the artefacts to be visualised). The idea of using haptics, in this case a placeholder object with markers, overlaps with the more refined showcase where a replica is produced of the object to be shown. No mention is made of any of these earlier contributions to which Epoch has access. Another issue is the large hardware investment that is being asked for: 60 kEuro. A lot for a Newton project (apart from the depreciation problems that it may raise)... This budget would be used to build 3 visualisation setups, one of which should produce 'floating 3D'. A project much too nice to kill, but I would put it on hold, i.e. ask the proposers to merge with the UBISCAN project, so that 3D from images is not duplicated, and a more complete and fully integrated pipeline comes out. I'm very tempted to cut the 60kEuro almost entirely. But a more effective approach would be to propose a joint 3DKIOSK + UBISCAN budget of 140 kEuro and let the partners decide for themselves how to spend it, come back with a reworked and merged proposal, and then we take the final decision later. Now we would just earmark that part of the budget. |
| **Proposed Decision** |
| put on hold, earmark 140 kEuro for this one + UBISCAN. |

| **Name: *AMA*** | |
|---|---|
| Archive mapper for archaeology | |
| **Requested budget** | 100 kEuro |
| **PM** | 25.5 (not all charged to the project) |
| **Duration** | 18 months |
| **Reviews** | |
| The first reviewer thinks this is an excellent proposal submitted by an excellent team. Very well in line with the call. The budget yields good value for money and additional resources are brought in. It is not clear whether the developed tools will be open domain and there is no clear path towards subsequent availability, although the level of documentation would make wide availability feasible. (*average score = 4.75*)<br>The second reviewer also got a very positive impression, calling this submission 'the strongest of the four submitted' to the reviewer's evaluation. The proposal is clearly written and the technical and CH aspects are well integrated and balanced. The envisaged toolkit will be user friendly. The multidisciplinarity is very strong. The landscape aspect is less well pronounced. The proposal looks feasible. Testing is an important facet of the proposal and will be based on actual datasets of excavations, artefacts, and museum collections. The CIDOCCRM compliance is noted. A side product of interest will be a survey of existing documentation systems. (*average score = 4.875*)<br>The third reviewer judges that the quality of the proposal is good and that it is well structured. Producing a support tool for mapping existing data content to a CIDOC-CRM compatible form is seen as fitting the needs of priority 2. The goals are considered ambitious. In terms of the budget, the reviewer believes that too much is going to travel. In terms of the usability testing, the reviewer suggests that the case studies be described better. The team is considered strong and its multi-disciplinarity is highlighted. (*average score = 3.875*)<br>The fourth reviewer finds the proposal lacks some clarity and that it is not clearly | |

| |
|---|
| demonstrated that the result will be state-of-the-art. The reviewer sees a good balance between the goal, the timetable, and the budget. The reviewer is also not impressed by the description of the testing and the feedback to the developing process is uncertain. The reviewer notes the multi-disciplinarity of the consortium and believes that they are competent, but would have liked to see this being better documented. Although it is stated that the toolkit will be made available to the partners, it is not clear at what additional cost. Yet, the reviewer believes in the sustainability of this effort and believes it will have an impact on standardisation, although the latter does not clearly transpire from the proposal. (*average score = 3.875*)<br>The fifth reviewer feels the proposal covers the priorities of the Research Agenda. The reviewer is not satisfied with the budget in that too much money is going to travel, and also the rest of it is not justified well. On the other hand the reviewer feels usability is very good ('some very strong points like the integration tool for new users') The reviewer thinks the consortium is very complete, but that it lack coordination. Even then, the reviewer feels the impact will be limited 'as there are more countries than three' and multiple languages may be used in each. The reviewer thinks that taking legislation into account is a positive element and that the project would make good contributions. (*average score = 3.125*) |
| **Comments** |
| All reviewers seem quite happy. The consortium includes several partners that have already been actively supporting the network, but also includes some additional ones, incl. from industry. |
| **Proposed Decision** |
| Accept with a budget of 85 kEuro (partners have low budgets already). Seek clarification whether tools would be open domain. |

| | |
|---|---|
| **Name: *UBISCAN*** | |
| Versatile and ubiquitous scanning | |
| **Requested budget** | 102 kEuro |
| **PM** | 20.5 |
| **Duration** | 18 months |
| **Reviews** | |
| The first reviewer sees the absence of an archaeological partner as a weakness and raises doubts whether working through a web interface is always appropriate. The reviewer questions whether the proposers have the necessary background in database and web issues, but recognises their expertise in computer vision and 3D reconstruction in particular and believes that 3D model generation can have a large impact if the generation is easy. The creation of a 3D model archive is highlighted as an additional contribution. (*average score = 3.75*)<br>The second reviewer considers the proposal of high scientific quality and based on a very promising collaboration. This reviewer states that this new tool 'should be very efficient for people involved with archaeological survey'. The reviewer concurs on the absence of an archaeological partner as a weakness. The reviewer considers the problem of special camera orientations as not too serious a problem in archaeological surveys, and would have liked to read more on the problem of independently moving objects and the possible use of ancillary information on camera orientation via GPS, DGPS, sonar, etc. This reviewer considers the web access to be very interesting in terms of sustainability and that 'this should be an efficient way to share knowledge in the network'. The reviewer would like to know whether the user | |

| |
|---|
| will be able to also use a part of the tools, e.g. geometric simplification for data coming from another source. (*average score = 4.625*) |
| **Comments** |
| As to the comment of having no archaeological partner, the Leuven Sagalassos Division of course also has archaeological expertise and the tools will be tested at Sagalassos for sure. The multidisciplinarity of this partner seems to have gone missed on the reviewers, i.e. should have been spelled out more clearly in the proposal. As a note on the use of parts of the software, it will be possible to use the 3D modeling and the 3D editing tools separately and it should be made clear to the proposers that this should remain the case. Interestingly enough, the second reviewer (an archaeologist) likes the idea of a web tool, whereas the first (a technologist) believes that this approach may be a problem for archaeologists. This project would go together well with 3DKIOSK, as both taken together would start to build a complete 3D pipeline, from data capture over data editing, to data visualisation. Such collaboration should also avoid recreating a 3D from images algorithm needed in 3DKIOSK. |
| **Proposed Decision** |
| on hold, propose to join with 3DKIOSK with a joint budget of 140 kEuro. |

| **Name: *IMODELASER*** | |
|---|---|
| Integration of image and laser scan data for 3D modelling | |
| **Requested budget** | 148 kEuro |
| **PM** | 30 |
| **Duration** | 24 months |
| **Reviews** | |
| The project proposes an airborne integration of image and laserscan data. A Byzantine basilica serves as a test case. The proposers already made first tests of the technique on other sites and want to integrate the results of these experiences in this project. The first reviewer sees the lack of partners that can judge the results as a weakness though and would have liked so see one or more CH partners getting involved with a test case they currently deal with. The reviewer feels the proposal fits very will in the priority list and that the complete scanning of highly structured objects is well worth investigating. The reviewer considers the proposing group to be very experienced and states that all subgoals are clearly specified and realistic. The reviewer feels that the impact on the archaeological community is unclear, since it is not stated which form the archaeological end users would like the tools to take. (*average score = 4*)<br>The second reviewer also regrets the absence of an archaeological partner and that a single lab goes it alone. But the reviewer feels that the proposal matches the priorities very well and that the team has sufficient and relevant expertise. The proposed technology is very interesting and offers a draft of what the next generation of survey tools should be like. The reviewer raises the issue that it is not clear whether the final product, i.e. the software, will be available to the Epoch partners. (*average score = 4*) | |
| **Comments** | |
| I may add that I know Gruen's group is working closely with archaeologists (he had an archaeologist working in his team for a long time, for instance). | |
| **Proposed Decision** | |
| accept, 50 kEuro | |

| **Name: *UPGRADE*** | |
|---|---|
| Underwater photogrammetry and archaeological data enhancement | |
| **Requested budget** | 185 kEuro |
| **PM** | 54 |
| **Duration** | 2 years |
| **Reviews** | |
| Only 1 (but solid) review so far, giving an average score of 4 (simply averaged over the 8 criteria). Compared to the typical review we got, this isn't so high a score. The reviewer likes the idea of integrating the different data capture modalities, but also raises the question whether it is possible within such a small-scale project. The reviewer also believes the roles of the different partners are not always equally clear (esp. of Cienca Viva), but praises the measures planned to ensure usability. The reviewer also raises the issue of how equipment-specific the developed tools will be, i.e. in how far other underwater sites can be expected to benefit. The proposal is judged to be weak at the level of contributions to datasets, standards, etc. The reviewer also suggests to let Armin Gruen (ETH) join the group, because of his photogrammetric expertise and the fact that we have another project from ETH on underwater stuff (UNDERWATER). | |
| **Comments** | |
| More than any other does this one come with an additional political component. In a way we (had to) let them down already once... if this project is not supported, it will put a major strain on relations. I don't think there is a clear benefit or need to include ETH: the ETH 'underwater' proposal was among the weakest of all, Gruen didn't really do so much for underwater conditions, the UPGRADE team have photogrammetrists on board already, they already seem to act as a team, and last but not least, the money would be spread even more thinly among the partners... | |
| **Proposed Decision** | |
| Accept the proposal with a reduced budget of 120 kEuro. Ask them to clarify the role of Cienca Viva and how other underwater sites could benefit, also if not using the same equipment. We have to explain that we cannot spend too much on underwater archaeology, as it is a niche within archaeology, which itself is only part of our focus. The poll showed that this field, although judged relevant, was not getting top scores. Don't ask to integrate yet another team from ETH... | |

**Summary of the proposed decisions**

Here the overview of the proposed decisions:

1. POPULATE: on hold, merger with VIRTUMAN, 100 kEuro
2. TATOO: reject
3. CULTOURIST: reject
4. WEBTOARCH: reject
5. WBTLK+: on hold, 120 kEuro
6. CIMAD: accept, 90 kEuro
7. VIRTUMAN: on hold, merger with POPULATE, 100 kEuro
8. CRMAP: reject
9. TOOLS&GROOVES: reject
10. UNDERWATER: reject
11. 3DSOUND: reject
12. 3DKIOSK: on hold, merger with UBISCAN, 140 kEuro
13. AMA: accept, 85 kEuro
14. UBISCAN: on hold, merger with 3DKIOSK, 140 kEuro
15. MODELASER: accept, 50 kEuro
16. UPGRADE: accept 120 kEuro

# Accepted projects

Based on the review (summarized in the WP3's coordinator report to the EXC in section 6 and detailed in Appendix II) a selection of proposed Newton projects was made by the EXC and communicated to the proposers on 1 April 2005. The budgets of all projects were reduced however. Also, some projects were merged in order to avoid overlap and to increase integration. Currently, the Executive Board should have been in negotiation with the partners about the fine detail of each Newton, in the light of the cuts and mergers. Given the outcome of the 1st EPOCH review, these talks are currently on hold, however. Here all – preliminary - accepted projects (some mergers of two original proposals) are listed.

**3DKIOSK:**
*Consortium:* partners 4, 19, 21, and 33
*Total budget:* 140 kEuro
*Duration:* 18 months
The project covers the entire chain of steps in 3D processing, from different techniques to capture 3D data, over ways to clean up these data and integrate the results into models, up to ways of visualising the models. The project offers novel solutions at each of these levels. At the level of 3D data acquisition, it ventures into the use of special setups to not only capture 3D geometry, but also surface reflectance characteristics, as well as into solutions that may yield less precise models, but that require minimal hardware and infrastructure and give users access to 3D data generated automatically on the basis of images that they have uploaded. The latter will be built on top of a service developed under Activity 3/3 (Common Infrastructure), where this Newton adds an additional layer of user support. The project will also offer an entire pipeline to edit the 3D data that have been acquired, including registration, cleaning, decimation, and remeshing tools (e.g. integrated with the web service). Finally, novel visualisation techniques will be experimented with, e.g. to create 3D stimuli that seem to float in mid air.

**AMA:**
*Consortium:* partners 2, 10, 39, 52, 53, 61, 67, 74, 76, and 98.
*Total budget:* 115 kEuro
*Duration:* 18 months
The AMA project will provide a flexible Open Source tool support for mapping existing datasets, as archaeological excavation data, museum collections (based on diverse data structures as well as non-structured data, i.e. text descriptions) to a CDOC-CRM compatible form, suitable for data interchange and to aid interoperability between existing and future

repositories. It will additionally generate from such mapping the necessary information to convert individual datasets to the common, CIDOC-CRM compliant structure. This will allow the use of interoperable tools e.g. for search. AMA will provide an initial set of mappings from a number of currently used national or official standards that should cover a substantial amount of system currently in use, allowing also for small variations and providing a guideline for further mapping implementations. It will start from a survey of ongoing projects on documentation standards and will build on previous work as the one done in UK and Italy. Others contributions from national standards or widely used de-facto standards come from Norway, the Netherlands, Romania, Italy/France, and Israel. Collaboration is envisaged with the CIDOC-CRM SIG and teams working in similar issues outside Europe, as the XSTAR community of users in USA.

**CIMAD:** Consortium: partners 29, 30, 32, 52, and 68.
*Total budget:* 90 kEuro
*Duration:* 15 months
The goal of the project is the exploratory implementation of a framework for smart CH environments supporting distributed and mobile on-site applications, from data capture to public dissemination. Applications will be configurable, according to a variety of policies and specifications. Within CIMAD a Smart Environment is any confined area of cultural interest where there are means enabling IT devices to detect the occupants context, so that contextual information can be used to support and enhance their abilities in executing application specific actions. These means may be sensor systems embedded in the environment itself, sensors integrated in the platform, or both. The smart environment generated by the project will include networked context-aware mobile devices, repositories, context-servers and stationary clients. Existing context-aware mobile devices operating at the data capture end, such as PDAs able to collect contextualized field notes, will be made inter-operable with recording systems and repositories created by other EPOCH sources, and the recommendations of the standards group. These repositories will provide contextualised and conformable digital data to an authoring module specifically devised to develop context-related content tailored to the mobile clients operating at the dissemination end within the smart environment. The mobile clients will access the repositories according to a context-aware navigation and interaction policy implemented by the proposed framework and specified by the curator or by the target institution authority.

**IMODELASER:**
*Consortium:* partner 48
*Total budget:* 50 kEuro
*Duration:* 18 months
In recent years a number of data acquisition tools have been developed which are of great relevance to the acquisition documentation and analysis of CH objects. Video and still image cameras, digital panoramic cameras, laser scanners, structured light systems, GPS/INS, and other positional and attitude sensors all have become available in portable forms. Traditionally single sensor approaches have been chosen. The resulting quality often is insufficient for CH applications. Either one take resort to semi-automatic methods or one integrated different types of tools. The project follows the second route, and proposes to integrate laser scanners and imaging devices, both at the sensor and data integration levels. Laser scanners generate very dense 3D point clouds very quickly. However, due to the regular

sampling laser scanning provides insufficient information about edges, which are crucial to many CH applications. Digital images, on the other hand, provide excellent information on edges. This approach will be elaborated further, using techniques like least squares matching and view-point dependent texture mapping.

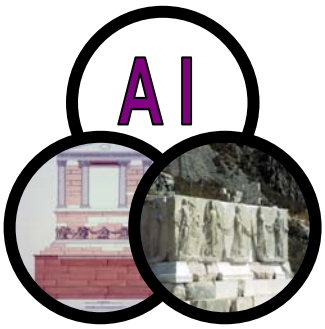
**UPGRADE:**
*Consortium:* partners 7, 16, 31, 65, 81, 85, and 86
*Total budget:* 120 kEuro
*Duration:* 24 months
The project objective is the development of a software suite, together with a set of best practice recommendations, for the integration and fusion of acoustical, optical and platform navigation data in the exploration and mapping of underwater archaeological sites. In particular, the software tools will aim to make the data fusion process largely automatic, in order to facilitate the construction of integrated, geo-referenced, large-to-medium 3D scale maps of underwater archaeological areas from optical and acoustic data. Both Autonomous Underwater Vehicles (AUVs) and Remotely Operated Vehicles (ROVs) will be used as platforms to collect data. In particular, AUVs are used for performing preliminary, large scale acoustic surveys and exploration, while ROVs are used for collecting close distance data of a photogrammetric nature. By controlling at the same time the vehicle motion and the data acquisition process, one can correlate data coming from different sensors, The results (2D and 3D) will be produced using different software and formalisms in order to reach several goals: sharing data and information on-line through the internet, or allow for an in-depth, off-line investigation.

**VIRTUMAN:**
*Consortium:* partners 1, 49, 50, and 56
*Total budget:* 100 kEuro
*Duration:* 18 months
The project will create a Scene Population Toolkit to place intelligent, multilingual avatars into virtual scenes, which have been created using the partners' avatar creation software and which are powered by speech synthesis. The toolkit will feature intelligent navigation, within a scene as defined by the scene description. Distribution of the crowds throughout the scene will be initialised automatically using a `placement tool', with the possibility of interactive modifications. Crowds will thereafter behave intelligently, with the corresponding runtime engine avoiding collisions, supporting interactions with the user, steering gestures, and following crowd dynamics simulation. Appropriate LOD descriptions and level blending schemes will be developed in order to let the avatars maximally engage the user. Multi-lingual speech technology will be integrated. File formats are expected to be standardised at all stages of the avatar creation pipeline.

In addition, partners POLIMI and UNISI have been invited to draft a report on the potential of gaming technologies and shared, web-based environments. The Executive Committee plans to invite additional authors, who are well acquainted with the fast developments in the gaming area, to contribute to this report, which is seen as essential preparity work to inform both the common infrastructure and the potential 2nd call for Newton proposals.

## Priority areas for the research agenda

- ❑ semi-automatic mapping to CIDOC (AMA)
- ❑ two-way communication (not covered yet)
- ❑ mobile applications from data capture to public dissemination (CIMAD)
- ❑ versatile 3D acquisition (3DKIOSK,UPGRADE)
- ❑ underwater data collection and photogrammetry (UPGRADE)
- ❑ recording of archaeological excavations (CIMAD)
- ❑ authoring tools for 3D experiences (3DKIOSK)
- ❑ web tool for joint experiences (not covered yet)
- ❑ populating 3D environments (VIRTUMAN)




# Appendix I: Submitted proposals

## *1. POPULATE*

1) TITLE:
**Tool creation for populating environments with interactive avatars and crowds for cultural heritage applications**

**Abstract:**
An easy to use toolkit to create avatars in response to the model metadata that will add realism and interest for the user. Avatars will provide interactive guides that communicate with the visitor in their own language and according to their age and experience. Crowd scenes will also be created economically and their presence will enhance the realism of the scene.

2) PARTNERSHIP
**University of East Anglia (partner 56):**
Researchers: A.M.Day **amd@cmp.uea.ac.uk**,
J.RW.Glauert, R.Elliott
School of Computing Sciences,
UEA, Norwich, UK, NR47TJ, FAX 01603 593345,

**University of Brighton (partner 1):**
Researchers: Prof David Arnold (D.Arnold@brighton.ac.uk); Dr Lyn Pemberton; Karina Rodriguez-Echavarria; Tudor Jenkins; Craig Moore
Faculty of Management and Information Sciences, Watts Building, Lewes Rd.,
Moulescoomb, Brighton BN2 4GJ, UK

3) PRIORITY

**7 Virtual humans/Avatars** – populating 3D environments

4) TECHNICAL PROPOSAL

We propose to create a Scene Population Toolkit to place intelligent multilingual avatars created using our Avatar Creation software and powered by speech synthesis, using intelligent navigation, within a scene as defined by the scene description.

**Prerequisites (i.e. work expected to be undertaken elsewhere as a pre-requisite to the integration of this Newton)**

Pre-requisites for Avatar Creation Software:
Our existing avatar creation software will be utilised to provide avatars for the population toolkit and scene runtime.
Data for the avatar creation is expected to be sourced from existing packages (3DSMax, Maya, and UEA ARP toolkit).
File formats are expected to be standardised at all stages of the avatar creation pipeline in work undertaken in 3.3 (see section RELATED ACTIVITIES below)
Avatar standard format to be defined, under infrastructure priority for technology area 7 (taking into account work on standards in 4.2 and elsewhere (e.g. in MPEG).

Pre-requisites for Scene Description and mark up:
It is assumed that a scene description standard suitable to support the deployment of intelligent avatars in virtual environments for CH applications will be established. This scene description would consist of object descriptions which contain meta data:

- type of object (building, river, museum artefact, ...)
- geometric values (location, dimensions, orientation)
- supplementary data specific to this object (text, images, video, url)

Other data will define navigable areas for user, guide avatar and crowds within and outside this object (streets, rivers, bridges, paths, crossings, etc.).
This will be interrogated in real time to provide both responses to users' enquiries and assist in the navigation of the autonomous avatars (see 3.3 future work in RELATED ACTIVITIES below).This is necessary to support user driven navigation and interactive use in real time.

**Development Work**
Population Toolkit
Our toolkit will be constructed to facilitate rapid population of a scene with avatars, sourced from standard files as exported from the Avatar Creation Toolkit (exact file standards to be determined/defined in Activities 3.3, 4.2).
An initial distribution of virtual humans will be generated automatically from the scene description and default control parameters. This will then be edited using user friendly tools (for example, drag-n-drop within areas constrained by definitions of navigable areas). In order to provide a realistic environment, the suggested initial placement will be dependent on the content of the scene as defined by the Scene Description. E.g.: avatars will be placed in front of the main entrance to a building of interest so as to be suitably located for the role of Guide. The main populace of a scene will be positioned so as to be in likely locations, and to be in densities such as may be expected in a real setting. We will implement simple options for simulating intelligent crowd behaviour based on the given scene description and approximated crowd dynamics. For a truly interactive environment, all people in the scene must be constructed such that they can engage the user. For this to happen:
Dynamically-created billboards will be used for rendering crowd avatars at the lowest LOD of 'normal' 3D avatars.

The system will then use blending designed to move seamlessly between these characters and into full 3D when necessary, as the user approaches and engages with specific characters or groups in the scene.

Dynamic Intelligent Avatars and Speech Synthesis
In addition to the pre-processing stage of populating a scene, we will provide functionality to control all avatar behaviour.
This will require interfacing to:

- the scene description for supplementary data – in particular this will provide the text as spoken by the avatars. If a natural language generation module is developed or provided elsewhere in EPOCH we will define a suitable interface. Otherwise textual descriptions preloaded in the supplementary data will be used
- the user navigation module of the parent application. This will be used with crowd motion simulation algorithms to prevent the avatars interfering with the user and to enable avatars to engage the user / approaching ,greeting and looking at them.
- speech synthesis software, where it is expected that modules developed outside EPOCH will be used for the range of languages included.
- the parent application, providing a high-level API suitable for any rendering engine for the creation, positioning, updating, interaction, etc. of the avatars.
- Marked up (or "coloured") text will be used to control gesture animations

The development team will collaborate with those developing and choosing the EPOCH rendering engine included in the standardised infrastructure.

**Partner roles**
**UEA** will be responsible for avatar creation and rendering, speech and interaction.
**UoB** will be responsible for tool usability testing and evaluation.
Any included demonstrations would be jointly developed.

**Milestones**

**4 months:**
Define framework and interfaces

- standards relating to avatar construction/creation/description/functionality
- scene description
- avatar import/export/file formats

**6 months:**
Speech synthesis work deadline

**8 months:**
Avatar animation and rendering

- extend existing work:
  - crowds and crowd motion/dynamics simulation methods chosen
  - LOD
  - billboard-3d blending (possible)
  - separate upper/lower body animations

**12months:**

- Placement tool:
  - research into placement methods
  - create tool

- Runtime engine:
  - Avatar navigation (collision detection/prevention)
  - Interaction with user (methods of interacting with the scene/guide/world)
  - Crowd motion/dynamics simulation implemented
  - Implementation of gesture animation from annotated pre-scripted texts

**14 months:**
Placement toolkit deadline.

**16 months:**
Runtime engine deadline (final version sent to UoB for testing)

**18months:**

- Content creation
- Final toolkit & documentation
- Usability testing and evaluation

**Deliverables**

Model for scene description
Definition format for guide avatar behaviour
Scene Population Toolkit
Runtime avatar control & interaction engine
Documentation

**Showcase**

This tool kit will be suitable for producing a showcase and if EPOCH decides this is part of dissemination an additional 12KEuro budget will be sought. This would comprise a scripted example of using the tools to create a populated interactive virtual environment (based on models produced elsewhere in EPOCH) and a run-time system produced using the tools, for visitor exploration/evaluation.

5) RELATED ACTIVITIES

**a) Achievements in 3.3**

- Avatar and urban modelling technology surveys
- contribution to surveys elsewhere (website)
- experimentation with industry standard software
- investigation of feasibility of conversion of UEA's CHARISMATIC urban modelling and rendering software to OpenSG
- investigation of feasibility of conversion of UEA's Avatar rendering platform to OpenSG
- Avatar meshes, textures, morphs, animations all created from scratch
- Investigation of existing ARP format to support OpenSG:
  - animation from synthetic and motion captured animation

    - facial gestures and mouth movements using morph targets or video tracking data
    - multi-level resolution meshes
- investigation of CHARISMATIC urban modelling and rendering software to OpenSG: pipeline conversion from existing Scene Assembler/Shell Modeller program through to OpenSG rendering applcation.
- Occluder technology researched to automatically calculate occluder lines from buildings.
- Terrain algorithm ROAM investigated
- Impostor technology considered for OpenSG.
- Other content / minor algorithms researched.
- Speech technology
    - Synthesizers investigated
        - Survey of synthesizers that could used in the toolkit. Considerations included, quality of speech, text parsing capabilities languages supported (currently and in future versions), and ease of integration.
    - Synthetic lip motion investigated
        - Reviewed existing lip synthesis techniques and their applicability to our own problem.
        - Developed a novel method for generating synthetic lip motion that maximised the information available from TTS systems.
        - Produce examples in both English and French.

**b) Future activities in 3.3**

File formats will be standardised at all stages of the avatar creation and deployment pipeline in work

It is expected that the work on standards will not be restricted to any particular framework. CH metadata will be preserved while converting between formats in order to use commercial and open source tools for processing of avatars.

For example:

**Avatar creation**

- Import of models and animation data from other sources
- Reuse of animation data within a range of avatars
- Construction of the avatar mesh with high level controls for character variation – generic root model to derive all meshes

**Rendering and animation**

- Evaluation of existing open source collision engines and systems for collision avoidance through route planning/control for incorporation into OpenSG
- Implementation of efficient algorithms for collision detection/avoidance and intelligent and realistic behaviour simulation of avatars/crowds
- Research into continuous LOD for deformable bodies
- Decreasing the distinction between crowd/billboard and single/3D avatar
- XML-based scripting language for real time synthetic animation
- Gesture annotation and animation

**Interaction**

- Complete but constrained user control of walkthrough
  E,g. mouse controlled, click on map control
- Speech synthesis and lip animation for additional languages and improved realism:
  - Add the ability to generate reasonable lip animation for other official European languages.
  - Evaluate and analyze the synthetically generated articulator motions and thus the lip motions.
  - Find and utilize a database containing information about lip spreading and lip rounding.

**c) Achievements in 2.4 (showcase 4)**

A prototype multi-lingual avatar guide for an urban model has been implemented using OpenSG , NLG and a synthetic speech from text engine. This was presented in preliminary form at VAST 2004. The scene can populated with simple crowds and the avatar guide has basic gesture and lip synchronisation.

**d) Potential future activities in 2.4 (showcase 4)**

- Find and convert non-real time open source renderer for OpenSG (an offline radiosity renderer)
- Improve realism of existing rendering (lighting, texturing, shadows (removal of, addition of), ...)
- put showcase software on Linux
- Implement multi-channel rendering

6) NEWTON SHOWCASING

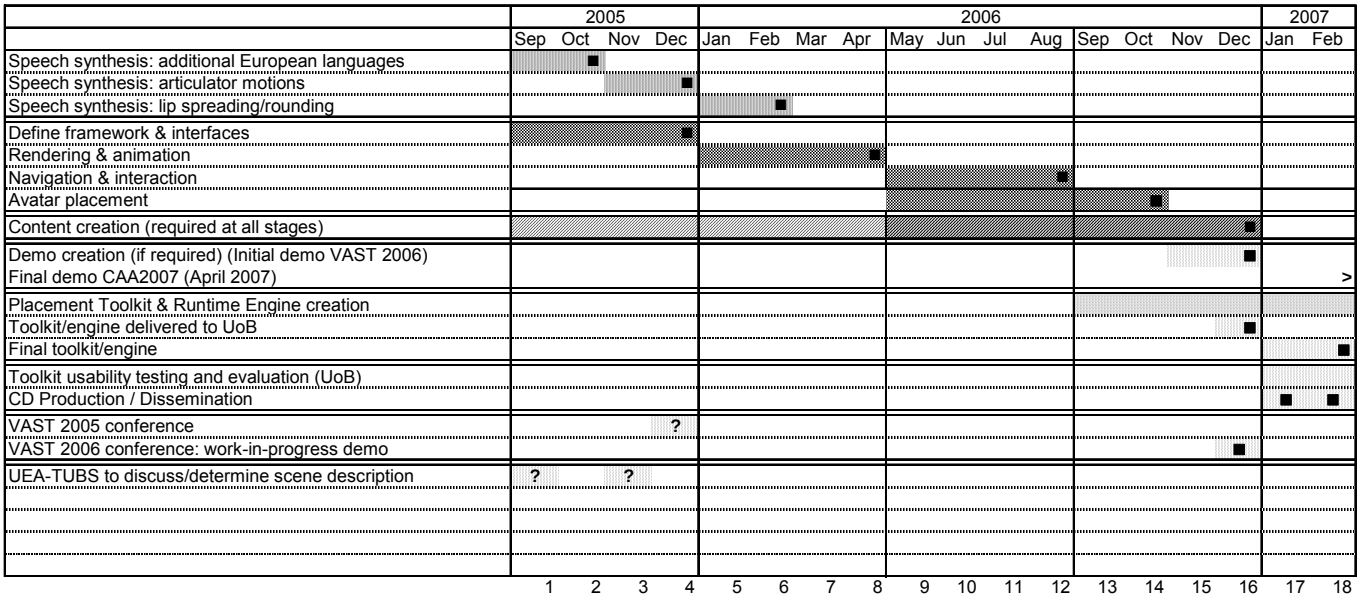
**1) What we propose to show**

- A scripted CD/DVD showing the use of the toolkit in creating an environment
- Improved and new Avatar toolkit used in example scene

**2) How we will show it**

- Hands on demonstrations at conferences exhibitions, workshops
- CD/DVD (non-interactive (movie) )

7) TIMETABLE




8) PROJECT IN NUMBERS

**Overall**

1) Duration: 18 months
2) Requested budget 134.4K Euros

**Per partner**

**UEA**

1) number of person months 20
2) labour cost 80K
3) other costs 20K
4) overhead 20K
5) total for partner 120K Euros

**University of Brighton**

1) number of person months 2
2) labour cost 9K
3) other costs 3K
4) overhead 2.4K
5) total for partner 14.4KEuros

**Potential showcase costs of 12KEuros would be split between UEA and UoB (if required)**

*2.TATOO*

# 1. Telearchaeologyst Toolkit 1.00 (TAToo)

## 2. Partnership:

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## 3. Priority:

Technology areas 2, 3 and 4 – Database / knowledge management throughout mobile applications for data capture in a process of recording of archaeological excavation.

## 4. Technical proposal:

The *Telearchaeologist Toolkit* is one segment of a more complex system for collective archaeological knowledge building, whose theoretical background was established by the authors of this proposal in *D.I.A.S.P.O.R.A.* (*Distributed Interactive Archaeology for Synchronized Platforms Of Research Activities*) and *Telearchaeology* projects respectively.

**Theoretical background**

Knowledge exists only if it is used, and grows only if we interact with it, using existent knowledge to generate and incorporate new knowledge. We strongly believe that archaeological knowledge building is a collective task and that WWW is a suitable vehicle for integration of archaeological reasoning and data processing into a single system.
Formal knowledge, quantitative or qualitative, expressed in form of concrete data structures and inference rules gives us the opportunity to add knowledge from different sources, and to integrate different voices and thinking into a single coherent, but diverse body of information, which can be used in an interactive way, without imposing a single way of thinking.
Archaeological data is the preliminary source of knowledge. They are produced by archaeologist's action at two different places: the archaeological site, and the laboratory. To transform data into knowledge, we should integrate these preliminary bits of information into a coherent body of problems and solution. And the only way of doing that is by using data to ask questions and to look for their answers.

**Goals**

As a first stage of the construction of the whole system for collective knowledge building, we propose us to create a new tool for field data adquisition, which will provide not only the basic data register in a form of computer data base, but also full integration of acquired data sets within one research project. Thus, the *Telearchaeologist Toolkit* 1.0 (*TAToo*) have a 4 main and evident purposes:

- excavation documentation,
- data integration,
- standardization and
- teleoperability of data.

The first input of data is thought archaeological documentation databases. During the process of excavation we always try to shorten the time which pass from data acquisition to its integration in related site documentation. Results of this integration may influence on further decisions made in order to adjust dynamics of excavation. Introduction of numeric data proceeding from Total Station, georeferenced images from 3D scanners or photographic cameras, make obsolete classical graphical documentation, saving that way a lot of time for other research activities, and increase precision of data collection and guarantee safety storage of data and archaeological materials. All excavation and laboratory activities are registered to main database through mobile and fix computer units. The system include a bar-code labelling system which enable following of excavated object through all phases from enearthing to definitive storrage.
Archaeological excavation is qualitatively advanced by application of *Telearchaeology* method. It is no more a blind unearthing of hidden objects, but an understandable production of new data using a coherent framework made of previous knowledge. You can understand the activity areas, occupation floors, walls, etc. you are excavating, because you can recognise them as such when integrating all data at the same moment you obtain them. It is not a question of waiting for the end of the excavation phase to understand what you have been making.
One of the most important goals of *TAToo* system is to synchronize data input and integration with generation of knowledge, and enable permanent advance, based on simultaneous availabillity of all of actual knowledge. Using *TAToo* we shuold be able to register, follow

and manage archaeological excavation, and have as a inmediat result one consistent documentation at the moment of closing of excavation site. This documentation, preserved in digital format, could be ploted for different research or administrative purpouses.
The data collection proceeds using pre-established standards for data-input and data integration in a consistent archaeological documentation. This allows more efficiency in data management on a scale of particular field work, or on a wider scale of a research project(s). These standards, applied in DataWerehouse (DWh) also enable communication between different data-sets and facilitate its teleoperability. Integration of data corpus obtaind by archaeological excavation in Telearchaeology DWh enlarge research fundus and knowledge base.
Integrated data make possible application of distributed work and knowledge sharing, same on local as on global scale. It open the door for application of *telearchaeology* principal that we don`t need to be phisically present in the same room or in the same field to be able to work on the same research object in *real time*. The distance appears to be the main problem when we are speaking about synchronized activities on the same object, or, in another words, when we use a specific knowledge (use in sense of: obtain, generate, store, apply). The *Telearchaeologist Toolkit* is a tool for long distance collaboration and interaction, and should make possible that feedback from laboratory (field) for data introduced in a field (laboratory) can be synchronized.
A flexible standard of input and output of data , in most of cases make unnecessary migration of existing data, and save a research time of repeating previously finished job. Nevertheless, on a way between input and output of data, there is a Resource Description Frame, witch stands for optimal standardisation of data input in DWh.
Interoperability of data systems is the basic condition for building of distributed knowledge sources networks. DWh is the vehicle of data integration which store data provenient from direct input, and rules which are results of analytic processes and interaction. Using data and previous knowledge, we generate new knowledge units which integrates in the network. The *TAToo* is one of the tools which apport solutions for integration of field and laboratory data, and solutions for its processing in other specialised software.

**Functioning**
*TAToo* is proposed as a open & flexible structure, in order to enable usage of data stored in DWh, in other Analytic and Data Storage Software (ADSS) and establish exchange between DWh an ADSS. There are 3 basic methods of *TAToo* operation:

- *TaToo* can be operated off-line, on a individual computer during data collection on remote field without IC. In this case, *TAToo* update and upload DB once connected to Internet.
- *TAToo* can be operated on-line introducing data from field documentation in laboratory (p.e. old field paper-documentation, or data collected manually on a field), or using analytic forms and methods.
- *TAToo* can be operated of-line, in LAN environment, enabling distributed data collection from different sources - Total Station, 3D scanners, photo cameras and Palm Top computers – streaming directly in a DB on a central computer. Once connected to Internet, central computer updates with DWh. Frequency of data upload from field will determine dynamics of data feedback, produced in a laboratory.

The *TATOO* system is composed of Data Wherehouse and distributed collecting units. The system communicates between fields and laboratories, making accessible all other data sets which participates in collective knowledge building in DWh.
Most of previous experimenting and methods pre-seting is allready done by the partners in this project. Some basic structures of field databases, adapted for use in GIS aplications (as for exemple Manifold), are allready configured by Oriol Vicente and Raquel Piqué. These structures were tested in the form of individual imput masks on archaeological excavation of Ewan I site, Tierra del Fuego, Argentina. On the bases of experience obtained by test aplication, O.Vicente and R.Piqué will prepare database set for integration in *TATOO*. Creation of DWh, which will be the center for integration and standardization of distributed data, will be responsabillity of I.Bogdanovic and J.A.Barceló. The general, and in some of particular aspects of DWh concept areallready layed-out. I.Bogdanovic will "translate" these concepts in database driven interactive internet and stand-alone application. Each partner will be responsable for creation of program documentation in his/her domain of develloping work. All partners will participate in the creation of input masks for analythic documentation of archaeological matherials included in the firs relese of *TATOO*.

# 5. Related activities:

**Juan Antonio Barceló**

He is working in the field of computer-assisted archaeology, principally in ambits of statistics, artificial intelligence and virtual reality. Here we will mention only some of the research projects, which he was leading as a principal investigator for the last 7 years:

- *Application of Artificial Inteligence tecniques to optimization of determination of archaeological lithic instruments.* Financed by Consejo Superior de Investigaciones Científicas - CSIC; Dirección General de Investigación Científica y Técnica (DGICYT). 1998-2001
- *Use of computer assisted visualization tecniques. Topography and Fotogrametry*. Financed by Departament d'Universitats, Recerca i Societat de la Informació; Generalitat de Catalunya, 2001-2002
- *Use of computational and Virtual Reality technologies for archaeological excavations*. Financed by Departament d'Universitats, Recerca i Societat de la Informació; Generalitat de Catalunya, 2001- 2002
- *European Research Network on Integrating Technologies for Intelligent Recording, Reconstruction and Communication of Cultural Heritage* (EPOCH), financed by European Comisión. 6th. Framework on Research, Technological Development and Demonstration. 2003 - 2006

J.A.Barceló has published results of his research on this topic in some books and articles:

- Automatic Problem Solving in Archaeology, *Archeologia e Calcolatori* 4: 61-80, 1993
- Computer-based techniques for the representation of automatic problem-solving in archeology, *Computing the Past.* Comp. T. Madsen et al. , Aarhus University Press, 1993
- Using Intelligent Data-Bases in Archaeology, *Aplicac*iones Informáticas en Arqueología. Teorías y Sistemas. vol. I, 1993

- Middle-Range Theories and Artificial Intelligence, *Data management and Mathematics in Archaeology.* Edited by A. Voorrips and R.R. Laxton. Nitra: AcadSlovakian Academy of Sciences, 1994.
- *Arqueología Automática. El uso de la Inteligencia Artificial en Arqueología*, Editorial Ausa. Barcelona, 1996
- Beyond GIS. The Archaeological study of social spaces, (with: M. Pallares), *Archeologia e Calcolatori* No. 9, 1998
- Juan A. Barcelo, I.Briz, A.Vila (eds.) *New Techniques for Old Times. Computer Applications in Archaeology*. Oxford: ArcheoPress (British Archaeological Reports S757), 1999
- Juan A. Barcelo, M.Forte, D.Sanders (eds.), *Virtual Reality in Archeology,* ArcheoPress (British Archaeological Reports) , 2000
- J.A.BARCELO
- Image Quantification as Archaeological Description, (with: J. Pijoan, O. Vicente), *Computing Archaeology for Understanding the Past.* Edited by Z. Stancic and T. Veljanovski, ArcheoPress (British Archaeological Reports, s934), PP. 69-78. 2001
- Virtual Reality and Scientific Visualization. Working with Models and Hypothesis, *International Journal of Modern Physics C, Vol. 12, No. 4 (2001)* 569-580. 2001.
- Virtual Reality for archaeological explanation. Beyond "picturesque" reconstruction, *Archeologia e Calcolatori No. 12,* pp. 221-244 2001
- Archaeological Spatial Modelling. A case Study from Beagle Channel (Argentina), (with: E.L. PIANA, D. MARTINIONI), *Archaeological Informatics: Pushing the Envelope.* Edited by G. Burenhult. Oxford, ArcheoPress (BAR Int. Series 1016), pp. 351-360. 2002.
- Virtual Archaeology and Artificial Intelligence, In *Virtual Archaeology*. Edited by Franco Nicolucci. Oxford: ArchaeoPress. BAR International Series S1075., pp. 21-28. 2002.
- Towards a 3D representation of Archaeological Layers, (with: de Castro,O., Travet,D, Vicente, O.) *Archeologie und Computer* vol. 6. Wien, Phoibos Verlag. 2002
- A 3D Model of an Archaeological Excavation, (with: De Castro,O., Travet,D., Vicente,O) In: *The Digital Heritage of Archaeology. Computer Applications and Quantitative methods in Archaeology.* Edited by M. Doerr & A. Sarris. Hellenic Ministry of Culture. Archive of Monuments and Publications. 2003.

In the NEWTON project J.A. Barceló will apply on general concepts of *The Telearchaeology Toolkit* his experience and results achieved untill now. This will be engaged mainly in the concepts for Data Wherehouse configuration and data feedback methods.
After the conclusion of the *TAToo* project, he will keep-on devellopping tools for Telearchaeology, and applying these tools in his archaeological research.

**Igor Bogdanovic**

From 1992 he is working on computarization of archaeological documentation and research process. Methods and principals of archaeological classifiations elaborated in his first M.A thesis: *Principals and model of archaeological clasification*, defended on the Department for Prehistory, Belgrade University (1996), were a logical starting point for further research on collective knowledge building, aided by web comunication.
Some results of this research are presented in his second M.A. thesis: *Internet, distributed knowledge, and archaeological problem solution*, defended at the Prehistory department, UAB, 2002. Beside the last cited work, published on Telearchaeology.org WEB site, I. Bogdanovic has published several papers and congress communications:

- Archaeological Web Symposia (with: Nenad Tasic), International symposium: *Computer Applications in Archaeology*, Barcelona 1998
- The theory of Archaeological Knowledge Building by Using Internet, The DIASPORA project (with Juan Anton Barceló i Oriol Vicent), International symposium: *Computer Applications in Archaeology*, Dublin, Irlanda. 1999
- Telearchaeology, *Gli Calcolatori*, (with: J.A. Barceló y R. Pique - 2004)

He is experienced in DB and WEB programming, especially with a ASP.NET technology, which is to be applyed in *Telearchaeologist Toolkit* creation.
A part of theoretical background application, I.Bogdanovic will be encharged for several aspects of work on *TAToo*:

- programming of systems for data integration, distribution and interaction.
- configuration and programming of Data Wherehouse
- developing together with Raquel Piqué interactive data base in archaeobotany, and on-line colaboration pack which will be tested and adjusted through its aplication during the work on the data from Ewn site together with our partners in Argentina.
- Igor Bogdanovic is working on his PhD thesis: *Telearchaeology*.

After the conclusion of the *TAToo* project, he will keep-on develloping tools for Telearchaeology, mainly in aspects of communication and generation of knowledge, and applying these tools in his archaeological research.

**Oriol Vicente**
During the last six years he has been working on research, develloping and application of new technologies in arqueological data adquisition and representation on several archaeological sites in Europe, America and the Near East. He is a partner in the Quantitative Archaeology lab of the Universitat Autónoma de Barcelona and has publish results of his research in several articles related on this topic:

- The theory of Archaeological Knowledge Building by Using Internet, The DIASPORA project (with Juan Anton Barceló i Igor Bogdanovic), International symposium: *Computer Applications in Archaeology*, Dublin, Irlanda. 1999
- Towards a 3D representation of Archaeological Layers, (with: de Castro,O., Travet,D, Vicente, O.) *Archeologie und Computer* vol. 6. Wien, Phoibos Verlag. 2002
- A 3D Model of an Archaeological Excavation, (with: De Castro,O., Travet,D., Vicente,O) In: *The Digital Heritage of Archaeology. Computer Applications and*

*Quantitative methods in Archaeology.* Edited by M. Doerr & A. Sarris. Hellenic Ministry of Culture. Archive of Monuments and Publications. 2003.

O.Vicente has elaborated a system of graphical capture of data, by application of photogrametry within an archaeological excavation and its integration in GIS applications. This system has been applied on differents archaeological sites, as: *Can Roqueta*, Sabadell-Spain, *Ewan I*- Argentina, *Tell Halula* –Siria.

Actually Oriol Vicente elaborates his PhD thesis: *Application of new technologies on recording and representation of archeological sites.*

The contribution on the NEWTON project is related to:

- concepts of field data acquisition and management.
- concepts of georeferencing
- concepts of photogrametry

After the conclusion of the *TAToo* project, he will keep-on develloping tools for Telearchaeology, mainly in aspects of recording and representation of archaeological sites, and applying these tools in archaeological excavations.

**Raquel Piqué**

She is working in archaeobotany and hunter-gatherer archaeology. She has managed several field work seasons in Catalonia and Tierra del Fuego, as well she has participate at more than 20 field work season in America, Europe and near East. She applied in Ewan site (Tierra del Fuego, Argentina) the system developed by Oriol Vicente, and explained before.

In the archaeobotany field she is specializad in charcoal and wood analysis. She applied the image analysis sistems to charcoal and wood identification, in order to quantify and measure automatically the anatomical features. This work was achieved in the frame of the project "Computer assisted visualization and automatic classification of archaeological material" financed by Ministerio de Educación y Ciencia (Spain). She also has been working in quantitative analisys of archaeobotanical data. The results of this work has been published in several papers:

- PIQUÉ, R.; PIQUÉ, J.M. 1992 " Application du traitement d'images digitalisées a l'Anthracologie" *Bulletin de la Société Botanique de France*, 139: 237-244
- PIQUÉ, R.; PIQUÉ, J.M. 1993 "Automatic recognition and classification of archaeological charcoals", a: ANDRESEN, J.; MADSEN T.; SCOLLAR, I. (eds), *Computer Applications and Quantitative Methods in Archaeology*. Aarhus: Aarhus Univ. Press. Pp: 85-90
- PIQUÉ, R. 1999 "Quantification in archaeobotany: charcoal analysis and fire-wood management" , a: BARCELO, J.A.B., BRIZ, I., VILA, A. (eds) New Techniques for old times. Computer applications and quantitative methods in archaeological research. Oxford: British Archaeological Reports. Pp: 189-200
- PIJOAN-LOPEZ, J.;, BARCELÓ, J.A.; BRIZ, I.; VILA, A.; PIQUÉ, R. 1999 "Image Quantification in Use.wear Analysis". A: FENNEMA, J.; KAMERMANS, H. (ed) Making the Connection to the Past. Leiden: Leiden University Press. Pp: 67-75
- PIQUÉ, R.; BARCELÓ, J.A. 2002 "Firewood management and vegetation changes. A statistical analysis of charcoal remains from North-East Iberian Peninsula Holocenic Sites.", a: S. THIEBAULT (ed.) Charcoal analysis methodological approaches,

paleoecological results and wood uses. BAR-IS, 1063. Oxford: British Archaeological Reports. Pp: 1-8

- ADÁN, M.; BARCELÓ, J.A.; PIJOAN, J.; PIQUÉ, R. TOSELI, A. "Spatial statistics in archaeological texture analysis.", a: DOERR, M.; SARRIS, A. The Digital Heritage of Archaeology. CAA 2002. Athens: Archive of Monuments and Publications, Hellenic Ministry of Culture.

The contribution in the NEWTON project will be focused in:

- testing the application of sistemas de data capture during the field work in hunter-gatherer sites from Tierra del Fuego
- developing together with Igor Bodaganovich interactive data base in archaeobotany, in order to share with other specialist the amount of data generated from cahrcoal and wood analysis, and an interactive data base to work simultaneously with our argentinian partners the data from Ewan site.
-

# 6. Newton showcasing:

The *TATоо* will be applied on the next season of excavation of Ewan archaeological site, Tierra del Fuego, Argentina, which is a part of long-term research project carried out in collaboration of *Prehistory Department, Universitat Autònoma de Barcelona* and *Centro Austral de Investigación Cientifica*, Ushuaia, Argentina, and other excavations resulting form this cooperation. The cost of testing and evaluation of *TATоо* will be the responsabillity of archaeological excavation project.
The results of testing and *TATоо* itself will be presented on the next annual *Computer Applications in Archaeology* congress.

# 7. Timetable:

The creation of Telearchaeologist Toolkit should follow the task schedule in which some processes could be simultaneous:

- Complete and adjust database structures, and establish relationships between data sets (first month)
- Configure Data Wherehouse and updating protocols (II-III months).
- Create Internet application with correspondent interfaces for data input and analysis. (IV to VI months)
- Create stand alone application with correspondent interfaces for data input and analysis, and communication with internet application and DWh. (VII to IX months)
- Elaboration of program documentation and help files. (during all the time of program devellopement, and all X months)
- Testing of integrated functions and adjustments if procedes. (XI-XII months)

# 8. The project in numbers:

overall figures:
Duration of the project: 1 year
Requested project budget: **26.565** €

Per partner:
Number of person months: 2

Labour cost: 900 €

Other costs: 1.500€ (will be necessery to purchase some of peripherals and mobile units as 2 palm-top computers, barcode printer and barcode reader, which will be used in elaboration of the LAN functioning of *TATOO* during the data collection on the field)
Overhead: (as allowed within standard FP6 costing models applicable to each partner) 15% of retention by UAB.

Total for partner. **26.565** €

## *3. CULTOURIST*

# Cultural Heritage Services for Tourists

7th February, 2005

***1. Project title***: Cultural Heritage Services for Tourists (CULTOURIST)

***2. Partnership***:

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***3. Priority***: 3

***4. Technical proposal***:

***Scope***: Tourists and people on the move frequently do not have easy access to information on cultural heritage sites whilst they are visiting or passing through a locality. They are either simply not aware of sites or even if they are aware of the site they do not know the range and quality of objects, exhibitions and activities, and therefore do not visit cultural heritage sites that may be of interest to them. IP Datacast is a technology that enables broadband mobile multimedia IP content and services to be delivered over multiple classes of mobile radio IP networks (DVB-T, DVB-H, UMTS, GPRS, wireless LAN) to multiple types of end-user terminals (tablet PC, PDA, mobile phone). The speed of IP Datacast technology development has been so fast that already test trials of IP Datacast services and networks are being conducted in Berlin, Helsinki and Oxford and the roll out of the first commercial services and networks are expected to occur in 2007. This project aims to help cultural heritage institutions to take commercial advantage of IP Datacast systems.

***Objectives:*** The first aim of the CULTOURIST project is to demonstrate how a typical museum or archaeological institute could derive extra visitors and income by creating

mobile multimedia cultural heritage services for delivery over converged digital broadcast and cellular networks to a wide class of mobile terminals (e.g. Tablet PC, PDA and Mobile Phone) whilst maintaining digital protection of their media through watermarking. The second aim of the CULTOURIST project is to design and implement a set of tools that quickly and efficiently repurposes the content stored on a museum or an archaeological institute database (e.g. the National Museums of Scotland with reference to CIDOC guidelines) into mobile multimedia services. The final aim of the project is to define a set of cultural heritage end-user preference key words to allow enduser
terminals to filter out those cultural heritage services that may not be of interest to an end-user.

***Project Plan:*** The CULTOURIST project intends to enhance the reference implementation of the broadcast and cellular IPDatacast system (see Figure 1) being built at Brunel University with additional "3rd Party" Cultural Heritage Content Creators, namely: museums and archaeological institutes.

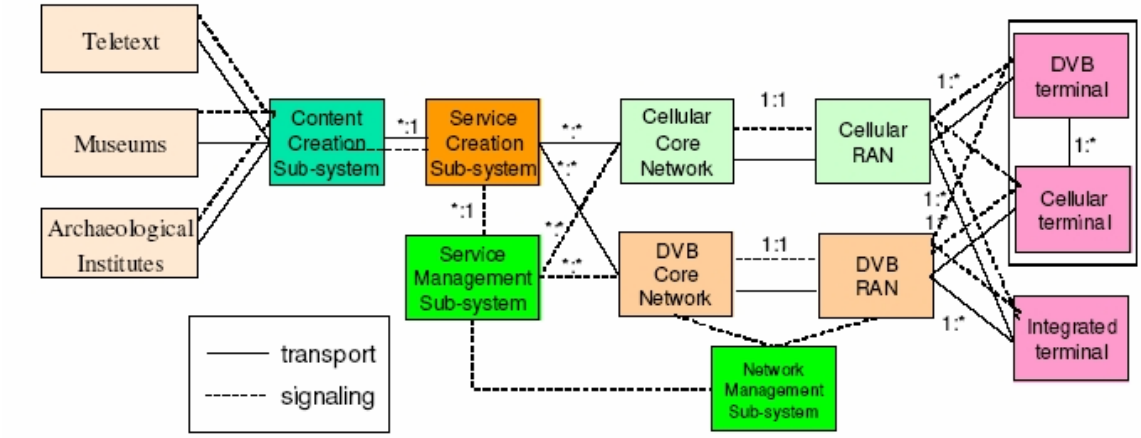



**Figure 1: Reference Implementation of Broadcast and Cellular**

All sub-systems of this IPDatacast reference implementation have been designed and are now being built in the EU IST Integrated Project – INSTINCT (http://www.brunel.ac.uk/instinct/). Of particular interest to the CULTOURIST project is the other "3rd Party" Content Creator, namely: teletext. A set of Content Creation tools is used to repurpose teletext efficiently into thematic Internet pages, which are enhanced with additional audio-visual, graphics and image media to create thematic services. The Service Creation tools describe these services for an Electronic Service Guide (ESG) and scale the media for delivery over a range of end-user terminals and networks. The Service Manager then announces to users services from a number of different service providers (e.g. news, sport, cultural heritage etc.) using the ESG. Users are then free to select which services they wish to consume and pay through subscription or on-demand. A contractual framework is used to establish business-to-business contracts and business-to-user contracts that define for example what services are delivered, when, where and at what quality they are delivered, who pays what to whom etc. The CULTOURIST project therefore plans to:

1) Extend the business model to include content creators and 3rd party content creators (this has not been done in the INSTINCT project)

2) Interface the databases of museums and archaeological institutes to the service and content descriptions of the ESG and describe cultural heritage services in the ESG.
3) Build tools to efficiently repurpose museum and archaeological institute media into Internet pages enhancing them with audio-visual, graphics and image media.
4) Generate and demonstrate mobile multimedia cultural heritage services on Brunel reference IP Datacast system.
5)

***Task 0: Project Management***

Objectives

Timely completion and successful conclusion to project

Description of work

The Project Manager will chair the project meetings, organise the preparation of quarterly reports, deliverables and annual review reports.
Technical Management: The overall technical management of the project is the responsibility of John Cosmas from University, who will review all the technical deliverables and project review reports. Activities will include;

- Definition and agreement of Project Plan and test plans for all phases of the project.
- Review and revision of tasks as required by results of this work
- Review of technical progress on a regular basis
- Production and submission of technical progress reports
- Completion of project and preparation of final technical report

***Task 1: Specification of Services***

Objectives

The objective of this task is to conceive of cultural heritage services and their use cases. Use cases of these proposed services and a simulation of these services will be created and then tested on users for acceptability of use of the service and the acceptability of the design of the services.

Description of Work

This task identifies the potential cultural heritage IP datacasting services that would be of interest to cultural heritage institutions, generates them as a use case storyboard and models them using a desk-top publishing system. The first step for determining user acceptability of the cultural heritage service is to conduct an acceptability test with the cultural heritage end-users and people involved in museum and site marketing to determine which use cases of the service are of interest to end-users. This will include establishment of a panel/ focus group of potential users stratified by age, origin (including language) and ensuring coordination with relevant and related national (e.g. 24 hour museum and the t-Museum Documentation Association (t-MDA)) and European work (liaison with DigiCult and other FP 6 projects such as BRICKS. The second step is to test the acceptability of the cultural heritage services using a simulation of the services.

Deliverables

Del 01: Results of Cultural Heritage Use Case and Simulated Service Tests

***Task 2: Extending Business Model***

Objectives
The objective of this work is to define content creation contracts between cultural heritage content creators and other content and service creators and to build a contract negotiation system between these business entities.

Description of Work
This task identifies the potential cultural heritage businesses that will be interested in providing IP Datacasting services, categorises them into different business groups and derives a XML description of the "Cultural Heritage" content creator contracts. These contracts are between the cultural heritage content creators and other content creators or service creators. A secured Internet page will be used for cultural heritage content creators to draft contracts between other contract creators or service creators.

Deliverables
Del 02: Content Creation Contract Definition and Negotiation System

### Task 3: Interfacing Cultural Heritage databases to ESG

Objectives
The objective of this work is to develop tools to semi-automatically generate service and content descriptions for the ESG from cultural heritage databases.

Description of Work
This task identifies the databases that are currently used by the cultural heritage content creators in the CULTOURIST project e.g. CIDOC members. These databases will then be modelled in XML and software developed to map their data onto IP Datacast content XML files. This software will semi-automatically map the cultural heritage XML file into the ESG's content description.
Note that CIDOC produces reference documents, standards guidelines etc – but does not itself have collections databases, although its members' institutions do of course. There are a wide variety of database systems used and therefore the CULTOURIST project will consider in detail the case of the NMS initially and survey others e.g. some of the major London museums and galleries and those in the EPOCH network (e.g. Israel Museum with whom NMS has good relationships), the Institute of Archaeology at UCL (Europe's largest and at which both Dr Clarke and Dr Hemsley gave guest lectures in 2004) and, in particular with museums in the range of the proposed UK Testbed (See Section 5).

Deliverables
Del 03: Semi-automatic Generation of Content Descriptions from Cultural Heritage Databases

### Task 4: Repurposing of Cultural Heritage Media

Objectives
This task develops a tool that will semi-automatically generate cultural heritage service descriptions for integration into the ESG's service description and semi-automatically generate user interfaces and applications.

Description of Work
This task will develop a tool that will cluster cultural heritage content into themes and semi-automatically generate services from these themes. Using this tool cultural heritage

content will be graphically integrated into these thematic services. The tool will then be designed to semi-automatically generate cultural heritage service user interfaces, MHP/MIDP applications and ESG's service descriptions.

Deliverables
D04: Semi-automatic Generation of Service Descriptions from Cultural Heritage Databases

### Task 5: Dissemination of Cultural Heritage IPDC Services

Objectives
This task demonstrates the simulated and real IP Datacast services. This task will also explore the exploitation of this system in advance prototype form to museums and sites across the European Research Area.

Description of Work
This task will disseminate the cultural heritage IPDC services first though demonstrating the simulated service and then through demonstrating the real service on an IPDC reference platform at Brunel University.
The importance of the NMS as one of the key 'opinion leaders' in the museum world in the UK and the EU (c.f. its leadership of the EC's ORION project) will be valuable in dissemination. There will be dissemination by:

- Encouraging museums to visit the IP Datacast system at Brunel—e.g. with a series of workshops for museums (note that there are some 300 in London alone and to get 30 to visit in small groups should not be too difficult);
- Raising awareness in the EU through the ARCH IT Workshop at EVA London each July;
- Raising awareness in Scotland (e.g. with major new Highland Heritage initiative already being planned for 2007, thus showing extension outside the Edinburgh area) where some key people in Scottish government circles will be invited and the system shown in demonstrator/ showcase form.

In order to exploit such a system the CULTOURIST Newton will explore the possibility of establishing a cultural heritage service provider contract with Vodafone, Orange etc. for London and Edinburgh.
We shall consider disseminating the results of the CULTOURIST project with suitable existing members of the EPOCH network such as the Israel Museum with whom we have good relations. In addition we shall try to get the involvement of a suitable member from a new EU country state such as Poland or Lithuania with whom we also have good relations and have provisionally included a budget of 11k euro for such additional new member(s) in Year 2 of the project and other directly related EVA network activities to complement and reinforce EPOCH's actions at the VAST and CAA Conferences..

Deliverables
D05: Dissemination of the Simulated IPDC Cultural Heritage Service
D06: Dissemination of the Realised IPDC Cultural Heritage Service

***5. Related activities*:**
Interfacing Strat tool to JNet provided us with much needed experience on how to interface XML schemas together. This work will be very useful to the CULTOURIST Newton because it will form the basis for interfacing archaeological and museum

databases to the ESG of the IP Datacast service provisioning system. Although Brunel University is not yet conducting outside broadcasts (we broadcast within our laboratory for the moment), we have submitted two projects DVB – Diversity Transmission (a Craft proposal) and Physical Layer DVB Transmission Optimisation (4th Call) that will see Brunel broadcasting with a research broadcast license at a 90o angle to the west of London into Buckinghamshire (Beckonscot Model Village) and Berkshire (Windsor Castle) as shown in Figure 2.

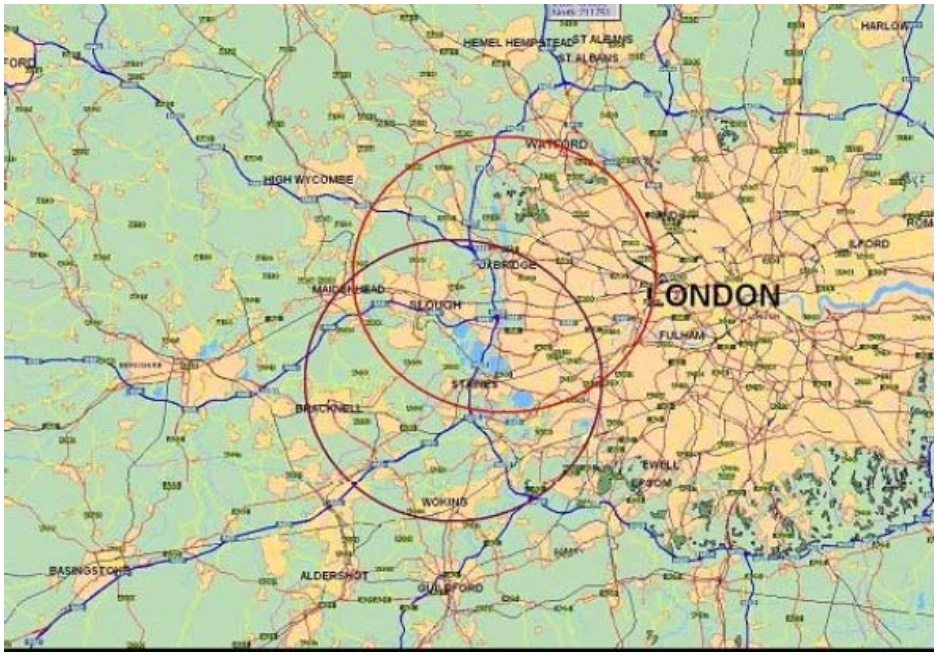



**Figure 2: Proposed Trial Coverage for UK Test Bed (Red from Uxbridge Campus and Green from Runnymede Campus)**

The tools developed in the CULTOURIST project to interface archaeology and museum databases will be made available to other members in the EPOCH consortium to use and create cultural heritage services. The EPOCH partners will be able to use these tools and other tools developed in the INSTINCT to create Cultural Heritage services for broadcasting.

***6. Newton showcasing*:**

In the first phase the interface between STRAT tool and JNET was showcased.
Two results can be showcased from the result of this Newton project. The first is a simulation of the Cultural Heritage service on a Lap Top, PDA or mobile phone and the second would be the actual broadcast services delivered in the West of London area of Buckinghamshire and Berkshire (all these devices are DVB and cellular radio network enabled). Example of the portal for services for a mobile phone is provided in Figure 3(a). Within the portal a Cultural Heritage icon would be provided to introduce subscribers to cultural heritage sites in the region, which they roam. In addition to traffic services, as shown in Figure 3(b), there could also be local cultural heritage sites service based on broadcast location areas. In addition to AV content for sports services, as shown in Figure 3(c), there could also be AV content for cultural heritage services.

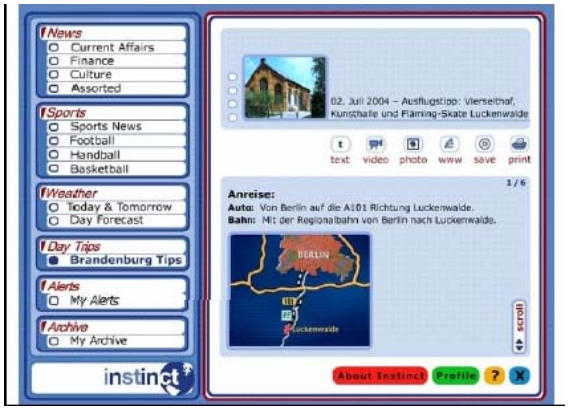
(a) Portal for Services (b) Traffic Service (c) Sports Service

**Figure 3: Mobile Phone Services**

Example of the portal for services for a PDA is provided in Figure 4(a). Within the portal a Cultural Heritage icon would be provided to introduce subscribers to cultural heritage sites in the region, which they roam. In addition to weather and news services, as shown in Figure 4 (b), there could also be local cultural heritage sites service based on broadcast location areas. In addition to AV content for single cultural services, as shown in Figure 4 (c), there could also be AV content for a much wider range of cultural heritage services.

(a) Portal for Services

(b) News and Weather Service




(c) Culture Service

**Figure 4: PDA Services**

## 7. *Timetable*:

### Gantt Chart of Tasks

| Year | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Month | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| Milestones | | | | | | | | | | 1 | | 2 | | | | | | | | | | 3 | | | 4 |
| Task 0: Management | Brunel | | | | | | | | | | | | | | | | | | | | | | | | D6 |
| Task 1: Specification of Services | MOS | | | | | | | | | | | | | | | | | | | | | | | | |
| Task 2: Extending Business Model | MOS | | | | | | | | | | | | | | | | | | | | | | | | |
| Task 3: Interfacing Cultural Heritage databases to ESG | Brunel | | | | | | | | | | | | | | | | | | | | | | | | |
| Task 4: Repurposing of Cultural Heritage Media | Brunel | | | | | | | | | | | | | | | | | | | | | | | | |
| Task 5: Dissemination of Cultural Heritage IPDC Services | Brunel | | | | | | | | | | | | | | | | | | | | | | | | D6 |

DN Denotes Deliverable N

M01: Simulation of Specified Services
M02: Dissemination of Simulated Services
Business Model Negotiation System
M03: Generation of Cultural Heritage IPDC Electronic Services
M04: Dissemination of Cultural Heritage IPDC Electronic Services

| Total | | Brunel | MOS | INVITED | Total |
|---|---|---|---|---|---|
| Task 0: Management | Brunel | 2.0 | 1.0 | 0.0 | |
| Task 1: Specification of Services | MOS | 5.5 | 5.0 | 0.0 | 10.5 |
| Task 2: Extending Business Model | MOS | 5.0 | 5.5 | 0.0 | 10.5 |
| Task 3: Interfacing Cultural Heritage databases to ESG | Brunel | 5.5 | 5.0 | 0.0 | 10.5 |
| Task 4: Repurposing of Cultural Heritage Media | Brunel | 5.0 | 5.0 | 0.0 | 10.5 |
| Task 5: Dissemination of Cultural Heritage IPDC Services | Brunel | 1.0 | 2.5 | 4.0 | 7.5 |
| | | | | | |
| Total | | 24.0 | 24.0 | 4.0 | 52.0 |

For Brunel University the management of the project and the Dissemination of Cultural Heritage Service will be conducted by members of Brunel staff and is conducted for free thereby constituting added value to this Newton.

## *8. The project in numbers*:

**Information on Brunel and the NMS is contained in the EPOCH Contract documentation since both are EPOCH, members.**

1. duration of the project: 24 months
2. requested project budget: 199,085 Euro

| Participant Role (22) | Participant No (23) | Participant Short Name (28) | Number of person/months (29) | Person Costs (29) | Durable Equipment (29) | Subcontracting (29) | Travel and Subsistence (29) | Consumables (29) | Computing (29) | Protection of Knowledge (29) | Other Specific Project Costs (29) | Overhead Costs (29) | Total Costs (32) | Costs Basis: FC/FF/AC (29) | % Requested from the Community (29) | Requested Contribution from the Community (29) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | 1 | Ubrunel | 21.0 | 76,238 | | | 2,000 | | | | | 15,248 | 93,485 | AC | 100.00 | 93,485 |
| CR | 2 | NMS | 21.0 | 72,000 | | | 8,000 | | | | | 14,400 | 94,400 | AC | 100.00 | 94,400 |
| CR | 3 | INVITED | 4.0 | 6,000 | | | 4,000 | | | | | 1,200 | 1,200 | AC | 100.00 | 11,200 |
| | | | | | | | | | | | | | | | | |
| | | Totals | 25 | 78,000 | 0 | 0 | 12,000 | 0 | 0 | 0 | 0 | 15,600 | 105,600 | | | 199,085 |

### *9. Meeting the Criteria*

QUALITY: The proposed project takes full advantage of a major EC ('integrated') project in FP 6 (INSTINCT in which Brunel plays a leading role), which is recognised to be producing successful results in a key area (mobile digitalTV). Moreover, the heritage partner has had significant experience in pioneering new technologies in the museum environment --see below – and the project is thus at the leading edge of R&D.

FOCUS: The project focuses on a specific topic - Mobile Digital TV -in one of the areas in the Call, 'Mobile/ Wearable/Ambient systems', and as indicated above the project will produce state of the art results by extending the work of INSTINCT as described in the proposal with regard to the important field of Cultural Tourism which is the application focus of the project.

FEASIBILITY: We believe that the goals are realistic and achievable since they represent a logical continuation of significant prior and current R & D work by the lead partner (with others) applied in an important specific field, Cultural Tourism, with a strong application sector partner with many relevant relationships inside and outside the EPOCH consortium -- see below.

USABILITY: As described above the plan is to ensure that a usability- based approach drives the whole project from the beginning and usability trials are of course included during and at the end of the project. Furthermore we shall pay particular attention to disabled access by including issues of inclusiveness right from the start and take new standards work on this into account.

TRACK RECORD: Brunel has one of the leading university research groups in the world in the field of Digital TV Broadcasting and a record of successful EC R & D projects, including in working with the Heritage Sector (e.g. 3D MURALE). The National Museums of ScotlandNMS, not only have taken a pioneering role in the introduction of digital technologies in Scotland (e.g. the MOSAICS system for the new Museum of Scotland - opened to time and budget in 1998 - and in the establishment of the Scottish Cultural Resources Access Network, SCRAN, but also led two recent EC projects -ORION (3D for Archaeology Museums) and EVAN, the EVA Networking project. Due to the novelty of Mobile TV, NMS (nor any other museum to our knowledge) have not yet worked in

this specific field because of its newness but are well placed to be the first museum organization to do so.
I
MPACT: Because of the massive consumer markets confidently anticipated for Mobile Digital TV (http://www.theregister.co.uk/2005/01/28/mobile_tv_prediction/) this technology will be very affordable because the major players will drive costs down the cost curve. The contribution of this project will thus be part of much broader affordable packages and as such will result in an 'impact per euro' of very high value by helping to open up the cultural tourism market for Mobile Digital TV. The high profile of the national Museums of Scotland in the European and international museums world and its important role as one of Scotland's top tourist attractions (some 1,000,000 visitors per year) will ensure major impact -- including in the media.

N.B. We thus believe that this can be a major 'Success Story' for EPOCH and the EC -- and a very highly cost-effective one at a budget of just less than 200,000 euro.

SUSTAINABILITY: As described in the proposal there is a clear goal of continued availability after the project and also at other sites. As regards integrating the work into the EPOCH Common Infrastructure the CULTOURIST results will constitute an additional and important part. Because of the enduring nature of both partners there is a confident belief in the sustainability of the work.

ADDITIONAL CONTRIBUTIONS; Although the NMS data sets to be used in the project are to a considerable extent already available, the project will enable these to be extended, updated as appropriate, and repurposed in a form which can be made more available (subject to the usual IPR) agreements etc) to EPOCH partners. Standardisation contributions are expected to emerge via the MDA and CIDOC, especially since the NMS are the 'arm' of the MDA for Scotland and thus also contribute to CIDOC work. Moreover as regards disabled access standards and guidelines the project should enable contributions to be made in this vital area and we envisage working particularly closely on it with the UK Museums, Libraries & Archives Council, MLA, and the MINERVA project at the European level.

## *4. WEBTOARCH*

# A Newton Project Proposal

**1. Project title:** *Web-based Tool for Archaeological Data Processing and Storage (WebToArch)*

**2. Partnership:** New Bulgarian University (EPOCH Part. No 13)

Petko Staynov, Department of Computer Science, NBU – e-mail: petko@staynov.com

Prof. Ivan Gatsov, Department of Archaeology, NBU – email: igatsov@yahoo.com

**3. Newton priority:** Recording/data representation (Recording of archaeological excavations)

**4. Technical proposal:**

**A. Introduction**

Information regarding the archaeological material and its transfer through interaction of cultural spheres within a pan- European perspective is very important in the modern research. Regardless the contemporary possibilities the archaeological cultures have been studied often by different specialists in isolation, analyzing their various aspects separately and in accordance with the modern political boundaries. Yet the ancient systems of interaction crosscut modern boundaries and demand wider geographical spheres.

**B. Motivation**

Function of these tools is documentation of research process in the field, applying of qualitative methods, space analysis and visualization of the results on the geographical maps. It allows the specialists to work on different themes on their own and the factual presentation of the subject matter. The direct access to the primary archaeological context provides equal and standardized basis for the researchers, who could use the data without any special provisions. Within the context, the used terminology also must be reduced to common criteria. This feature supposes a kind of linguistic and technical standardization, realized in the circle of interdisciplinary and multinational cooperation. The tools must be used as means of implementation of different scientifically approaches and to compare the information of various analytical approaches as well.

Different theoretical problems could be resolved in this way. This would be tools, accessible to everybody, who wants to work with data base within the frames as well of common study, as of the specialized one. At the same time by the means of the unified source, we are trying to impose work standards, possibility for comparison of data for different periods and different categories of archaeological finds – an approach, which is unfeasible with the conventional ways.

### C. Focus of the proposed research

The project focuses on construction of a multifunctional database management system, allowing the storage and processing of information regarding features of the technology, usage, art history, primary and secondary archaeological context from various archaeological sites in different areas. The selected fields will refer to several quantitative and qualitative variables regarding raw materials, dominant production techniques, exchange patterns, artifact typology and discard. Database will also contain of representative artifacts and structures.

### D. Innovative aspects of the project

The innovative aspects of the project lie on:

- Providing a unified tool allowing the building of common databases respecting certain common standards
- Reconstructing cultural (i.e. technological) spheres of interaction and on providing a common ground for expanding and perpetuating common knowledge regarding the organization of ancient systems of cultural activity.

### E. Existing needs

The project is meant to response to the following needs:

- documentation of the results of archaeological field work – excavation and survey; the need is for a flexible tool (in respect of the artifact type and the methods of research), based on certain standards, allowing to storage of multimedia data (texts, images, clips, etc.), as well as the preparation of results for publication;
- quantitative processing of data – the tool should allow the preparation of the collected data for such type of processing;

- correlation of the results of interdisciplinary research, and comparison of the results of different researchers, working in similar fields;
- visualization of results on geographical maps
- dissemination and vulgarization of the archaeological researches
- integration of the results from field work into the existing museum information systems (the data entered at the field level should be easily transferred into the museum information systems when the corresponding artifacts are presented in museum exhibitions)

### F. Characteristics of the proposed tool

We are proposing the development of DBMS based on client/server technology accessible both on line on the Internet and offline on PCs and PDAs.

The main characteristics of this system are:

- multilingualism – it will allow the translation of its interface into different languages as well as the storage and processing of multilingual data
- multifunctionality – it could be adapted to different types of archaeological data and different methods for data collection and processing
- modularity – it will be build on a modular basis including two main types of modules:
    - General modules – related to the context of the archaeological research and providing information about the sites, the archaeological team, the chronological systems, as well as about the research fields.
    - Specific modules – a specific module could correspond to a different artifact type or to a specific method of research
- scalability – the system will be flexible enough in order to be used with different amounts and different complexity of data.

The tool will have the following functionalities:

- entering of data through a friendly interface, adaptable to the needs of the different types of users
- preparation of data for quantitative processing
- online publication of data
- online aid for translation of specialized documents.

The tool will be targeted at the following types of users:

- field workers (for documentation of the results of field research)
- archaeologists working in laboratory conditions
- scholars doing interdisciplinary research
- university lecturers and students
- museum workers
- virtual exhibitions curators
- mass audience

### G. Technological solution

#### a. Online module

This module will comprise a MySQL database and PHP scripts which will allow the entering, the processing, the searching and the display of the archaeological data. The reason for choosing MySQL is that it is one of the fastest and most stable DB engines (proven by benchmark and other tests), allowing to work with very large amounts of data. The PHP scripting engine, even if it has been developed only recently, at the moment provides all the means necessary for building any kind of dynamic web based applications. Another worth of this technology is its platform independence and its portability.

#### b. Offline module

As this module is meant to provide the same user interface as the online one, it will be realised with the following technology:

The user wanting to use this module will have to download an XML schema of the MySQL database corresponding to his particular needs. This schema will be produced with PHP. The downloaded XML schema will be visualised in the user's browser by means of an XSL template. The data entered in offline mode will be saved in XML format and when the user will be connected to the server they will be uploaded to it. A Java server application will parse the XML file and transfer the new data to the MySQL database. This technology will also allow the synchronisation of the offline and inline database structure. This

means that that user will be able to modify offline the structure of the database he is working with and afterwards to apply these modifications to the online version of the tool.

**c. PDA version**

The PDA version will also rely on XML/Java technology which depending on the OS, will either allow the use of a browser, or will make use of a special Java client. Like in the normal offline version all the modifications made in offline mode will be transferred to the online tool when the PDA will be connected to the server.

## H. Dissemination of the project results

The WebToArch will be made available to all the EPOCH community**.** All EPOCH members will be able to use the online version of the tool at the NBU server. They will also have the possibility to download and use the offline module and the PDA version of the tool. On special request the EPOCH partners will receive the complete version of the tool which they will be able to install on their own servers. During the project the tool will be presented to three international forums dealing with the use of ICT in Archaeology:

The EAA 2005 annual meeting

The VAST 2005 conference

The CAA 2006 conference

Information about it will be also available on the NBU web site, as well as on the Bulgarian ArchWeb (Bulgarian Archaeological Portal).

## I. Project's team

1. Petko Staynov – Computer science, project's leader
2. Prof. Ivan Gatsov – Archaeology, scientific coordinator
3. Ass. Prof. Boyan Dumanov - Archaeology, expert
4. Ass. Prof. Petranka Nedelcheva - Archaeology, expert
5. Ass. Prof. Georgi Fournadjiev - Computer science, Java programmer
6. Ass. Prof. Svetlozar Ivanov - Computer science, PHP/MySQL programmer

7. Ass. Prof. Vassil Ilinski - Computer science, Java and network programming

**5. Related activities**

The Department of archaeology of the NBU has taken part to the development of two systems which are related in way or another to the present project:

- A multifunctional DBMS developed in the framework of Greek-Bulgarian cooperation and allowing the storage of data concerning chipped stone tools and their visualization on digital maps (accessible at the following address: www.csisb.org/arcada). This tool could be used as a basis for the system to be developed under the present project, but it needs a lot of improvements:
    - implementation of multilingualism
    - development of an offline version of the system
    - development of interface allowing the generation of new specific modules (for other types of artefacts) and for adding new categories and attributes in the for the existing domains; the system is flexible enough, but this kind of expansions could be done only by the system designers…
    - a multimedia module should be added to it, allowing intelligent search among different document formats;
    - the system should be made CIDOC compliant in order to ensure a certain level of standardization and to facilitate the data exchange and transfer with other IS in the field.
- A Museum information system developed for the National Archaeological Museum in the framework of Archterra – an INCO Copernicus project aiming at the transfer of European archaeological standards to three Eastern European countries. The main merit of this system is its CIDOC compliance, but it is not suitable enough for the needs presented above because of the technology used (ORACLE) and because of its adaptation for specific museum purposes which are quite different from those of the field workers. Nevertheless it could be used as model for the development of the tool this project is aiming at.

## 6. Newton showcasing

All the elements of the WebToArch tool can be showed to the potential users. The team of the project can make an online demonstration of the web-based module. We have at our disposal large amounts of data concerning stone artefacts which could be entered into the system and made available to the EPOCH partners for further processing or for comparison with their own data. This will show on the one hand the power and the flexibility of the proposed tool, and on the other hand it will allow the potential users to test the system by themselves.

Another way to showcase the system will consist in giving free access to the potential users to enter their proper data into the online database, as well as to allow them the set up the tool according their own particular needs.

## 7. Timetable

| Work package\month | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Development of the online module | | | | | | | | | | | | |
| 2. Implementation of CIDOC compliancy | | | | | | | | | | | | |
| 3. Development of the offline module | | | | | | | | | | | | |
| 4. Development of the PDA version | | | | | | | | | | | | |
| 5. Testing of the online/offline module | | | | | | | | | | | | |
| 6. Testing of the PDA version | | | | | | | | | | | | |
| 7. Dissemination | | | | | | | | | | | | |
| 8. Project management | | | | | | | | | | | | |

**Description of the work packages**

**WP1. Development of the online module**

a. Design of the database model
b. Implementation of the MySQL database
c. PHP scripts development
d. HTML templates design

**WP2. Implementation of CIDOC compliancy**

a. Adaptation of the CIDOC CRM to the specific project's goals – documentation, processing and
b. Implementation of the specific model with XML (RDFS, OWL)

**WP3. Development of the offline module**

a. Developing of the client's side software
b. Developing of the server's side software

**WP4. Development of the PDA version**

a. Developing of a browser based client's software
b. Development of a Java client

**WP5. Testing of the online/online module**

a. Testing of the modules with different artefact types and with different languages
b. Testing of the modules with users with different computer skills

**WP6. Testing of the PDA version**

a. Testing of the PDA version with different OS
b. Testing of the PODA version in field work conditions with different type of archaeological sites

**WP7. Dissemination**

a. Presentation of the tool at international an d national meetings
b. Deployment of a demo version of the tool on the NBU server
c. Publication of information about the tool on the Internet and in specialised archaeological reviews

**WP8. Project management**

## 8. The project in numbers

### A. Overall figures

Duration of the project: **12 months**

Requested project budget: **34 025 EUR**

### B. Per partner

Number of person months: **34**

Labour cost: **23 900 EUR**

Other costs: **8 200 EUR**

Overhead: **1 925 EUR**

Total for the NBU: **34 025 EUR**

| Budget item | Measure | Number | Price per unit EUR | Total per item EUR |
|---|---|---|---|---|
| **Labour costs** | man/months | | | |
| ➢ **online module programming** | | 6 | 700 | 4 200 |
| ➢ **CIDOC compliancy implementation** | | 4 | 700 | 2 800 |
| ➢ **offline module programming** | | 6 | 700 | 4 200 |
| ➢ **PDA version implementation** | | 3 | 700 | 2 100 |
| ➢ **testing** | | 11 | 600 | 6 600 |
| ➢ **project management** | | 4 | 1000 | 4 000 |
| **ICT costs** | | | | |
| ➢ **Linux server*** | un its | 1 | 2 500 | 2 500 |
| ➢ **PDA**** | units | 3 | 500 | 1 500 |
| **Travel expenses** | | | | |
| ➢ **International travels***** | travel | 3 | 1 000 | 3 000 |
| ➢ **Field testing******** | week | 6 | 200 | 1 200 |
| **Overhead – 6%** | | | | 1 925 |
| **Total** | | | | **34 025** |

* As the online tool should be available to all the EPOCH partners the NBU needs a special server (machine) for running this application

** We need three different kinds of PDAs because these devices generally use 3 different OS – Simbian, Palm OS and Windows CE, and the PDA version of **WebToArch** needs to be tested on each of these OS

*** According the dissemination plan the tool should be presented at three international meetings: the EAA 2005 annual meeting, the VAST 2005 conference and the CAA 2006 conference

**** The tool should be tested in fieldwork conditions at different type of archaeological sites

## *5. WBTLK+*

## EPOCH 1st Call for NEWTON Projects

## 1. PROPOSAL TITLE

**WBTLK+** (*Webtalkplus*): a flexible tool for effective creation of 3D shared worlds

## 2. PARTNERSHIP

| Partner Name | Short Name | EPOCH # | Contact Details | Key Researchers |
|---|---|---|---|---|
| *Politecnico di Milano* | POLIMI | 29 | HOC-Hypermedia Open Center<br>Department of Electronics and Information<br>Politecnico di Milano<br><br>Via Ponzio 34/5<br>Milano (Italy)<br>tel: +39 02 23993505<br>fax: +39 02 23993411<br>email: garzotto@elet.polimi.it | Prof. Paolo Paolini *(Project Coordinator)*<br>Prof. Franca Garzotto (contact person)<br>Dr. Eng. Timothy Barbieri<br>Dr. Nicoletta Di Blas<br>Caterina Poggi |
| *Tekniska Museet Stockolm* - National Museum of Science and Technology in Stockolm | TM | 78 | Tekniska museet<br>National Museum of Science and Technology<br>Museivägen 7, Box 27842,<br>SE-11593 STOCKHOLM<br>Tel +46 8 4505600 (and fax)<br>Tel +46 8 4505663<br>Mobile +47 0707 140376<br>email:<br>anne.louise.kemdal@tekniskamuseet.se | Anne Louise Kemdal (contact person)<br>Anders Möllström<br>Helene Sjunnesson<br>Åsa Lindgren |
| *Università della Svizzera Italiana* | UNISI | 96 | TEC-Lab, Università della Svizzera Italiana<br>via G. Buffi 13, 6900 Lugano, Switzerland<br>tel: +41 58 6664523<br>fax: +41 58 6664647<br>email: randazzg@lu.unisi.ch | Dr. Giovanni Randazzo (contact person)<br>Prof. Antonella Carassa<br>Dr. Davide Bolchini |

## 3. PRIORITY

This proposal is a *direct response* to the Newton Call Topic "**Web tool for joint experiences**" (Technology Area 5: **Visualization and Rendering**).

Still, other fields included in the Priorities for Research Agenda may benefit of the output of this project (as discussed in section 5):
- *Authoring tools for 3D experiences* (Area 5: Visualization and Rendering)**;**
- *Characteristics of engaging stories* (Area 1: Multi-lingual / semantic data processing)
- *Games and Edutainment* (Area 8)

In turn, projects in the above areas can provide tools that can be integrated with WBTLK+, and valuable inputs for the applications developed in WBTLK+.

# 4 TECHNICAL PROPOSAL

## 4.1 The project at a glance

WBTLK+ aims at building a wizard-configuration tool that allows Cultural Heritage institutions and organizations to build effective *3D worlds* that are *shared* by several users connected simultaneously over the Internet. The tool will support the development of *cooperative experiences*, an alternative way for conveying multimedia CH material and educational content.

As discussed in the next sections, the conceptual ground for building effective cooperative experiences in 3D worlds is quite well understood by the proposers (see Annex 1. Qualification and Publications of the Partners), and the basic tools for the technology are essentially there. Still, making real those concepts, and assembling the technology is still a (relatively) complex task for an "average" cultural institution - and a quite expensive job.

In order to master this complexity, WBTLK+ allows developers to build 3D cooperative "experiences" by assembling pre-existing software "modules" (middleware structures, interaction and communication patterns, and templates of 3D virtual spaces) and by customizing them (though appropriate parameters and XML configuration files). As explained in section "4.3 Technology", the WBTLK+ tool supports the generation of two different XML files: the world description (describing the world and the objects within it) and the cooperation features (i.e., how the users interact each other, through chats and the avatars). The WBTLK+ wizard does not eliminate the problem of graphic modelling (this activity can be performed using other existing 3D modelling tools, including those ones developed within EPOCH). Still, it greatly alleviates the difficulties of putting these "pieces" together, and makes the hard part, i.e., the control of the cooperative behaviour of avatars and users, much easier.

The WBTLK+ wizard will be built on top of the WEBTALK-cube technology, which has been shown to be highly effective for building effective educational 3D environments; it has been tested with the project SEE (over than 1,400 users in 2 years), Learning@Europe (that will be deployed in Europe in February 2005, (with more than 1.200 users, in 6 countries, by June 2005) and Stori@Lombardia (that will be deployed in Italy in February 2005 with more than 1,000 users by June '05).

The test case for the overall technology and for the WBTLK+ wizard will be an edutainment museum application about *Energy* (see section "4.3. Test-bed application"), based on the multimedia material developed by National Museum of Science and Technology in Sweden.

The next sections we outline the core conceptual issues and requirements, the background technology, and the test-bed for experimenting and validating the tool.

### 4.2 Concepts and Requirements

User experiences with 3D environments have turned out, sometimes, to be unsatisfactory (or not as satisfactory as expected). After a bit of exploration, the interest of the user vanes down, for, on one side, no matter how carefully reconstructed the place is, the experience cannot be compared to the real-world experience, and, on the other, no meaningful goal is offered to trigger interaction. The "magic" of the real experience is not there, the engagement is low, and the information conveyed is not rich enough. These experiences clearly show that trying to mimic the real visit (to a museum, an archeological park, a castle…) is generally very difficult, and not always fulfilling the promises.

We claim that an interesting goal, for 3D technology, is to create an environment where people can meet, socialize and, possibly, learn something while having a meaningful and engaging experience. To this aim, a "faithful reproduction" of a "real" (or realistic) place is of limited use. To this end, a fundamental role is played by virtual presence, i.e., the *sense of "being there"*, the magic glue binding together the visitors of the 3D environment. A strong sense of virtual presence is achieved by means of an accurate design of the experience, including effective graphic, engaging interaction, and a well-planned activity workflow.

*What Virtual Presence is*
There are many definitions of virtual presence, all sharing a common trait: in order to speak of "virtual presence", the person must feel to be "somewhere different" from her/his actual location (the working room, the office, the school, etc.).
What experts disagree about is the nature of the "where" the person is supposed to be. We can basically distinguish three main opinions: the first is that the user is projected in a *replica of a real place* (e.g., a city, a palace, an ancient location, etc.); the second opinion is that the user is projected in a *fictitious* (more or less realistic) *environment* (e.g., what some videogames do); the third opinion is that the user is projected in a *situation*, where by the meaning of "situation" is something more complex and more comprehensive than a mere "place".

*What Virtual Presence can be effective for*
On the ground of the previous discussion, we think that virtual presence, when achieved through 3D environments, can satisfy different purposes. A specific 3D application can, obviously, try to achieve more than one goal, but, in general, one of them will be the most prominent one:

a) *Understanding how a real place is (or was):* e.g. allowing a user to explore the ancient Roman city of "Pompeii", or an Egyptian tomb, or a far-away museum.
b) *Conveying the "emotion" of being in a real place*: e.g., recreating the emotion related to the above experiences.
c) *Creating the illusion of being in "fantasy" place*: e.g. fairy tales places or places in which videogames take place; we know that they do not exist, but still we feel an emotional attraction for them.
d) *Creating an immaterial situation*: e.g. a conversation among peers, a conversation with an expert, a teaching-learning situation, a competition, etc.

*How Virtual Presence can be achieved*
"Situational virtual presence" is not achievable by reproducing a virtual copy of a "real-life place", but rather focusing on what goes on in the situation, and trying to put the users in the best position to "feel in the situation".
**WBTLK+ aims at making easy the development of 3D environment where mainly "situational virtual presence" is at stake, in order to engage the users in a rewarding activities.**
High quality graphic replicas of "real" environments is not precluded, but it is not among the favourite applications of WBTLK+.

### 4.3 Technology

The WebTalkCube system architecture is written in different programming languages: Lingo (Director coding) with its recently made available extensions, Netlingo and 3Dlingo; Actionscript2 (Flash coding); and Java2, to implement the Web Services layer.

The architecture is based on a client/server paradigm and exploits an application server hosting a Web Server for static and dynamic contents, a Communication Server (Macromedia Flashcom) for sharing data in cooperative and distributed applications, and a Web Service Provider (Macromedia Remoting). While the server is appointed to listen to client connections and to distribute events among the participants, maintaining a centralized state repository, the client side is a Shockwave plug-in that runs within a regular internet browser, such as Netscape or Explorer.

The average user is likely to have either Netscape or Explorer, and the Shockwave plug-in installed on the system.
When a user activates a WebTalkCube HTML page of a WebTalkCube application on the Internet, the embedded Shockwave player is loaded: the user can see a browser window split in two.
The upper half is a W3D movie showing the graphical representation of the 3D world, in which the visitor can move and interact with objects. In this portion of the screen the user can also see other users[3] moving and performing actions. The bottom half of the screen features a chat window in a flat Flash panel, in which users can type messages to each other and read incoming messages.

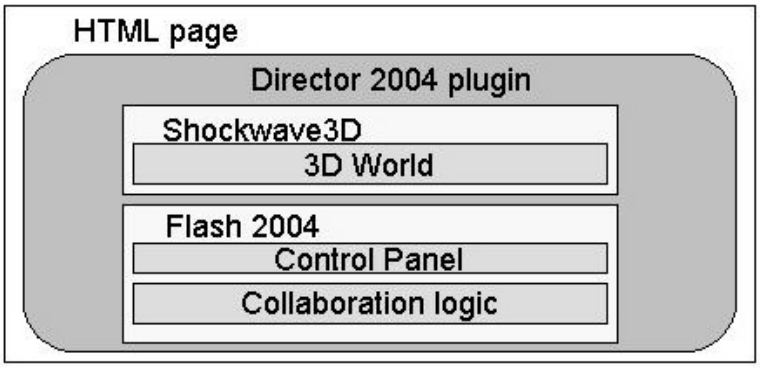



**Figure 1** – Web browser window structure

In order to build a generally accessible application, the W3D portion does not embed 3D geometries: the system builds the virtual scene in real time, fetching each geometry and texture from a repository; geometries come in the most common formats currently available: 3DS, Plasma, Maya or Lightwave.

The collaboration logic via the WebTalk Interaction Engine (WtIE) detects any event generated either in the 2D or in the 3D interface, and forwards them to the Server through the Real Time Message Protocol (RTMP). Likewise, any other events generated at the same moment from other clients connected to the same webpage are distributed by the Flash Communication Server to the Shockwave plug-in on client side, which passes them up the stack into the W3D worlds.

Users can thus see each other's avatar and active objects moving and changing in response to the manipulation of other users.

[3] Users are represented by *avatars*, i.e. human-shaped graphical figures.

The system architecture is built up around the MVC (Model View Controller) design pattern, in which the **model** represents the shared world state, the **view** represents each client web application, and the **controller** is the programming logic that builds up and regulates each end-user GUI as well as the shared state.
The following elements are present on the Server Side:
- World Repository
- Web Server
- Communication Server
- Web Service Provider

World repository contains the following information:
- The XML description of each world ready to be loaded
- The W3D models and textures that can be loaded in real time by the WebTalk engine
- The behaviors that can be attached to each model (how it interacts with the user: by single click, by proximity, etc.)
- The user profiles and authorizations
- The definitions and configurations of each cooperative session
- The history log of every interaction between a user and the world, as well as among the different users

World XML Description contains information about:
- Geometry appearance, texture, position, orientation, and scale
- Objects link references
- Behavior prototype reference applied to each object
- Avatar model, skin, starting position and its animations references

While the Web server is a generic server (as IIS or TomCat) hosting web pages, 3D object models and world description files, the Communication Server is a dedicated server managing the interaction between users and the shared world state; this is technically made by instancing a couple of "Shared Objects" for each interactive model present in the virtual world:
- One "remote shared object" preserving the state of each model on the communication server;
- Many "local shared object" (one for each client connected to the virtual world) being updated locally.

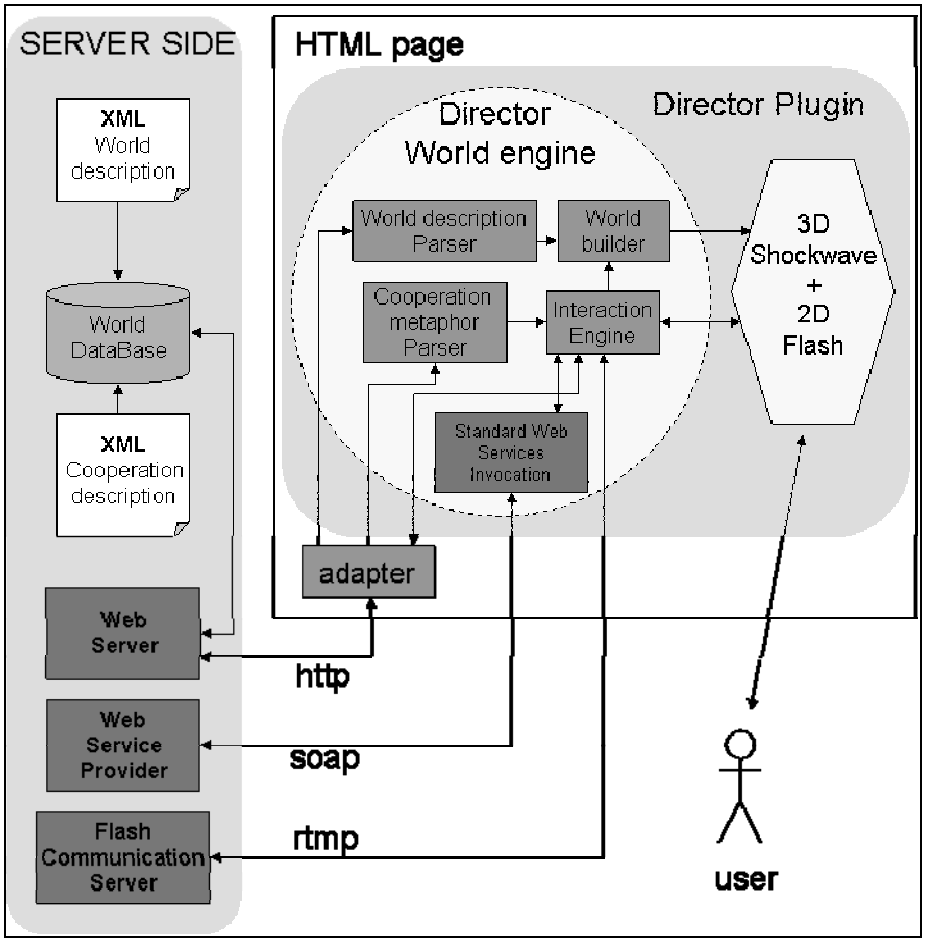



FIGURE 2 – WEBTALKCUBE GENERAL ARCHITECTURE

Whenever an interactive model changes one or more of its properties, its corresponding local shared object is refreshed; at every "onSync" event generated by the communication server, each client notifies to the server only the changed properties of its local shared object, updating the corresponding remote copy.

### 4.4 Test case

The WBTLK+ tools will be validated and tested by the National Museum of Science and Technology of Sweden for the development of a 3D cooperative edutainment application related to "scientific cultural heritage". More precisely, the topic will be *energy*, addressed from multiple perspectives: historical, scientific, social, ethical, environmental. Devoted to users of age between 12 and 19, the application aims at generating interest in the subject, stimulating new visions in the teen-agers, attracting people at the museum, providing motivations for further digging into the content, and establishing cross-national virtual communities of young people who are sensitive to the multiple issues related to energy, and more generally, to technological development.

The test bed will exploit the existing digitized material of the museum, as well as the expertise achieved by the museum staff in CH communication and education. In particular, the museum will exploit the experience achieved in *Young Minds* – a project started in 2002 as a joint initiative between six museums and science centers in Sweden. Young Minds' goal is to develop informal collaborations of *schools* with *museums and science centers*, in order to increase teenagers' interest in science and

stimulate challenging visions of the future based on the many possibilities offered by technology. In its present form, Young Mind focuses on four major thems (biotechnology, communication, human-machine, and environment) and has been involving over 12,000 pupils (aged 12-19) and 1200 teachers. Young Minds is carried on thorugh physical events and live experiences, e.g., visits to musuems, exhibitions, and scientific institutions, workshops with scientists, dialogues, debates and seminars between pupils and between pupils and scientists, museum curators and educators, politicians and business men. The pupils' work ends with the "Day of the Future" - a multi-school public event where the teenagers have the opportunity to present their experience, their understanding, and their vision.

The test case developed within EPOCH will offer the opportunity to amplify the Young Mind concept and to achieve a truly European dimension in the dissemination, understanding, and fruition of scientific cultural heritage. Our plan is to involve pupils not only in Sweden (thorugh Yound Minds "connections") but also in other European countries - exploiting the existing network of contacts with schools and educational institutions established by POLIMI within the SEE and Learning@Europe projects.

The test bed application will allow teen-agers to experience new forms of fruitions of energy-related museum resources and to interact - between peers and with big players in the arena of "scientific cultural heritage" - in a cooperative context even when their real world location is very far apart.

High quality multimedia content will be made available through a combination of a "traditional" 2D website and shared 3D worlds, inspired by the natural sources of energy (e.g., in Sweden, the waterfalls), old and contemporary energy infrastructures, innovators in the energy field, and technical developments during the industrial era. The 3D worlds will offer a discussion space and a collaborative playground, where pupils will explore a shared 3D space, see what the (avatars of) other users are doing, exchange information and opinions with other visitors, interact with virtual exhibits or operate with CAD models of old and modern energy plants and equipment. Pupils can play together educational "games", or listen and watch at interviews on social, scientific, and industrial issues related to energy and environment. One of the games that the museum has already conceived is about our common technological future and its environmental consequences. Its objective is to engage children and teen-agers in matters relating to technological development and global environmental scenarios, and to promote the concept that by a commitment to environmental issues and technology it is possible to influence our common future. The game activities, carried on by groups in different countries, will enforce a mutual view on these issues and contribute to a broader and deeper understanding of them. A wide set of 2D and 3D multimedia resources, based on the museum vast collection, archives, and library, will provide some of the key facts and answers the users need to understand and interpret in order to progress in the game.

# 5 RELATED ACTIVITIES

None of the partners participating in this proposal has any "formal" allocation to activities related to WP3 or WP2.4.
For the entire project life time, the only "official" involvements of POLIMI and UNISI are in WP4 and WP1.
In terms of numbers, for JPA18:

- POLIMI:
  - WP1 (Project Management): 0.2 MP (as member of the Board of Directors); WP4.2 "Standards and Evaluation: 3 MP.
- UNISI:
  - WP4.2 "Standards and Evaluation: 9 MP.

For TM, the only official involvement is as member of the boar of Director (with a budget allocation of 1 MP on the entire duration of EPOCH).

For both POLIMI and UNISI, the work carried on so far (in close cooperation) has focused on the inventory of current practices and standards adopted by the CH community in usability and design, and in the dissemination of know-how in usability and accessibility assessment (Tutorial at VAST'05).
The usability study carried on within WBLKT+ will be therefore coordinated with the efforts in WP4, and represents a potential candidate for future training activities to be carried on in this WP.
In addition, the use of multimedia and web standards that will be necessarily experimented during WBLKT+ development activities (related to both tools and test-bed) will offer a valuable case-study to be exploited and disseminated in WP4.

In addition, both POLIMI and UNISI has been involved in the activities of WP2.1 ("Stakeholders Needs"), actively participating to the WP2 workshop in Brussels in 2004 and contributing to the production of the WP2.1 deliverable on User Needs.

Finally, POLIMI has participated in the WP3.3 activities, collaborating with ARCES (Partner #30), attending meetings, and contributing to the inventory of available /existing technologies.

For all the above considerations, POLIMI and UNISI are in the position of acting as effective liaisons between these three workpackages (WP2, WP3, and WP4). The participation of TM in the Board of Directors gives to this partner a higher visibility within the EPOCH consortium, and especially among the other CH institutions involved in the project, thus putting TM in a stronger position for contributing to the dissemination and show-case of the WBTLK+ results.

Let' us now shortly discuss *future plans* and the possible *relations* of this project with the JP19-30 work in the areas of Common Infrastructure (WP 3.3) and showcases (WP 2.4).

There are several reasons why it is worth to invest some resources in the future workplan to achieve an effective, reliable integration of WBTLK+ with the Common Infrastructure.

In terms of functionality, WBTLK+ is located at the "last" stage of the EPOCH pipeline, being essentially a tool helping application developers to convey CH multimedia resources to the end user in innovative, engaging ways.

Thus WBTLK+ is a *candidate for integration with any CI component that support developers in building appealing multimedia contents and graphical "artifacts"*. And WBTLK+ applications can exploit the multimedia resources developed by EPOCH showcases, e.g., *showcase 4 : Multilingual Avatars; showcase 6: Avatar based interactive storytelling; showcase 8: Image-based Modeling.*

In addition, there are a number of outputs from activities concerning the themes of the current workplan and of the proposed Priorities for Research Agenda, where are potentially related to WBTLK+. To mention the most relevant:

- ***5. Visualisation and Rendering: Authoring tools for 3D experiences***

*"To come up with an easy-to-use toolkit to create 3D multimedia presentations and good-looking 3D exhibitions, e.g. in museums. Target users for the authoring application are museum curators and CH professionals, whereas the user community for the virtual worlds is the public. …"*
Here the liaison with WBTLK+, and the potential for integration, is evident. The tools developed under this theme can be used to build 3D worlds (and other multimedia artifacts) upon which

cooperative experiences can be build using WBTLK+. Thus, WBTLK+ and these tools should be part of the same toolkit offered to CH institutions.

- ***8. Games and Edutainment***

*"…to make more explicit the need to investigate the implications for Intelligent Cultural Heritage of developments in games/edutainment"*

Our experiences in previous cooperative 3D applications have shown that the game activity is crucial to "keep user engaged" and stimulates learning (even of "abstruse" subjects, such as The Dead Sea Scrolls! See figure 3 – project SEE- Shrine Educational Experience).

**Figure 3**. SEE Project – Avatars/Students trying to reconstruct meaningful pairs among the cultural objects found related to Dead Sea Scrolls in the labyrinth (Matching Pairs game) while others are discussing on the chat area

In principle, "any" interactive multiuser game can be integrated in a WBTLK+ application - as any other graphic component (as far as it meets the WBTLK+ "format" – see section 4.3).

Thus WBTLK+ is the ideal environment where the role of edutaiment can be experimented and investigated. This issue will be partially explored also in the context of the proposed project (see section 4.4) where the National Musuem of Science and Technology has already conceived an interactive game on energy that will be implemented and tested with pupils of different countries in the test-bed application.

***- 1 Multi-lingual / semantic data processing: Characteristics of engaging stories***

*"… there is a need for a sense of engagement in story-telling in order to create demand for the digitised collections and the knowledge of the artefacts, etc. ….. to attempt to assess the likely engagement of alternative ways of conveying particular experiences."*

Merging the potential of interactive multimedia with the educational benefits of a "traditional" education/fun activity- *story-telling*, is a challenging task. Story-telling is not only one of the oldest

known human activities - an important part of how we educate ourselves, pass down culture across generations, and entertain each other. According to Bruner[4], narrative's structures are the first linguistic forms that children acquire and use to construct meaning. And story-telling has also an enormous pedagogical potential: a number of studies shave shown that it helps children to develop different knowledge and mental skills, such as communication, recognition and recall, analysis and synthesis ability [5].
Again, WBTLK+ provides the playground where the story-telling communication paradigm can be "easily" implemented and experimented, applying it to build stories related, for example, to the contents exhibited in a museum. We are currently investigating this idea in project carried on by a group of graduated students from the Industrial Design Faculty. They are designing a (cooperative) application for children aged 5-8, which is inspired to a story described in one of kid's books in the series "Kathy in the Museum" [New Minds Press, 2002]. These stories tell what happens to a young girl – Kathy, when she visits a fine art museum with her grandma. She "interacts" with the paintings, "chats" with the personages (e.g., La Gioconda), "gets into" the painting scene (e.g., the hypothetical balcony where La Gioconda presumably sits), and makes a lot of trouble there…The project is still in its very preliminary stage ("concept" and mock up prototype) and will be implemented (by Computer Engineer students) using the current WebtalkCube technology. We are planning to re-implement it using WBTLK +, once its tools will be available.

# 7 SHOWCASING

A showcase activity could be considered as a follow-up of the project, in order to provide practical and appealing live demonstrations of the WBTKL+ tools and applications, to stimulate their adoption by both cultural institutions and SME's involved in CH developments.

A more general goal of the showcase activity is to convince the CH community that by alleviating the "technology burden", a "shift of focus" is possible: from technology "problems" (implementation, digitalization of multimedia contents, development of graphic "objects") to the *conception* of new forms of *communication* and *fruition* of CH resources. And CH institutions can invest their best energy, talent and know-how in the effort in *designing* (rather than implementing) engaging forms of user interactions and new computer mediated experiences.

The showcase work could be embedded within tutorials and workshops at major conferences and meetings, both at national and international level. Specific courses and brokerage activities could be developed, in coordination with WP4. In addition, a showcase opportunity could be offered by the events organized in the context of the Young Minds project (see section 4.4). Furthermore, WBTKL+ functionality and application could be demonstrated by TM to the European organisation ECSITE (European Collaborative for Science, Industry & Technology Exhibitions) in Brussels.

Finally, integrated efforts with other EPOCH partners (see discussion in the previous section) who are involved either in WP3 activities related to "visualization and rendering" and "edutainment", or in other showcases (such as #4 - Multilingual Avatars, #6 - Avatar based interactive storytelling - and #8 - Image-based Modeling) could lead to showcase coordinated activities.

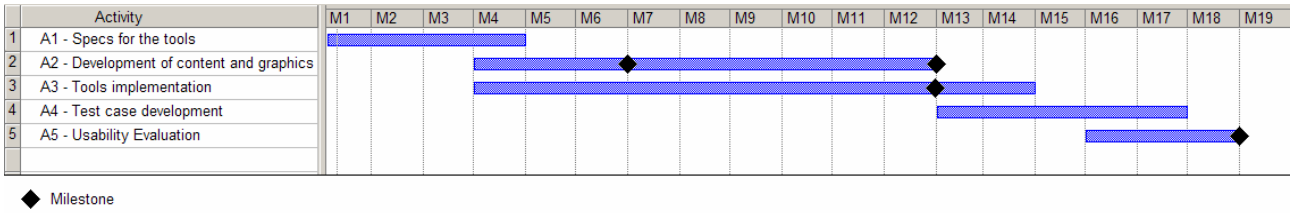
[4] Bruner, J. S. (1979). On knowing. Cambridge, MA: Belknap Press of Harvard University Press.

[5] Bloom, B. et alii (1964). *Taxonomy of educational objectives*. New York, David McKay.

# 8 TIMETABLES

In this section we will outline the plan of activities, the milestone, and the key deliverables of the project.

| *Activities* | *Responsible partner* | *Description* |
|---|---|---|
| A1 | *POLIMI* | *Detailed specifications for the tool*<br>Defining the details for the WBTLK+ wizards, balancing technical details with usability for application developers. |
| A2 | *TM* | *Developing content and graphics for the test-bed app*<br>- Conceptual design of the 3D cooperative experience for the "Energy" test bed (information design of 2D-3D contents, design of cooperative activities and user/avatar behaviors, interaction design of active and reactive components)<br>- Developing the 2D and 3D multimedia content and graphics elements for the test-bed (according to the standards defined in A1) |
| A3 | *POLIMI* | *Implementing the tool*<br>- Implementation of the WBTLK+ wizards as a smart interface over the WEBTALK-cube technology<br>- Technical testing |
| A4 | *TM* | *Developing the test–bed app*<br>- Using the WBTLK+ wizards to load the multimedia 2D and 3D contents and graphic elements and to define the cooperative behaviour of avatars and users<br>- Development of a full size 3D cooperative experience for the TM museum |
| A5 | *UNISI* | *Usability Evaluation*<br>The tools developed will be evaluated from a usability point of view, and also for functional effectiveness. Peer reviews, inspection and empirical testing will be used, according to the formal methodology MILE+ (see Publications) |




**MILESTONES AND DELIVERABLES**

| **Milestone** | **Achievements** | **Deliverables** | **Deliverable Nature** | **Responsible Partner** |
|---|---|---|---|---|
| Month 6 | Detailed specs for tools completed | D1: "WBTL+ Tools specifications" | R | POLIMI |
| Month 12 | - Test Bed experience design completed<br>- Test bed contents fully developed:<br>- Tools 70% implemented | D2: "Conceptual Design of the Test-Bed Experience"<br><br>D3: " 3D and 2D multimedia content for the test-bed experience"<br><br>D4: "WBTL+ Tools – V1.0" | R<br><br>D<br><br>D | TM, UNISI<br><br>TM<br><br>POLIMI |
| Month 18 | - Tools | D5: "WBTL+ Tools – V2.0" | D | POLIMI |

| | | | | |
|---|---|---|---|---|
| | implementation completed<br>- Test case fully deployed<br>- Usability evaluation completed | D6: "A 3D cooperative virtual experience on Energy"<br><br>D7: "Usability Evaluation of the WBTL+ Tools" | D<br><br>R | TM<br><br>UNISI |

# 9. NUMBERS

The following tables shows the allocation of contribution to partners and activities.

The calculation has been made adopting an average MP cost of € 6.000, including "other costs" (such as digitalization costs, consumables, and travel) as well as overhead.

| | Country | Costs | Funding | Person-months |
|---|---|---|---|---|
| **TOTAL** | | **€ 330.000** | **€ 198.000** | **55** |
| POLIMI-HOC (1) | IT | € 168.000 | € 84.000 | 28 |
| TECH. MUSEUM (2) | SE | € 96.000 | € 48.000 | 16 |
| UNISI-TECLAB (3) | CH | € 66.000 | € 66.000 | 11 |
| (1) FC: funding =50% of costs; 70.3% overhead | | | | |
| (2) FCF: funding = 50% of costs; 20% flat overheard rate | | | | |
| (2) AC: funding=100% of costs | | | | |

| **Activity** | Person/Month | Cost | % of effort |
|---|---|---|---|
| A1 : Specs for the tools | 10 | € 60.000 | 18,18% |
| A2 : Development of content and graphics | 11 | € 66.000 | 20,00% |
| A3 : Tools implementation | 24 | € 144.000 | 43,64% |
| A4 : Test case development | 6 | € 36.000 | 10,91% |
| A5 : Usability Evaluation | 4 | € 24.000 | 7,27% |

# Annex I - Qualification and Publications of the Partners

The partners undersigning this proposal is strongly *multidisciplinary*, with backgrounds in both the scientific and humanistic field (computer engineers, graphic designers, experts in communication technologies but also philosophers and linguistics). The three partners are widely experienced in technological and communication sectors related to CH.

Politecnico di Milano has a strong background in ICT *technologies and applications for CH* (being involved in over 20 national and international projects in this area). Being the developer of the technology underlying the proposed tools, it will assure the feasibility of the proposal's goals.
The National Museum of Science and Technology has a strong experience in *educational activities* for CH, *scientific communication*, and *technologies for CH*. They also cooperate with researchers in educational projects related to scientific CH, and arrange seminars with school children and researchers (e.g., in the Young Mind Project – see sect. 4.4).
Università della Svizzera Italiana has a strong experience in *communication for CH,* in *requirements elicitation*, *user requirement analysis*, and *usability and accessibility* for the Web.

The background and qualification of partners is also witnessed by the following publications:

- Barbieri T., Paolini P., et al. (1999). *Visiting a museum together*. In: Proceedings Museum&Web99, New Orleans (Best of the Web 1999 Award).
- Barbieri T., Paolini P (1999). *WebTalk: a cooperative environment to access the web*. In: Proceedings EUROGRAPHICS'99, Milano.
- Barbieri T., Paolini P, et al. (1999). *Cooperative Visits to 3D Virtual Museums.* In: Proceedings International Conference for Cultural Heritage & MEDICI day, http://www.medicif.org, , September 1999.
- Barbieri, T. (2000). *Networked Virtual Environments for the Web: The WebTalk-I and WebTalk-II Architectures*. IEEE for Computer Multimedia & Expo 2000 (ICME), 2000, New York, NY
- Barbieri, T., Garzotto, F., et al. (2001). *From Dust to StardDust: a Collaborative Virtual Computer Science Museum*. ICHIM 2001 International Cultural Heritage Informatics Meeting, 2001, Milano, Italy.
- Barbieri, T. & Paolini, P. (2001). *Cooperation Metaphors for Virtual Museums.* Museums and the Web 2001, Seattle, WA
- Bolchini, D., Mylopoulos, J. (2003). *From Task-Oriented to Goal-Oriented Web Requirements Analysis*. In: T. Catarci et al. (Eds). *Proc. International Conference on Web Information System Engineering (WISE'03)*, Rome, Italy.
- Bolchini, D., Triacca, L., Speroni M. (2003). *MiLE: a Reuse-Oriented Usability Evaluation Method for the Web*. In: C. Stephanidis & J. Jacko (Eds). *Proc. HCII 2003 International Conference on Human-Computer Interaction*, Crete, Greece.
- Bolchini, D., Paolini, P. (2004). *Dialogue-based Design for Multichannel Interactions*. In: M. Matera & S. Comai (Eds). *Engineering Advanced Web Applications*, Proc. of Workshops in Connection with the 4th International Conference on Web Engineering ICWE'04, Munich, Germany, May 2004.
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- Bolchini, D., Yu, E. (2004). *Modelling User Requirements for Web Applications.* Studies in Communication Sciences, 4 (2) 2004.
- Bolchini, D., Piccinotti, N., Randazzo, G., Speroni, M. (2005). *IDM – A User-Centred Model Shaping User Interaction as a Dialogue*. To appear on Proc. HCII 2005 International Conference on Human-Computer Interaction, Las Vegas, USA, 2005.
- Bolchini, D. (2005). *Guidelines for Describing Usability Problems*. To appear on Proc. HCII 2005 International Conference on Human-Computer Interaction, Las Vegas, USA, 2005.
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## 6. CIMAD

### 1. Project title

**CIMAD: {Common Infrastructure, Context Influenced} Mobile Acquisition and Delivery of CH data**

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## 3. Priority:

This proposal is a direct response to:

- Technology area: "3) MOBILE/WEARABLE/AMBIENT SYSTEMS"

Topic: "Mobile applications from data capture to public dissemination"

However, the proposed approach will also enable support for the requirements of

- Technology area: "4) RECORDING/DATA REPRESENTATION"

Topic: "Recording of archaeological excavations"
This could be achieved at the marginal cost of specifying an additional profile for the application builder component, together with evaluation at a suitable site.

## 4. Technical proposal

GOALS
The main goal is the exploratory implementation of a framework for smart CH environments supporting distributed and mobile on-site applications, from data capture to public dissemination. The framework is intended to become a CI component, and it will be made conformable with other adjacent tools created by this NEWTON call.
Applications will be configurable, according to a variety of policies and specifications**.** The proposed framework (fig. 1) will be published with an appropriate licence agreement, to be agreed with EPOCH management.

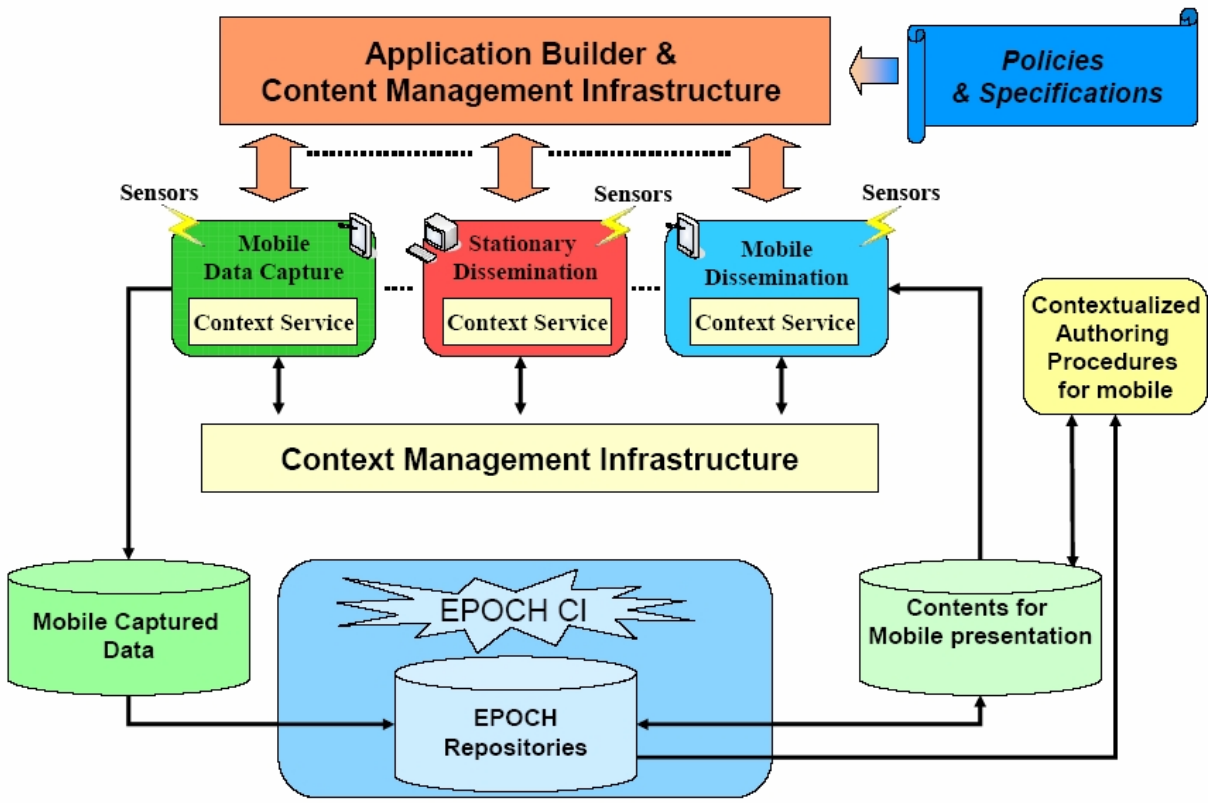


**FIG. 1 – OVERVIEW OF THE CIMAD FRAMEWORK**

Within CIMAD a Smart Environment is any confined area of cultural interest (for example a Museum, a Temple, an Archaeological Site, an historical City Center, but also, an industrial heritage site, an historical cemetery... ) where there are means enabling IT devices to detect the occupants context, so that contextual information can be used to support and enhance their abilities in executing application specific actions. These means may be sensor systems embedded in the environment itself, sensors integrated in the platform or both.

The smart environments generated with the proposed framework will include networked contextaware mobile devices, repositories, context-servers and stationary clients.
Existing context-aware mobile devices operating at the data capture end, such us PDAs able to collect contextualized field notes [1] will be made inter-operable with recording systems and repositories created by other EPOCH sources, (tools generated by Activity 3.3 or 3.2), and the recommendations of the "Standards" group (Activity 4.2).
These repositories, will provide contextualized and conformable digital data to an authoring module specifically devised to develop context-related content tailored to the mobile clients operating at the dissemination end within the smart environment (on-site access to CH). The mobile clients will access the repositories according to a context-aware navigation and interaction policy implemented by the proposed framework and specified by the curator or by the target institution authority.
The proposed framework will include three *modules* (fig.1):
• the *Application Builder,*
• the *Context Management Infrastructure*,
• the *Authoring procedures for context-aware mobile*.

The Application Builder
The *Application Builder* is a suite of tools for generating the desired application, customized at *run time* according to the *current context of use* – namely, the constraints and capabilities of the specific delivery device, the *user characteristics*, and current *location*. The *Application Builder* conception and

implementation will capitalize on the partners'experience in developing MUSEXP, the interface definition framework for WHYRE [2] and on existing tools for web-based application generators [7, 10, 11], developed by the partner POLIMI (largely within in a previous EC funded project "UWA-Ubiquitous Web Applications") [9]. The application builder will exploit a *schema-driven approach* and have the following capabilities:

1. to enable the specification of the *schema* (or *model*) of the application. This will be specified by application designers; it is defined at *design time* and defines the content, navigation, operations, and lay-out properties of the application. The application design standard UML (Unified Modeling Language) will be adopted as schema specification language. Different schemas will be defined for different types of *devices* and *user profiles*, the latter being organized in major "macro profiles", for example researchers (and more general, CH specialists) and general public
2. to *identify the schema* corresponding to the macro-profile of the user and the device type
3. to *detect the context of use, i.e* the users macro-profile with their specific characteristics, the device features, and the context information provided by the *Context Management Infrastructure*
4. to *dynamically instantiate* the application schema according to the user's current *request for information* and to the *current context of use*. This requires: i) retrieval of contents that "match" the context of use and the user request through a component called the *Content Management Infrastructure*; ii) dynamic composition of the retrieved contents in the presentation and interaction structures defined by the schema

In this way, the *Application Builder* will address specific information access and procedural requirements (from process recording to end-user services) throughout the CH pipeline from data capture, through conservation, analysis, interpretation and general management, to professional dissemination and general public fruition.
Two of the major user "macro profiles", i.e. researcher and public, will be demonstrated in associated showcases (Deliverables D6 and D7). These profiles align with the needs of actors at the two ends of the EPOCH pipeline.

The Context Management Infrastructure
The *Context Management Infrastructure* is a distributed and cooperative infrastructure intended to manage all contextual information within the smart environment, and to provide appropriate contextual information to all of its nodes. It is based on the existing MobiComp context-aware infrastructure [1,6], and on the experience gained by the partners with WHYRE, during its development, usability analysis and user testing [3, 4].
The Infrastructure is configurable. Its agents (*ContextServices*) run in every node of the smart environment and are tailored to the nodes' application, constraints, needs, capabilities and policies. The proposed framework will address the following system models [1,5]:

- *standalone client*
  No network communication and no "Global Context" are available. Only the "Local Context" is handled. The local context can be defined, for example, as the node position and orientation, derived from on-board sensors and associated with the user's current activity and the abstraction level of his/her focus of attention
- *centralised infrastructure*
  Local Context is available on each node, together with "Global Context" which is obtained from a central service by Client-Server communications
- *distributed/cooperative infrastructure in center-based applications*
  Cooperative applications are supported by Client-Server and Client-Client communication; the "Global Context" is managed by the server which may also act as a proxy for any firewalled nodes
- *distributed/cooperative infrastructure in networks (for example ad-hoc networks)*
  Client-Client communication, no centralized "Global Context" exists

Applications running on each node will use their local ContextService to infer their required contextual information from:

1. spatial knowledge (GIS), either loaded on the node or requested from the server

2. "context-change events" originating from the local sensory subsystem or elsewhere in the smart environment

The sensory subsystem may include on-board sensors at the mobile nodes or may rely on sensor sub-systems controlled by static nodes and embedded in the environment (server or infrastructure based sensing). On board sensors may include, for example, compass, gyro, accelerometers, multiradio receivers (GPS, 802.11, Bluetooth, RF-ID, etc.), and other less conventional sensors (audio, light, temperature, proximity, etc.) and video. A clear interface to sensor subsystems will be defined in order to support third party sensors.

Authoring procedures for context-aware mobile applications

This module should provide the authoring guidelines and the procedures to generate the desired contents in a format suitable for the mobile platform. Digital resources will originate from contents in standard formats in EPOCH open repositories. Authoring for mobile devices is a challenging topic. How can the context support content presentation? How should the context impact the interaction and the input/output communication? How do mobility and contextawareness influence navigation? How can we import virtual theatre models into a mobile smart environment? Which visit modes are most effective in a smart environment? There is not only an obvious downscaling issue here, but there is also the opportunity to conceptualize the mobile communication process and access methods taking into account the fast evolving technology of mobile devices. In this scenario the proposed module intends to demonstrate how to import and adapt to smart mobile environments conformable EPOCH CH data to be delivered on-site, with the goal of maximizing engagement and dissemination. This exploratory module is currently conceived as a set of guidelines and software assisted procedures that should represent the seed for a significant contribution to the CI (matrix cell 5E, expected to provide CH data to the tools located in cells 3E and possibly 3D).

ACTIVITIES

- **ACTIVITY A1: Specs and planning**
  - **Partners involved: ALL**
  - **Responsible: UNIBO**

This is a planning and integration activity aiming to:

1. functionally detail each of the three CIMAD modules
2. specify the EPOCH Standards that will apply to all modules and communications
3. specify the interfaces between such modules
4. agree the interface between this NEWTON and tools produced by other NEWTONs or already specified in the CI
5. agree the showcases (sites and targets); in principle a showcase could be agreed with another NEWTON; this will be decided in this activity
6. address the mobile platform architecture issue: which platforms should be supported (HW, OS, SW)? Which development environments? What are the requirements for the "ideal" mobile platform?

Specified EPOCH Standards shall be adopted wherever appropriate (data, metadata, transport and communication). For example, a mapping between all data capture objects and the CIDOC CRM will be developed and spatial data formats will comply with the OpenGIS GML standard. A clear interface to sensor subsystem will be specified in order to support third party sensors. Interaction with other NEWTONs and with the CI is a requirement of this activity. Such interaction shall be agreed with the WP3 Leader.

**Deliverable D1:** Report on activity A1 (Specifications and Planning) (Month 3)

- **ACTIVITY A2: Context Management Infrastructure**
  - **Partners involved: UNIKENT / UNIBO / DS**
  - **Responsible: UNIKENT**

This is a software development and integration activity, building on previous work by the partners and ongoing work within the framework of the EPOCH Common Infrastructure. The expected result is a

distributed context management infrastructure based on the existing MobiComp system [1,6]. The resulting software components will include ContextService instances capable of running on each node and managing local context and communication of global context. The infrastructure will manage information sharing amongst the individual Services running into each device and by the sensing subsystems embedded in the environment.
Any necessary development of the existing MobiComp infrastructure will be undertaken by UNIKENT as part of its current obligations under the CI activity (WP3.3). Additional tasks directly addressed in this NEWTON project, and undertaken jointly by the named partners will include (i) modularisation of the MobiComp components to support application composition using the Application Builder in A3, and (ii) development and testing of the generic sensor interface based on extensions to the current MobiComp Tracker components.

**Deliverable D2:** Report defining the software interface to the sensor systems (Month 12)
**Deliverable D3:** Report defining the "Context Management Infrastructure" (Month 12)

- **ACTIVITY A3: Application Builder**
  - **Partners involved: POLIMI / UNIBO / DS**
  - **Responsible:POLIMI**

This is a software development and integration activity. The expected result is a prototype of the *Application Builder*. The development of the Application Builder involves the following activities:
- Design and implementation of the application schema specification tool (a customization of existing UML based tools)
- Design and implementation of the *Context-Aware Data Capture Interface*
- Design and implementation of the *Content Manager Interface* (in charge of retrieving the contents according to the current context of use)
- Design and implementation of the *Presentation Engine* (in charge of presenting the retrieved contents on the delivery device)
- Testing and validation using two reference platforms as identified in Activity A1.
  Potential candidate devices include:
  → PDA like platforms with Windows CE or Pocket PC
  → Tablet like platforms with Windows XP or Linux

**Deliverable D4:**
4.1 Design of the Application Builder components (month 4)
4.2 Initial prototype of the Application Builder (month 8)
4.3 Implementation and testing of the Application Builder components (month 12)

- **ACTIVITY A4: Contextualized authoring**
  - **Partners involved: UNIBO/POLIMI/UNIKENT**
  - **Responsible: UNIBO**

This is a design and integration activity. With reference to Fig. 1, within this activity the guidelines shall be defined to import EPOCH conformable CH data, including the output of other NEWTONs (for example *Versatile 3D acquisition, Authoring tools for 3D experiences, Populating 3D environments, Web tools for joint experiences*). These CH data should be mapped into contents for context-aware mobile applications, in order to extend the user perception level and catalyse engaging learning experiences on-site. The following aspects related to the contents perceived quality shall be handled: platforms, computational load, codecs, bandwidth, protocols, context and power constraints, user needs.

**Deliverable D5:** Report with "Authoring guidelines and procedures for context-aware mobile applications" (Month 12)
In addition to its essential contribution to this NEWTON project, this activity addresses some of the **Supportive Measures** assigned to the **CI (WP3, activity 3).** UNIBO shall carry out this activity using the pre-allocated budget included in the JPA.

- **ACTIVITY A5: "Data capture end"**
  - **Partners involved: UNIKENT, UNIBO, plus two additional partners with suitable field sites**
  - **Responsible: UNIKENT**

This is a NEWTON application and testing activity. It intends to demonstrate the effectiveness of the approach taken when context-aware data capture applications are addressed. Additional partners with suitable field sites for testing and evaluation will be confirmed in Activity 1.
This activity includes developing a suitable profile for the "Application Builder" to enable composition of "data capture end" applications. This will then be used to construct mobile and server node applications appropriate for the data collection requirements of the selected partner field sites. The approach will be equally applicable to field survey and excavation data capture, hence this activity can also be seen as a response to the NEWTON topic "recording of archaeological excavations" in the technology area: "4) RECORDING/DATA REPRESENTATION". The intended showcase is described in para. 6.

**Deliverable D6:** "Data capture end" Showcase DEMO (Month 13)

- **ACTIVITY A6: "Dissemination end" showcase**
  - **Partners involved: ALL**
  - **Responsible: UNIBO**

This is also a NEWTON application and testing activity. It intends to demonstrate the effectiveness of the approach taken when a context aware dissemination application is addressed. It will also demonstrate the level of integration reached inside and outside the proposed NEWTON (Intra/Inter NEWTON integration) and impact on the CI.
The target field site shall be defined in activity A1.

**Deliverable D7:** "Dissemination end" showcase DEMO (Month 13)

The budget shall be taken by the pre-allocated budget included in the JPA. In fact this activity supports the NEWTON dissemination, and also, it addresses issues included within the following proposed CI project: Topic: **Contextual Cultural Information,** Technology area: "3) MOBILE/WEARABLE/AMBIENT SYSTEMS"

- **ACTIVITY A7: Verification & Validation**
  - **Partners involved: ALL**
  - **Responsible: IBC**

This is an assessment activity and all of the partners are involved. Both, the tools and the showcases, shall be evaluated. The tools shall be validated and evaluated to provide answers to the following questions:
• How effectively do they fit within the CI?
• To what extent are they conformable with adjacent NEWTONs?
• How effective and useful is the proposed architecture?
• How much are the tools focused on the state-of-the-art mobile technology (platforms, sensors, interface devices such as displays, TTS and STT/ASR tools,…..)?
The showcases will be evaluated through **usability** analysis and user testing. Usability analysis of **both** showcases shall be carried out using the SUE-Mile method [8]. User testing shall be carried out with ad-hoc questionnaires. This activity shall provide the required feedback to allow EPOCH to move one step forward towards the next step.

**Deliverable D8:** Final Report on Usability analysis and tool evaluation (Month 15)

This activity shall be supported by the pre-allocated budget included in the JPA. In fact it considers the NEWTON from the point of view of the CI integration, and it also addresses issues included within the following proposed CI project:
Technology area: "3) MOBILE/WEARABLE/AMBIENT SYSTEMS"
Topics: **Supportive measures** and **Contextual Cultural Information**

➢ **ACTIVITY A8: Showcase dissemination** (subject to availability of additional funding)
The showcases set up within activities A5 and A6 will be designed as application examples suitable for dissemination. This activity (A8) shall be carried out using the NEWTON Extra-budget for dissemination, if available. Potential ways for CIMAD results dissemination may include:
• presentations and demos at conferences
• dedicated events at the showcase field sites agreed (to be specified in activity A1)
• dedicated seminars aiming to support other partners in building their own CIMAD showcases
• presentation and documentation on EPOCH web site
• any other sustainable way agreed with EPOCH management

**MILESTONES & DELIVERABLES:** See section 7, *Timetable*

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## 5. Related activities

**UNIKENT Achievements**
UNIKENT receives the following current funding within EPOCH JPA18

2.4 Showcase Integration: 8k (1PM) months 1-12 only
3.3 Common Infrastructure: 42k (6PM)
4.2 Standards and Evaluation: 18k (3PM)

To date (month 10), approximately 5PMs of effort and 40% of this budget have been expended in rough proportion to the above figures. Involvement in two showcases (3 and 7) has resulted in a higher than originally expected effort and expenditure in this area. This additional effort can mostly be characterised as infrastructure support for the showcases, with a smaller component of standards related work.

We are developing the initial prototype *jnet* 'Harris Matrix' tool to the point where, following completion of showcase 3 (Tool for Stratigraphic Data Recording), an initial public release will be possible. A variant of the same tool is also being used to provide infrastructure support for showcase 7 (Archaeological Documentation for the Semantic Web). In this case the tool is employed for visualising document structure in a CIDOC CRM compliant form. One infrastructure and standards related result from this work will be to enable *jnet* to be used as a component of a CRM compliant excavation recording system, with the capability to run on handheld, desktop and server platforms.

Our other main focus is in the Mobile/Wearable/Ambient area. Here, we have done further work on our existing FieldMap data collection tool (in collaboration with EPOCH partner 84 RUG) and the MobiComp context-aware infrastructure on which it is based [1,6]. MobiComp provides a simple coordination framework for sharing contextual information between distributed platforms ranging from embedded sensor devices, through handheld PDAs, phones and tablets, to central servers. It is therefore a key infrastructure component for building smart environments of the form envisaged within Mobile/Wearable/Ambient area.

So far, experience with MobiComp is limited to a very small number of applications, and this will be significantly strengthened by this project.

**UNIBO achievements**

UNIBO receives the following current funding within EPOCH JPA18

2.4 Showcase Integration: 1k (0.2PM)
3.3 Common Infrastructure: 48k (6PM)

To date (month 10), approximately 4PMs of effort and 50% of this budget have been expended.

UNIBO effort in Activity 3.3 is mostly focused on the Mobile/Wearable/Ambient area.

- Recruitment for 2005 contribution to EPOCH was carried out, with two grants assigned
- EPOCH was presented in one International scientific event (2004 IEEE Symposium on Wearable Computers) and two national cultural events
- Tools are being evaluated for integration within the CI, particularly in mobile systems, at both ends of the chain of practice in archaeology/museums; among these:
  → voice technologies (i.e Text-To-Speech and Automatic Speech Recognition tools and frameworks), including their impact on power consumption and CPU usage; the tools under evaluation are: ScanSoft and SVOX, with VXML coming next)
  → head-up and head-worn displays for fruition in outdoor archaeological sites
  → Context management frameworks including EQUIP (University of Nottingham, EU supported), LocationStack, (Intel Research, Seattle), and, obviously, MobiComp (UNIKENT) and GEOLOC (Ducati Sistemi S.p.A.)
- An experimental integration activity of EQUP mobile cooperative support within the WHYRE framework was carried out during a research period at the Augmented Reality Lab in Nottingham (this activity being cofunded by UNIBO)

Power and resources management/optimization is also a key aspect in mobile systems. In this respect, they are being defined and tested procedures to evaluate multimedia contents from the point of view of the "quality" versus impact on power and resources usage in mobile systems. Models to use context information for activity recognition are being investigated, with the goal of supporting the interface, the presentations and the resource management of mobile devices.

**UNIKENT: relation between CI and NEWTON - future plan within the CI**

The proposed Newton project will bring together partners with a range of complementary experience in smart environments with the aim of ensuring that MobiComp is developed to the point where it can applied

throughout the spectrum of CH applications. UNIKENT will provide development and core support for MobiComp as part of its contribution to the 3.3 CI in order to match the requirements produced in Activity A1. The subsequent modularisation of the infrastructure and sensor support will take place as a joint effort within this Newton under Activity A2.
One of the proposed showcase applications will then explore the extent to which it is possible to create configurable data capture tools of the complexity of FieldMap using the Application Builder and a kit of modular components. The other proposed showcase builds on the experience of UNIBO, DS and IBC in mobile museum guides to show how a similar architecture and tool set may be used to develop mobile dissemination systems.

**UNIBO: relation between CI and NEWTON - future plan within the CI**
UNIBO will contribute inside this NEWTON project with the development of some support systems to the MobiComp infrastructure. For example we will bring together our sensory system and the above infrastructure. This will take place with the implementation of "Trackers" and "Aggregators" for the infrastructure.
With reference to the Activities listed in para.4, the following activities assigned to UNIBO are related to the Newton integration within the CI or address issues included in voted CI projects: A4, A6, A7 (see para.4).

**POLIMI: funding and relation between CI and NEWTON - future plan within the CI**
In JPA18, POLIMI is involved in WP1 (Project Management): 0.2 PM (as member of the Board of Directors) and WP4: 3 PM (Specific sub activity: 4.2 Standards and Evaluation). Its main activity so far has been therefore focused on WP4, with the development of a field study questionnaire for exploring current practices and standards in usability and design, as well as in dissemination of know-how in usability evaluation and accessibility assessment (Tutorial at VAST'05).
In addition, although POLIMI has no involvement WP3.3, neither in the current JPA18 nor JPA19-30, it has been participating in the WP3.3 activities, collaborating with UNIBO, attending meetings, contributing to the inventory of available/existing technologies.
In EPOCH activities for the next period (months 19-30), POLIMI can contribute to WP3.3 in supporting a stronger integration of CIMAD results in the Common Infrastructure. In particular, POLIMI effort will be devoted to increase the robustness, modularity, and flexibility of the Application Builder, re-engineering its functionality and its software interfaces to the other CI components. The Application Builder is located at the very end of the EPOCH pipeline, being essentially a tool for conveying CH multimedia resources to the end user thorough navigational interfaces on mobile devices. By its very nature, the Application Builder can be potentially integrated with any CI component that provide multimedia contents in the required Application Builder interchange format, thus becoming a tool for *fast prototyping* of interactive multimedia applications on mobile devices. Finally, the results of activities A4, A6, A7 (see para.4), in which POLIMI is involved, address issues included in several voted CI themes.
*(Notice: For all the above considerations, and also observing that POLIMI effort is equivalent in this Newton activity to the one of UNIBO and UNIKENT, the requested contribution is €33k from the NEWTON call and €27k on the WP3.3 budget of the future JPA19-30)*

## 6. NEWTON showcasing

In the last period of the CIMAD project, two showcases will be set up, one for each "end" of the chain of practice in archaeology and museums: data capture and dissemination. As shown in para.4, subpara. ACTIVITIES, the showcases shall be set up within two dedicated activities (A5 and A6). ACTIVITY A7 will be dedicated to usability analysis, user testing and infrastructure evaluation.
The context-aware platforms will be chosen according to the selected CH site constraints and user needs. The showcase software will be developed using the same "application builder" and have similar capabilities, but will employ different policies and different contents.
Both showcases will be set up according to the infrastructure user manual (see deliverable D1). Together with the usability reports, the user manuals will act as an encouragement to further showcasing for NEWTON results dissemination.

• **Showcase on Data Capture**
The software for this showcase will be modelled on the functionality of the existing FieldMap application [1]. The application will provide a simple portable GIS interface in which multiple layers of raster and vector spatial data may be displayed. Data including annotated spatial objects, measurements and images are collected in field survey campaigns, or on-site in an appropriate format to be transferred to EPOCH conformable repositories. Compliance with EPOCH Standards will ensure that tools developed in other NEWTON projects or in the CI could share this content.
The new application will be composed from modular components using the Application Builder, and deployed on handheld and tablet devices in the field. Evaluation will be undertaken at the field sites of two EPOCH partners (awaiting agreement to be finalised within activity 1), one with previous experience of using FieldMap, and one with no previous experience of context-aware field tools. A single portable server node will be used at each site for context coordination, device synchronisation, and data transformation. Where it is appropriate to use wireless networking onsite, such updating and data sharing will take place whenever nodes are within range.

• **Showcase on Dissemination**
An application showing on-site context-aware access will be presented. During **activity 1 (see para.4)**, the site most suitable for the showcase will be chosen. Main candidate sites are Pompeii, la Certosa e Museo di San Martino in Napoli and the University Museums in Bologna. Contents shall be generated using CIMAD contextualized authoring module, starting from EPOCH conformable CH data. For example it is expected to import and adapt models originated by other NEWTON projects (for example the tool addressing the the topic "Versatile 3D acquisition", submitted by ISTI-CNR and KUL . We may also have WHYRE as CIMAD mobile device in this SHOWCASE.

## 7. Timetable:

**ACTIVITIES**

| ACTIVITIES | MONTHS | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| A1 | | | | | | | | | | | | | | | |
| A2 | | | | | | | | | | | | | | | |
| A3 | | | | | | | | | | | | | | | |
| A4 | | | | | | | | | | | | | | | |
| A5 | | | | | | | | | | | | | | | |
| A6 | | | | | | | | | | | | | | | |
| A7 | | | | | | | | | | | | | | | |
| A8 | Activity A8 will be carried out starting on month 15, if funded | | | | | | | | | | | | | | |

**DELIVERABLES and MILESTONES**

| DELIVERABLES | | MONTH |
|---|---|---|
| D1 | Report on activity A1 (Specifications and Planning) | 3 |
| D2 | Report defining the software interface to the sensory systems | 12 |
| D3 | Report defining the *a posteriori* "Context Management Infrastructure" architecture | 12 |
| D4 | 4.1 Design of the Application Builder components | 4 |
| | 4.2 Initial prototype of the Application Builder | 8 |
| | 4.3 Implementation and testing of the Application Builder components | 12 |
| D5 | Report with "Authoring guidelines and procedures for context-aware mobile applications" | 12 |
| D6 | "Data capture end" Showcase DEMO | 13 |
| D7 | "Dissemination end" showcase DEMO | 13 |
| D8 | Final Report on Usability analysis and tool evaluation | 15 |
| MILESTONES | | |
| M1 | First CIMAD prototype ready | 12 |

## 8. The project in numbers:

**OVERALL FIGURES**

| | |
|---|---|
| Duration of the project | **15 months** |
| requested project budget | **€113.95k** |
| Subdivision | **€33k** each for POLIMI, UNIKENT, UNIBO;<br>**€7.2k** for IBC, **€7.75k** for DS |

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| **Alma Mater Studiorum - Università di Bologna – UNIBO** | **Partner n. 30 (Cost model: AC)** |
|---|---|
| number of *additional* person months | 3PM |
| *Additional* labour cost | €18k |
| other costs, with short justification | €5k travel (project meetings, field trials)<br>€3.4k hardware (additional mobile devices for project use by UNIBO and IBC) |
| Overhead (20% of additional direct costs) | €6.6k |
| Total for partner | **€33k** |

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| **University of Kent - UNIKENT** | **Partner n. 52 (Cost model: AC)** |
|---|---|
| number of *additional* person months | 3PM |
| *Additional* labour cost | €18k |
| other costs, with short justification | €4k travel (project meetings, field trials)<br>€4.4k hardware (additional mobile devices for project use by UNIKENT and additional testing/showcase partners) |
| Overhead (20% of additional direct costs) | €6.6k |
| Total for partner | **€33k** |

---

| **Politecnico di Milano - POLIMI** | **Partner n. 29 (Cost model: FC)** |
|---|---|
| number of person months | 6PM |
| labour cost | €36k |
| other costs, with short justification | €4.7k travel (project meetings, field trials) |
| Overhead (70.3% of labour cost) | €25.3k |
| total eligible costs for partner | €66k |
| Requested budget to NEWTON (50% of eligible costs) for partner | **€33k** |

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| **Ducati Sistemi S.p.A. - DS** | **Partner n. 32 (Cost model: FC)** |
|---|---|
| number of person months | 1.5 |
| labour cost | €9k |
| other costs, with short justification | €2k travel (project meetings, field trials) |
| Overhead (50% of labour cost) | €4.5k |
| total eligible costs for partner | €15.5k |
| Requested budget to NEWTON (50% of eligiblecosts) for partner | **€7.75k** |

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| **Istituto per i Beni Artistica, Culturali e Naturali della Regione Emilia Romagna – IBC** | **Partner n. 68 (Cost model: AC)** |
|---|---|
| number of *additiona*l person months | 0.5 |
| *Additional* labour cost | €3k |
| other costs, with short justification | €3k travel (project meetings, field trials) |
| Overhead (20% of additional direct costs) | €1.2k |
| total for partner | **€7.2k** |

NOTE: UNIBO and UNIKENT will contribute matching efforts in PMs from their current WP3.3 Common Infrastructure budgets. Part of the proposed contribution by POLIMI is, in effect, a contribution to the CI. For this reason we request an additional €27k from unallocated CI budget to support this contribution.

## *7. VIRTUMAN*

# Virtual Human Open Simulation Framework for Cultural Heritage

February 9th 2005

**Keywords:** VR/AR System architecture, real-time application development frameworks, software integration, middleware, virtual human simulation, cultural heritage applications

# 1. PARTNERSHIP

| Affiliation (EPOCH number) | Key Researchers | Contact | Email |
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| EPFL- Ecole Polytechnique Fédérale de Lausanne (50) | Professor Dr. Daniel Thalmann | Phone: 0041-(0)21 693-5214<br>Fax : 0041-(0)21 693-5328<br><br>Address:<br>EPFL<br>IC ISIM VRLAB<br>Station 14<br>CH-1015 LAUSANNE | Daniel.Thalmann@epfl.ch |

# 2. PRIORITY

This proposal aims to set up an infrastructure project for the topic "**Avatar Standards for Cultural Heritage**" of the priority **7 Virtual Humans / Avatars.**

Currently, in EPOCH virtual humans are already considered and we propose to extend existing activities by developing **a real-time integrated platform for mixed reality cultural heritage populated storytelling realistic simulations** and by **delivering open source tools and software for direct application in EPOCH showcases**. Furthermore, regarding standardization, we propose to use the **existing MPEG standards such as MPEG-4 FAP** for facial animation of the avatars, **MPEG-4 AFX BBA** for body animation, and **extend these specifications with**

requirements coming from the **Cultural Heritage** scope, through the already existing involvement of partners in MPEG.

# 3. TECHNICAL PROPOSAL

## 3.1 GOALS

Modern 3D VR **systems** relay heavily on the **interplay** of **heterogeneous technologies**. Because of that inherently interdisciplinary character the VR domain can be viewed as a **melting point** of **various technologies** which although complementary are non-trivial to put together. Many of those technologies attract a lot of individual R&D interest but their integration is still not generally understood and there are **barely any** accepted **guidelines** and **approaches** for **integration** of those **functional** artifacts under the umbrella of *a single consistent framework*. In other words we now have many excellent exemplar of individual atomic technologies but still we lack a well understood and generally accepted strategy for putting them together so that they provide *a whole which is bigger than the simple sum of its parts*. The missing element is **an open source *framework* to glue them together**. This would **curb the complexity** and **make** the **resulting** system machinery a **consistent** and seamless **unity**, leaving at the same time **open handles** and hooks for **replacements** and **extensions**. In this proposal, the **basic components** of such a **middleware** framework will be **released** with full source code to the EPOCH community, based on many years of research and development undertaken by MIRALab and VRLab. This proposal aims to enhance the development of the interactive audio-visual real-time systems featuring real-time virtual character simulation for cultural heritage, depicted in **Figure 1** and **Figure 2**. As described in [1], there are already numerous available 3D engines and platforms but none of them supports VR/AR virtual character simulations in the extendable, customizable and configurable manner that cultural heritage simulations require and VHD++ provides. The main **goal** is to offer **complete** and highly realistic source code libraries for virtual human simulation with body animation, skin deformation, facial animation, speech, in realistic 3D environments as they were already developed, tested and highly used in numerous EU projects [depicted in following figures].

**Figure 1** JUST immersive VR situation training of health emergency personnel and LIFEPLUS virtual life simulation in ancient Pompeii.

**Figure 2** CAHRISMA and ERATO VR reconstruction, preservation of cultural heritage with virtual character simulations in ancient mosques and theatres

## 3.1.1 Background

MIRALab and VRLab have already advanced with the implementation of a modern real-time **framework** codenamed **VHD++ [1]** (**Figure 2**) and successfully adopted it in various EU projects: JUST, CAHRISMA, STAR, LIFEPLUS, ERATO and ETailor. The complete VHD++ **framework** provides an efficient research environment a) offering full power to researchers and at the same time b) allowing them to easily publishes their research results in form of ready to use, **plug-able Services** (plug-ins encapsulating heterogeneous technologies) that are plugged to the generic Runtime Engine, as depicted in the following **Figure 3**. These Services encapsulate the heterogeneous technologies in order to **cope** with real-time **VR/AR character simulation demands**.

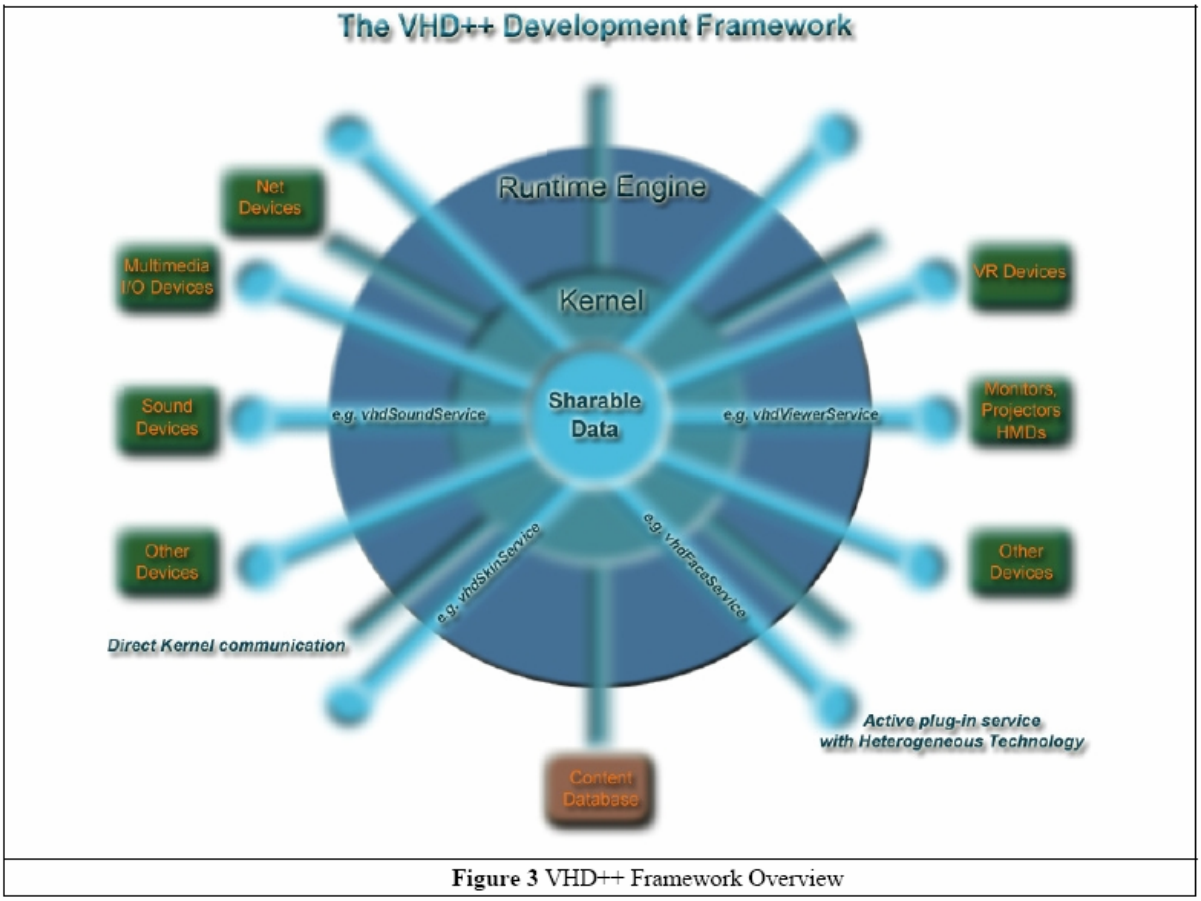



**Figure 3** VHD++ Framework Overview

The University of Brighton experience arises from the relatively recent transfer of Prof Arnold from UEA and has led to the establishment of Brighton as Coordinator of the EPOCH FP6 NoE on Technology and Cultural Heritage. A new usability lab is also being established for opening in 2005 again building on the experience of the Visualisation lab at UEA and other projects at Brighton.

## 3.1.2 Objectives

Hence the main challenge that MIRALab and VRlab will undertake is: **elaboration of methodology**, **guidelines**, **architectural**, **design** and **behavioral** patterns leading to the *construction* of a **vertical middleware framework** that would support development of the interactive audio-visual real-time systems featuring efficient real-time virtual character simulation especially for 3D Virtual Heritage Simulation.. The goal of this proposal is to **release** as **open source** the **basic VHD++** kernel and plug-in technologies to enable 3D virtual character simulations in 3D cultural heritage environments.

## 3.2 PARTNERS ROLES

MIRALab and VRLab have been actively working towards releasing **a sub-set of the above services** to the opensource community. However, considerable amount of development effort has to be given in order to **ensure the interoperability** of this subset of services and the **portability/usability** of the provided **source code** (e.g. dependencies to third party libraries etc.). Hence MIRALab is **proposing** to **release**

- the **basic** virtual **human** and 3D **environment** VHD++ **rendering** services and libraries with **full source code** to the EPOCH-NEWTON.
- the main virtual human body skinning and facial animation libraries

VRLab will be working according to the above principles and towards releasing:

- the main **Kernel** and **Runtime Engine libraries** of VHD++ with full source code to the EPOCHNEWTON community
- the virtual human animation engine
- the framework interactive scenario scripting involving various characters

The University of Brighton would be responsible for tool evaluation and testing the resulting acceptability of experiences generated using the tools. In addition this project will be integrated with the Natural Language Infrastructure work being undertaken by Brighton under Activity 3.3

## 3.3 DELIVERABLES AND MILESTONES

- D1: VHD++ open source Specification and Documentation
- D2: VRML97 and HANIM parser (library for VRML97 and H-ANIM Parsing)
- D3:VRML97 and HANIM loader (library for loading VRML97 and H-ANIM virtual characters )
- D4 : VR/AR Renderer for Virtual Characters (main VR/AR character rendering service )
- D5 : Virtual Human Deformation (virtual human body deformation service )
- D6 : Virtual human Facial Animation and Speech (virtual human voice service )
- D7 : Virtual human Body Animation (virtual human body animation service )
- D8: Framework Kernel (basic VHD++ framework)
- D9: Framework RunTime Engine (basic VHD++ application layer)
- D10: Framework Action Scripting Engine (python scripting capability of all VHD++ exposed functionalities)
- M1 Complettion of Specification
- M2 Main Virtual Character simualtion SDK
- M3 Basic framework prototype application
- M4 Showcase Demonstrator
- M5 End of Project

### 3.3.1 Standards

This section is a description of MIRALab's (MIRALab - University of Geneva) activities within the Motion Picture Experts Group (MPEG), or as it is more formally known ISO SC29WG11. This report consists of an overview of our work, and a list of our latest contribution to MPEG during the project duration.

MIRALab has been an active participant to the MPEG Standardization group almost since the introduction of graphics into the MPEG-4 standard. During the initial phase our contribution mainly focused on the face representation and animation within the Synthetic and Natural Hybrid Coding (SNHC) sub-group. The majority of our work was completed at the end of the year 1999 when all the contributions were combined into a single document and made into an International Standard by the International Organization for Standardization (ISO). We are now continuing our activities on core 3D representation and animation technologies in this group, as well as launching investigations and specifications of descriptors for 3D data in MPEG-7, and adaptation of 3D content in MPEG-21 Digital Item Adaptation (DIA).

MIRALab has made several contributions mainly to MPEG-21 (Content Control), centered on the scaling and adaptation of virtual humans towards different target devices and networks, and will be continued during this project.

University of Brighton has worked on the use of OpenSG in showcase 4. This experience has resulted in inputs back to the OpenSG standardization efforts.

# 4. RELATED ACTIVITIES

## 4.1 MIRALAB AND VRLAB TASKS IN ACTIVITY 3.3

It consists in designing and implementing the common infrastructure. The activity will start on Month 13 for both partners and the main goal is the Investigation and integration of different relevant technologies dealing with Virtual Human and Avatar:

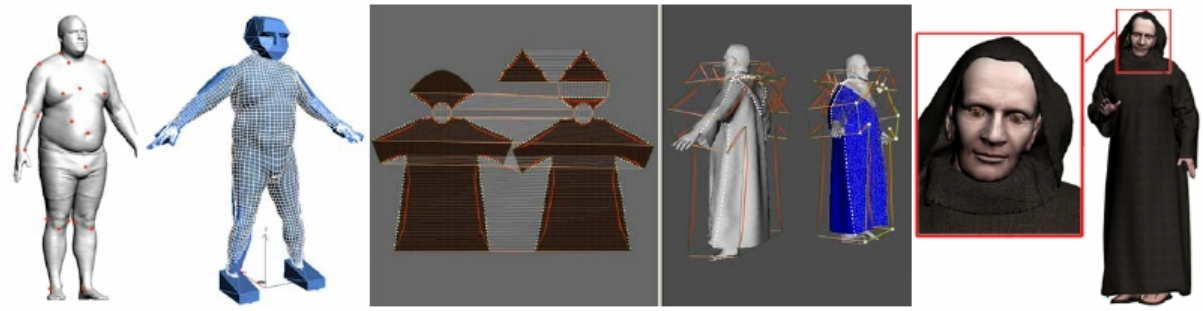
- putting together inventories of available / existing technologies according to the above categories
- identify relevant formats and standards for these categories, and analyze them from a CH point of view
- technical benchmarking of those technologies compatible with CH needs

## 4.2 MIRALAB TASKS IN ACTIVITY 2.4.6 – SHOWCASE INTEGRATION

MIRALab is involved in the showcase 6, "Avatar based interactive storytelling". The archeological site of Ename and its abbey has been chosen for the 3D simulation of the daily life inside the Abbey during the 12th century. The main objective in this activity is focused in utilizing virtual humans to illustrate social structure, trades, and daily activities. The component we provide has been integrated in a "virtual" walk-through composed of a series of several interlinked panoramas at various points in the archeological site of Ename and its abbey.

The virtual human technologies being employed in this activity are as follows:

- **V**irtual humans' creation,
- Virtual humans' animation,
- Virtual cloth simulation.



## 4.3 VRLAB TASKS IN ACTIVITY 2.4.2 – SHOWCASE INTEGRATION

EPOCH showcases 2.4.2 present a reconstruction of the abbey of Ename and its inhabitants in historical times from around 1050 A.D. in a 3D scenario. The aim of the scenario is to present the "kromstaf" (a crosier) as it was used in historical times. The scenario shows the monks and the abbot walking in the "ambulatory" part of the abbey, entering the church and performing a religious ceremony.
VRLab's tasks are:

- **Design** of the virtual monks and the abbot who were populating the abbey around 1050 A.D. based on historical descriptions of their clothes, shoes, hairstyles, etc.
- **Animation** of these virtual monks inside the virtual abbey (reconstructed by *EnameCenter*). Animations will be mainly of walking with the following constraints: specific walking path range, varying speed, ensuring a diversity of walking personifications, avoiding collisions with the environment and between the virtual humans.
- **Rendering** of the whole scene into a video sequence which will be used in the final multimodal interface to present the "kromstaf".

## 4.4 BRIGHTON TASKS IN ACTIVITY 3.3

Working on Natural Language Infrastructure

## 4.5 BRIGHTON TASKS IN ACTIVITY 2.4.4 – SHOWCASE INTEGRATION

University of Brighton has worked on the use of OpenSG in showcase 4. This experience has resulted in inputs back to the OpenSG standardization efforts.

# 5. NEWTON SHOWCASING

This platform is proposed to be an **object oriented modular software platform** providing a necessary set of programming tools facilitating consistent development of applications dedicated to **author and perform audiovisual interactive simulation of 3D virtual environment (VE) with virtual humans (VH)**. VE is assumed to be a collection of spatially localized elements possessing appropriate and distinguishable properties. VE simulation is assumed to be a time-based representation of subsequent transitions reflecting mutual and dynamic relationships between the VE elements and the VH.
The proposed platform will cater the following needs

- Real-time 3D VE simulation framework (player/client) adhering to XML, VRML97, X3D, H-ANIM 1.1, and MPEG-4.
- The platform will also act as a tool for specific application development for Virtual Reality environments
- The use of an object oriented programming language such as C++ (VC++, CC), Java, Python
- Platform independence (OpenGL, win32)
- Well defined plug-in architecture – Plug-ins can be a dll in the case of C++ development or a Python module/package
- For GUI, it is mainly QT or Python.
- Real-time rendering – OpenScenegraph Open source renderer that is available on win32 as well as other platforms.

The University of Brighton will undertake the role of creating the demo showcase of this project, utilizing the above VHD++ based framework:

- **Accurate virtual representation of historic and cultural landmarks** – High-quality graphic realism, interactive visualization and scientific accuracy of the models, are the primary demonstration aims.

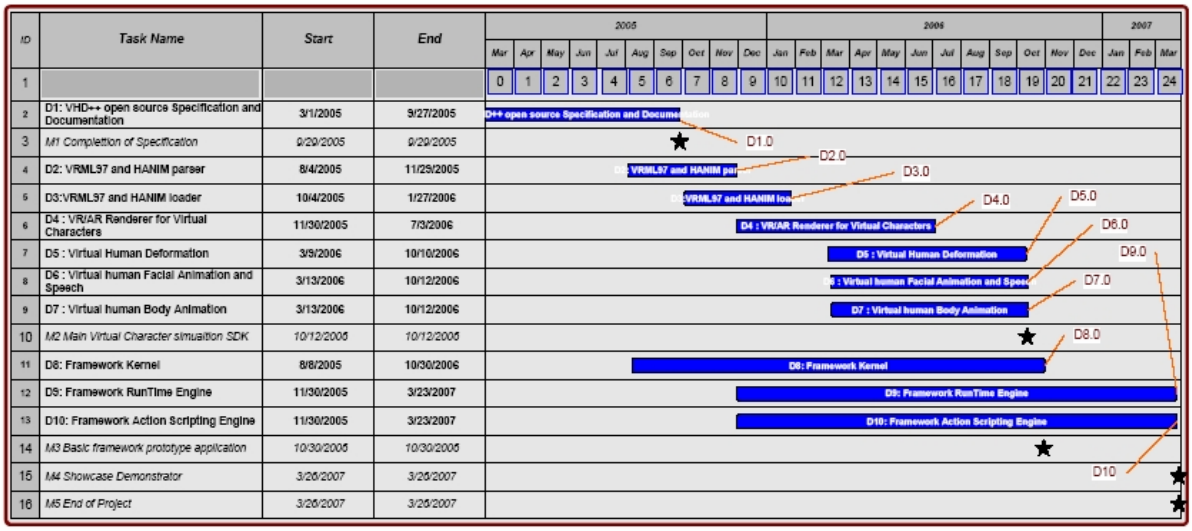
- **Realistic virtual embodiments** - One of the main objectives in this project is to have virtual embodiments of humans for representing the participant and the people of a certain era. Comlete and realistic simulation of the ancient characters will involve body animation, deformation, speech and scenario scripting for the creation of virtual storytelling.

- **Interactive navigation** - The advanced path finding techniques borrowed from the robotics field will minimize the difficulties world travelers often have in finding their way in large, unfamiliar Virtual Environments. These new path finding techniques will enable travelers to best find their way to locations of interest and then find their way back to locations previously visited. In addition, the ability to ask the virtual humans about their way to locations will also be available.

This framework will be suitable for producing a showcase and if EPOCH decides this is part of dissemination an additional budget will be sought. This would comprise a scripted example of using the tools to create a populated interactive virtual environment (based on models produced elsewhere in EPOCH) and a run-time system produced using the tools, for visitor exploration/evaluation.

# 6. TIMETABLE

## 6.1 DIAGRAM WITH MILESTONES AND DELIVERABLES




# 7. THE PROJECT IN NUMBERS

This project is expected to last two years in total, including the specification, the development and the test and validation phases of the tools and platform. The overall targeted budget is 173.6 kEuros.

The following table details figures per partner:

| Partners | Number of PM | Labour Cost (Euros/PM) | Other Costs (Euros) / Justifications | Overheads (Euros) | Total (Euros) |
|---|---|---|---|---|---|
| **MIRALab** | 12 | 5280 | 0 | 10240 | 73600 |
| **EPFL** | 12 | 5280 | 0 | 10240 | 73600 |
| **Brighton** | 4 | 4500 | 4000 | 4000 | 26400 |

# 8. REFERENCES

[1] [VHD++03] Ponder, M., Papagiannakis, G., Molet, T., Magnenat-Thalmann, N., Thalmann, D., VHD++ Development Framework: Towards Extendible, Component Based VR/AR Simulation Engine Featuring Advanced Virtual Character Technologies, IEEE Computer Society Press, Proceedings of Computer Graphics International (CGI), pp. 96-104, 2003

# 9. NOTE

According to our contacts with the University of East Anglia and University of Brighton there is an overlap of our proposal with the proposal „Tool creation for populating environments with interactive avatars and crowds for cultural

heritage applications“ and given more preparation time we could have opted for a joined proposal. The main difference lies that our current proposal focuse on high quality realistic complete virtual human simulation (body, face, speech) for both VR and AR cultural heritage storytelling simulations.

## 8. CRMAP

*1. Project title*:

# CIDOC CRM Data Mapping Tool

*2. Partnership*:

| Name | Affiliation | EPOCH # | Contact Details |
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| | | | |
| Tyler Bell<br>Technical Director | Oxford ArchDigital Ltd | 67 | 27 Park End Street<br>Oxford OX1 1HU<br>Tel +44 1865 793043<br>Fax +44 1865 794891<br>tyler.bell@oxarchdigital.com |
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| Ellen Jordal<br>Programmer | Unit for Digital Documentation | 39 | e.k.a.jordal@muspro.uio.no |

*3. Priority*:

2 Databases / knowledge management:
Semi-automated mapping to CIDOC

*4. Technical proposal*:

**Overview:**
This tool is a server-based application that facilitates, collates and manages the mapping of cultural heritage information resources to the CRM. The tool has been designed to achieve three specific goals:

1. *Enhance accessibility to the CRM*: the CRM is the universal tool for the amalgamation of heterogeneous cultural resources, but it remains under-utilised throughout the sector, in part because its comprehension and facility remains the domain of data specialists only. The primary goal of the application, therefore, is to make the CRM more accessible to heritage professionals.

2. *Bridge the gap between CRM theory and application*: the CRM is of course highly conceptual. This abstraction, combined with the object oriented format of the ontology, makes it a bit of an 'unknown quantity' to heritage managers and even IT specialists. The secondary purpose of this tool is to facilitate the use of the CRM as a *practical* mechanism for the mediation of heritage resources; it will do this largely through the standardised representation and delivery of CRM mappings which can in turn be employed by third-party information management applications.

3. *Serve as a repository of standardised CRM mappings*: a large number of CRM mappings have been performed by CRM professionals in the last five years, but the resultant files exist in disparate formats in multiple locations; the lack of a standardised resource makes it difficult for new data mappers to exploit the state-of-the-art and learn from best practice. The tertiary purpose of this tool is to bring together CRM mappings in a standardised format so that existing mappings can be made available to new users. The creation and exploitation of a standardised mapping format (in consultation with the CRM Special Interest Group – CRM-SIG) will allow for machine-readable comparisons between datasets, and also provide an automated mechanism to assist data mappers in creating maps of their own datasets.

At a functional level, the application is intended to assist heritage information managers in mapping their datasets to the CRM, and will provide a step-by-step 'wizard'-like interface for the mapping process. Having completed the mapping process, heritage information managers will be provided with a formalised schema of their mappings which captures the semantic structure, as well as the intellectual content, of their datasets. Of equal importance, the

system (with the user's permission) will store the results of that mapping, allowing it to serve as a repository for mappings act as a interoperability reference; it will also use existing mappings as a guide to new users, providing suggestions and pointers to exemplars for information units similar to the one being mapped.

The system will of course be multi-lingual: it will contain the CRM itself, with accompanying scope notes, in all available languages; a multi-lingual interface to the system will also be provided.

The application will take the form of a server-side program with completely browser-based interface and administration tools. Although the designers have conceived of the application a central repository for the EU cultural heritage sector, there is no reason that institutions cannot create their own instance of the application for internal mapping management. Development of the application will take advantage of existing technologies wherever possible; the result will be released under the GPL.

**Specific Requirements:**

Multilingual: the universality of the CRM must be fully exploited to facilitate mappings between languages

Provide a mechanism to facilitate mapping: the primary intention is to increase the accessibility of the CRM by providing a mechanism with facilitates the processes thorough ease-of-use, automated assistance, and the encouragement of best practice

Security layer: the system must employ a user- and group-level access control layer (ACL) so that content mangers may control access to their mappings

Long-term preservation: the system must store mappings for the purpose of ongoing interoperability and dataset documentation

Standardisation: the system must support the creation and exchange of XML schema that represent CRM mappings; this is to be developed in consultation with the CRM-SIG.

API: an XML-based API must be developed that supports the export and extraction of mappings to be usable by commercial tools and other transformation tools developed by EPOCH projects. In effect this will provide an instruction set for these separate tools to follow to perform transformations.

Specific requirements related to the mapping procedure:

- Must manage intermediate keys.
- Must provide a mechanism for record condition statements (SQL-like syntax)
- Should provide hints while mapping, and provision of similar mappings
- Must include room for notes to capture intellectual content of the mapping
- Must provide the ability to document, validate, and map against extensions to the CRM
- Must provide the ability to import schema used to describe information resource – units of information – and the schema itself.
- Must allow a mechanism to record where information units must be concatenated
- Must accommodate branching (cf. PRN example of MIDAS mapping).
- Must be able to decompose units within data and supply rules for chopping

up data in a specific field.

The system must be informative, as well as normative; the purpose is to elucidate rather than dictate

**Milestones**

This document and technical overview has been designed by the key partners – software architects and information specialists – and is confirmed as being achievable in the time required. The primary components of the application will serve as the milestones:

1. XML schema for representing CRM mappings. The need for this element as part of the fundamental CRM 'toolkit' was identified at the CRM-SIG meeting in Heraklion in April 2004; it will be developed in hand with CRM-SIG. The schema will ensure that mappings of different datasets can be compared by an automated or semi-automated process.

2. Mapping Architecture and API: the primary architecture underlying the entire application will consist of a storage mechanism for the mappings, and an interface that allows a mapping to be retrieved manually, or via an XML-based API.

3. CRM manager: one of the core components of the system will be an application that stores the CRM itself, and related scope notes in not less than three languages. The CRM manager will also provide a mechanism for user input, where comments can be made on specific classes, properties, mappings and class-property chains; the intention is to provide a means whereby the system will act as an institutional memory for the CRM mapping community. This milestone includes the process of 'loading' the CRM into the application.

4. Interface: the interface will be multi-lingual, and will automatically detect language based on browser identification. Data will be held in UTF-8 format ensure true multi-lingual capability. The interface module includes a mechanism for uploading XML definitions of existing datasets.

5. Pre-loading the system with examples of good practice: a selection of quality mappings will be pre-loaded into the system as examples of good practice and state-of-the art. These will also be used to test the system and the associated mapping intelligence.

6. Mapping intelligence: the fifth component incorporates the business logic of the application. As a user begins the mapping process, the system will reference similar mappings that already reside in the system for comparison. A 'mapping wizard' will make available links between CRM classes and the corresponding properties, ensuring that all resultant mapping are consistent with the structure of the CRM itself.

**Dissemination**

The dissemination and testing package will include up to 4 Masters Students from Southampton University who will utilise the package to map data structures from a number of

sources (probably including both research and commercial excavations). The results of their mappings will be presented at CAA2006. The tool and all documentation and training materials will be submitted to the CIDOC CRM-SIG for distribution through there website as well as through the EPOCH website. The package will be presented at CRM-SIG working meetings and will be tested with the CRM-FRBR Harmonisation Working Group of IFLA. Presentations of the software and examples of successful use of the package will be presented at a number of important CH and other conferences and fora. The current list of proposed venues includes VAST, CAA, EAA, CIDOC, ICOM, Wien Workshops, W3C, DC, ECAI, UISPP, TAG and IFLA

**Deliverables**:

1. CRM mapping application released under the GPL
2. Documentation for end users and developers
3. XML schema for recording CRM mappings, documentation and instance documents
4. XML schema dictating the format of how data definitions should be uploaded, documentation and instance documents
5. Training Materials that integrate into existing CRM training collateral

**Summary**:

It must be stressed that this application is designed as an extremely fine-grain metadata management tool, and is intended to enhance all cultural heritage projects and enterprises that may benefit from the use of the CRM. It should be regarded as independent of any particular transformation tool or environment. The market for ETL tools is mature and not specific to the cultural heritage domain, therefore we feel that separating the intellectual content of the mapping from the transformation allows this existing technology to be exploited. The system is therefore an uber-management tool which is has been designed to have significant, favourable, and long-term influence on the cultural heritage sector.

*5. Related activities*:

**Paveprime (61)**
Not involved in Activity 3.3 (Common Infrastructure).
Role in showcases: To offer advice on the use of the CRM. This tool will aid in the understanding and capture of the mappings involved in showcase 7 and produce output suitable for the control of subsequent data transformations.

**Oxford ArchDigital Ltd (67)**
Not involved in Activity 3.3 (Common Infrastructure).
Not involved in showcases.

**Unit for Digital Documentation (39)**
Not Involved in Activity 3.3 (Common Infrastructure).
Role in showcases: Participation in showcase 7, sub-case "extraction of information from grey documents into a CRM compatible format by the use of XML mark-up". The tool will ease the design of the document genre dependent XML-schemas and the mapping from these into CRM compliant databases/XML-structures.

*6. Newton showcasing*:

The tool will be showcased by the loading of a number of already completed mappings and the development of new mappings. This work is included in the development timetable as it is an integral part of development, deployment and testing.

*7. Timetable*:

| Project Part | Start Month | End Month | Deliverable/Milestone |
|---|---|---|---|
| CRM mapping Application | 1 | 4 | Beta release Month 3<br>Final Release Month 4 |
| Application Testing | 3 | 5 | Beta test document Month 4<br>Application Sign-off Month 5 |
| Documentation | 2 | 5 | Full Documentation delivered Month 5 |
| XML Export | 3 | 6 | Beta release Month 5<br>Final Release Month 6 |
| Export Testing | 5 | 6 | Beta test document Month 5<br>Export Sign-off Month 6 |
| XML Import | 3 | 6 | Beta release Month 5<br>Final Release Month 6 |
| Import Testing | 5 | 6 | Beta test document Month 5<br>Import Sign-off Month 6 |
| Dissemination, Training and Exploitation | 7 | 12 | Load key mappings as determined by CRM-SIG.<br>Develop at least 4 new mappings for archaeological, museum and archive data standards and operational data bases. |

| | | | |
|---|---|---|---|
| | | | Develop training materials and deliver the training on at least 2 occasions. |

*8. The project in numbers*:

Overall figures:

3. 12 Months
4. €113923

Per partner:

**Paveprime (61)**

1: 2 Person Months
2: Labour Cost: €2495 * 80% = €1996
3: Travel Costs: Paveprime Personnel €4000
Travel Costs: Sub-contractors €11000 This is to cover the travel of Graeme Earl and 4 Masters students to CAA2006 as part of the testing and dissemination package and for Graeme Earl to attend project meetings.
4: Overhead: 20%
5: Total: €20395 including overhead

**Oxford ArchDigital Ltd (67)**

1: 6 Person Months
2: Labour Cost: €53050 * 80% = €42440
3: Travel costs: OAD Personnel €5000
Travel costs: Sub-Contractors €6000
Sub-contractor costs for CRM experts €9200
Sub-contractor costs for Technical Author €1800
4: Overhead: 20%
5: Total: €77328 including overhead

**Unit for Digital Documentation (39)**

1: 2 Person Months
2: Labour Cost: €11000
3: Travel costs: €3000
4: Overhead: 20% on labour costs only
5: Total: €16200

## *9. TOOLS&GROOVES*

# Tools and grooves – matching tool marks with tool profiles on archaeological artefacts

***Partners***
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**Stockholm University (External partner, not a member of EPOCH)**
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Archaeological Research Laboratory (AFL)
Stockholm University
Greens villa
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***Priority***
Versatile 3D acquisition, Recording of archaeological excavations

***Technical Proposal***
Micro-topographical mapping of rock art and portable artefacts is an essential part of research at the Archaeological Research Laboratory (AFL) at Stockholm University. The applications include cut mark analysis on Bronze Age rock art (1800-500 BC) and Viking Age Rune Stones (800-1130 AD), interpretation of iconography and inscriptions on corroded bronze mounts and studies of bronze casting techniques by comparisons of fragmented moulds to the finished objects. All these studies concern ancient technology, handicraft organization and taphonomic processes. A key to the understanding of organization of handicraft in ancient times is to identify workshops and individual handcrafters. It is known that when individuals learn a handicraft, they develop their own motor performances in the various tasks involved. Translated to tool marks, this means that in the groove base a sequence of deep and shallow pits can be discerned which is unique for the individual (Kitzler, 2000). The same applies for the cross-section of the grove. Thus, this project proposes the development of *a graphic tool*

*for matching tools marks by similarity in the cross-section and in the groove base*. Since the AFL is presently engaged in the purchase of a new high resolution 3D scanner to the laboratory, this is also an excellent opportunity to develop new analytic tools in co-operation with EPOCH researchers at the Royal Institute of Technology (KTH).

Contour matching is a frequent problem within computer vision, and consequently, many documented algorithms have been developed (see, e.g., Gdalyahu & Weinshall, 1999 for an overview). Recently, contour matching algorithms have also been used within archaeology to reassemble 3D-scanned pieces of broken artefacts (e.g., Kong & Kimia, 2001, Cooper et al., 2001). Our proposed application is somewhat different from these efforts in that our proposed tool will be used for *scientific analysis* rather than reconstruction, documentation or preservation. In general, 3D contour matching is a difficult problem, but in this case we will mainly focus on two-dimensional situations. More specifically, a three-dimensional tool groove on the artefact can be represented by a set of sampled cross-sections along the groove. Similarly, the tool can also be represented as a set of two-dimensional cross-sections. Each cross-section comparison thus reduces to a two-dimensional curve matching problem.

We envisage that our tool will accept a sequence of groove cross-sections and a set of tool contours as input (these datasets can be generated from other applications already available at AFL). Then, a "percentage" match will be computed, based on a metric appropriate for the contour matching algorithm chosen. If possible, we will allow the user to choose from several matching algorithms. Our program will also provide a graphical visualization of the matching process and its results.

The project will begin by reviewing relevant literature within computer vision. Also, the problem statement will be re-formulated in mathematical terms appropriate for the algorithms in question (month 1). The outcome of the literature review will be a set of potential algorithms for testing. Then, KTH will test these algorithms in close cooperation with AFL and initiate a usability design process. For a laboratory such as AFL, it is critical that the applications we develop can be used by researchers with limited experience of computer-based analysis tools, and the Royal Institute of Technology have a long history of developing design methods for usability (e.g., Taxén et al., 2001, Lindqvist & Westerlund, 2004). Such methods may include workshops (where users and system designers work together to develop functionality and user interfaces) and situational studies (where an educationalist or ethnographer investigates the context in which the system or tool will be used). Our tool will thus be developed through iterative prototyping. In this phase of the project, the chosen algorithms will be implemented, a user interface will be developed, and the accuracy of the results will be determined by KTH and AFL. The entire phase is expected to take roughly 4 months.

During the last phase of the project, we will prepare the tool for public use (under the GNU GPL) and disseminate our results (1 month). As part of the dissemination work, KTH will design an exhibit in close collaboration with AFL and the Museum of Science and Technology that presents the tool and its context of use. The EPOCH network will also be showcased in the exhibit. KTH have a history of producing successful interactive exhibits for the museum (e.g., Taxén et al., 2003).

**Project timeline**

| Month | Activity | Deliverables (at end of period) |
|---|---|---|
| 1 | Problem statement, literature review | Literature review document |
| 2-5 | Tool development, usability work, testing | Tool prototype |
| 6 | Dissemination, exhibit development, tool distribution | Tool distribution package, exhibit at TM |

**References**

Cooper, D. B. et al. (2001). Assembling Virtual Pots from 3D Measurements of their Fragments. In *Proceedings of the International Symposium on Virtual Reality, Archaeology and Cultural Heritage* (VAST '2001).

Gdalyahu, Y., and Weinshall, D. (1999). Contour matching: problem and related work. Online report available at http://homepages.inf.ed.ac.uk/rbf/CVonline/LOCAL_COPIES/GDALYAHU/gdalyahu.html

Kitzler, L. (2000). Surface Structure Analysis of Runic Inscriptions in Rock. A method for distinguishing between individual carvers. *Rock Art Research*. 17(2), 85-98.

Kong, W., and Kimia, B. (2001). On solving 2D and 3D puzzles under curve matching. In *Proceedings of the 2001 IEEE Computer Society Conference on Computer Vision and Pattern Recognition*, 583-590.

Lindqvist, S., and Westerlund, B.(2004). Artefacts for understanding. In *Working Papers in Art and Design*, Vol 3.

Taxén, G., Druin, A., Fast, C. and Kjellin, M. (2001). KidStory: a technology design partnership with children. *Behaviour & Information Technology*, 20(2), March-April 2001, 119-125.

Taxén, G., Hellström, S.-O., Tobiasson, H., Back, M. and Bowers, J. (2003). The Well of Inventions - Learning, Interaction and Participatory Design in Museum Installations. In *Proceedings of the Seventh International Cultural Heritage Informatics Meeting* (ICHIM 2003).

***Newton showcasing***

An exhibit that presents our tool and demonstrates how it is used will be put on display at the Science Centre at the Museum of Science and Technology in Stockholm. The exhibit will also present EPOCH and its activities.

***The project in numbers***

**Overall figures**

| | |
|---|---|
| Duration: | 6 months |
| Requested project budget: | **51650 euro** |

**Per partner - KTH**

| | |
|---|---|
| Number of person months: | 6 |
| Labour cost: | 38.000 euro |
| Other costs: | 0 |
| Overhead: | 6.400 euro |
| **Total:** | *44.400 euro* |

**Per partner - TM**

| | |
|---|---|
| Number of person months: | 1 |
| Labour cost: | 5.000 euro |
| Other costs: | 1.000 euro |
| Overhead: | 1.250 euro |
| **Total:** | *7.250 euro* |

## 10. UNDERWATER

Eidgenössische Technische Hochschule Zürich
Ecole polytechnique fédérale de Zurich
Politecnico federale di Zurigo
Swiss Federal Institute of Technology Zurich

**Institute of Geodesy and Photogrammetry**

*ETH-Hoenggerberg*
*CH-8093 Zurich*

Zurich, 9.2.2006

*Prof. Dr. A. Gruen*
*Photogrammetry and Remote Sensing*

*Phone: + 41 1 633 3038*
*Fax: + 41 1 633 1101*
*e-mail: agruen@geod.baug.ethz.ch*

PROPOSAL FOR EPOCH NEWTON PROJECT (2)

**1. Title of proposal:** Calibration and 3D modeling in underwater photogrammetry

**2. Partnership:** Prof. Dr. Armin Gruen, EPOCH Partner No. 48, Institute of Geodesy and Photogrammetry, ETH Hoenggerberg, 8093 Zurich, Tel. 0041 1 633 3038, Fax 0041 1 633 1101, agruen@geod.baug.ethz.ch

We were a bit surprised to find the issue of underwater photogrammetry being voted for as a priority topic and as a matter of fact we could not identify a partner among the EPOCH members to set up a joint project. Since we have a longstanding experience in multimedia photogrammetry (including underwater applications) we believe that we can contribute something substantial to this topic.

We assume that we are, among all EPOCH partners, the group with the most experience with multimedia photogrammetrie. Therefore we would like to ask the EPOCH Executive Committee to establish the contact with other groups interested in this topic.

**3. Priority:** 4 Recording/data representation: Underwater data collection and photogrammetry

**4. Technical proposal:** We started our work in multimedia photogrammetry in 1990 with the development of a PTV (Particle Tracking Velocimetry) system for the measurement of

turbulent flow in water. This system includes the following components for underwater photogrammetry: Sensor model, calibration procedure, orientation methods, image analysis techniques, automated 3D measurement routines. This system is now used regularly in scientific applications in the Institute of Hydromechanics, ETH Zurich. It has also been acquired by the following Universities: TU Dresden, Universität Innsbruck, Cambridge University, University of Plymouth. It is considered the worlwide leading system for the 3D measurement of turbulent flow by PTV. It has been adapted to measurements under zero gravity in MASER rockets and has been extended to be used with a highspeed CCD camera for the measurement of chemical reactions under turbulent flow.
We would make the system components and our experience available for this project. The main work would consist in the adaptation to archaeological applications.
For more information on our system see www. photogrammetry.ethz.ch under PROJECTS and the References.

**Milestones and deliverables:** To be adjusted to the project requirements.

**5. Related activities:** NA

**6. NEWTON showcasing:** We can use the results of this project to build up a new showcase, demonstrating the use of photogrammetry in underwater applications.

**7. Timetable:** Depends on the overall project.

**8. The project in numbers:**
Duration of project: 1 year
Requested budget: EU 55K

1. Number of person months: 12 months researcher
2. Labor costs: EU 50K
3. Other costs:
4. Overhead: EU 5K
5. Total: EU 55K

**References**

Maas, H.-G., 1992: Digitale Photogrammetrie in der dreidimensionalen Strömungsmesstechnik. Dissertation Nr. 9665, ETH Zurich.

Maas, H.-G., 1997: Mehrbildtechniken in der digitalen Photogrammetrie. Mitteilungen Nr. 62, IGP, ETH Zurich, 118 pages.

Maas, H.-G., Stefanidis, A., Gruen, A., 1994: From pixels to voxels – tracking volume elements in sequences of 3D digital images. IAPRS, Vol. 30, Part 3/2.

## *11. 3DSOUND*

### Proposal for a Epoch NEWTON project

*1. Project title*: Immersive culture heritage experience through wireless 3D-sound system for binaural reproduction.

*2. Partnership*:
Peter Lundén, Interactive Institute, Box 7964, 90719 Umeå, Sweden, plu@tii.se, EPOCH participant #46

Prof. John Waterworth, Interactive Institute, Box 7964, 90719 Umeå, Sweden, john.waterworth@tii.se, EPOCH participant #46

*External partner not financed by this project:*

Dr. Per Hedfors, Department of Landscape Planning Ultuna, Swedish University of Agricultural Sciences

*3. Priority*: 3 Mobile / wearable / ambient systems, public dissemination and 5 Visualisation / rendering, Authoring tools for 3D experiences

*4. Technical proposal*:

The bells of the cathedral sounds twice when I'm leaving the murmuring of the town behind me. I put on the headphones given to me by the hostess of the park and most of noise from the city is closed out. Now I hear squealing and creaking from the passing horse wagon and neighing from the horse dragging the wagon. I walk further into the garden. Under the trees in front of me I can hear calls from the exotic pinioned birds. The birds seams to be upset by my presence. As i walk on suddenly there is a rattle of chains behind me I turn around and hear jabbering of the monkeys from their cages standing on poles beside the path. This is a description of an fictitious visit in the Linnaeus botanical garden in Uppsala.
In 2007 the 300:th anniversary of Carl von Linné (Carl Linnaeus) will be celebrated at the Linnaeus

Garden in Uppsala, Sweden. The Linnaeus Garden is a reconstruction of Uppsala University Botanical Garden the way it looked during Linnaeus days. It is the oldest botanical garden in Sweden. It was first laid out in 1655 by Olof Rudbeck the elder, professor of medicine. In 1741, Carl Linnaeus was appointed professor of medicine and became responsible for the garden.

Per Hedfors at the Department of Landscape Planning Ultuna, Swedish University of Agricultural Sciences is together with us at the Interactive Institute planning to do a reconstruction of the soundscape of the original garden as it would have sounded during the life time of Linnaeus. Back then, exotic pinioned birds gave calls and cries, and chained monkeys jabbered from cages in the garden. In his private garden, Linnaeus used small glass bells clinking in trees, which may also have formed part of the garden soundscape in the

botanical garden as well. In addition to all these sources inside the garden, the surrounding murmur from the city and traffic has differed, coming at one time from horses' neighs and squeaks from carriage wheels. The resulting virtual soundscape is planned to be presented in the actual park during the Linnaeus anniversary in the summer 2007 using the wireless sonic VR system developed in this project. The park is approximately 60x100m, the goal is to cover the whole area. This describes a showcase for this project, it will be developed in a separate project founded by other sources. The showcase will also work as a test case during this project.

Sonic VR can be at least as immersive as visual VR, and in combination the two will give the audience a very strong immersive experience. In this project we will investigate how the quality of the virtual soundscape will influence the presence. Sonic VR can be used in many cultural heritage applications as a vehicle for dissemination as in the example above. We can easily expand the example with hotspots at different locations in the park giving spoken information about artefact at the site, e.g. information about the flowers found in the garden or the history of a building. For blind people this is one of the few possible media for an immersive experience.

Recently there has been a greater interest in using 3D-sound in museums and cultural heritage exhibitions but the technology is immature and difficult to use, this hinders a wider spread of this technology. When examining some of the most spread VR systems it become evidently that the VR related research has mostly been concerned with the visual part of the immersive experience ignoring the importance of high quality 3D sound. There are some research about the basic technology of 3D-sound but it is far from the maturity of the visual counterpart. Nowadays VR systems has a variety of tools to help the author to create visually realistic worlds overcoming the shortcomings and performance problems of the 3D-graphics. Tools like billboards, particles and level of detail (LOD). This tools are essential for the quality of the immersive experience when authoring complex worlds. Almost every computer game uses this kind of tools to create appealing 3D-graphics. There is a complete lack of similar tools for 3D-sound. This is a serious obstacle when trying to create a more complex sonic virtual world and it will limit the quality of the immersive experience. One of the goals in this project is to develop such tools.

There are 2 very different approaches to 3D-sound depending on the reproduction system. One is to use loudspeakers the other is to use headphones, the later is known as binaural reproduction. The choice have an major impact on the underlying technology that need to be specialized on either of the 2 types of reproduction. In this project we have chosen to use headphone, because the listener experience that we are trying to achieve is to override the sonic environment with another one coming from our 3D-sound system and not superimpose a sonic world over the reality.

The binaural technology of today is based on Head-Related Transfer Functions (HRTFs). HRTFs are generally measured in the form of a set of impulse responses, usually using approximate impulse excitation via pseudo-random sequences. An HRTF impulse response can unambiguously characterise the acoustic modification between a particular location and one of the ears. However there is some difficulties using this technology in a virtual environment. The major difficulty is to use sound material recorded using HRTF-technology

because the relation between the recorded environment and the listener is fixed, e.g. from the listeners perspective the direction to sound sources are fixed in the movement of recording and can not be altered. The problem is that we can not align the direction to sound sources with the orientation of the listener in the virtual world. The consequence is that we can not use any pre-recorded HRTF based material. We have to synthesise the directional features of the sound sources at real-time. Next problem is that each single sound source has to be filtered by a HRTF to give it the directional features, a process which is computational demanding. This will limit the number of sound sources that can be active simultaneously. In a natural sonic environment there will be hundreds of sound sources that will contribute the total sonic image. Today it is to computational demanding to achieve this. Is there a technique that can over come this difficulties?

Ambisonics is a 3D-sound technology used for loudspeaker based system. Its a technology including recording of sound and reproduction over a verity of loudspeaker configurations, from a single mono speaker to huge arrays of loudspeakers. The basics of the technology is the use of spherical harmonic functions to represents the sound field surrounding the listener. This form of representation has some nice properties that facilitates rotation of the sound field. This solves the problem of alignment of the sound field with the listener. Combining ambisonics with binaural technology is possible using the concept of virtual loudspeakers. Then a complex sonic environment can be reproduced using a combination of pre-record soundfield for sounds far from the listener that make up the background and point sources using binaural technology for closer sounds persevered as foreground. We can save allot of computational power by this without sacrificing the quality of the immersive experience. We can now compose our sonic world of pre-recorded sound-field, premixed complex backgrounds and highly immersive binaural process sound sources. This will give us the power to author virtual soundscapes of much higher complexity which will have a great impact on the level of the immersive experience.

Now when we are able to use recordings of the sound field at a single position a new problem arise, how can we create an experience of a continuously changing sound field as the listener is moving around in the world. The solution is to interpolate between a set of spatially distributed sound fields. The listener can then move from one sound field to another without perceiving a sharp border between the two sound fields. There are limitation of this technique, it can only be used on sound fields that has a background characteristics and without any sharp sound sticking out, but for background environmental noise sounds i will work fine.

The 3D-sound system is hosted by a small cluster of stationary computers. The listeners will wear wireless headphones and a head tracking device. The tracking is using GPS to get the static position, and accelerometer to track the movements and a gyroscope to track the direction of the visitors head. The tracing data is transmitted to the stationary system by GPRS and Internet. The goal is to cover an area of 100 x 100 meters. The restriction of the area is caused by the range of the wireless headphones. We have chosen to use commercially available wireless headphones which are using a low power FM radio in the 900Mhz band with a range of about 100m. In a future system the audio signals to the headphone can be transmitted by other means, e.g. by UMTS.

The system will be based on the Uni-Verse Acoustic Simulation Framework (UVASF) and an

extended version of the sound rendering module developed in the Uni-Verse project. Uni-Verse is a EU funded project (IST-2002-2.3.1.8 ), in the 6:th framework, aimed to develop a platform for distributed VR, including both high quality real time 3D sound and 3D graphics. All software developed in the project is released under an open source licence policy. Peter Lundén is one of the major developers of the audio part of the Uni-Verse project. The UVASF can be view as a sonic VR engine, on the front end side it receives world data and position information of listeners and sound sources. It builds a scene graph based on this information, performs geometric and acoustic calculation and on the back end sided it controls a set of 3D-sound renderers, one for each listener.

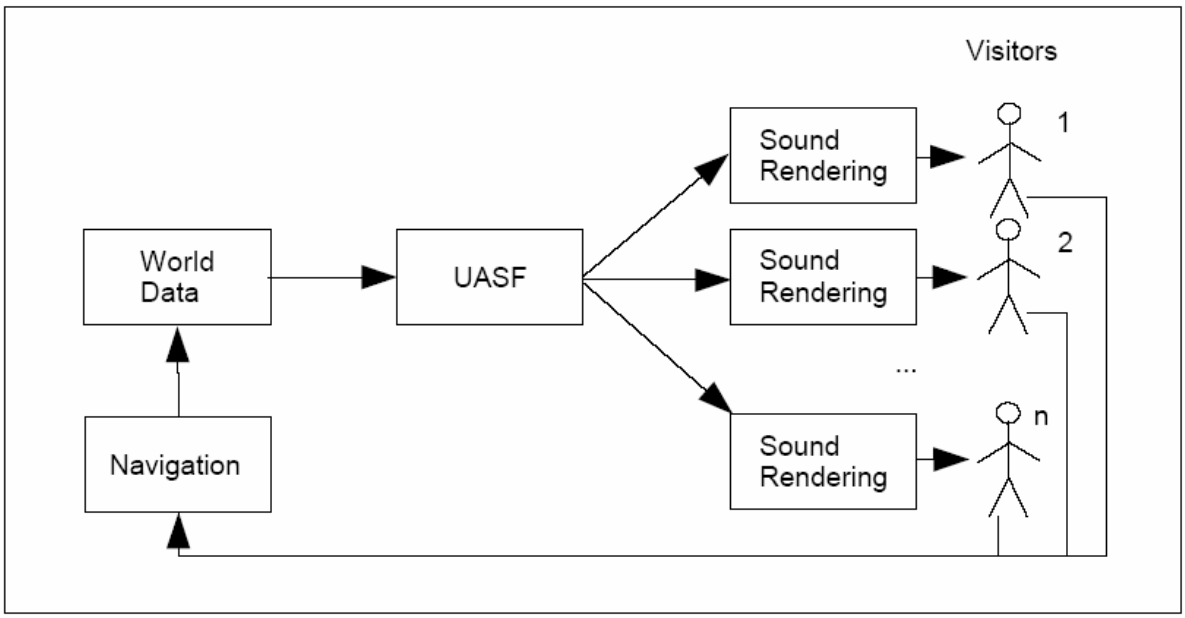


Fig 1. System overview

Hardware for a prototype system has to be included in this project to be able to develop and test the system. The hardware consists of 2 PC computers running LINUX, 2 GPS position tracking devices and 2 wireless headphones.

**Milestones**

Specification of the tools.

Implemented and tested navigation module.

Implemented and tested virtual ambisonics module.

Implemented and tested sound field interpolation module.

Evaluation of the tools developed in the project.

**Deliverables**

Specification of system and modules.

An sound rendering module for virtual ambisonics for binaural reproduction and extension of the UVASF to handle this.

A module for handling the navigation in the virtual world using a wireless GPS based position tracing system transmitting position information over GPRS/Internet.

A module for interpolated sound fields.

A report on how the quality of a virtual sonic world influences the experience of presence.

All software developed in the project will be released under an open source licence policy.

*5. Related activities*:

*6. Newton showcasing*:

As described in the beginning of this application.

*7. Timetable*:

Month 1-4 Specification of the system and software modules.

Month 5-16 Development and implementation of modules.

Month 17-18 Testing and evaluation of modules

Month 19-21 Investigation of presence

8. *The project in numbers*:

duration of the project is 21 month. From 2005.08.01 to 2007.05.31

requested project budget is 156500€

labour force is 12 person months i total, Peter Lundén 10 months and prof. John Waterworth 2 months.

labour cost is 85300€

other costs 11500€ in total, 6000€ travel expenses, headphones 500€, computers 2000€ and tracking devices 3000€.

overhead 59700€

## 12.3DKIOSK

Epoch Network of Excellence – IST 2002-507382
Newton Proposal

# The Epoch 3D Multimedia Kiosk

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Computer Graphics
Braunschweig

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ISTI-CNR
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Computer Graphics
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9. February 2005

**Abstract**

The goal of this project is to make 3D technology an obligatory standard for museums. Our project will realize an integrated turnkey solution, specially tailored for the needs and requirements of museums: Easy to use and affordable. It comprises a well-balanced package of hardware and software.

Our project touches also on the acquisition side: Partners from Pisa and Bonn bring in their state of the art 3D scanning technology and multi-resolution mesh processing know-how. Besides handling massive meshes, special care will be taken for the faithful acquisition of small beautiful and precious artifacts: A new camera based acquisition system, originally developed for the measurement of reflectance properties, will be extended to capture both the geometry and reflectance properties of small sized objects. Recent advances in high quality appearance acquisition and rendering technology will guarantee authentic virtual representations. Our system will allow visitors and also researchers to investigate the artifacts in detail, and even to apply relighting techniques.

Once the artifacts are digitized they must be brought to the public. Our authoring software for 3D presentations will be specially designed for museum professionals. The rendering frontend integrates both a module for viewing massive meshes, and a module for the visualisation of models with captured reflectance properties. It will be built upon an extensible open source scene graph engine, the OpenSG library.

A substantial portion of the project is also devoted to the physical realization of three different configurations of presentation hardware, *small*, *standard*, and *augmented*. They use different output devices to illustrate the trade-off between cost and quality. However, all configurations will support the same two input devices: image-based tracking of marker objects, and as fallback solution a trackball. The project software can be configured to run on all our supported hardware configurations.

Our three hardware configurations are supposed to become *the* reference presentation platforms within the Epoch network. Physically, they will have a professional, representative outward appearance. Furthermore the hardware will be transportable, so that it can be used for professional Epoch presentations at events and conferences. And finally, the consortium will make sure that the system is also commercially available – provided we eventually succeed in stimulating the museums' desire for 3D.

# 1 Project Title

**The Epoch 3D Multimedia Kiosk**

# 2 Partnership

## 2.1 CG-TUBS

Address: Institut für ComputerGraphik
Mühlenpfordtstraße 23
38106 Braunschweig, Germany

Participants:

- Prof. Dieter Fellner Department Head and Lead Researcher
- Sven Havemann Research Assistant

### 2.2 ISTI-CNR

Address: ISTI-CNR
Via Moruzzi, 1
56124 Pisa, ITALY

Participants:

- Dr. Roberto Scopigno Senior Researcher
- Dr. Paolo Cignoni Researcher

### 2.3 CG-Bonn

Address: Institute for Computer Science II
Römerstr. 164
53117 Bonn, Germany

Participants:

- Prof. Reinhard Klein Department Head and Lead Researcher
- Gero Müller Research Assistant

# 3 Priority

## 3.1 No. 19: Authoring tools for 3D experiences

We have thoroughly thought through this call and found that we have to extend it a little bit to maximise the benefit of our project for Epoch. We think the possible impact of only software is too small. Our bid therefore comprises not only

- an easy-to-use authoring application,
- a viewer for three specified data formats,
- and support for 'evolving' virtual reconstructions.

but also three prototype hardware configurations. The reason is that it is not feasible to expect any software to support every possible combination of input and output devices. A small set of stable hardware configurations will not only enable us to better test and optimize our software, but will also allow us to work out precise specifications and recommendations for the actual use of 3D in museums and exhibitions.

## 3.2 No. 14: Versatile 3D acquisition

This call points at four practical shortcomings of current acquisition technology: Portability, wider size ranges, reflectance plus geometry, and preview capabilities.
Our project is targeted at a museum setting. Here visitors are usually confronted with relatively small artifacts of relatively high cultural value, the products of sophisticated arts and crafts – which is just the reason why they are shown in a museum. But we found that current 3D acquisition techniques, especially the predominant laser-range scanning, are totally insufficient in order to capture the beauty and richness of the interesting precious small-scale artifacts.
Therefore we believe that to faithfully capture, and to interactively display, objects with complex reflectance properties is both the theoretically most challenging and practically most relevant of the four problems from this call. This is why we chose to work on it.

# 4 Technical Proposal

## 4.1 Strategic Goals

It is essential for Epoch that all the beautiful ideas and approaches as, e.g., shown on last year's VAST conference in Brussels, find their way to the public audience through museums and exhibitions. In terms of interactive 3D presentations, much more is possible than what can be found today in average museums. We want to change this situation, and make using interactive 3D a standard. Without a doubt this will happen in the foreseeable future anyways – but we want to set the trend. The key features of our solution are therefore *usability* and *affordability* – and, of course, *amazing results*, which is why we are also developing novel acquisition technologies for reflectance properties.
The technical agenda of Epoch is based on the idea of a *CH pipeline*, a complete workflow that ranges from the archeologist that finds an artifact in the field to the presentation of the artifact in a museum. We think we should start to create a demand for content at the *end* of the pipeline – in order to stimulate the development of a CH market based on Epoch technology on the *whole* pipeline.

### 4.1.1 A Concrete Target Scenario

A museum curator decides to make a new exibition on the Etruscian period. He hires a company that digitizes the tiny golden brooches and small pieces of precious jewelry he is going to present. From a recent excavation campaign he purchases the scanned 3D datasets of the different strata of the archeological site where the beautiful historic artifacts were found, as well as laser scans of the remains of houses, pillars, statues, etc. He puts all the digital artifacts into the 3D presentation software, chooses a theme (skin) that fits with the look of the physical exhibition, and uploads the new presentation to the 3D multimedia kiosks via network.

In the exhibition, visitors can see all the real artifacts, as usual behind glass. But in every exhibition hall there is also a 3D multimedia terminal where the visitor can inspect the small beautiful artifacts interactively from all sides – which is not possible with the real. The visitor can also have a quick look at the archeological site where the artifact was found, which also brings up a few statues and some interesting architectural ornaments. The latter are shown in the form of high-resolution 3D scans. The photogrammetrically reconstructed heightfield of the archeological site is transparently overlaid with a virtual reconstruction of how the site probably looked during the respective period in the past.

## 4.2 Novel Acquisition Techniques for Objects with Complex Surface Reflectance

Simultaneous acquisition of the geometry and reflectance properties of 3D-objects is a hot research topic in computer graphics and vision and has an immediate application in the field of digitizing cultural artifacts. Several methods have been developed over the years, but a robust system for simultaneous acquisition of geometry and complex reflectance properties is not yet available. Existing systems for 3D-photography typically rely on laser range scanning technology for capturing the geometry of the object. The spatially varying reflectance properties are then estimated from images of the object that are registered against the 3D model. Unfortunately, many interesting objects, such as small shiny brooches or coins, are too reflective to be captured by laser scanners reliably. Furthermore, the acquisition of the reflectance properties, which depends on the viewer position as well as on the light position – which both have to be sampled densely –, is a tedious and very time consuming task.

Therefore, in this project we will extend our existing system that is currently being developed in the context of the RealReflect project (IST-2001-34744) for the purpose of capturing the Bi-directional Texture Function (BTF) of planar objects (see Figure 1). Data captured by this system already allow for authentic rendering of materials in the automotive and architectural industry. The system is equipped with more than 150 digital still cameras and ten commodity PCs for parallel data storage and processing. To our knowledge there is currently no device which offers comparable measurement speed and accuracy. It captures not only the lighting variability of the surface but the full 6D-reflectance field for directional lighting.

In order to capture simultaneously geometry and reflectance properties with our device, we will first perform a dense matching of a subset of the captured images which are already registered by the system. The resulting point clouds will then be registered and integrated in one triangle mesh. To enhance the reconstruction quality, a structured light pass can be employed if necessary. Having the geometry at hand, the object will be parameterized using a per triangle parametrization. Then shadow regions will be identified and discarded during the reconstruction and compression of the reflectance field, which is performed in a similar way as for the planar probes.

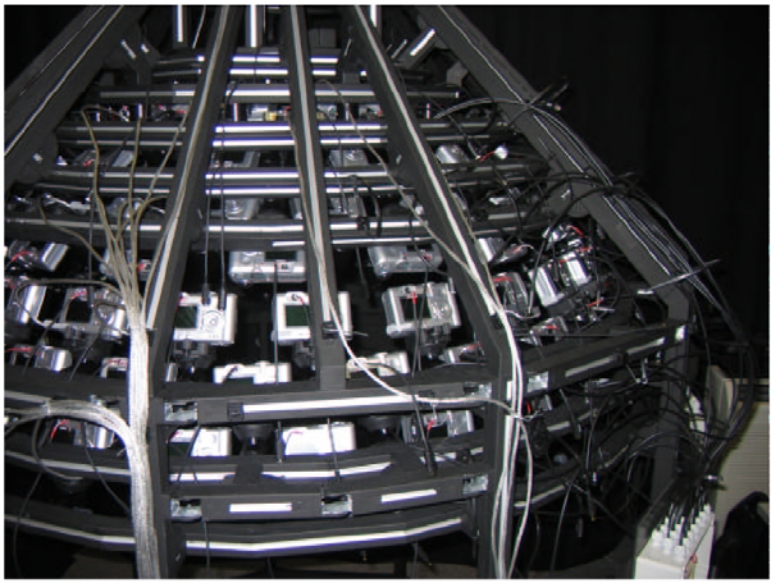

Figure 1: The image acquisition system

## 4.3 3D Kiosk – Software Components

The 3D kiosk software consists of an authoring application and a renderer.

### 4.3.1 Authoring application

The primary feature of the authoring application is that it is very easy to use. Authoring a 3D presentation will only require a level of expertise that is lower than or comparable to the expertise needed for creating 2D presentations using, e.g., MS Powerpoint. It will offer a number of *themes* to choose from to determine the look and feel of the 3D presentation.
The authoring tool shall support only a very limited functionality when designing a presentation. The reason is that it is going to be used by museum professionals with a background in art and human sciences, rather than engineering or computer science. By keeping the authoring application simple, the usability can be greatly improved, streamlined, and optimized. The basic functionality of the authoring tool is the import (e.g. via drag & drop) of

- textual annotations, images as billboards or background, GUI elements like buttons, arrows, or hyperlinks
- massive triangle meshes, typically from laser-range-scanning of large outdoor objects or areas
- small objects (jewelry etc) with BTF-based shading for faithful reproduction of complex reflectance properties
- virtually reconstructed cultural heritage sites that show the hypothetical historic appearance in an idealized way

The limited freedom for authoring does not impair the functionality of the tool: All other aspects, such as the scene properties (lights, materials), interaction modes, transition effects etc. will be configurable through the use of a scripting language, the GML. During presentation design, it is only possible to choose from a set of pre-defined scripts to manipulate certain aspects of the presentation. A powerful collection of scripts is provided by the consortium – or may be created by designers with an engineering/computer science background.

### 4.3.2 Renderer / Presentation Module

The renderer will be based on the OpenSG scene graph system. It is mandatory to use OpenSG is to keep the important option of synchronized rendering with multiple clients (*cluster rendering*), which is very hard to realize otherwise. It is a prerequisite for using high-end configurations with one or more stereo screens (Power-wall, CAVE) in the future.
The partners' core expertise will manifest itself basically in three rendering modules. Existing modules and modules currently under development will be transferred to the OpenSG framework by wrapping them into OpenSG nodes:

- ISTI-CNR: **Virtual Inspector Node**
  for the high-performance visualization of massive datasets acquired by 3D scanning
- CG-Bonn: **Authentic Rendering Node**
  for the visualization of small artifacts with captured reflectance properties
- CG-TUBS: **City Rendering Node**
  for the display of (dynamic) virtual reconstructions of deteriorated sites

These core modules are complemented by the following additional modules.

**Preprocessor for Large Meshes.** Meshes acquired by 3d scanning technologies are typically very large, complex, unstructured, and not manifold. We will support the import of meshes of this kind *without imposing any limit to the mesh complexity* – in contrast to any other software available on the market. To achieve this goal our software will include top-performance multiresolution technologies that allow the interactive display of massive meshes with an unprecedented level of accuracy and responsiveness.

**Scripting Engine for All Runtime Features.** The output of the authoring application is a number of simple 3D scenes composed of 3D models with text and images. The scripting nodes contained with each scene may modify any aspect of the scene at runtime: Change the interaction mode, move, scale, and rotate elements in the scene, trigger events, and even modify or deform objects. – Some information on the technical background of scripting is given in section 4.5.1.

**GUI Elements and Interaction Module.** A number of OpenSG nodes will be added for displaying the GUI elements of the presentation, such as text, frames, buttons etc. GUI elements may also switch between different interaction modes, so that the haptic interactor (camera tracked marker, or trackball, see 4.4.1) can have different meanings: It can either move the artifact, or a point light source around the object, or it can rotate a whole environment map around the object.

**High-Fidelity Rendering with BTF Materials.** Visually important reflection effects like complex non-diffuse reflection, shadowing, masking, intersurface reflection, surface roughness etc. have to be simulated in order to get authentic renderings. All these effects are included in the Bidirectional Texture Function (BTF), a 6-dimensional texture representation which extends the common textures by dependence on light- and view-direction. We will support real-time rendering of artifacts textured this way by employing novel compression techniques and exploiting state-of-the-art graphics hardware. Special cases like fixed light (surface light field), fixed view (reflectance field) or homogenous reflectance properties (BRDF) renderings will be realized as well.

## 4.4 3D Kiosk – Hardware Components

The hardware configuration consists of three parts:
- input device – a 'human interface device' designed as 'haptic interactor'
- output device, one or more (CRT, LCD) displays, or a projection, and
- processing unit, one or more computers for the renderer software to run on.

Experience, e.g., with the CAVE-System in Braunschweig, shows that the success of the entire complete system depends crucially on *soft factors*: Is it possible for the user to lose the orientation in 3-space ('lost in cyberspace' effect)? Are motions sometimes abrupt or always guaranteed to be smooth? How does the system react on invalid user input (gimbal lock etc.)? Practical experience dictates that ideally the number of input devices to

support is very small. Therefore we are planning to use actually just one single input device whenever we can, and only one alternative input device as a fallback.
By far the most expensive component of the complete 3D kiosk system is typically the output device(s). Since our goal is to establish our system as a museum standard, it is important to make practitioners realize the pros and cons of the different output options. We therefore plan to realize three different output solutions that greatly vary, as well in price as in quality.

### 4.4.1 3D Input Device: Haptic Interactor

No assumptions can be reasonably made about 3D interaction and manipulation skills of all museum visitors. Therefore only input devices that require no learning at all are acceptable for the 3D kiosk system.
By far the most intuitive 3D input device is a 3D object. One standard technique is to provide the object with marker patterns that can easily be recognized using standard image processing techniques. Fig. 2 shows a standard application that works 'out of the box' with one USB camera mounted to a Windows or Linux PC. It is taken from the AR toolkit, an open source software library. The position and orientation of the rectangle is calculated with 30 Hz, which is quite responsive and gives a good feeling of interaction. Even when charged with output of the camera image and rendering an OpenGL cube on top of it the CPU load is only 50%-70% on a moderate PC (PIII 866 MHz). For our 3D kiosk we will not use the AR-Toolkit directly; the robustness needs to be improved, possibly by using more than one camera, and we will optimize the recognition procedures for a few specific patterns.
In cases where we cannot use the camera-based tracking as 3D input device, the fallback solution is to use a trackball. Care will be taken that the rotation of the ball is really identical to the motion of the object on the screen. Furthermore it is important that our trackball allows to change all three Euler angles (also roll), not only two (azimuth and elevation).

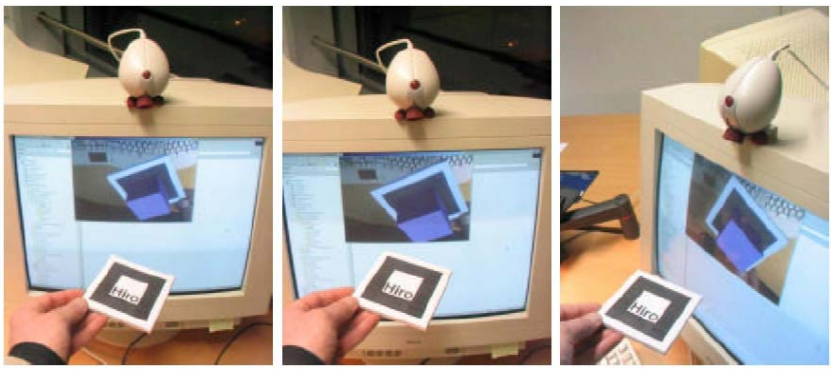

Figure 2: Camera-based tracking of a marker, a standard demo from the AR-Toolkit. Due to the high recognition frequency (30 Hz), the user has the strong impression to manipulate the blue OpenGL cube directly. Robustness is an issue, though.

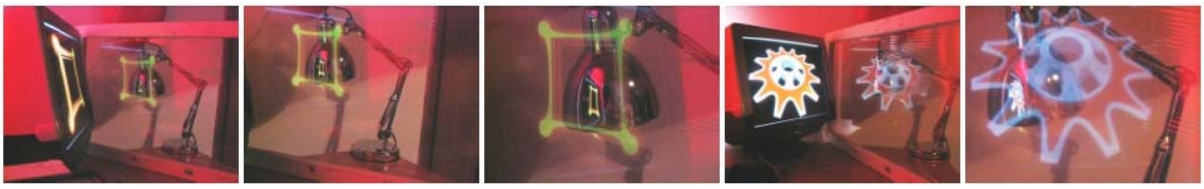

Figure 3: Augmented Setup: Principle of images floating in space. This is mono; the kiosk will show this in stereo.

### 4.4.2 Small Setup

The simplest, and most affordable, setup equals in principle the one from Fig. 2: A standard computer monitor (monoscopic display) with a single USB camera on top of it for tracking the marker, together with an off-the-shelf computer. – We will realize this configuration physically with one LCD panel integrated into a piece of a

wall: 50 cm wide 200 cm high 20 cm deep, with the computer integrated with the basis. Besides the marker object, tied to the wall with a strip or a chain, the only physical input elements are a few buttons below the LCD panel.

#### 4.4.3 Standard Setup

The standard setup will superficially resemble an arcade game. It has a larger screen with a diagonal of 70-100 cm. The output device is a pair of stereo projectors instead of a monitor. The projectors are integrated with the base, and the base contains also the PC with twin CPU and a dual-headed graphics board. A mirror is used to increase the projection distance within the base, in order to avoid expensive wide angle optics. The projection screen is almost horizontal (like with an arcade game) rather than vertical as in the small setup. Two cameras are invisibly integrated with the top of the casing above the screen, directed downwards, in the height of the user's head.
The challenge is to design this system so that it can be easily transported, but that it is also very stable and reliable when assembled. We consider it to be a great asset for Epoch presentations on any type of event. The standard setup can in principle also be combined with a (CRT/LCD) monitor rather than a pair of projectors. It may also be used with a trackball instead of the cameras, for instance if a closed casing above the screen is to be avoided.

#### 4.4.4 Augmented Setup

Usually the 'top of the line' is a large stereo rear-projection screen, probably of at least 3m 2.25m, or even two of such stereo screens next to each other (a Powerwall). Unfortunately, although such a setups are impressive, they are not new in principle – stereo experiences are known to a large audience from, e.g., Imax cinemas (in Germany).
We would like to do something extraordinary instead: Stereo images floating in space. The principle is shown in Fig. 3: A transparent film (foil) is suspended in a frame. Under certain lighting conditions, the film (foil) can reflect an image such that the image appears to be floating freely in space. Now the problem is that although the image shows a 3D object, the floating image itself is perceived as flat – which it is, of course. This can be remedied when using a pair of stereo images: It is then even possible to let an object move not only within the image plane, but also back and forth! – This way, an object (person, animal, historic artifact) can also move closer and farther away from the visitor. This method can also be nicely combined with the *panorama* technique, which is often used, e.g., in museums of natural history.
The physical setup we will realize in our project is a pair of stereo projectors with polarized filters projecting upwards against a small ceiling of size 1m 1m. The ceiling has a silver coating, so that it maintains the polarization. Between the ceiling and the projectors is a piece of transparent film, 1m 2m in size, 45 degrees diagonally slanted backwards from the viewer's position. It reflects the image on the ceiling to the viewer's eyes – and the stereo images appear to be floating in space: The observer can see through the film, but the ceiling is occluded. The only problem remaining is to find a transparent foil that maintains the polarization – but partners have managed solve the secret, and a first experimental setup gave stunning results. Again the challenge will be to realize this in a transportable fashion.
We think this is very catchy for Epoch presentations, since, as far as we know, it has not been realized before.

### 4.5 Partners' Roles and Responsibilities

#### 4.5.1 CG-TUBS

Our group was active within the Framework 5 project Charismatic on cultural heritage, and within Epoch in Showcase 4, *Multilingual Avatars*. In the context of the *3D Multimedia Kiosk*-project our group will have the following responsibilities.

- **City Modeling: Synthetic Reconstruction of CH Sites**
  One result of the Charismatic project is a modeling application for rapid urban reconstructions, also known as 'city modeling'. Recently, in the context of Showcase 4, shown in Brussels, the city renderer frontend has been ported to the OpenSG framework. This work was done in tight collaboration with the

group of Dr. Andy Day from the University of East Anglia (Epoch partner 56). So we can readily contribute the city renderer.

- **Hardware coordination**
  We have much experience with projection systems, which we have gained, e.g., with the DAVE – a CAVE system from off-the shelf components that became possible only through a peculiar innovation: World's first direct synchronization of eight digital DLP projectors, by slightly modifying the projector's electronic mainboards.
  We have done this and other projects in very close collaboration with a projection company, digital image, that was actually founded by an alumni of our group, Dr. Armin Hopp. digital image is specialized on affordable projection technology, which is exactly what will be necessary to make the *3D Kiosk* a museum standard.
- **'3D Powerpoint' Authoring Application**
  Technically this is realized by the deep integration of a scripting language, the *Generative Modeling Language* (GML), into OpenSG. The integration is two-way: Through a generic mechanism, all fields of all nodes in an OpenSG scene graph can be set and queried by the GML. On the other hand, the scene graph may also contain GML nodes that trigger actions – like creating a house, in fact: Besides the OpenSG connection, the GML brings also full mesh modeling capabilities to the runtime viewer. So in principle it is not only possible to actually create a house (i.e., have a GML script model it at runtime), but also to show how it evolves. Concerning flexible behaviour functions, one of the features of the GML is that it supports cut-and-paste of functions to create new functions ('behaviour cut-and-paste'). For more info on the GML see www.generative-modeling.org .

### 4.5.2 ISTI-CNR

ISTI CNR will contribute with its well known state-of-the-art technologies for the interactive visualization of massive triangulated models. The CNR out of core multiresolution structures for the efficient display of large meshes will be integrated in the OpenSG framework in the form of a custom node of the scene graph. Tools for the out of core preprocessing of raw triangulated surface and the construction of the the multiresolution structure used by the renderer will be made available to the project.
Furthermore ISTI-CNR is the only partner with experience in the museum sector: Its *VirtualInspector* software has been very successfully exposed to the public in several museums and exhibitions.

### 4.5.3 CG-Bonn

At the university of Bonn we will concentrate on the acquisition, compression and rendering of small sized artifacts with complex reflectance properties.
For authentic rendering of the acquired data different OpenSG material nodes will be implemented. The main focus is laid on a real-time authentic BTF-rendering node, but nodes for other variants of reflectance, like surface light fields, reflectance functions or BRDF models, will also be implemented and integrated into the authoring and presentation applications developed by CG-TUBS.
Last but not least we will investigate possibilities to realize a portable variant of the new measurement setup such that it can be used directly at museum locations. In the meantime, we will seek opportunities to acquire a representative number of historic cultural artifacts. This is indeed quite realistic due to the great number of reputable museums located in Bonn ('Bonner Museumsmeile')

**Milestones for CG-Bonn.**

1. Acquisition of the geometry and reflectance properties (6D-reflectance field) of small cultural artifacts of up to 20cm$^3$ in size
   (a) Reconstruction of 3D-geometry using dense matching of the registered images. For objects with uniform surfaces structured light can be exploited.
   (b) Parameterization of the recovered geometry using a per-triangle parameterization.
   (c) Assembling of the captured reflectance functions per texel. Includes additional post-processing like shadow removal and sample weighting.

(d) Analysis and compression of the assembled reflectance functions using for example our techniques developed for BTF-compression.

2. Development of OpenSG rendering nodes for compressed surface reflectance functions, ranging from surface light fields to BTFs

3. Feasibility study of a portable version of the existing acquisition setup.

# 5 Related Activities

## 5.1 CG-TUBS

We are active partners in 3.3, Infrastructure. We will pursue the following activities during the next 12 project months. These activities ideally support and complement our Newton bid, since they create the basis for it.

- **Establish OpenSG + GML as new 3D standard**
  Other than VRML, the GML really is a *modeling* language – it brings its own flexible *combined B-rep* meshes, which combine both polygonal and free-form models into a single representation. Furthermore, mesh construction operations can be scripted on the level of individual halfedges. – This functionality is currently being combined with a scene graph engine: OpenSG. This makes OpenSG scriptable, and GML can be triggered using scene graph events.

- **New house representation**
  We will integrate a new 3D object representation into both the GML (scripting) and OpenSG (rendering): Objects composed of convex polyhedral solids. This object representation is the technical basis for the huge virtual worlds in today's game engines (Quake etc.), because it allows for aggressive rendering optimizations.

- **New city modeling application**
  We will use the experiences we've made in reconstructingWolfenbüttel for Showcase 4 to rewrite the city modeling application using the new object representation (convex solids). Ultimate goal – and measure of success – is very high usability and modeling efficiency ('5 minutes a house').

## 5.2 ISTI-CNR

The output of this project are high resolution meshes obtained by 3d scanning technologies and they will constitute one of the natural input of the 'Massive Mesh Viewer': The Newton project 'Versatile and Ubiquitous Scanning' is presented by CNR-KUL under the *Recording and Data Representation* priority.

## 5.3 CG-Bonn

Not funded in 3.3.

# 6 Newton Showcasing

This whole proposal is all about Epoch presentations.
We would be glad to contribute both the hardware and software resulting from our project to improve, if possible, Epoch presentations, and the presentation of Epoch, at various events and conferences. The hardware alone will be an attractive setting to present with it also other than our own software. If the hardware is accepted as Epoch reference platform, a variety of software deliverables from various sub-projects should run on it without much re-configuration.
Another way of showcasing and disseminating the results of our project, and the achievements of Epoch, is to install our presentation prototypes in selected museums, just for a week or two, since our ultimate goal is to bring stunning 3D eventually into the museums.

# 7 Timetable

The great challenge of the software development is to create not just prototype level software, but to turn the combination of several research prototypes into one robust, production-level, software package. As additional challenge, the software is to be used by people who are definitely non-experts, and who will probably turn away from the whole system immediately if they experience unexpected problems with the software. The project therefore has basically two phases.

Month 1-6: Software integration to make the modules from three groups run together in a single OpenSG application.

Month 7-18: Intensive testing, longtime stability, 100% usability

# 8 The Project in Numbers

The project duration is 18 months, the requested project budget is 150.000 Euros.

## 8.1 Funding Figures per Partner

| Partner | receives | contributes |
|---|---|---|
| CG-TUBS | 30kEuro | 3D-Powerpoint authoring application, hardware specification, supervise manufacturing |
| ISTI-CNR | 30 kEuro | Massive Mesh Viewer + museum experience |
| CG-Bonn | 30 kEuro | Simultaneous acquisition of geometry and reflectance properties + rendering module |
| Hardware | 60 kEuro | 3 transportable presentation units: small, standard, augmented configuration |
| Overall sum | 150 kEuro | |

## 8.2 Budget Justification

The partners believe in the outstanding value of the proposed project and its strategic significance for Epoch. Compared to the opportunity, the budget is not very high, this all the more since 40% of the budget is spent for professional Epoch demonstration hardware. Despite the comparably low funding per group the partners will contribute highly performant, state-of-the-art software modules to the Epoch network in the form of one polished bundle.

## *13.AMA*

CALL FOR PROPOSAL FOR NEWTONS

*1. Project title*:

# Archive Mapper for Archaeology - AMA

*2. Partnership*:

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| Mike Vandamme<br>P. Kaczmarski<br>Gildon Sadat | VARTEC | 10 | Holstraat 19, 9000 Gent<br>Phone: +3292699966<br>Fax: +3292699969<br>Mike.Vandamme@vartec.be | BELGIUM |
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*3. Priority*:

## 2 Databases / knowledge management: Semi-automated mapping to CIDOC

*4. Technical proposal*:

**Overview**

This Newton project aims to produce flexible tool support for mapping existing data content to a CIDOC-CRM compatible form, suitable for data interchange, and to aid interoperability between existing and future repositories. Thus, the tool will facilitate mapping different archaeological and museum collection data models (with various structures, as well as non-structured data, i.e. text description) to a common standard based on CIDOC-CRM. Additionally, it will generate from such mapping the necessary information to convert individual datasets to a common, CIDOC-CRM compliant structure. The common structure will facilitate interoperability, for instance creating a search tool or adapting existing ones..

Specifically, this general aim may be synthesized into the following goals:

a) Enable easier mapping of data models to a CIDOC-CRM-compliant system

b) Promote multi-lingual accessibility to the CRM

c) Stimulate adoption of CIDOC-CRM as reference model by heritage professionals and heritage policy makers, showcasing the bi-directional equivalence between it and existing national or de-facto standards and providing the tools to implement such mapping.

Access to data, interoperability and standard structure are vital to guarantee the usability and usefulness of Cultural Heritage records, as yet digitally archived in a myriad of different ways, stored separately from each other and dispersed, as the material culture they refer to, in huge quantity of different institutions.

Proposed standards have as yet met the diffidence of culture professionals and heritage policy makers for the difficulty of mapping existing data structures to them and thus ensure the preservation of existing archives. However, though facilitated by the proposed tool, mapping will nonetheless require skills and knowledge which are uncommon among those who should do the job. In fact, it is not the absence of a facilitating tool, but the existence of practices, legal obligations and the lack of a clear motivation that has as yet delayed or reduced the creation of such mappings to a handful cases. In other words, a mapping tool which does not take into account the legitimate operational interests of stakeholders, i.e. usability (can I do that?), usefulness (why should I do that?) and legality (does the result comply with the regulations of my country?), would be probably destined to the use of a limited circle of ontology professionals only. Moreover, the design of the proposed tool must start from an accurate knowledge of the material it will work on (in this case, the source data structure or, at

least, their common matrix as generated by national regulations and most common practices) and must be tested an a wide sample of such material.

The tool will in principle operate on any preliminary, fragmentary or old format archaeological, monument or museum data (both structured and non-structured), and modern datasets, mapping their structure into a single, standardized CRM-compliant system, easily accessible for investigation by means of a web-based interface. Since CIDOC-CRM is well dealing with museum collections, while work is still to be done for archaeological excavation data, and still more for monuments investigation and landscape analysis, the proposed project will consider also such aspects.

The project envisages use by experts, possibly teams, representing technical and cultural high-level expertise, as well as by normal users. It fosters the empowerment of culture professionals, by offering them a usable set of mapping tools, not requiring specialized technical skills, a facilitated route to the creation of their own mapping, and an ultimate answer to their practical needs (manage and search documentation) is one the goals of the project. It avails of the collaboration of a number of national antiquity agencies or ministries, in order to possibly obtain in the future the stamp of official approval for the tool and for the mapping it will produce.

For these reasons, the present project not only fully complies with the addressed priority but also necessarily incorporates other goals (as providing tools for the actual conversion of existing datasets to the standard format), actually part of the common infrastructure activity.

**Detailed Description**

The proposal includes, as its first step, a survey of existing documentation systems, aimed at producing the detailed tool specifications. The survey report and the tool specification will be the project's first two deliverables.

The overall design is outlined below. It shows that instead of a "tool" it would be more proper speaking of a "toolkit" to describe the project outcome.

Such a toolkit is based on the concept of "template", this being the instantiation of the abstract mapping between the source data structure and the standard one. A template documents the source data structure and the mapping, using formal XML documents, and automatically supports the conversion of actual datasets when desired. Templates capture the semantic structure, as well as the intellectual content, of the sources and their transforms. They ensure the modularity and future maintenance of the system, in case new or extended versions of the standard are available. Authoring templates will thus be one of the toolkit main functionalities. The toolkit will moreover enable the creation, management of and access to a public repository of mapping/templates on the EPOCH server, to which creators of templates will be asked to contribute.

Individual cultural professionals, with limited technical skills, wishing to map their datasets to the standard will be greatly facilitated by the existence of such templates, which will provide them a simplified way to create their own mapping. When it will be possible to re-conduced such datasets to a general template (as is the most common case, current data models being usually a variation of a more general one, defined for instance by national regulations or by a model widely accepted in the archaeological community), identification of the reference template and mapping of any necessary extension, i.e. any feature not present in the template, will be facilitated by the use of a wizard-like interface. Thus it will be possible in a vast

majority of cases that culture professionals may autonomously create their mapping with limited effort and training. In exceptional cases, when no available template fits with the source dataset, the wizard will allow a facilitated creation of the mapping/template from scratch.

A description of the relevant templates will be also the document to be proposed to public authorities for consideration.

Once a mapping is available, the system will support the extraction of existing data from structured sources (including databases), with automatic conversion to CRM form suitable for information transfer. This stage should support any necessary additional annotation of the dataset, either as a whole or in part.

In addition to mapping and extracting structured data, the project will also investigate and attempt to develop tool support for mapping non-structured and semi-structured textual content encoding to CRM. This will build on the work of showcase 7 and initially use the prototype markup employed there.

The system will support the extraction of data from common database formats.

In order to encourage and support widespread adoption of the CRM, the entity and property definitions together with their scope notes will be made available in a wide range of languages. Initially, we will request partners to provide suitable translations into their own languages and, subsequently, examine how best to extend the multilingual coverage where no suitable partners can be found. Also templates will be available in the languages for which they are relevant (e.g. a template relating to the official documentation of a country will be available in that country's language). Of course, multi-lingualism will include the toolkit user interface. Therefore, the researcher from a country for which a suitable template exists, will be enabled to work completely in his/her native language.

To date, reverse mapping from CRM encoded sources to common structured data schemas has been less well explored. Practical experience of mapping has shown that this often involves branching and recombination, thus leading to a lattice form. It is essential that such models be reversible. The project will conduct a full examination of the issues involved and attempt to ensure that any mapping template produced will be capable of reverse transformation.

In conclusion, the toolkit will have the following main functionalities:

1. **Authoring of templates**. Accepting as input a formal description of the source data model, or providing the tools to create it, the tool will enable the creation of the mapping template and any other related activity.

2. **Management of the contributed template repository**. Apart from usual maintenance functions, this tool will allow internal access to other tools when required, and will store information about template history and derivation.

3. **Extension wizard**. This tool will guide the "lay" user to the selection of a suitable template, the identification of its structure with the one defined in the template, and extension when additional features are present. In principle, a full template may be created with this tool from scratch, even if expert users will prefer the authoring tool.

4. **Extraction tool**. Tool to support database extraction.

5. **Conversion tool**. Basing on a previously defined template, the tool will manage transfer of datasets to the standard format.

6. **Search tool**. Its main goal is showcasing one of the most interesting results, from the users' perspective, on test datasets; it may however turn into a real working tool in the future, if enough converted datasets are uploaded to a common data repository, which is not a deliverable of the present project but may be easily implemented if useful.

6. **Management of the converted data repository**. To manage the test datasets, and possibly create a joint archaeological archive.

7. **Text encoding tool**. An experimental tool, to be further defined during the project, as stated before.

It must be noted that the toolkit will be available on-line, stand-alone and off-line: i.e., the standalone toolkit will also include an upload functionality towards the common repository.

To sum up, the project's **milestones** are:

1. conduct a survey in selected countries (which geographically represent different areas in Europe) in order to identify best-practices in the relevant field and most common data systems.
2. define the template for each of the case-studies.
3. create the mapper.
4. create a web-based search tool.
5. create a template editor for the integration of new data systems.
6. create an integration tool for new users
7. write the relevant reports (survey, templates, mappers, etc.)

Therefore, the **deliverables** will be:

1. A toolkit, as described above, for mapping to CIDOC-CRM
2. A search tool independent of the source data model (web implemented on a test set)
3. An initial set of mapping templates, stored in the template repository.
4. The relevant reports

One of the keys of the sustainability of the project and its success relies on the framework agreement that already exists (and has been successfully applied in past and present common projects) between partners submitting the present proposal and the Italian Ministry of Culture – Soprintendenza Archaeologica della Toscana (the Italian body in charge of the archaeological documentation) on one hand, and the Israel Antiquities Authority (both Epoch's affiliate partners) on another. This circumstance will enable the testing of the official archaeological documentation formats and thus reach hundreds of thousands of documents and data sets. The same is true for Cimec, in Romania, the Institute for Cultural Memory, an institution under the Romanian Ministry of Culture and Religious Affairs, which has in its

repository hundreds of thousands of relevant data sets and is in charge, among others, of annually printing the official reports on the on-going excavations in Romania.

The activity of the above external collaborating institutions is not funded by the project budget.

Comparison of results and mutual exchange of information is envisaged with teams (U. of Berkeley – U. of Chicago – NSF) working on similar problems in the US:

The entire mapping process will be developed and implemented in strict collaboration with the CIDOC-CRM SIG, of which some of the project's partners are members, and under the supervision of Christian Emil Ore, one of the project's partners and chair of the CIDOC-CRM team.

The role of each partner for all the activities will be:

| | |
|---|---|
| Specification | – All partners |
| Development | – Unirel |
| Templates and mapping | – PIN, CISA, CIMEC, UiO, Vartec (+ external) |
| Testing and evaluation | –CIMEC, UiO, CISA |
| Infrastructure support (3.3 budget) | – PIN, UniKent |
| Standards support | – UiO |

## *5. Related activities*:

Activities related to the common infrastructure have already been introduced in the toolkit description. In sum, they will consist in the extension of the project to include such parts as the conversion of datasets, the search tool and the shared dataset repository which are not strictly included in the relevant Newton priority but are necessary for the project success. Such activity will be supported by the partners' WP3.3 already allocated budget. This refers, in particular to partners 2 and 52 who will not receive any funding by this project, except travel costs, as detailed below.

A substantial involvement of SMEs is also a characteristic of the proposal; previously with no EPOCH budget. It must also be noted that all the partners with labour costs had previously no budget within EPOCH.

The contribution to standards does not need further evidencing in a project as the present ones, completely focused on standard issues. Also funding from WP4.2 will concur to the present project.

## *6. Newton showcasing*:

The project pushes forward the results achieved so far in the development of Showcase 7, Archaeological Documentation for the Semantic Web and will be integrated in the dissemination scheme of EPOCH. Showcasing will be guaranteed through the EPOCH web site. Moreover, the project will be proposed to all Epoch's partners (affiliates included) and to any other potential users, both at national and international level. Relevant research institutions, CH administrative bodies and museums will be contacted and help upon request will be offered in order to integrate their data system and make it CIDOC CRM compatible.

*7. Timetable*:

| ***Activity Number - Type*** | | ***Partecipants*** | ***Start Month*** | ***End Month*** | ***Deliverable*** |
|---|---|---|---|---|---|
| 1 | Survey and specifications | All partners | 1 | 3 | 1. Report on Survey.<br>2. Detail toolkit design |
| 2 | Development of initial prototype | UNIREL | 4 | 10 | 3. Toolkit Prototype. |
| 3 | Initial template production | PIN, CISA, CIMEC, VARTEC, UiO | 4 | 10 | 4. Beta Templates |
| 4 | Initial testing and evaluation | CIMEC, UiO, VARTEC, CISA | 11 | 12 | 5. Report on Testing |
| 5 | Revised requirements | All partners | 13 | 13 | 6. Updated Templates |
| 6 | Development of first release | UNIREL | 14 | 16 | 7. Toolkit version 1.0 |
| 7 | Final testing, evaluation | CIMEC, UiO, CISA | 17 | 17 | 8. Report on Final Testing and Evaluation |
| 8 | Showcase development | All partners | 14 | 18 | 9. Showcase |
| 9 | Management | All partners | 1 | 18 | 10. Final report |

*8. The project in numbers*:

overall figures:

5. Duration: 18 months
2. Total project budget: **€ 100K**

per partner:

| ***Partner*** | ***PM*** | ***Labour Cost*** | ***Other Costs*** | ***Overhead*** | ***Total for Partner*** |
|---|---|---|---|---|---|
| PIN* | 4* | - | € 8K (travels) | As appropriate | € 8K |
| VARTEC | 2** | € 6K | € 4K (travels) | As appropriate | € 10K |
| UiO | 4* | - | € 8K (travels) | As appropriat | € 8K |

| | | | | | |
|---|---|---|---|---|---|
| | | | | e | |
| UNIVERSITY OF KENT | 2* | - | € 4K (travels) | As appropriate | € 4K |
| CIMEC | 1 | € 8 K | € 4K (travels) | As appropriate | € 12K |
| UNIREL | 10** | € 30K | € 4K (travels) | As appropriate | € 34K |
| CISA | 2.5 | € 16K | € 8K (travels) | As appropriate | € 24K |
| | | | | | **PROJECT TOTAL € 100K** |

* Additional PM from common infrastructure and standards budgets
** Only 50% of PM charged to the project (commercial company)
Overheads are included, according to individual cost models.

### *14. UBISCAN*

# 1. Project Title:

## Versatile and Ubiquitous Scanning

# 2. Partnership:

- **Visual Computing Lab, CNR – ISTI**


| | | |
|---|---|---|
| Address | CNR – ISTI<br>Via Moruzzi,1<br>56124 Pisa, Italy | |
| Participants: | Dr. Roberto Scopigno | Senior Researcher |
| | Dr. Paolo Cignoni | Researcher |


- **Katholieke Universiteit Leuven**


| | | |
|---|---|---|
| Address: | ESAT-PSI/VISICS<br>Kasteelpark Arenberg 10<br>B-3001 Heverlee<br>BELGIUM | |
| Participants: | Prof. Luc Van Gool | Head ESAT-PSI/VISICS |
| | Maarten Vergauwen | Researcher |


# 3. Priority

No. 14. Recording and data representation: Versatile 3D acquisitionThe research that will be performed in the scope of this Newton project will increase the flexibility of the generation of 3D data. Only a digital photo-camera and an Internet connection will be necessary prerequisites for a user to reconstruct scenes in 3D. Digital cameras with high resolutions become very common. The amount of pixels of these cameras increases rapidly and techniques that reconstruct 3D information from these images have the advantage that the resolution of their output is directly related to this number. The fact that simple hand-held cameras can be used to record the necessary data for 3D acquisition makes the process highly flexible. Furthermore, the user is only in need of an Internet connection to upload his images to a server in order to finally obtain an integrated 3D model.

# 4. Technical Proposal

We propose an integrated 3d scanning and archival system that is based on low cost hardware (digital photo-/video-cameras) and provides free-of-charge web-based service for the raw data processing. The aim is to bring 3d scanning technologies to a larger audience with the secondary target of also avoiding the dispersion of an acquisition campaign through the offer of a centralized processing and archival system.
The whole system is built by merging and integrating the existing technologies from two Epoch research groups, KUL and CNR.

The main idea of the proposed project is to provide a web service coupled with some off line tools that allow an authenticated user to access to 3D scanning technologies in a simple and economical way.
The whole 3D scanning system is based on the technologies developed at K.U. Leuven, Belgium for the creation of high quality 3D range maps from sequences of high resolution photos and on the software tools developed at ISTI – CNR for the efficient and simple processing of range maps.
The web-based interface will allow to the user to upload a set of photo sequences to a web server that will automatically reconstruct from the photos and archive a corresponding series of range maps. The user will then locally process the range maps with a simple application that will allow to align and clean the range maps. Once the alignment has been executed the collected alignment information will be again uploaded to the web service, and the latter will automatically merge all, or a subset of the range maps to a single accurate (and probably very large) 3D mesh.
The user can preview the reconstructed model and choose to download the original or a simplified version of the model in some common 3D formats.
During the various steps of the process the web service will store all the processed data, and the user will be forced to compile some HTML forms for collecting useful meta-data that document the scanning actions with sufficient detail.
Given the sensible nature of 3D data and the obvious copyright issues, the models on the repository will be subject to an explicit licensing scheme chosen based on the Creative Commons licensing schema, leaving the property of the data to the users, but explicitly granting some right of access to the 3d data to other users as well.

It has to be noted that not all the scanning processes have to be performed in a *web connected* status, but the two most user-intensive steps of the scanning pipeline, taking the photos and cleaning and aligning range maps, are designed to be performed without the need of a web connection. This is important in all situations where the scanning artifacts are in an area that is not well connected to the Internet (think for example to archaeological campaign in developing countries).

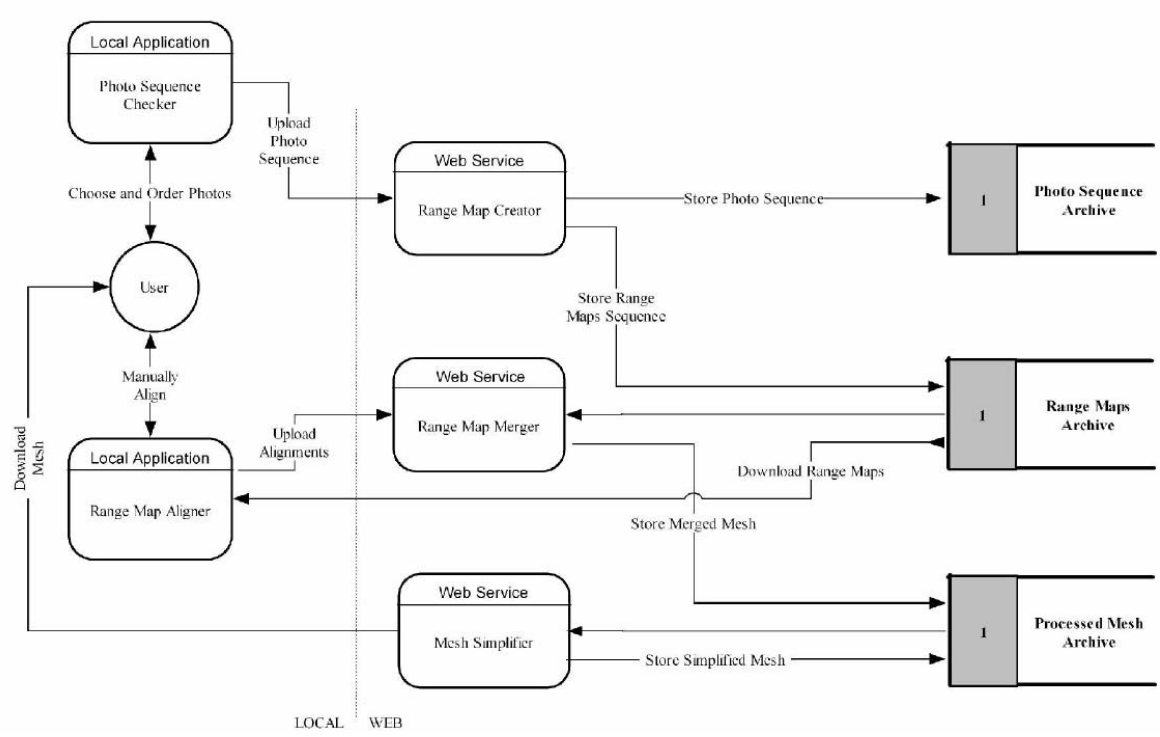


Fig. 1 The main architecture of the system: a local application prepares and checks the photos collected by an user and uploads them to a web service; the web service creates and stores range maps; these range maps are then aligned by the user and finally merged, simplified and exported to various formats.

In a first (test-) phase only members of the Epoch consortium will have access to the proposed 3D reconstruction service. Interested partners can ask for a user-id and a password. The experience gained from the data of the partners will be an important input for the improvement and further development of the tools. In a second phase, the service will be opened for non-Epoch partners although subscription, and probably conditional acceptance to avoid misuse of the service, will remain compulsory. After subscription, users can download the necessary software application. Unauthenticated users will be able to just browse the thumbnails of reconstructed objects and download a few *sample* objects.

### *Subsystems*

The architecture of the system, depicted in the Fig. 1, is composed by the following subsystems.

### Web Service: range map creator

The range map creator takes as input a sequence of high-resolution photos. It stores them and produces a sequence of range maps in a common reference system.
When the operator has recorded digital images and these have been transferred to his computer, the client application will give the operator the opportunity to select the images he wants to use for 3D reconstruction. In its simplest form, the client application allows the operator to order the images into a sequence. When he is satisfied with the input data, the operator connects to the server, authenticates himself and uploads the data to the server. An

automatic 3D reconstruction process is launched and when the resulting 3D reconstructions are ready they become available in the form of range maps registered to the same coordinate system. The work to be performed in this project contains the implementation and improvement of both the client- and the server side of the service.

The Server side of the range map creator is split in several tasks, including the web server tools, authentication, database storage and the actual 3D reconstruction processes. The image data uploaded from the client application will already be structured in sequences, which helps the reconstruction processes. However, our experience with reconstruction from images taken by non-computer vision experts has taught us that the image data is often not as clean as expected by the standard reconstruction algorithms. We want the server side tools to be equipped to deal with these situations. Different strategies must be available if the standard sequential reconstruction fails. Research in this area will focus on the following points.

- **Dealing with badly structured data**

  If the images have not be recorded or ordered sequentially, the reconstruction must find the order in which images can be processed.
- **Wide baseline matching**

  If the images have clearly been taken too far apart, standard matching fails and wide baseline matching techniques must be applied to find two-view and multiple view matches.
- **Opportunistic approach to reconstruction**

  Image sets can contain parts that cause problems for reconstruction algorithms, such as planar parts or purely rotating cameras. A possible way out consists of the automatic detection of non-degenerate parts in the sequence. The calibration that is obtained from reconstructing this part can then be inferred to the other, problematic parts of the image data. It will also be investigated if hierarchical techniques, which first deal with subsampled images and then extend the results to the high-resolution imagery, can improve reconstruction processes.
- **Faster dense matching**

  Dense matching using stereo algorithms with dynamic programming searches typically take up the largest amount of processing time. Lately very promising techniques have been implemented which employ directly programmable graphic cards (GPUs) to perform this dense matching in a fraction of the time. We will investigate if we can incorporate these techniques in the reconstruction pipeline and improve them to make use of multiple images at the same time.

**Client Application: Photo Sequence Checker and Uploader**

For standard Structure And Motion processes to be successful, the input data needs to be structured in certain ways. There are quite a few prerequisites that have to be fulfilled in order for the reconstruction processes to be able to compute the calibration and 3D data. Some important constraints are:

4. The images should be organized as a sequence with consecutive images not too far apart.
5. The images should always focus on a part of the scene where enough 3D information is available. Hence, sequences where only a planar part is visible cause problems. Care should be taken that the non-planar structure is not just visible in consecutive images

but in triplets of images.

6. Consecutive images should be taken such that a baseline exists between them. This means that taking images while rotating on the spot causes problems.

Potential users of the 3D reconstruction service need to be aware of these constraints and take them into account while recording the data. In this Newton proposal we aim at alleviating the hard constraints mentioned above or, if this is not possible, to give the client an early warning that the proposed image sequence will cause problems for 3D reconstruction purposes. This will make the technique more usable and avoid impossibly high expectations or disappointments.

Some concrete strategies that will be investigated to improve the performance are:

- Detection of problems related to the scene.
  - Scenes that are close to planar can be detected
  - Scenes with not enough texturing can be detected
- Detection of problems related to the camera
  - Detection of very large jumps in image sequences
  - Detection of purely rotation cameras
  - Detection of blurry parts, due to fast motion of the camera

**Local Application: Range Map Aligner**

The Range Map Aligner is a local application that takes as input from the web repository a set of sequences of range maps and allow the user to clean and align them. The alignment and cleaning information are then uploaded back to the web service.

Each sequence of photos generates a sequence of range maps in a common reference system, A scanned object is composed by many different sequences in order to succeed to cover the whole object. These range maps sequences are therefore in different coordinate systems and have to be aligned together. Moreover range maps obtained by reconstruction processes usually contains portions of extraneous, non-pertinent surfaces that are of no-interest for the reconstruction of the scanned object. Typical examples are supports and stands of the scanned objects, surrounding walls, people walking in front of a facade etc. This unimportant (and often inconsistent) 3d data has to be removed before the final merging of the range maps.

Given the interactive nature of the cleaning and aligning actions, for sake of efficiency, they will performed using a tool that once the reconstructed range map sequences have been downloaded, will work in a interactive standalone manner. The cleaning will be done using a simple painting interface that will allow deleting unwanted 3d data for each range map sequence by simply painting on it with a virtual brush/eraser.

The aligning process will require that the user manually choose three or four rough reference points over the range map sequences, and places them in a chosen reference system (usually with the vertical direction aligned with one of the axis). Starting from the rough user input the system will automatically precisely align all range maps using global ICP techniques.

In this application will also be possible for the user to manually set the absolute scale and position of the aligned models, a requirement for using topographic reference system.

From a technical point of view the output of this module is composed by transformation matrices and cleaning masks only, and, once the user has completed its job it will be updated back to the web service.

**Web Service: Range Map Merger:**

The Range Map Merger web service takes as input, from a authenticated user, the result of the Range Map Aligner tool i.e. transformations that bring the range maps in a common reference system and masks that cut away unwanted portions of the range maps.
From this information the Merger, using a volumetric reconstruction approach, will build a single merged surface from all the collected range maps. The user will choose the reconstruction resolution by specifying a *voxel* size that will determine the size of smallest feature that could be reconstructed by this module. The system will allow previewing the result of reconstruction by showing a small portion of the final result. The whole high resolution reconstruction process is usually time consuming so it will be performed in a batched manner and the reconstructed high resolution mesh will be stored on the server.
During this step the user can also choose what photos taken during the acquisition must be used to recover the color and texture of the reconstructed object.

**Web Service: Mesh Simplifier and Exporter**

Starting from the high-resolution mesh produced by the Range Map Merger, this web service functionality allows to access the simplified models and export them for their final use. The reduction of the complexity (and the size) of the 3D data is performed by applying state of the art high-quality geometric simplification algorithms. The resulting 3D models are made available to the user in different formats (vrml, stl, etc) for their use in production or to be imported in authoring systems.
The user who is also the copyright owner of the produced data, will be constrained to choose a licensing scheme for the produced models; the licensing schema can allow the access to the models to other authenticated users under some various restrictions like requirement of attribution, use in non commercial works, etc..

**Archive**

It is the main repository of everything produced during the scanning process. There are three main repositories for large binary objects:

- Photo Sequences Archive
- Range Maps Archive
- Processed Meshes Archive
-

These objects will be associated to the user who created them; the archive provides metadata carrying information about the real nature of the object, date and place of the scanning campaign, etc..

# 5. Related Activities

**ISTI-CNR**

There is a natural connection between this project and the Newton Project called ***The Epoch 3D Multimedia Kiosk*** presented by CNR-KUL under the priority *5) VISUALISATION/RENDERING: Authoring tools for 3D experiences*. The mesh generated by

this system will be one of the possible kind of starting 3D data to be shown in the above framework.

**KUL**

As one of the partners of the Epoch Network of Excellence, KUL brings its expertise in 3D reconstruction from images to the Epoch common infrastructure. A basic version of the web service that allows users to create 3D range maps from video sequences will be available to the Epoch partners. We believe that the extensions and improvements described in section 4 of this proposal will upgrade this basic service to a highly usable tool, especially in conjunction with the tools of ISTI-CNR.

**ARCES**

We also foresee natural connections with the CIMAD Newton Project proposed by the ARCES research center, that aims to build a framework per to develop context-aware mobile applications and that will be able to import contents from other Epoch tools (like the one that we are proposing here).

# 7.Newton Showcasing

Partner KUL is active in Activity 2.4 on Showcase 8 about image-based modeling. In this showcase the result of automatic 3D reconstruction from imagery tools is shown. The work that will be performed in this Newton project has a strong relation with this showcase. Thanks to the new pipeline, the quality, completeness and realism of the resulting reconstructions will be much higher than before. Furthermore, since the new tools will be available to Epoch partners in a first stage and to non-partners in a later stage, the amount of possible showcase examples is expected to increase very much.

# 8.TimeTable

The project will have a length of 18 months. Most of the tools described in this project come from existing and tested technologies from both the partners, therefore most of the time will be devoted to the integration and the adaption of these existing technologies and tools.

The project will be subdivided into 8 work packages. The effort is indicated man-month for each package. Mainly most of the effort will be concentrated in the first 12 months where a fully functional version of the system has to be completed and released to a selected set of partners. We reserve the last six month to an extensive testing and fine tuning of the whole system.

During that final period we will also set up a formal assessment of the system by collecting and reporting effective results and end-user opinions.

| *Work packages* **No** | **Title** | **Lead** | **MM Effort CNR** | **MM Effort KUL** | **Start** | **End** |
|---|---|---|---|---|---|---|
| WP1 | User Requirement and interchange formats | CNR | 0.5 | 0.5 | 1 | 2 |
| WP2 | Database Service Set up | KUL | 0.5 | 2 | 2 | 9 |
| WP3 | Range Creation tools | KUL | 0.5 | 4 | 1 | 18 |
| WP4 | Mesh Alignment and Cleaning Tools | CNR | 3.5 | 0.5 | 1 | 18 |
| WP5 | Merging and texturing Tools | CNR | 3 | 0.5 | 2 | 18 |
| WP6 | Simplification and exporting Tools | CNR | 2.5 | 0.5 | 2 | 18 |
| WP7 | Assessment and Validation | KUL | 1 | 1 | 12 | 18 |

The above workpackages corresponds to the various subsystems described in Section 4, plus an initial part for an infomal definition user requirement and functional specification and a formal description of the interchange formats. Even if most of the subsystems/workpackages are planned to be under development for the whole project we aim to reach a reasonable stable beta stage at the end of month 9.

# 9.The project in numbers

1.The project will have a length of 18 months and a requested project budget of 102 kEuro.CNR
CNR plans to use 11,5 man months (partially as senior researcher and partially as simple researcher) according to the following table. The overhead is 85,1%.

| | **CNR Hourly Cost** | **Overhead 85,1%** | **Monthly Cost** | **Monthly Overhead** | **Month Effort** | **Labor Cost** | **Labor Overhead** |
|---|---|---|---|---|---|---|---|
| Senior Researcher | 46,67 | 39,72 | 5740,41 | 4885,09 | 5,0 | 28702,05 | 24425,44 |
| Researcher | 30,54 | 25,99 | 3756,42 | 3196,71 | 6,5 | 24416,73 | 20778,64 |
| | | | | | | 53118,78 | 45204,08 |

Next to labor cost, we plan to spend 2kEuro on travel. This brings the final budget for CNR to:

| **Labor cost** | **Travel cost** | **Total w/o overhead** | **Overhead (85,1%)** | **Total = (total + OH)/2** |
|---|---|---|---|---|
| 53118,78 | 2000,00 | 55118,78 | 46906,08 | 51012,43 |

**KUL**

KUL plans to spend 9 man months of a researcher on the project. Travel costs are budgeted at 1kEuro only, since KUL is active in activity 3.3 and funding is foreseen for travel in this scope. We plan to have the meetings for this Newton project coincide as much as possible with meetings for activity 3.3. The overhead is 20%.

| *Researcher Hourly Cost* | *Researcher Monthly Cost* | *Month Effort* | *Labor Cost* | *Travel Cost* | *Total w/o Overhead* | *Overhead (20%)* | *Total = total + OH* |
|---|---|---|---|---|---|---|---|
| 37,40 | 4600,00 | 9,0 | 41400,00 | 1000,00 | 42400,00 | 8480,00 | 50880,00 |

## 15. IMODELASER

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Zurich, 7.2.2006

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PROPOSAL FOR EPOCH NEWTON PROJECT

**1. Title of proposal:** Integration of image and laserscan data for 3D modeling

**2. Partnership:** Prof. Dr. Armin Gruen, EPOCH Partner No. 48, Institute of Geodesy and Photogrammetry, ETH Hoenggerberg, 8093 Zurich, Tel. 0041 1 633 3038, Fax 0041 1 633 1101, agruen@geod.baug.ethz.ch

We received the list of NEWTON project topics after voting on 27 January 2005. The very short timespan of just nine working days until 9 February 2005 (submission deadline of this proposal) and the many commitments that come with the end of a semester at a University did not allow us to search for project partnerships and integrate those into this proposal.

We believe that it is one of the responsibilities of the EPOCH Coordinators (WP2: Integrating activities) to bring people and groups together. Therefore we would hope and expect that this proposal, if it cannot be accepted as a stand-alone effort, will be integrated into the work of other EPOCH partners, given the strong interest of many EPOCH members in the Topic 4: Recording/data representation.

**3. Priority:** 4 Recording/data representation: Versatile 3D acquisitions

**4. Technical proposal:** In recent years a number of data acquisition tools have been developed, which are of great relevance to the acquisition, documentation and analysis of Cultural Heritage (CH) objects: Video and still video cameras, digital panoramic cameras, laserscanners (with and without integrated cameras), structured light systems, GPS/INS and

other positional and attitude sensors. All these devices share the common features that they allow to collect primary data in flexible and very fast modes, to be used in portable mode, to collect geometric, radiometric and attribute information, to process it effectively through automated and semi-automated techniques and results to be visualized and animated on-line and in attractive 3D modes. The techniques for processing the primary data have essentially been developed in photogrammetry and computer
vision. Traditionally, single sensor approaches are chosen and have been optimized. The automated processing techniques have reached a level of performance where on the one side it is difficult to improve them any further substantially, and on the other side the results are most often not yet acceptable for critical users of CH in terms of quality and reliabilty. There are two ways out of this dilemma: (a) Focus on semi-automated processing techniques where the user interacts much stronger with the processing algorithms, and (b) integration of different kinds of data to facilitate and ease automated processing.
With this proposal we follow case (b). We propose to use laserscanners and imaging devices in an integrated fashion both on the sensor and data integration levels. Laserscanners generate very dense 3D pointclouds at very fast modes. These pointclouds are a good basis for the geometric description of the object. However, due to the regular sampling modus laserscanning provides insufficient information about edges. A good representation of object edges is very important for the modeling of a great majority of CH objects. Digital images, on the other hand, provide excellent information on edges. Therefore both sensors laserscanners and highresolution CCD/CMOS cameras are complementary. From their integrated use we expect significant improvements of the quality and speed of automated 3D modeling.
Integration can be done on the sensor level and on the data level. We plan to do both. Some laserscanners do have already digital cameras integrated. Therefore we can distiguish two modes of data acquisition: (1) the fixed attachment of cameras to the laserscanner and (2) the separate use of cameras. Mode (1) has the advantage that the calibration and orientation of both devices can be done simultaneously, while, as a disadvantage, the fixed coupling reduces the flexibility in data acquisition, and thus reduces the data quality. Mode (2) displays exactly the reverse features; it allows better to optimize the data acquisition process by chosing the type of camera and the positions of image acquisition freely, but it requires extra efforts for calibration and orientation.
Laserscanners come in a great variety of types and products, providing for the possibilities to scan from very close-range (e.g. fragments and other excavation artifacts) up to objects at very large distances (up to several hundred meters).
We work in research, development and application of digital cameras and processing techniques in CH since 20 years and have conducted many successful projects

(www.photogrammetry.ethz.ch under PROJECTS). In the context of this work many data processing methods and the related software have been developed, which form the basis of this proposal. In addition we have turned our attention lately also to the processing of laserscan data and panoramic camera data. We have already had much success with our work on the accurate and automated co-registration of point clouds by 3D Least Squares Matching, which in theory and practice performs better than the very popular ICP (Akca, Gruen, 2005) and with the calibration and high precision use of digital panoramic cameras (Amiri Parian, Gruen, 2004). We are also currently contacting a first project of integrating laserscanning and imaging data under contract and in cooperation with the German Archaeological Institute (DAI) and the Kommission für Allgemeine und Vergleichende Archäologie (KAVA). Over an Inka settlement in Pinchango Alto, Peru we have produced a large highresolution surface model with 57 terrestrial laserscans and integrated image data. In addition we are processing aerial still video images, acquired with a digital CANON camera from a model helicopter. The first experiences with these techniques, including the use of commercial and own software, allow us very well to pinpoint the problems where substantial additional research is requested in order to make full and appropriate use of those sensors.
For this NEWTON project we propose to further develop techniques for integrative processing of this diverse data. We would focus on the extraction of structured and topologically correct objects from laserscanner pointclouds. We would consider those as first approximations which have to be refined by information from image data, in particular by edge information. For this we have already developed powerful image matching techniques, based on geometrically constrained multi-image Least Squares (LS) matching (Zhang, Gruen, 2004). Our general approach combines point feature and edge feature matching in LS mode with gridded multi-patch matching. Since laserscan data provides already for good information on smooth, possibly non-textured surface parts, we will not use the grid matching here, but focus on the other techniques. Also, we have collected first experiences with a new viewpoint-dependent texture mapper, developed in our group (Gruen et al., 2001c). This promising technique will be further improved in the sense of robustification and general usability, also with terrestrial and aerial images of different image scales and spectral/radiometric properties. We will integrate semi-autoamted approaches for object reconstruction for the purpose of quality control, validation and improvement of results.We plan to use an approach similar to CyberCity Modeler (Gruen et al., 2003) for this purpose. We propose a two year project, consisting of the following parameters.

**Milestones and deliverables:**

+ After 1 year: Integration of laserscanning and image matching for surface modeling. Case study: Architectural object Bycentine Basilika in Greece. Use of model helicopter for acquiring aerial images of the roof structure and the surrounding terrain.
Integration of project results into a Showcase.
+ After 2 years: Demonstration of the whole system , including the successful view-dependent texture mapping. Case study: The Basilika mentioned previously. We will make our data available through the Internet to open repositories and will prepare it for use in tutorials and training sessions.

**5. Related activities:** See 6.

**6. NEWTON showcasing:** We will use the results of this project to build up a new showcase, demonstrating the usefulness of integrated sensor/data approaches. We will make transparent our algorithmic approaches. Since we are product-oriented we will also include our produced 3D model. (Bycantine Basilika). This model will consist of both geometry and texture and be visualized in a low-resolution mode for Internet use and a highresolution mode for CD/DVD-based presentations. We will clearly emphasize what makes the integrated approach superior to the single sensor approaches.

**7. Timetable:**
**Months 1-5:** Data acquisition of Basilika by laserscanning, terrestrial imaging and aerial imaging with model helicopter. Experimentation with various commercial surface generation software from laserscan pointclouds. Status report. Integration of own, currently developed surface modeling approach. Comparison study of commercial and own software.
**Months 5-9:** Adaptation of our Least Squares image matcher to 3D edge modeling. Use of laserscan results as approximations for matching and 3D edge definition/detection. Production of a manually measured reference object model. Comparison studies and perfomance report.
**Months 8-12:** Integration of laserscan and image-based approaches. Production of a manually measured reference object model. Comparison studies and perfomance reports.
**Months 13-16:** Analysis of problems in texture mapping. Further improvement of our view-dependent texture mapping technique. Automatic handling of full and semi-occlusions. Selection and mapping of optimal texture patches.
**Months 15-20:** Integration of terrestrial and aerial images. Shadow analysis and shadow area enhancement. Integration/adaptation of geometrically and radiometrically varying image data (terrestrial and aerial images).

**Months 21-24:** Final project report. Showcase preparation. Setup of teaching/training material.

**8. The project in numbers:**

Duration of project: 2 years
Requested budget: EU 148K

2. Number of person months: 30 (6 months Postdoc, 24 months researcher)
3. Labor costs: EU 30K (6 months postdoc)
   EU 87K (24 months researcher)
4. Other costs: Transport, insurance and rent/flight of model helicopter: EU 10K
   Transport, rent and use of laserscanner: EU 2.5K

   Travel costs, per diem: EU 5K
5. Overhead: EU 13.5K
6. Total: EU 148K

This project, due to its flexible approach for data acquisition and processing, is applicable to many CH activities. Although we will use as an example a Bycentine Basilika (because of its complexity) the developed approaches are scalable to other smaller and larger projects (up to extended sites).
We hope and expect that the EPOCH Executive Committee will find partners for this project. Partners may come from any of the areas of data processing, visualzation/animation, spatial information systems, communication and teaching. The 3D model of the Basilika can be animated by Avatars and used as an example in a Monument or Tourist Information System. The results can be used in Showcases and teaching/training sessions as well.
Our group's work has a strong history of successful projects in CH. We have lately worked on the generation of highresolution 3D models of
+ Bayon Temple, Angkor Wat (Gruen et al., 2001c)
+ Great Buddha of Bamiyan, Afghanistan (Gruen et al., 2002, 2004)
+ Mount Everest (Gruen, Murai, 2002)
+ Geoglyphs of Nasca, Peru (Gruen et al., 2001a, Lambers, Gruen, 2002)
+ Inka settlement Pinchango Alto, Peru
+ Tucume, Peru

+ Machu Picchu, Peru
+ Xochicalco, Mexico (Gruen, Wang, 2002)
+ Rock Church Bet Georgis, Lalibela, Ethiopia (Buehrer et al., 2001)
+ Ayers Rock, Australia
+ Pfyffer's relief of Central Switzerland

IN PREPARATION: JERASH, JORDAN

Our work was lately honored with the following awards:

+ D. Akça: "Best Young Author" Award, ISPRS Congress Istanbul, 2004
+ E. Baltsavias: ISPRS Schwidefsky Medal (2004) for significant contributions to photogrammetry and remote sensing through publications, 2004
+ A. Grün: Mieghunyah Distinguished Fellowship Award, University of Melbourne, Australia, 1999

Honorary Professor Yunnan Normal University (Kunming, China), 2002

Honorary Member of the Japan Society of Photogrammetry and Remote Sensing, 2002

+ A. Grün, M. Sinning-Meister, H. Dan: ISPRS U.V. Helava Award 2000 (best paper published in ISPRS Journal of Photogrammetry and Remote Sensing in the period 1996-1999)

+ M. Honikel: "Best Young Author" Award, ISPRS Congress Amsterdam, 2000
+ M. Pateraki, E. Baltsavias: Best Technical Paper Award and Best Paper Presentation Award in Asian Conference on GIS, GPS, Aerial Photography and Remote Sensing "MapAsia 2002", Bangkok, Thailand
+ D. Poli: "Best Young Author" Award, ISPRS Commission I Symposium, 2002
+ F. Remondino: "Best Young Author" Award, ISPRS Commission V Symposium, 2002
Best Poster Award, EPSRC/British Machine Vision Summer School in Computer Vision, 2001
+ G. Schrotter: Best Poster Award, 10th EPSRC Summer School on Computer Vision, 2004
+ Ch. Zhang: ETH Zürich Silver medal for his Ph.D. thesis, 2003

This strong track record will ensure that we have sufficient competence to get the planned job done, and we can guarantee that we will also in the future put much emphasis on the issue of 3D modeling of CH. As a Member of the Forum UNESCO/University and Heritage Network and organizer of various CH-related conferences Prof. A. Gruen has shown his strong involvement in CH. The close cooperation with users (e.g. archaeologists and art historians from DAI and KAVA, Universty Zurich, etc.) ensures that the practical relevance of our work will be maintained.

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## *16. UPGRADE*

# UPGRADE

**Newton Project Proposal submitted to the EPOCH NoE**

**Project Title:**
*Underwater PhotoGRammetry and Archaeological Data Enhancement* - **UPGRADE**

**2. Partnership**

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**3. Priority**

Technology Area: Recording/Data Representation
Topic Area: Underwater Data Collection and Photogrammetry

## 4. Technical proposal

### *4.1 - Objective*

The project objective is the development of a software suite, together with a set of best practice recommendations, for the integration and fusion of acoustical, optical and platform navigation data in the exploration and mapping of underwater archaeological sites. In particular, the software tools will make the data fusion process largely automatic, providing integrated, geo-referenced, large-to-medium 3-D scale maps of underwater archaeological areas from optical and acoustic data.

The scenario considered will witness the combined use of Autonomous Underwater Vehicles (AUVs) and Remotely Operated Vehicles (ROVs) as platforms to collect data. In particular, AUVs are used for performing preliminary, large scale acoustic surveys and explorations, while ROVs are used for collecting close distance photogrammetric data. This choice allows for the exploitation of the different characteristics of the two kinds of vehicles, while compensating for their limitations. AUVs can in fact navigate autonomously for long distances and survey large areas in short time, while ROV can manoeuvre to get close to points of interest and take accurate pictures. By controlling the vehicle motion, one can add geo-related data to the visual and acoustic images of the area. Geo-referenced images thus collected can then be processed, together with navigation data, to create a large scale, geo-related virtual map, containing both visual and acoustic information, that can be navigated and used to plan further interventions on the site. These results (2D and 3D) will be produced in final output using different software and formalism in order to reach several goals: sharing data and information on-line through the internet, or allow for an in-depth, off-line investigation (Drap and Grussenmeyer, 2000).

### *4.2 Motivations and background*

Underwater archaeology requires the identification of sites of interest, followed by accurate geo-referenced mapping of selected target areas. The maps obtained play a key role in the documentation and preservation of archaeological sites and allow for better planning of further excavations and interventions. The above tasks are usually performed by resorting to a *decreasing-scale, increasing-resolution* strategy: first, the ocean floor is surveyed on a large scale (using for example a side-scan sonar or a magnetometer towed by a ship) and potential sites are identified. At the second stage, the resolution and quantitative refinement of the data acquired increase as observations are made at closer ranges. At this level, a number of procedures can be used. These procedures have traditionally relied on human divers. Over the past decade, however, with the growing challenge of reaching deeper sites, while minimizing the operation cost and human life risks, human divers are being slowly complemented with, or replaced by, ROVs equipped with sonar and vision equipment and even tools to sample the seabed and manipulate artefacts. Regardless of how data are acquired, the crucial problem of overlaying the different data sets so as to generate composites of the archaeological site at both large and small scales has not been satisfactorily resolved yet - see (Akal et al., 2004),

for a recent and remarkably complete view of adopted survey and data display techniques in the field.

In summary, underwater archaeology requires the use of: i) *acoustic and vision sensors suites* to obtain archaeological-related data, ii) *platforms* and/or divers to carry the sensors around in a *controlled* manner, and iii) *navigation systems* capable of determining with great precision when and where the data were acquired (that is, for data geo-referencing). Finally, there is a need for iv) *signal processing algorithms* and *visualization software* to fully assimilate the data available and to produce accurate, realistic maps of the archaeological sites. Some of these requirements bear close resemblance to those that arise in the fields of marine biology, geology, and oceanography, in which fast paced developments in marine technology are providing scientists with increasingly advanced equipment and methods for ocean exploration and exploitation. Worldwide, the lessons learned and the experience acquired in these areas are steadily being brought to bear on the development of tools that will lead (in the not too distant future) to safer, faster, and far more efficient ways of performing archaeological surveys (Foley and Mindell, 2002). As a contribution towards meeting this goal, the present project aims to develop a set of best practice and tools to drastically improve the process of mapping underwater archaeological sites. This will be done by resorting to state-of-the art autonomous and remotely operated underwater platforms equipped with acoustic and vision sensors, advanced navigation systems for accurate geo-referencing, and software processing techniques for data assimilation and visualization. The efficacy of the tools developed will be evaluated in simulation and through a series of tests at sea in controlled conditions, over a known and documented archaeological site.

*4.3 Methods and approach*

In order to make the above scenario real, this proposal is concerned with:

1. the development of a software package to process acoustic, optical and navigation data to construct geo-referenced, virtual maps of underwater archaeological environments and sites;
2. the definition of a set of best practice procedures to collect data of good quality (accuracy, precision, and resolution) that will be fed into the software suite developed in item 1. Data acquisition will be done through the combined use of AUV on a large scale and ROV on a smaller scale.

No off-the-shelf tools are available for the purposes of item 1. In particular, regarding this item, the following issues have not been yet convincingly addressed in the scientific literature and no efficient software tools are available to solve them:

- accurate navigation of underwater platforms without having to resort to prohibitively expensive inertial sensor suites. Meeting this objective requires the integration of complementary information obtained with conventional attitude and velocity sensors, together with position data obtained via acoustics (Bechaz and Thomas, 2000).
- automated processing of underwater images for photogrammetric purposes in the presence of environmental disturbances (as for instance moving algae) - the approach to overcome this problem with images collected from an ROV, will consist of exploiting the ROV navigation data (geo-referenced camera position and elevation,

orientation) to increase the likelihood of matching corresponding features in different, overlapping images;
- estimation of camera parameters from a set of nominal parameters and adapting common calibration software to this specific case. Several distortion

models will be used to approximate the multimedia mage formation (Butler et al., 2002).
- integration of Digital Terrain Models (DTM) at different resolution scale, associated with the corresponding navigation data, with 3-D information from photogrammetric data. In particular, DTMs can be obtained with several possible sensors (interferometric side-scan sonars, multibeam echosounders, pencil beam laser), each one corresponding to a different resolution grid. The models must be compatible among themselves and with the photogrammetric data. To develop the software of item 1, the process of blending together the information from the different DTMs and photogrammetry will be cast in the form of a state estimation problem. The system state is the true DTM, while the available DTMs, the navigation data (platform position and attitude in time) and the photogrammetric data are the measured data. A Kalman filtering-.like post-processing approach (or, if needed, more evolute non-linear ones, based for instance on a robust outliers detection) will be applied, in order to obtain an estimated final DTM+photogrammetry model, together with the variance of the estimate;
- compatibility of the DTM+photogrammetric data with archaeologically oriented metadata; in particular, the integrated DTM/photogrammetric data can be used to generate ortophoto, geo-referenced images. The developed software tools will explicitly consider the need of an archaeologically oriented metadata description of the processing, and the automated or semi-automated production of metadata compatible with the CIDOC-CRM standard (Doerr, 2003);
- compatibility of the DTM+photogrammetric data with 3-D Virtual/Augmented reality systems, with particular attention to requirements in the education and learning sector and to standards supported or indicated within EPOCH.

The results obtainable with the above approaches will in any case depend on the input data characteristics. For this reason, to complement the data integration system of item 1, a study of the system performance with respect to accuracy, precision and resolution of the various data sets will be performed. The study will be pursued with simulation and with field experimentation using available, state of the art, AUV and ROV systems (Conte and Zanoli, 2003), and it will eventually lead to a set of best practice recommendation for archaeological site survey. In particular, the following points will need to be addressed:
- minimum requirements on the guidance, navigation, and control systems of AUVs and ROVs to make them manoeuvre with the required precision along planned trajectories;
- minimum set of sensorial information and actuator capabilities required on AUVs and ROVs;
- minimum requirements on image acquisition for photogrammetry in particular regarding: the number of overlapping images of the same artefact in dependence of the visibility conditions; the maximum allowable vertical distance from the artefact; the frequency of image shooting while in navigation; the flash power of the illumination system required to follow this frequency.

The above items are interlaced in a rather complex manner: for instance, it is clear that, with an ROV acquiring pictures for photogrammetric purposes over a pre-specified trajectory, the slower the ROV motion, the lower the requirement on image acquisition rate; however, at very slow ROV motion, difficulties in controlling the vehicle on the prescribed trajectory may arise. All these issues need to be addressed and evaluated; the methodological approach will consist in testing in simulation the software of item 1 as it is being developed, with realistic, already available, vehicle and sensor models. Further to that, experimental tests with the available equipment will be performed, to confirm or correct with field data the results of the simulation investigation.

*4.4 Workplan structure*

The work plan of the project is divided in three main tasks, the first two corresponding to the objective of item 1 and item 2 of the proposal (paragraph 4.3), the third one devoted to coordination and management activities, including a final evaluation of the results. In the following, a synthetic description of each tasks is given, together with main subtask divisions, participants acronym, temporal development in months from the beginning of the activities (beginning of month 1: start of the activities). Subsequently the contribution of each partner to the project activity will be illustrated. The project duration is 24 months

Task 1: Development of acoustic/optical data fusion software package
*Responsibility and timing:* CNRS, month 0 to24;
*Other partners:* All
Task 1 is divided in 3 main subtasks: definition of data format and data flow through the software modules (1.1 - month 0 - 6); software development (1.2 - month 3 - 12); software testing, including field data processing (1.3 - month 9 - 21). In particular, subtask 1.1 will define general input data structure to accommodate for most common acoustic and image data input format, and for navigation data; output data format will be defined according to the needs and standards (possibly as recommended by EPOCH activities) of 3-D visualization/rendering data in the perspective of their use within successive animation and educational/learning purposes; data format must be compatible and consistent also with metadata descriptions according to archaeological needs, and in particular with the CIDOC-CRM recommended metadata standard for cultural heritage; all partners will contribute to this activity, each one according to its peculiar expertise. In subtask 1.2, starting from existing software already developed in house by the interested partners (and that as such constitutes previous know-how of the partners) the additional software modules for acoustic, optical and navigation data will be developed. Subtask 1.2 will be mainly carried on by CNRS and UIBK, with ISME acting as algorithm definer in the filtering and estimation techniques implementation for the data fusion process and IST developing an acoustically aided AUV navigation system for the integration of medium - large scale maps. Subtask 1.3 will mainly involve CNRS, UIBK and SIMVIS, each one testing its own developed software.

Task 2: Requirements definition and best practice recommendation
*Responsibility and timing:* ISME, month 0 to24;
*Other partners:* IST, CNRS
Task 2 is divided in three main subtasks: Analysis of performance with simulative data (2.1 - month 6 - 15), Field experiment, including equipment preparation (2.2 - month 12 - 18),

Analysis of performance from field data (2.3) - month 18 - 24). Simulative data will be prepared by ISME (multibeam echosounder and navigation data), IST (mechanically scanning pencil beam sonar, side-scan sonar, and navigation), CNRS (images/photogrammetry), and given as input to 1.3; evaluation will be performed accordingly to 1.3 output at month 12. The field data activity are conventionally fixed at month 18, although date may vary according to available ship time and experiment location. IST will operate an AUV for large area survey with acoustic instrumentation, while ISME will operate an ROV with camera for photogrammetric data acquisition; field data will constitute a new input to 1.3; output of 1.3 at month 21, together with evaluation of the experimental procedures, will be the input to 2.3, that will be conducted by IST and ISME each one with respect to its own operated equipment. A final recommendation and best practice report will be jointly written by ISME and IST at the end of the activity.

Task 3: Activity coordination and final evaluation
*Responsibility and timing:* IST, month 0 to24;
*Other partners:* All
Task 3 will consist in two subtasks: Activity coordination (3.1 - month 0 -24), in which IST will take care of coordination and monitoring in order to favour the smooth procedure of the various project subtasks. The final evaluation activity will be directed toward the software package developed and will involve CNRS and UIBK as software developer, and SIMVIS, DRASSM and Ciencia Viva as end-users of the tool, in order to have a proper usability evaluation.

*4.5 Partners responsibilities and track record in the field*

***Ciencia Viva***: requirements for exploitation of 3-D virtual map in educational products (T.1.1); software package evaluation activity (T.3.2).
Ciência Viva has been contributing for the promotion of scientific and technological culture in Portuguese society since 1996. In particular, Ciência Viva develops and supports projects to promote public awareness of S&T. Ciência Viva is a member of ECSITE and EUSCEA and is a partner in several EC funded projects in the area of Science and Society.

***CRNS***: input data structure definition for optical images (T.1.1); data fusion software development with photogrammetric data (T.1.2); software testing with simulated and field data (T.1.3); simulation of photogrammetric data (T.2.1); final evaluation of the developed system (T.3.2)
The group of Pierre Drap at CRNS is working in the field of close range photogrammetry applied to archaeological and architecture survey since 1983; since 1985 the group has started collaboration with DRASSM on underwater photogrammetry with the "Carry le Rouet" wreck. The work has evolved in recent years toward deep wreck photogrammetric survey and archaeology-guided 3-D data reconstruction.

***DRASSM***: metadata requirements and compatibility from archaeological needs (T.1.1); software package evaluation activity (T.3.2).
Luc Long is the responsible in DRASSM of the underwater archaeology of the Mediterranean coasts of France, of deep sea archaeology and of the use of semi-automated devices, as ROV

and submarines, on almost ten deep water wrecks, down to 700 m depth, one of them being an Etruscan wreck dating about 500 BC.

***IST***: definition of data format/requirements as for navigation data (T.1.1); algorithm definition for acoustically aided AUV navigation system (T.1.2); generation of simulative data for AUV mission and analysis of performance (T.2.1); field experiment preparation and execution with AUV in survey mode (T.2.2); AUV mission analysis and best practice recommendation (T.2.3); project coordination and monitoring (T.3.1).
Over the past years, IST has coordinated a number of national and international projects that led to the development of marine robots for scientific applications. IST owns the INFANTE AUV and the DELFIM autonomous surface vehicle that are routinely operated at sea in the Azores. IST has also a long standing experience in the study of advanced algorithms for navigation, guidance, and control of marine robots.

***ISME***: definition of data format/requirements as for acoustic data (T.1.1); algorithm definition for data fusion estimation and filtering (T.1.2); simulative acoustic data for both AUV and ROV mission (T.2.1); field experiment preparation and execution with ROV, including acquisition of optical images for photogrammetric purposes (T.2.2); ROV mission analysis and best practice recommendation (T.2.3).
ISME groups together the Italian university researchers in oceanic engineering. Researchers in ISME have a wide experience in underwater acoustics and marine robotics, with participation in national and international research programmes since 1992. Since 2001 ISME regularly participates in underwater archaeology sea trials on the Italian coast, operating a ROV for optical images acquisition and video surveys. Within this project ISME group is complemented by researchers from the Italian National Research Council detached to University, with former experience on ROV use in extreme environments (Antarctica) for oceanographic and biological purposes.
***SIMVIS***: definition of output data format requirements for 3-D rendering and animation purposes (T.1.1); test of state-of-the-art 3-D visualization/rendering software on the data output from the developed software tool (T.1.3); final evaluation of the system (T.3.2).
Paul Chapman, SIMVIS leader in the project, holds BSc, MSc and PhD degrees in computer science and computer graphics. His main research work is focussed on effective 3D visualization of the offshore environment and he has 5 years experience working with survey vessels, ROVs and sonar equipment in the offshore industry.

***UIBK***: definition of data format and requirements for camera calibration estimate (T.1.1); development of camera calibration estimate algorithms (T.1.2); development of data interface toward metadata documentation (T.1.2); processing of simulative and field data (T.1.3); software package evaluation activity (T.3.2).
Klaus Hanke and his research group have a long record of project participation in photogrammetric applications to monuments and cultural heritage sites; among his memberships to scientific groups, he is secretary general of the International Committee for Architectural Photogrammetry (CIPA), chairperson of the working group on Cultural Heritage Documentation of the International Society of Photogrammetry and Remote Sensing (ISPRS).

*4.6 Milestone and deliverables*

The project has two milestone (M1, M2), one at the end of the first year, one at the conclusion of the field experimental activities. The major final project deliverables are the software package itself and the best practice recommendation report; however, both the raw field data and the processed data will be made available in order to allow other groups experimenting with the data set (D1 - D4). Some intermediate deliverables (ID1 - ID3) are defined, for internal purposes, in order to establish a data flow agenda internal to the project.

**M1** - month 12 - conclusion of software package development (T.1.2).
**M2** - month 18 - conclusion of experimental activities (T.2.2).

**D1** - month 18 - raw data from the experimental activities (T.2.2)
**D2** - month 21 - processed data with the developed software (T.1.3)
**D3** - month 24 - software package, with usability evaluation (T.3.2)
**D4** - month 24 - report on best practice recommendation (T.2.3)

**ID1** - month 3 - internal report on data format (T.1.1).
**ID2** - month 15 - internal report on performance analysis with simulative data, and indications for experimental testing (T.2.1)
**ID3** - month 18 - experimental activities report (T.2.2)

## 5. Related activities

None of the proposer is involved in Activity 3.3

## 6. Newton showcasing

Showcasing of the project results can be made at the following different levels:

- demonstration of the use of the processed data from the software package in 3-D virtual navigation and rendering; visitors are shown the final output from the system, and can experience virtual navigation on the mapped archaeological site using, for instance, VRML or other suitable VR application; the show can be complemented with movies of the experimental work on the field and other educational items. Among the project partners, Ciencia Viva and SIMVIS will be interested in the participation to such a showcase;
- demonstration of the use of the software tool itself, oriented toward professional and practitioners of the archaeological field; the demonstration may show the advantages offered by the availability of the new tool for creation of documented integrated maps of an underwater site. Among the project partners, DRASSM and CNRS may be interested in the participation to such a showcase

## 7. Timetable

| ***months from project beginning→*** <br> ***↓ tasks*** | *0 –3* | *4 – 6* | *7 – 9* | *10 – 12* | *13 – 15* | *16 – 18* | *19 – 21* | *22 – 24* |
|---|---|---|---|---|---|---|---|---|
| **T.1.1** <br> **data requirements** | | | | | | | | **ID1** |

| | |
|---|---|
| **T.1.2**<br>**software development** | ***M1*** |
| **T.1.3**<br>**software testing** | **D2** |
| **T.2.1**<br>**performance in simul.** | **ID2** |
| **T.2.2**<br>**experimental activity** | ***M2***<br>**ID3-D1** |
| **T.2.3**<br>**performance in field** | **D4** |
| **T.3.1**<br>**project coordination** | |
| **T.3.2**<br>**final evaluation** | **D3** |

## 8. The project in numbers

**Duration of the project: 2 years**
**Requested project budget: 185.000,00 Euro**
**Person-month effort: 54 person-months**

***Ciencia Viva***
Number of person months – 4
Labour Cost -
Other Costs – 8.300,00 Euro (trainee)
Overhead (FP6 cost model: Full Cost) – 1.700,00 Euro
Total Cost – 10.000,00 Euro
Budget Requested (100% of Total Cost) – 10.000,00 Euro

***CNRS - UMR 694 - MAP GAMSAU, Ecole d'Architecture de Marseille***
Number of person months – 9
Labour Cost - 17.600,00 Euro
Other Costs – 3.200,00 Euro (travel)
Overhead (FP6 cost model: Additional Cost) – 4.200,00 Euro
Total Cost – 25.000,00 Euro
Budget Requested (100% of Total Cost) – 25.000,00 Euro

***Département des Recherches Archéologiques Subaquatiques et Sous-Marines (DRASSM)***
Number of person months – 4
Labour Cost - 5.600,00 Euro
Other Costs – 2.500,00 Euro (travel)
Overhead (FP6 cost model: Additional Cost) – 1.700,00 Euro
Total Cost – 10.000,00 Euro
Budget Requested (100% of Total Cost) – 10.000,00 Euro

***Interuniversity Ctr. Integrated Systems for the Marine Environment - ISME***
Number of person months – 14
Labour Cost - 36.000,00 Euro

Other Costs – 9.800,00 Euro (equipment mobilization for experiment, travel)
Overhead (FP6 cost model: Additional Cost) – 9.200,00 Euro
Total Cost – 55.000,00 Euro
Budget Requested (100% of Total Cost) – 55.000,00 Euro

***Instituto Superior Técnico (IST)***
Number of person months – 10
Labour Cost - 33212 Euro
Other Costs (Travel for meetings, Equipment mobilization and personnel expenses for experiments)– 6388
Overhead (FP6 cost model: Full Cost) – 50400 Euro
Total Cost – 90.000 Euro
Budget Requested (50% of Total Cost) – 45.000 Euro

***University of Hull – Simulation and Visualization Research Group (SIMVIS)***
Number of person months – 5
Labour Cost - 10.000,00 Euro
Other Costs – 2.500,00 Euro (travel)
Overhead (FP6 cost model: Additional Cost) – 2.500,00 Euro
Total Cost – 15.000,00 Euro
Budget Requested (100% of Total Cost) – 15.000,00 Euro

***Institute of Geodesy, University of Innsbruck (UIBK)***
Number of person months – 8
Labour Cost - 17.300,00 Euro
Other Costs – 3.500,00 Euro (travel)
Overhead (FP6 cost model: Additional Cost) – 4.200,00 Euro
Total Cost – 25.000,00 Euro
Budget Requested (100% of Total Cost) – 25.000,00 Euro

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# Appendix II: reviews

## Newton 1
## Tool creation for populating environments with interactive avatars and crowds for cultural heritage applications

**1. Quality: 4**
Scientific quality very high. Proposal needs to articulate the project's ability to understand and respond to the heritage requirements for crowds. There is little articulation of the need for crowds in an historic period to behave and appear as though they were from that period.
**2. Focus: 4-5**
The project is well targetted and appears likely to deliver a state of the art solution
**3. Feasibility: 5**
Yes this appears to be an extremely robust proposal
**4. Usability: 4**
This seems to be implicit in project development description
**5. Track Record: 4**
Track record is extremely impressive scientifically - they need to demonstrate that they have appropriate heritage expertise to enable the avatars to be developed to an appropriate level of historic authenticity
**6. Impact: 4**
From the information provided the project appears to provide an easy to use populating tool at an affordable price
**7. Sustainability: 4**
It appears to provide a transferable model that can be applied in an infinite range of environments. The key will be to persuade potential users (and therefore funders) that the project offers them a useful and affordable tool. On the basis of virtual environment creation work already developed by the UEA, part of the partnership already has a good track record in translating research into practical, sustainable applications
**8. Additionality: 4-5**
The project appears to offer a very broad range of additionality

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**1. Quality: 4**
**2. Focus: 5**
The proposal is focused on almost all the specifications of the (7) Virtual Humans /Avatars (a) Populating 3D Environments and should provide a toolkit. It does not however respond to

all the requirements e.g. "…respond to the visitor according to their language, interests, and past experience."

**3. Feasibility: 3**

Too many pre requisites are required for the completion of the tasks of the proposal. It is not clear whether all of them may be ready in time for setting the ground for the developments proposed.

**4. Usability: 4**

**5. Track record: 4**

It is not provided in the proposal. A reference can be inferred from 5c "A prototype multi-lingual avatar guide for an urban model has been implemented using OpenSG, NLG and synthetic speech from a text engine."

**6. Impact: 3**

Not explicit in the proposal.

**7. Sustainability: 3**

It is not explicit in the proposal although can be inferred that will contribute to EPOCH's pipeline from previous showcasing of the authors.

**8. Additional Contributions: 3**

Almost no reference. The reference in the proposal is too generic:" It is expected that work on standards will not be restricted to any particular framework. CH metadata will be preserved…"

# Newton 2
## Telearchaeologyst Toolkit

**1) quality: 3**
The proposal is unbalanced since it devotes too much text to the Related Activities section (including long lists of bibliographical references), and the Technical Proposal sections deals more with theory and goals then with the ways the goals are going to be achieved.
**2) focus: 4**
In terms of priorities, this proposal attempts to cover three areas (2, 3, 4), and thus seems to be less focused.
**3) feasibility: 3**
The large coverage of the proposal and claims that by using the proposed TATоо system "You can understand activity areas, occupation floors, walls etc. because you can recognize them as such when integrating all the data **at the same moment you obtain them** (P. 3; emphasis mine), seem unfeasible. I doubt if such ambitious priority coverage and goals can be achieved with a relatively modest budget requested.
**4) usability: 3**
The project includes a usability test of materials from an ongoing dig of an Argentinean site, the nature of which is not specified. It is worth noting, however, that the cost of testing and evaluating the TATоо in not included in the proposed budget.
**5) track record: 4**
Members of the team are well established experts in computer based archaeology. However, the team is small, all its members are located in Barcelona and its interdisciplinary range seems somewhat limited.
**6) impact: 3**
The fact that the goal and the test case are limited to archaeological excavation suggest a limited impact.
**7) sustainability: 4**
The fact that it is not CIDOC compliant may limit sustainability.
**8) additional contributions: 3**
The raw data and testing is based on a limited data set.

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**1) Quality: 4**
Interesting proposal, but rather unclear at times as to exactly what is to be done, and where it differs from other products that are already available?
**2) Focus: 4**
It's not 100% clear from their bid, but presumably this fits primarily under 4 – Recording/data representation: recording of archaeological excavations. It certainly hits most of the targets in this respect, but to what extent is this a solution to a Barcelona situation given the team involved?
**3) Feasibility: 2**
There are no clearly identified goals – the ones there are (in section 4) are highly generic – so it is difficult to judge whether they are capable of meeting them within the timescale and budget requested. Budget details are very brief, so it isn't possible to evaluate this either

**4) Usability: 2**
There's no reference to usability – testing and evaluation is apparently the responsibility of the excavation project and this appears to happen at the end of the project with no allowance for any subsequent modification/improvement.
**5) Track record: 4**
The team is highly experienced and very capable – but there is a strong focus on one centre which is a shame?
**6) Impact: 4**
It sounds like a very useful project, but needs greater clarity in terms of its objectives and outcomes. There's no information about what the application will be built with or will require to operate, and no information about subsequent licensing of the product etc.
**7) Sustainability: 4**
Continued availability is presumably catered for by the applicants' research interests in the area, but it isn't clear how this would be applied elsewhere other than the Tierra del Fuego site so there's a risk it might seem to be overly site-specific?
**8) Additional contributions: 1**
Difficult to see from the bid whether there are any additional contributions.

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**1) quality: 5**
The quality of the project is very good and the proposal highlights the interdisciplinary aspects of archaeological research.
**2) focus: 4**
The aims pursued are good (automatic acquisition and transmission of archaeological documentation on the field), even if not too innovative. Interesting the synchronisation of archaeological activities and the proposal for a bar-code labeling system for excavated objects.
**3) feasibility: 4**
On the basis of the experience already gained by the proposing team, the integration and synchronisation between field work and laboratory data processing can be achieved without problems. The budget is adequate and justified by the objectives.
**4) usability: 4**
The toolkit, as it is conceived and partially experimented, will surely work during its testing phase; we can only suggest to increase the focus on the end-user needs.
**5) track record: 4**
The staff is very skilled and already present a good level of activity in this area, which guarantees the completion of the research project.
**6) impact: 4**
Since there is a precise archaeological aim (i.e. the application of the toolkit to the excavations in Tierra del Fuego, Argentina), the results can be achieved in short time and this technological tool will be reproducible also in different contexts.
**7) sustainability: 4**
The objectives and their concreteness justify the sustainability of the proposal even after the end of the project.
**8) additional contributions: 4**
Additional contributions relate to the activity of the partners (in particular J.A. Barceló: 041 UAB).

**1) quality: 4**
The Telearchaeologist Toolkit (a new tool for field data acquisition) is described as one segment of a more complex system. The proposal lacks some clarity in its project description.
**2) focus: 4**
The toolkit addresses the needs of the archaeologist in a modern, complex excavation situation with many, different digital data sources. The proposal outlines the use of data warehouse and distributed units. The main purpose is to synchronize data input. The setup is interesting.
**3) feasibility: 4**
The project is planned to last for 12 month. There seem to be a realistic balance between the goal, the timetable and the budget. It is noted that the budget could have been presented clearer.
**4) usability: 3**
The project include testing on one named archaeological site and possible on others as well. The impact of the usability on the development is uncertain.
**5) track record: 4**
The skills of the participants are very well documented and they cover a broad variety. However a broader institutional basis for the proposal may have given it a wider multidisciplinary base as well as a higher sustainability.
**6) impact: 3**
The costs involved in making the technology further available are not described very clearly in the proposal.
**7) sustainability: 3**
As mentioned under 5 the narrow institutional base for the project may have an impact on its sustainability. A broader base in terms of partners and institutions is likely to secure a higher level of sustainability.
**8) additional contributions: 3**
The additional contributions such as standardisation issues are not very well documented in the proposal.

# Newton 3
## Cultural heritage services for tourists

**1) quality: 2**
There is virtually no technical content described here
**2) focus: 4**
The project is squarely within the call, but it is not evident how it contributes to the state of the art – more likely it will lag behind actual commercial developments and be seeking ways to hook into them
**3) feasibility: 2**
The concept of repurposing content from museum databases to broadcast video is far from reasonable. This is a most unlikely way to produce a compelling broadcast medium
**4) usability: 3**
Not a strength of the plan
**5) track record: 3**
The absence of business development partners is worrisome
**6) impact: 4**
Except for the notion of semi-autonomously created content, the models could fit with a variety of technology directions, one of which is certain to succeed in the market
**7) sustainability: 2**
no strategy
**8) additional contributions: 2**
The dissemination task is indicative – if IPDC takes off, there won't be any need to entice a few museums to see what is happening at Brunel; if it doesn't (eg. the network effects from other uses of the medium aren't there), there won't be much point in demonstrating a cultural service in Edinburgh Overall, it's not clear what this project is contributing – scenarios and model contracts need to fit into a business model that presently doesn't exist and which the CH sector is not going to influence

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**1) quality: 4**
The proposer's claims re INSTINCT are compelling and subsequently acceptable.
**2) focus: 4**
Agenda Priority 3 is clearly addressed.
**3) feasibility: 3**
This reviewer is not qualified on this judgement. Hence neutral score.
**4) usability: 4**
Clearly addressed.
**5) track record: 5**
In this instance, the research background of the lead partner in this area makes for a convincing argument.
**6) impact: 3**
A note of caution. Business model claims for mobile TV have largely ignored the imminent introduction of HDTV standards for domestic users in US and Europe. As this involves a 6x larger image re pixels and a hike in frame-rate, the gap between mobile and domestic is due to grow again drastically.
**7) sustainability: 4**

Arguments accepted

**8) additional contributions: 4**

Noted contributions incoming from National Museum of Scotland and outgoing to CIDOC

GENERAL: a strong proposal, on-target as to cost but perhaps slightly over-reliant on a telecoms area which is subject to rapid revision against business models.

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**1) quality: 3**

The scientific contents seems to be sound. The Cultural Heritage contribution it is not clear except the users' role foreseen for the CH institutions. No tourist operator seems to be involved, except they are covered by the "*3rd party Cultural Heritage Content Creators, namely: museums and archaeological institutes*"

**2) focus: 4**

It covers the area of "Mobile/wearable/ambient systems" more specifically "Mobile applications from data capture to public disseminations"

**3) feasibility: 3**

In the project numbers are reported 25 man/months efforts but into the second table of timetable paragraph is reported the number 52.0 under the column Total. I assumed that this last number represented the man/months total efforts, in the case I'm not wrong why did exists a so big difference? Furthermore, there an almost uniform distribution of efforts for all the Tasks numbered from 1 to 4 although the time duration and the foreseen problems to cope with are significantly different. The Description of Task 2 activity is too generic and no clear figures are proposed to verify the goal achievements.

**4) usability: 4**

In the project is foresee the involvement of the Vodafone and Orange, member from new EU country state such as Poland or Lithuania.

**5) track record: 4**

The proposer institution seems to be involved in the EU INSTINCT project.

**6) impact: 4**

The proposed technology seems to me affordable considered the fact that the CH arena may be used as side contents with respect to the more traditional contents.

**7) sustainability: 3**

Although the proposer claims that " … there is a clear goal of continued availability after the project …" no evidence have been clear asserted in the project how to support the infrastructure costs after the end of the project.

**8) additional contributions: 4**

What described in the proposal seems reasonable and well described. I have been partner (provider of cultural content) in a nearly similar project in Berlin (*www.bissy-online.de*; German language only) running from 2000 to 2002 trying to make that service available with the introduction of UMTS-technology. Unfortunately the introduction UMTS was delayed by several years and the project funding ended before it. The information presented by that service had to be adopted to the screen size of end-user terminals and the information expected by end-users differed considerably from that one of website-users in the respect that BISSY-users were much more interested in up-to-date infos (what's going on there now, what are the actual opening times today, what cultural highlights are presented there now etc.). This necessitates a dynamic database on the side of the content providers, the cultural heritage sites.

Communication technologies developed in the last years will enable CULTOURIST to be present in number of mobile networks compared to the Berlin project. The partners of the proposal have answered the selection criteria themselves, but I doubt that CULTOURIST will become a mayor marketing instrument for cultural heritage sites in the next years because the acceptance of the service will be restricted (costs for service, end-user terminals not very widespread) and the content providers will in the long run not be able to provide the actual information level necessary for a high quality of that kind of service. I wouldn't give CULTOURIST a very high priority.

# Newton 4
## Web-based tool for archaeological data processing and storage (WebToArch)

**1) quality: 5**
This is a clear and well written proposal covering both the technological and CH points of view.
**2) focus: 4**
The proposal makes the impression of being oriented more towards recording archaeological fieldwork and research and from this perspective it is somewhat limited.
**3) feasibility: 4**
The creation of multilingual, multifunctional, modular and scalable tools seems to cost more than the relatively small sum requested for.
**4) usability: 3**
It is not clear how many modules will be ready after 12 months. The text of the Newton showcase suggests that only the stone artifacts module will be ready, thus the usability will be limited if the development of the tool ends with the termination of the project.
**5) track record: 4**
The team seems to be oriented towards archaeological research. Although one of the declared aims is museum information, no related expert is on the team.
**6) impact: 4**
Will have more impact on the archaeological community.
**7) sustainability: 4**
There seems to be an intensive phase of testing, although the cultural heritage data to be tested are not specified (digs? museums?). If the modules will prove successful, it seems that there is a potential for further development.
**8) additional contributions: 5**
The proposal has a potential of creating open datasets

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**1) Quality: 1**
This falls well short of the integrated recording system, focusing instead on several specific areas, closely associated with and developing from work that has already been undertaken
**2) Focus: 1**
This does not conform to the specification in the call – the focus is explicitly on artefacts (section 4C) and there is little attention paid to the integration of these data with survey, stratigraphy etc. which the call requires. In the end, this is not an excavation recording system – this is a system for bringing together some of the results of a number of excavations, which is rather different
**3) Feasibility: 3**
The goals as set are reasonable, but the budget seems rather light in significant areas for what is being attempted and given the equivalent of almost three fulltime posts and a very small travel budget.
**4) Usability: 3**
There is limited reference to usability testing – it appears in WP5 and WP6.
**5) Track record: 1**

Insufficient information provided to make a judgement. It's noticeable that the tool highlighted at www.csisb.org/arcada is far from complete.

**6) Impact: 3**

The technology will certainly be affordable, but the need is less clear

**7) Sustainability: 2**

There has to be a suspicion that this will be a tool that is developed and goes no further. Questionable application beyond its development area.

**8) Additional contributions: 1**

No additional contributions identified.

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**1) quality: 4**

It seems to aim high, very complete scope. I like it.

**2) focus: 4**

Neat, clear and straightforward

**3) feasibility: 5**

Both timetable and budget seems to fit in the Research Agenda

**4) usability: 4**

I'm looking forward to download the WebToArch, and it takes into consideration PDAs

**5) track record: 3**

One minor flaw on the project is that is a one country project lacking some expertise

**6) impact: 4**

It seems that WebToArch can positively impact the CH research in Europe and elsewhere

**7) sustainability: 4**

The fact that is developed upon previous systems guarantees its sustainability

**8) additional contributions: 4**

Although it is thought to meet CIDOC standards there is no word about availability of datasets introduce to the system.

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**1) quality: 4**

The quality and the scientific level of the project is good and the proposal is well structured.

**2) focus: 5**

The aims - which focus on standardisation and integration of archaeological information and above all on multilingualism - are remarkable and fit well the needs specified in the call.

**3) feasibility: 3**

Multilingual systems are normally difficult to be implemented. The archaeological case-studies should be better outlined. As for the timetable, it is well scheduled and the budget is adequate to the goals.

**4) usability: 4**

Principles of usability are well described. Good the technological solution and the flexibility of the proposed tool.

**5) track record: 4**

The track record of the staff is good; the team integrates the expertises of archaeologists and IT specialists.

**6) impact: 4**

The impact could be impressive, but the archaeological case-studies should be more precisely detailed in order to test the effectiveness of the technological solution.

**7) sustainability: 4**

The objectives and the expertise of the team justify the sustainability of the proposal. Continuity will be guaranteed by expanding the case-studies and increasing the support provided by other partners involved in the same kind of approach.

**8) additional contributions: 4**

comments: Additional contributions relate to the previous activity of the partners.

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**1) quality: 3**

The description of the WebToArch tool is not very clear, and it is therefore difficult to evaluate the scientific level of the proposal.

**2) focus: 3**

The project focuses on the construction of a multifunctional database management system aimed at field archaeologists as well as a wide range of other user types (including the public). The tools are meant for the recording of archaeological excavations and the proposal addresses a number of needs. However, the proposal lacks some clarity

**3) feasibility: 4**

The project is planned to last for 12 month. The described timetable and the budget seem to be realistic.

**4) usability: 3**

There is little focus on usability in the proposal. It is mentioned (in the budget), that there is an element of field testing. However, the impact on the project is uncertain. The dissemination of the results of the project is accounted for.

**5) track record: 3**

The proposal is based on one participating institution alone. A broader institutional basis may have given the proposal a wider multidisciplinary base as well as a higher sustainability. The skills of the participants are not documented in the proposal.

**6) impact: 4**

The WebToArch tool will be made available to the EPOCH community and since the technology is based on open source products such as MySQL it is regarded as affordable.

**7) sustainability: 3**

The narrow institutional base for the project may have a negative impact on its sustainability if the tool is not widely accepted by the EPOC community. A broader base in terms of partners and institutions is likely to secure a higher level of sustainability.

**8) additional contributions: 2**

The additional contributions such as standardisation issues are not well documented in the proposal.

# Newton 5
## Webtalkplus

**1) quality: 4**
Strong track record in research and publication. The shared presence VR environment is not in my view the highest priority CH application
**2) focus: 5**
Both shared virtual environments and tools for creating them are definitely state-of-the-art
**3) feasibility: 4**
**4) usability: 5**
This is a strength of the POLIMI group
**5) track record: 5**
Consortium of Swedish science centers is a strong pre-existing group; the combination of academic and museum institutions in three countries is good
**6) impact: 3**
At present, all VR, and especially collaborative environments, are expensive for most museums. This reduces costs but doesn't address making the graphics themselves.
**7) sustainability: 3**
If taken up by others, the application can have support, but there is no obvious path
**8) additional contributions: 4**
Strong grounding in usability and design standards

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**1) quality: 5**
The project it is well written and the proposed activities seems to be sound. One minor aspect is the use of the *semantic data processing* notion, in fact it seems that it used in the frozen context of the information system and not into the dynamical one of CH.
**2) focus: 5**
It covers mainly the area of Visualization/rendering, more specifically Authoring tools for 3D experiences.
**3) feasibility: 5**
The goals are realistic although the timeline may be it is too strict. The budget and the man month efforts reasonable distributed over the tasks workplan.
**4) usability: 3**
The usability efforts is too small (7,27 % of the total efforts). I suggest to augment the overlap of the A4 and A5 activities to improve the usability testing.
**5) track record: 5**
The proposer and partners expertise is well documented.
**6) impact: 4**
The topic seems to be sustained within the realm of improving the educational level of young people.
**7) sustainability: 4**
The integration of the results into the Communication Infrastructure seems to be achievable and it is expected.
**8) additional contributions: 3**
The results availability to an open community it seems have not been considered. This project is an excellent example for the PUS (public understanding of science) tradition. It has a

clearly defined target group (users aged 12 to 19) and a restricted contents (energy). In addition the project description covers many features described in the Research Agenda dated Dec 24, 2004.

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**1) Quality:**
From the cultural heritage view point the quality is sufficiently high because it introduces new features into edutainment applications.
**2) Focus:**
The new features will raise the acceptance of the target group
**3) Feasibility:**
Given
**4) Usability:**
Usability testing is included as well as peer interviews (does the project reach the target group ?)
**5) Track record:**
It is of advantage that one of the leading museums of science and technology in Scandinavia is one of three partners.
**6) Impact:**
I cannot judge the costs of a similar application on another content (e.g. tsunami). In Germany these projects could only be financed by sponsors, the regular budgets of cultural heritage organisations are too much restricted.
**7) Sustainability:**
I see no problems in integrating the planned project results into technical museums websites. In general I am in favour of that proposal.

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**1) quality: 2**
Shared world simulation with it's low fidelity representation and high levels of interaction have been around for over 12 years and may no longer be considered state of the art unless a proposal brings something fresh and innovative to the table. Perhaps more importantly, this approach has consistently failed to appeal to CH operators, and its support base remains academic.
**2) focus: 4**
Clearly the proposal is an accurate address to Agenda 5 Visualisation/rendering, and boasts a close correlation with the quoted example
**3) feasibility: 4**
The project appears neither ambitious nor over-expensive. If the theme addressed remains an agenda priority, and I must assume it does, then this project represents good value for money and resource consumed.
**4) usability: 3**
The involvement of the National Museum of Science and Tech in Sweden is noted as a qualification.
**5) track record: 3**
Although one would have welcome a behavioural psychology element in this case, the work is very well referenced, and I don't see any negative issues here.
**6) impact: 2**

This technology, and tools to enable it are undoubtedly affordable, but remain unattractive to the professional CH community. This situation is likely to prevail until a next generation shared world approach emerges – probably – but not necessarily on the current model of network on-line gaming.

**7) sustainability: 2**

As with comments (6), should a new model and subsequent specification for shared world activities emerge, the toolset as projected is likely to be of very limited use. Although WBTLK moves not to preclude higher fidelity approaches, the languages it has chosen for programming are not the tools of choice for high fidelity practitioners.

**8) additional contributions: 3**

Again – the contribution/collaboration of the Swedish Energy project is noted.

GENERAL: I would have scored this one lower, but for the fact that it is clearly roadmapped in the EPOCH agenda for research. And it is modest.

# Newton 6
## CIMAD (Common Infrastructure, Context Influenced)

**1) quality: 5**
Partners all have the requisite technical expertise and a framework for context aware mobile applications is very critical at this time
**2) focus: 4**
**3) feasibility: 3**
It's difficult to say, given that this is in effect an add on to a series of on-going projects, if it is either realistic or properly funded – the time frame for creating a common framework is very fast and involves no buy in except from the participants
**4) usability: 3**
Given that this is a framework, the question is a bit unfair – usability testing is not the right approach to take to evaluation
**5) track record: 4**
The three major players – UNIBO, Kent and POLIMI are very strong; an industry consortium would be a nice addition to a project creating implementation frameworks however
**6) impact: 3**
A great deal depends on whether this work is made available under an open-open licensing framework and involves industry in the process. The licensing question is begged in the proposal (Goals, Section 4)
**7) sustainability: 2**
Sustainability will come from buy-in by industry and there are no obvious plans for that
**8) additional contributions: 3**
Shows appropriate regard from standards framework but is not in itself contributing to standards which will limit the utility of the CIMAD framework

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**1) quality: 3**
I believe the criteria here to be met, but am concerned as to my qualifications to judge in this area. Hence neutral score.
**2) focus: 4**
Call research priority 3 and its subcontext are clearly addressed.
**3) feasibility: 3**
The budget is certainly reasonable. Again – concerned as to qualifications – hence neutral score.
**4) usability: 4**
Note that additional EPOCH stakeholders will be encouraged to join test programme.
**5) track record: 3**
We are aware of UNIKENT's historic strengths in Augment reality and wearable computing. Other partners only by reputation.
**6) impact: 4**
Smart Environments, as defined under CIMAD, represent a cost effective, non invasive and location-sensitive approach to many forms of CH site, and are likely to prove attractive to planners, environmentalists and other stakeholders.
**7) sustainability: 3**
The criteria appear to have been met

**8) additional contributions: 4**
Contribution towards CIDOC CRM and shared effort with MOBICOMP are noted.
GENERAL: Please note the reservations expressed in 1,3,and 5. This is probably a good project, and certainly modest as to cost. I regret not being able to assess it more properly.

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**1) quality: 5**
The project it is well written and the proposed activities seems to be sound. One minor aspect is the use of the *context* notion, this term is too generic in fact in the project proposal seems to be used to represents both the *conceptual context* and the *spatial context*. It could be useful to make clear the different uses.
**2) focus: 5**
The area covered by the project proposal are Mobile/wearable/ambient systems and Recording/data representation
**3) feasibility: 4**
The goals and the budget seems to be reasonable. One suggestion is to make stronger the coordination among the A2, A3, and A4 activities and the A1 activities, so to increase the guarantee to easily integrate the three modules.
**4) usability: 4**
The project plan dedicate one activity (A7) to the results validation and validation methodologies is proposed, the SUE-Mile.
**5) track record: 5**
The proposers have a good expertise into the area of the proposal as emerged from the references paragraph.
**6) impact: 4**
**7) sustainability: 5**
It is reasonable to expect that the results of the project could be used in many different sites, especially if commodity apparatus will became available.
**8) additional contributions: 4**
In the project there is the generic claim "… *The proposed framework will be published with an appropriate licence agreement, to be agreed with EPOCH management…*" it would be useful make more explicit the type of license and with parts it would cover. Hopeful that the proposer will choose the open source one. It took me strong efforts to understand that proposal because of the detailed description of technical details and technologies and the lack of cultural heritage content. I doubt that it will be possible to generate information which will satisfy researchers and public in the same way – both user groups not only expect different information, also the required semantic coding must be different to meet the expectations of these user groups. Nevertheless I think this is a very interesting proposal combining the areas of CH and Ubiquitous Computing.

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**1) Quality:**
Very advanced technology, Ch cannot be judged
**2) Focus:**
Ubiquitous computing is one of the recent research areas
**3) Feasibility:**

A very worthwhile, pretentious proposal. The budget is well below the upper limit as well as the time required for the project.

**4) Usability:**

D 8: Usability analysis

**5) Track record:**

Apparently the technical partners are leading institutions, the CH content provider cannot be judged.

**6) Impact:**

For the public a new guidance system can be developed if the project is successful
I am very much in favour of this proposal because of its use of advanced technology and the potential it has for CH sites.

# Newton 7
## Virtual Human Open Simulation Framework for Cultural Heritage

**1) Quality: 4-5**
Yes and heritage element is interesting. Hints at a degree of depth but probably needs further articulation - we need to be assured that C11th months will be acting like C11th monks and not just C21st humans in monks habits - how will the project secure this goal
**2) Focus: 4-5**
Yes and the project appears to have the potential to develop a state of the art solution
**3) Feasibility:**
Yes and deliverable within budget
**4) Usability: 4**
Yes
**5) Track Record: 4**
apparently strong
**6) Impact: 4**
Yes it would appear to be
**7) Sustainability: 4-5**
This appears to be a sustainable project
**8) Additional Contributions: 4**
acceptable

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**1. Quality: 4**
**2. Focus: 5**
The focus is clearly related to the requirements for Avatar Standards for CH; Avatar Development Tools and Populating 3D Environments.
**3. Feasibility: 4**
The proponents state that they have been actively involved in releasing a sub-set of tools they developed to the open source community. As this is one of the main objectives stated it enhances its feasibility.
**4. Usability: 4**
Usability seems focused in the research and technical community and not on CH practitioners.
**5. Track record: 5**
The main proponents have an excellent record of activity and contribution to different MPEG frameworks.
**6. Impact: 4**
**7. Sustainability: 3**
The track record of the proponents are a good guarantee they will continue to develop and open their products. On the other hand the proposal itself does not include the establishment of an specific framework for such purpose.
**8. Additional Contributions: 4**
The proposal indicates substantial contributions to activities 3.3 and 2.4.6 (ShowCase Integration)

# Newton 8
## CIDOC CRM Data mapping Tool

**1) quality: 4**
The quality of the proposal is high, although it emphasizes too much the technical aspects of the project at the expense of the CH aspects
**2) focus: 4**
The proposal is focused in terms of priorities (2), but the statement in the summary of section 4 that the tool "…is intended to enhance all heritage projects and enterprises that may benefit from the use of the CRM", seems too sweeping.
**3) feasibility:**
Don't know
**4) usability: 4**
The materials to be accommodated by the tool are vaguely defined. It is not stated explicitly what data structures will be mapped (it is only *probable* that research and commercial excavations will be included). Neither the nature of the testing nor the raw data for the tests are specified.
**5) track record: 4**
The teams is basically technical. The role of the English Heritage subcontractor unspecified.
**6) impact: 4**
Being of the Archaeology/CH constituency, the language used in the proposal suggests to me that the result will be less user friendly than desired. This may discourage users who are not computer experts from using it.
**7) sustainability: 4**
Since this seems to be a "commercial" proposal, it seems that its sustainability depends on additional funds for further developing.
**8) additional contributions:**
Don't know

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**1) Quality: 5**
Highly desirable piece of work
**2) Focus: 5**
Directly and clearly linked to call; potentially state of the art application
**3) Feasibility: 4**
It isn't made clear how the work breaks down between the partners and hence who does what? Project timetabled at 12 months but only 10 person months costed? Costs are high compared with other bids seen
**4) Usability: 3**
Usability not explicitly addressed, though presumably the use of postgraduate students as part of the dissemination and testing incorporates this?
**5) Track record: 5**
Several partners intimately involved with developments in CIDOC etc. making them highly suited to this task. Extremely strong IT development skills.
**6) Impact: 5**

Product available under GPL. Developers have excellent track record in producing powerful tools using public domain materials.

**7) Sustainability: 5**

The deliverables are to be documented, the application licensed under GPL, XML schema and training documents produced etc. so there should be no problem with future support and availability

**8) Additional contributions: 4**

Draws together a number of deliverables the need for which have been identified for some time. The mapping wizard looks an interesting idea.

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**1) quality: 5**

Somehow weak on the CH side

**2) focus: 4**

Well focus on the Research Agenda

**3) feasibility: 3**

It could be done with a lower budget

**4) usability: 3**

Test are restricted to people directly involved in the project

**5) track record: 3**

It seems to lack CH advisers

**6) impact: 3**

It seems that it will have a limited impact

**7) sustainability: 3**

I can't evaluate it

**8) additional contributions: 4**

GPL and documentation are good ideas

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**1) quality: 5**

The quality of the proposal is very good as well as the scientific level of the team.

**2) focus: 4**

The suggested aim to make the CRM more accessible to heritage professionals (or managers) is remarkable. In the description of the proposal, the adverb "probably", with reference to the involvement of the research sector in this process of amalgamation, is a weak point of the project.

**3) feasibility: 3**

It is not clear which will be the institutions involved into the mapping process: cultural heritage is articulated into many specific sectors and one year might be too short to test the data mapping tool. The cost of the proposal is a little too high with respect to its length.

**4) usability: 4**

Whether the principle to bridge the gap between theory and application is confirmed, the availability of the tool and its validation should be guaranteed by the competence of the team (software architects and information specialists).

**5) track record: 5**

The proposal will benefit by the scientific support of a skilled multidisciplinary research staff in this area of expertise, which can guarantee a good development of the research project.

**6) impact: 4**
Good, but it depends on number 4).
**7) sustainability: 4**
The aims are ambitious for a one year project but they fit well the efforts towards standardisation and semantic data processing. If achieved, they will provide a long-term support tool, but it would be useful to involve a larger set of partners, in order to collect a wider spectrum of contributions and research requirements.
**8) additional contributions: 4**
Additional contributions relate above all to standardisation and dissemination.

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**1) quality: 5**
The scientific level of the proposal is high and the proposed tool is an important step forward for cultural heritage sector. The primary goal is to make the CIDOC CRM more accessible to heritage professionals. The tool is aimed to have a longterm influence on the sector. I agree.
**2) focus: 5**
The proposal is targeting the needs in the call and the proposed CIDOC CRM data mapping tool will be "state-of-the-art".
**3) feasibility: 4**
The proposal aims high. However, as the project is planned to last for only 12 month, I have some (minor) concerns regarding the realism of the described 6 milestones and 5 deliverables.
**4) usability: 3**
As described in the proposal: "the dissemination and testing will include up to 4 master students and probably on both research and commercial excavation". The impact on the project of the usability process is uncertain. Regarding the very complex nature of the tool a stronger focus on usability would have been preferred.
**5) track record: 4**
The partnership is strong and represents a number of different institutions. This is definitely an advantage in a project like this. The persons involved are skilled, but this is not documented in the proposal.
**6) impact: 4**
The tool will be released under GPL. However, the costs involved in making the technology further available are not described very clearly in the proposal.
**7) sustainability: 5**
There is a very strong commitment among the people and institutions involved in the development of the CICOC CRM and the community behind is likely to keep the process moving.
**8) additional contributions: 4**
The project is believed to contribute to standardisation within the Cultural Heritage sector.

# Newton 9
## Tools and Grooves – matching tool marks with tool profiles on archaeological artifacts

**1) Quality score: 5**
The problem is clear and well described. The link between scientific aspect and cultural heritage is very interesting.
**2) Focus score: 4**
The topic is relevant for EPOCH. As this tool will be dedicated to artifact analysing, perhaps it's a pity that we don't find anything about metadata documentation in the project.
**3) Feasibility score: 4**
All the project is in fact depending on 3D acquisition from a laser which is not described in the project. If the laser is appropriate then the project has a good feasibility.
**4) usability score: 4**
The TM participation seems perhaps poor regarding the testing and publication phases.
**5) track record score: 4**
The team seems relevant for the project and the interdisciplinary aspect are very interesting. One shadow: The 3D scanner is not yet in use at the AFL; the type and model are not mentioned. Is it really the right one for the project?
**6) impact score: 5**
As the project is depending on 3D data acquisition from laser it should be interesting to try to generalised the software.
**7) sustainability score: 4**
The tool produced will be used by TM partner. I think all the partners have to think to future release after the first period of use.
**8) additional contributions score: 4**
The GPL aspect is very positive but the project does not mention the language used and perhaps a LGPL should be more appropriate. I hope one month will be enough to reach the goal. In the same way 4-5 month for the project phase seem short. The project does not mention the possible use of the software in other application in CH. (medieval archaeology, wood studies).

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**1) quality: 3**
The proposal falls under priority 4: Versatile 3D Acquisition and Recording of Archaeological Excavation, however it is not focused on that topic. It is more a technical contour matching problem, that is in my opinion a 2D problem (also if the data is acquired by a 3D scanner. Therefore the problem is more in the basic research area, the application data does not play a very important role. The proposal is rather short and it stays unclear how the proposed solution to the problem would look like.
**2) focus: 2**
The benefit for the Cultural Heritage community is not described appropriately, i doubt that the envisaged output would be a benefit for the users and the proposal is not really falling in the priority actions.
**3) feasibility: 2**

The proposers do not have specific experience in contour matching (at least from the references this stays unclear). Therefore, I doubt that the results could be achieved within 5 months. The project time line is unrealistic

**4) usability: 3**

If the goals would be achieved there would be some usability for archaeologists.

**5) track record: 1**

None given for the main developer

**6) impact: 2**

To develop the suggested techniques, more research effort would be necessary, otherwise results would not be acceptable for archaeologists. In the given proposal this goal is not reachable.

**7) sustainability: 2**

Contour matching is a research area of its own, many papers do cover this topic, however there are no solutions so far to handle for example the puzzle problems neither in 3d nor in 2d due to the complexity and the shape of real objects. It is hard to solve perfect puzzles, real puzzles like stones or ceramic fragments are much harder to solve since the shape of the object is no regular (which is the case in puzzles). Up to now there exist no algorithms that could handle these problems. Therefore it is unlikely that the similar problem could be solved in 5 months.

**8) additional contributions: 1**

None given

# Newton 10
## Calibration and 3D modeling in underwater photogrammetry

**1) quality: 4**
The ETH partner has of course a high scientific level to drive a project like "Calibration and 3D modelling in underwater photogrammetry" but the archaeological part seems to have gaps.
**2) focus: 2**
The project is too specific to match an EPOCH priority. The author seems to have poor experience in deep marine environment and deep water archaeology; as they recommend they need to integrate a wider set of partner.
**3) feasibility: 4**
ETH have already developed the application. The technical proposal is reduced to the description of existing system.
**4) usability: 2**
ETH needs to work with marine exploration laboratories and underwater archaeologists to make experimentations.
**5) track record: 4**
Regarding the project title the partner has a strong experience of the field but this does not match well the EPOCH priorities.
**6) impact: 3**
From the photogrammetric part the proposition is relevant but in the short paragraph describing the technical proposal we can't find a clear proposal for the adaptation of the actual product to archaeological investigation.
**7) sustainability: 2**
ETH asks to be connected with more relevant EPOCH partner in the field of archaeological underwater data collection.
**8) additional contributions: 2**
No more comment.

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**1) quality: 3**
The proposal falls under priority 4: Underwater data collection and photogrammetry. It is more a letter of intent than a proposal since there are no partners that could use the rich experience of the proposers. For a successfully application of the technique in the Cultural Heritage area this would be very important. The proposers mention the short time that was given for the proposal and therefore they did not find appropriate partners. However there was another proposal sent where these drawbacks are resolved. Therefore I recommend to include the goal of this proposal in the second proposal.

# Newton 11
## Immersive culture heritage experience through wireless 3Dsound system for binaural reproduction

**1) Quality: 4-3**
Scientific level good but specifically and generally the proposal doesn't sufficiently address heritage in any depth
**2) Focus: 4-3**
Yes it does address the call and although it identifies an interesting VR component, I'm not convinced that this is state of the art – yet
**3) Feasibility: 4**
Yes it looks feasible with budget
**4) Usability: 4**
It does but you have to question whether the onset of technological change and the inconvenience of headsets will mean that a binaural system is the best solution - it would have been helpful to review the rejection of alternatives
**5) Track Record: 3**
Probably but insufficiently demonstrated
**6) Impact: 4**
Probably but there is a concern about the pace of technological change and obsolescence
**7) Sustainability: 3**
This element is not as convincing as it might be
**8) Additional Contributions: 3**
Not astonishingly wide

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**1) quality: 2**
Just a showcase for another non NEWTON project (already financed by EU 6th framework)? Then I don't believe it is very well chosen. As a test case for that other project, however, it would be perfectly acceptable. It is not clear if any new technology justifying the time and budget requested would really be developed here, as opposed to just directly implemented from that other project. I believe the answer is most likely "NO" and the low score reflects that.
**2) focus: 3**
Yes, that other non NEWTON project, as reported in the proposal, seems to focus on some of the priorities for NEWTON proposals
**3) feasibility: no comment**
**4) usability: 5**
This being a showcase/test case
**5) track record: no comment**
**6) impact: n/a**
For appropriate cultural heritage sites, yes, pretty high, thus the score would be 5; but, again, this proposal *per se* seems just a showcase/test case, see above
**7) sustainability: n/a**
See point 6
**8) additional contributions: n/a**

See point 6

**1. Quality: 4**
**2. Focus: 4**
There is a clear focus on the priority (3) Mobile/wearable/ambient systems specially in (a) Contextual cultural information. This is the main strength of the proposal – to get feedback from users and tailor their virtual experience and enhance their feeling of presence. The focus on priority (5) Visualisation /rendering is less clear although it clearly contributes to bridging the gap between research and use of innovative [visualization] techniques.
**3. Feasibility: 5**
**4. Usability: 3**
The usability depends on further integration of the clear focus on this development of an Audio Immersive environment with other rendering and 3D applications and experiences. This is not expressed in the proposal.
**5. Track record: 5**
The proponents are expert with a good record in the area.
**6. Impact: 4**
There is the active participation of a CH professional in the basic team which increases the impact and dissemination of the technology to be developed.
**7. Sustainability: 3.5**
The application scenario focused on the Linnaeus Garden is quite convincing as a showcase. It may lead to further sustainable applications but these are not described expressly.
**8. Additional Contributions: 3**
The proposal does not make references to additional contributions to open datasets, standadisation etc.

# Newton 12
## The EPOCH 3D multimedia kiosk

**1) Quality: 4-5**
Scientific level is high and there is an encouraging demonstration of heritage application across a range of media (objects, environments)
**2) Focus: 4**
Yes and develops it further
**3) Feasibility: 4**
Yes and the budget appears reasonable
**4) Usability: 4**
This area appears to have been addressed
**5) Track Record: 4-5**
Sufficient expertise and an interesting combination of specialisms
**6) Impact: 4**
Yes, project looks to be affordable
**7) Sustainability: 4**
Yes, wide applicability potential in fact the project may be unnecessarily restricting its applications to relatively limited museum objects - wider applications could well be developed
**8) Additional Contributions: 4**
Provides additionality

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**1) quality: 5**
As a professional CH field worker and archaeologist the need for easy to use and implement VR/3D tools in CH sites/museums is very well understood. This project promises to deliver just such tools, especially going all the way to delivering prototypes of complete hardware setups and simple to use software authoring tools for non techies. The cost/time requested seems very reasonable, too.
**2) focus: 4**
This would take full marks if it was new original research especially developed for NEWTON; however, it typically builds on previous/concurrent expertise financed by other projects, which by design or chance had the merit of already addressing some of the priorities in this call
**3) feasibility: 5**
It sets precise and realistic objectives, with a realistic budget
**4) usability: 3**
Somewhat unclear in the hardware part and vague/missing in the image acquisition and software authoring aspects
**5) track record: 5**
It builds on a wide range of expertise in precisely this same field, see above
**6) impact: 4**
It would take full marks if portable data acquisition tools would also been prototyped, rather than just investigated in a final feasibility study
**7) sustainability: 4**

See point 6
**8) additional contributions: 1**
There does not seem to be any, but I stand to be corrected

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**1) Quality: 5**
**2) Focus: 5**
A well integrated proposal bridging between cutting edge technologies to its use by CH professionals. It is clearly focused on (19) Authoring tools for 3D experiences. Regarding (14) Versatile 3D acquisition it focuses on (b) and (c) but is not portable as suggested in 14 (a)
**3) Feasibility: 4**
**4) Usability: 4**
a. The deployment of the "3D Powerpoint" Authoring Application provides an excellent prospect for usability of the system
b. On the other hand the massive image acquisition system that will be used (150 digital still cameras, ten commodity PCs for parallel data storage and processing) may ground a service to which small CH objects should be sent for processing; the investment that it requires will limit its wide deployment).
**5) Track record: 5**
The record of the proponents is excellent in the area. Although the application in real settings is envisaged and clearly designed there is no direct participation of a CH in the team. The Bonn stack of Museums will be the focus of on-site initial experimentation with the products.
**6) Impact: 5**
The "3D PowerPoint" Authoring Application has a substantial potential for impact. It may give low tech CH professionals an excellent venue for experimenting and introducing 3D in their institutions.
**7) Sustainability: 4**
see usability
**8) Additional Contributions: 4**
This issues is not directly addressed in the proposal. However the adaptation of the reflectance measurement camera for and the pre processor for large meshes seems to be developments which may contribute to wider EPOCH purposes than those strictly defined in the proposal.

# Newton 13
## Archive Mapper for Archaeology

**1) quality: 5**
This is the best proposal of the four submitted to my evaluation. It is clearly written and the technical and CH aspects are well integrated and balanced. In addition to working within the framework of CIDOC-CRM, the proposal aims towards designing a toolkit that will be user friendly, to laymen as well. The multidisciplinary aspect of the proposal is very strong and is based, among other things, on a network of already established connections with technical and CH institutions in Italy, Romania, Israel and the U.S.
**2) focus: 4**
It is well focused to achieve the third item of priority 3. However, the aspect of landscape, one of the priorities within the Semi-automated mapping to CIDOC section is less pronounced.
**3) feasibility: 5**
The budget and the relatively long duration of the project (18 months) enhance its feasibility.
**4) usability: 5**
The testing of the toolkit is an important facet of the proposal. It is based on very large, actual datasets of excavations, artifacts and museum data held by the Italian Ministry of Culture, the Israel Antiquities Authority and the Romanian Institute for Cultural memory.
**5) track record: 5**
The team features a strong multidisciplinary base of computer, archaeology and museum experts and it is most inter-European in nature.
**6) impact: 5**
The intention to develop a toolkit that can search and retrieve data, also from preliminary, fragmentary and old formats, that does not require specialized technical skills, will have an impact of the CH community.
**7) sustainability: 5**
The CIDOC-CRM compliance will enhance sustainability
**8) additional contributions: 5**
A potential important additional contribution of the project will be a survey of the existing documentation system to be used as a benchmark for producing the specification of the new tool. The search and retrieve tool that can handle data from preliminary, fragmentary and old formats should allow to easily produce open datasets and enhance standardization.

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**1) Quality: 5**
Excellent proposal – ambitious and well-rounded. Strong international team making excellent use of links, including in US
**2) Focus: 5**
Highly relevant to the call and clearly targets the main areas required. State of the art deliverables
**3) Feasibility: 5**
Realistic goals given 18 month timetable (compared to 12 months of other proposals). Budget seems good value and makes use of other resources
**4) Usability: 5**

Testing and evaluation figures prominently, though there's no specific reference to usability as such. Clearly targeted at 'lay' users, which is important

**5) Track record: 5**

Very strong team with excellent experience and strong track record of producing tools to specification and to time.

**6) Impact: 4**

It isn't clear what the tools will be developed in but presumably these will be public domain?

**7) Sustainability: 4**

There is no clear pathway for subsequent availability or development identified, but the programme of work suggests that the level of documentation etc. would make this perfectly feasible.

**8) Additional contributions: 5**

Draws together a range of extremely important deliverables and goes beyond a toolkit to develop a search tool and (possibly?) a text encoding tool. Makes it look very good value for the money.

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**1) quality: 4**

It has quality to enough to fit in the Research Agenda

**2) focus: 4**

It is directed to cover the priorities in the Research Agenda

**3) feasibility: 2**

Too much money in travels and not well supported budget.

**4) usability: 3**

Some very strong points like the integration tool for new users

**5) track record: 3**

It is a very complete collection of researchers but it seems to lack some coordination

**6) impact: 3**

It will have a partial impact because there are more countries than three and there are countries with more than an official language. The idea of taking into consideration legislation is a good one, but needs a little more of work.

**7) sustainability: 3**

They feel confident enough to make AMA sustainable

**8) additional contributions: 3**

There are good contributions like the search tool and the template but it will good to open CH databases to the public and to researchers

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**1) quality: 4**

The quality of the project is good and the proposal is well structured.

**2) focus: 4**

The suggested goal - producing a support tool for mapping existing data content to a CIDOC-CRM compatible form - fits well the needs of priority 2.

**3) feasibility: 3**

The goals are ambitious, but well scheduled. With reference to the cost of the project, the percentage devoted to travels seems a little too high.

**4) usability: 4**

The proposal includes usability testing to validate the tool. Case-studies should be better delineated to ensure the effective completion of the project.

**5) track record: 4**

The track record of the staff is good; the team integrates the expertises of archaeologists and IT specialists.

**6) impact: 4**

If the major results will be achieved during the course of the project, the effectiveness and utility of the technological solution will be certainly helpful for cultural heritage professionals.

**7) sustainability: 4**

The proposal fits well the aims of the call for proposal. It is also important the effort to include further institutions in the testing of the proposed tool.

**8) additional contributions: 4**

Additional contributions relate above all to standard issues.

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**1) quality: 4**

The proposal describes a flexible tool (toolkit) for mapping existing data to a CIDOC CRM compatible form. The proposal lacks some clarity in its project description.

**2) focus: 4**

The proposal focuses on encouraging and supporting the adoption of CIDOC CRM. It is based on the creation of a toolkit / templates. It is not clearly demonstrated that the result will be “state-of-the-art”.

**3) feasibility: 5**

The proposal has 7 milestones and 4 deliverables. The project is estimated to run for 18 month. There seem to be a realistic balance between the goal, the timetable and the budget.

**4) usability: 3**

Testing will included both Italian and Romanian partners. However, the process is not very well described and the feedback to the developing process is uncertain.

**5) track record: 4**

The partnership represents a number of institutions with different skills, which is an advantage in a project like this. The partners involved are without doubt experienced, but this is not documented in the proposal.

**6) impact: 4**

It is noted that the toolkit will be made available to EPOCH partners and any other potential users. Additional costs involved in making the technology further available are not addressed in the proposal.

**7) sustainability: 4**

It is believed that the partnership and the framework described will secure the sustainability of the project.

**8) additional contributions: 3**

The proposed toolkit will probably have an impact on the ongoing standardisation process within the Cultural Heritage sector. However, this issue is not clearly addressed in the proposal.

# Newton 14
## Versatile and ubiquitous scanning

**1) quality score: 5**
The project has a high scientific level, and is based on a very promising collaboration by merging different knowledge and survey approaches.
**2) focus score: 5**
The project will be a new tool for EPOCH partner and should be very efficient for people involved with archaeological survey. The project is well 'network oriented' and have already connection with other NEWTON project.
**3) feasibility score: 5**
As mentioned in the proposal most of the elements are already developed, the project will synthesise and connect several already robust software in a single tool.
**4) usability score: 5**
The operative aspect will be the fruit of merging two efficient survey technologies and the phase for testing the web part of the interface seem to be clearly evaluated.
**5) track record score: 4**
Perhaps we can regret the absence of some final user in the project as an archaeologist to customize the final interface.
**6) impact score: 4**
Are the restriction of camera orientation a real problem in common archaeological survey ? This point is perhaps not well valuated. The other restriction is not mentioned as moving object in the scene (for example vegetation). Another point: is it possible to use approximate value for camera orientation data coming from other system (GPS, DGPS, sonar, other ..) in order to solve some restriction mentioned in the technical proposal ?
**7) sustainability score: 5**
The web access is very interesting, this should be an efficient way to share knowledge in the network.
**8) additional contributions score: 4**
It's not clear in the proposal if the final user can use only a part of the product, like mapping or geometric simplification algorithms with data coming from other media or pre-exiting data. In addition I didn't understand if the copyright aspect mentioned in the proposal is a real part of the project with specific investigation or if it's only a component with think that already exist.

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**1) quality: 4**
The proposal falls under priority 4: Versatile 3D Acquisition and Recording of Archaeological Excavation, and proposes a web-based 3D reconstruction system. Images or video images can be uploaded on a server and a stereo matching program computes the 3D range map out of the images. So far the technique is clear, both proposing organizations do have their algorithms already developed, the main contribution of this proposal is the web interface. Unfortunately there is no archaeological partner involved in the consortium, so the development and testing of the proposed system is only done by computer vision people. Furthermore I am not sure whether this web based solution is appropriate since the images needed have usually a high resolution and are many. So there are huge amounts of data to be

transfered via the Internet. Usually the monuments are huge and somewhere with low Internet connection which makes the approach not feasible since one has always to control the 3D model if there are holes in the model and if an additional image has to be taken to "fill" the hole in the model. So it would be good to have this feedback immediately and on site. For commercial applications this web technique would be much more appropriate than for archaeological applications.

**2) focus: 3**

The focus lies in building the web platform and the underlying database since most of the techniques for range image generation and registration already exist since the proposers have already long time experience in scanning and range image generation and registration. Again I am not sure if the target group would really need such an application and if they would like to use such a system.

**3) feasibility: 4**

The proposers do have a lot of experience in computer vision, however, there is also a need for web tools and database knowledge. If the proposers do have this knowledge stays unclear. Otherwise the time frame and the goals to be achieved sound realistic.

**4) usability: 3**

Again I am in doubt if the web based solution is the right way to do this reconstruction. A potable on site solution could be the better solution to the problem

**5) track record: 5**

The two Computer Vision groups involved do have large experience in 3D reconstruction.

**6) impact: 3**

The 3D data generation could have a high impact if the generation of models is easy to do and the models generated are accurate and complete. The web based approach has some problems in this sense, it will take relatively long to see the (possibly very large) 3D models and the interaction with the reconstruction software via Internet could be very tedious.

**7) sustainability: 4**

If the reconstruction software works correctly and the bandwidth of the Internet connection is high enough the proposed system could be interesting for CH applications. However, it is not clear if the handling of the system is acceptable for the target group.

**8) additional contributions: 4**

There would be also an archive and a large database developed for storage of the 3D models.

# Newton 15
## Integration of image and laserscan data for modeling

**1) quality score: 4**
We regret that there is nobody from the archaeological side in this project and more generally a proposal made by a single laboratory is not really 'network spirit'
**2) focus score: 5**
The problematic match very well with the EPOCH priorities.
**3) feasibility score: 5**
The team involved in this project has a sufficient and relevant experience to drive this project.
**4) usability score: 5**
The proposal include an experimentation to validate the development.
**5) track record score: 4**
The presence of a final user, I mean archaeologist who will use the result should be a good help in feature definition.
**6) impact score: 5**
The technical project is very interesting and surely a draft of what survey tools for the next generation will be.
**7) sustainability score: 2**
If the project is driven by only one laboratory the possible application by at least one other EPOCH partner seem difficult.
**8) additional contributions score: 2**
The proposal is not clear about the possible access to the final product, I mean the software. It should be interesting, if a new tool is developed, to organize a multi user access. How is the project a new tool for archaeologist? As the project is also strongly involved in 3D file generation I regret that the 3D file format aspect in EPOCH priorities is not mentioned.

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**1) quality: 4**
The proposal falls under priority 4: Versatile 3D Acquisition and Recording of Archaeological Excavation and proposes the development of an airborne integration of image and laserscan data integration tool, on the case study of a Byzantine Basilica. The proposers already made first tests of the technique on several other sites and want to integrate their experience in this new proposal. A severe drawback is the lack of partners that can judge the results and help and discuss the topics during the development. It stays also unclear why a Byzantine Basilica is the test object. Maybe one can find partners that really have the problem how to represent their CH monument in 3D. Therefore one or more archaeological and/or architect partners should be found and a comprehensible application should be defined. Of course, the short time for preparation hindered the proposers to compose a project team - however this is necessary for this proposal.
**2) focus: 4**
The proposal fits very well in the priority list and focuses on 3D acquisition techniques. Complete scanning of large highly structured objects is a complex procedure, which is worth to be investigated.
**3) feasibility: 5**

The proposers do have a lot of experience in photogrammetry and 3d acquisition. Therefore the project goals are reachable within the time frame given. All the subgoals are clearly specified and realistic.

**4) usability: 3**

The usability is given, however in the current proposal there is no partner that could adapt the technique for the end user needs.

**5) track record: 5**

The proposers do have an excellent knowledge of the topic.

**6) impact: 3**

The impact to the archaeological community stays unclear, since it is not stated in which form and which details the archaeologists would like to have their models and how they would like the system to be.

**7) sustainability: 4**

Creating 3D models of CH monuments is a very important aspect and is absolutely necessary. Any improvement in these techniques is therefore deserving

**8) additional contributions: 4**

The integration of laser-scanner data and images can be used in many different areas as well, so architects and artists could also benefit from better 3d models.

# Newton 16
## Underwater photogrammetry and archaeological data enhancement (UPGRADE)

**1) quality: 4**
The proposal falls under priority 4: Underwater Data Collection and Photogrammetry and has 7 partners from 6 countries with a clear application and archaeological partners. For the photogrammetric part, however, I would strongly recommend to add Prof. Gruen from ETH Zuerich to the consortium since this group has excellent experience and knowledge of archaeological applications of photogrammetry and have proposed a meaningful project with a lack of corresponding partners. Therefore an integration of this group into this proposal would enhance the consortium and thus the project output. The idea of the proposal is sound, the integration and fusion of acoustical, optical and platform navigation data for underwater exploration is important. The consortium consists of groups that have already experience in underwater archaeology and underwater exploration, so that the needs and the methods needed to achieve the goals should be clear to the partners.
**2) focus: 4**
The proposal adheres to the focus of the call however the goals and the role of the partners is not always clear. For instance the role of Ciencia Viva stays unclear, the expertise of UIBK could be supported by ETH. The project goal, the integration of different data sources into one common framework would definitely be good, if this goal can really be reached within the two years is questionable since there could be some unforeseen troubles in doing so. However, it would be a good starting point for further research.
**3) feasibility: 4**
The goals sound realistic but if it is really possible to combine these different data sets is hard to judge since I do not have any experience in underwater data acquisition. Reaching the goal might be too optimistic, however a basis for further research would be given.
**4) usability: 5**
Since there are many different partners involved, a usability test is foreseen. Otherwise it would be very complicated to judge the results. Furthermore best-practices studies are also planned which would be of great help for others working in underwater data acquisition for archaeological applications
**5) track record: 4**
The interdisciplinarity is given, most of the partners do have long experience in the field. ETH should be included, the role of Cienca Viva should be made clear.
**6) impact: 4**
If working, the integration software would be valuable, the best-practise study will be in any of case of help.
**7) sustainability: 4**
The proposal does not focus on a specific archaeological underwater site, the results should be applicable on any site. With the equipment that is necessary this might be different, I guess the methods developed are for specific equipment only so that this could be a problem.
**8) additional contributions: 3**
The proposal does not mention any additional contributions, the possibility to deduce a standard is however given.